

IEEE **women** *in* **engineering** MAGAZINE

Winter 2007/2008
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Iconic Women

Battles, breakthroughs, and bridging the gender divide

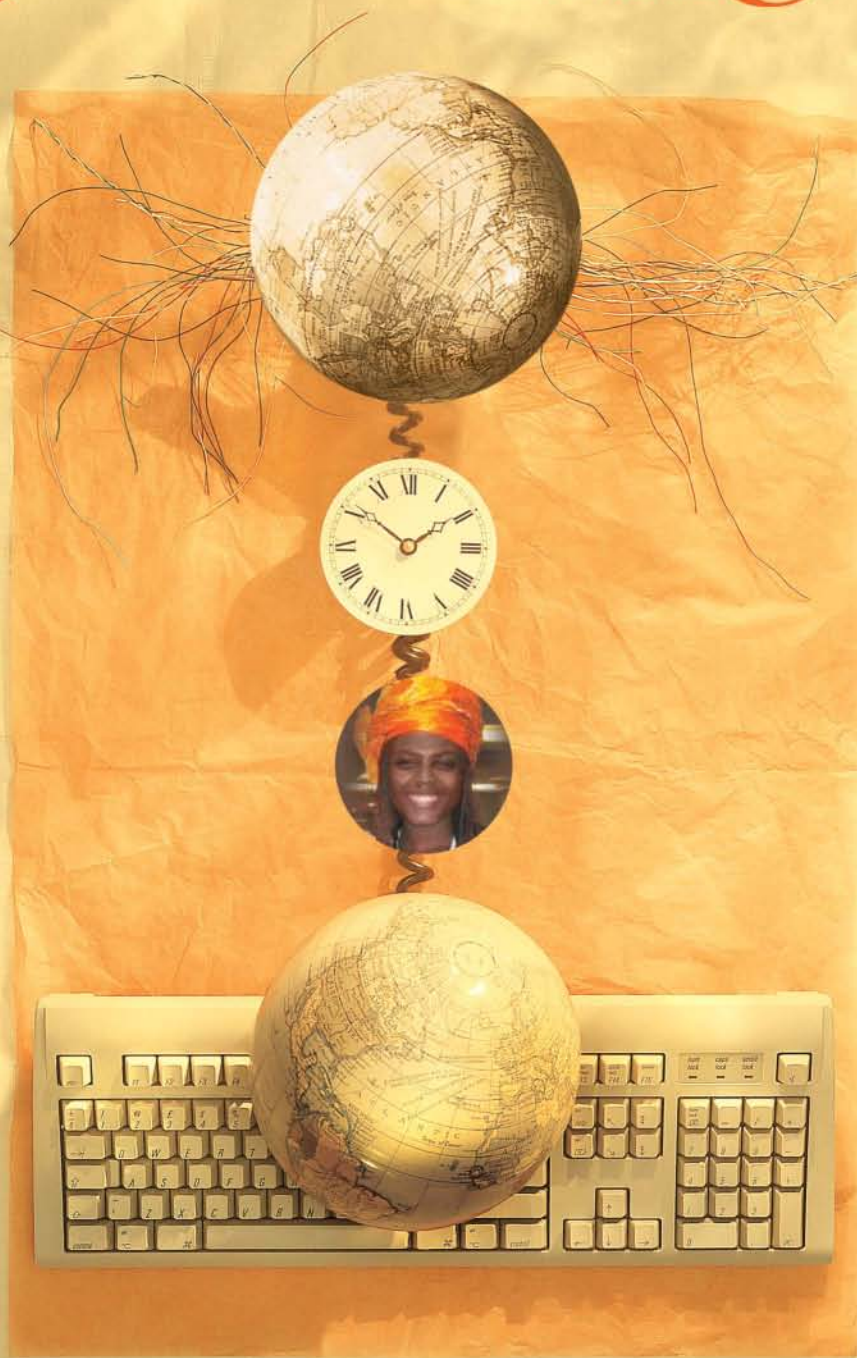
Clementina's legacy

Imagineering
Disney's kingdom

From pets to NASA pilot

Meet JPEG's mom

The brain
behind video games





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IEEE Women in engineering MAGAZINE

Features/ Incredible Careers

From Pet Shop to Pilot, p. 14

How NASA launched the career of one Latina.

By Julia C. Keller

Top Copy, p. 16

Michelle Gielan has engineered a fine network news career.

By Leslie Prives

A Force of Nature, p. 18

Inspiring women to focus on the technical aspects of engineering.

By Leslie Prives

Extra Sensory Perception, p. 20

From the CIA to the Johns Hopkins APL, Alison Carr is on the cutting edge.

By Leslie Prives

Chip Off the Old Block, p. 22

The powerful woman behind PlayStation3.

By Julia C. Keller

Looking at the Big Picture, p. 25

Bridging the gender divide with Joan Mitchell.

By Julia C. Keller



14
From simulators to the skies.

PHOTO COURTESY OF NASA AND SANDY GIBBS

winter 07/08

10
Disney rides the tide of its imaginers.



35
Some assembly is required for the BUA robotics team.



Columns/ Departments

- Letter from the Editor, p. 2
- Amperes: Current Affairs from Around the World, p. 4
- Women to Watch, p. 10
- The Good, the Bad, & the Ugly: Engineering FACTS, p. 13
- Career Advisor: Experiences from the Real World, p. 28
- Pipelining: Attractive Programs for Women, p. 32
- WIE from Around the World, p. 43

Letter from the Editor

Karen Panetta

Welcome to *IEEE Women in Engineering Magazine*

Working together to attract, sustain, and enrich women engineers

Welcome to the premiere issue of the *IEEE Women in Engineering (WIE) Magazine!* WIE now boasts over 12,000 members worldwide, with over 176 affinity groups, making us the largest international professional organization dedicated to promoting women engineers and scientists. As a member of IEEE WIE, you will be receiving future issues of this magazine as a benefit of your WIE membership. If you are not a member, we invite you to join us and help build our community of support and encouragement.

The goal of this magazine is to be your resource for helping to attract, retain, and sustain women in the engineering and

science fields. For parents and educators, *IEEE Women in Engineering Magazine* will showcase the exciting career opportunities in the IEEE fields of interest and provide you with access to successful outreach activities that will help encourage children to pursue engineering. The magazine will also provide networking and career support whether you are a student, young or seasoned professional, or reentering the workforce. Today, most individuals do not create a path plan to return to work after taking a leave of absence for family reasons. We will look at

“career maintenance” and life balance issues for families including young children or aging parents. *IEEE Women in Engineering Magazine* will showcase the best practices and profile the companies at the forefront of supporting their employees’ needs.

IEEE Women in Engineering Magazine will present informative topics in engineering and science, while providing a well-rounded and transnational view of current events affecting women of all cultures. Our first issue is dedicated in memory of Clementina Suduwa, one



Karen Panetta

of our own WIE committee members, who was violently slain in her native country of Nigeria. Her picture appears on our cover. Despite this solemn note, it is our intention to celebrate her life and support women in all regions of the world facing the same barriers that Clementina overcame during her life.

In this issue, you will find articles that highlight some of the interdisciplinary nature of electrical and computer

IEEE WIE CLEMENTINA SADUWA SCHOLARSHIP

ELIGIBILITY AND SELECTION:

Selection criteria will be reviewed by the IEEE WIE Committee. Scholarship applicants must:

- ▶ be female
- ▶ be a student from Africa, in good academic standing, and must provide information on involvement with academic, extracurricular, civic responsibilities, and outreach efforts to other women (scholarship open to all IEEE fields of interests)
- ▶ maintain a cumulative GPA of at least 2.8 on a 4.0 scale
- ▶ submit two referral letters from individuals who are qualified to evaluate your academic accomplishments (e.g., teachers, administrators)
- ▶ provide a personal statement (750-word maximum) that reflects your career goals.

The scholarship offer will be made to the selected candidate one time only. There will be two scholarships in the amount of US\$500 paid from the IEEE WIE budget through 2008. In addition to the monetary scholarship, WIE will pay IEEE membership for the selected candidates for one year.

The recipients will be selected by the IEEE WIE Committee. If suitable applicants are not available, no scholarship will be awarded for that year. Judgment will be based on the review of the application, endorsement letters, and personal statement and reviewed by the Selection Committee. Voting will take place under the leadership of the chair and the outcome will be based on majority vote.



Clementina Saduwa

engineering careers and the inspiring stories of the women in these positions. You will see how important it is for the engineer's voice to be heard beyond the cubicle. Engineers have a responsibility to properly inform government officials and the public regarding engineering and science issues to ensure that all aspects and implications of policies are thoroughly scrutinized. Having engineers integrated in all positions of society as educators, medical doctors, lawyers, and even as leaders of government will not only bring attention to the importance of engineering but will also help elevate more women into leadership positions. In this issue, we profile a young engineer who is now a reporter. What other individual is better suited to ask the tough questions about engineering and technology than an engineer?

Oftentimes, I am met with questions about the need for the existence of groups such as WIE. Less than 30% of all engineers are women, with the majority of this number falling in the chemical and biomedical engineering fields. Electrical engineering and computer engineering still continue to be the most underrepresented engineering fields for women. The attrition of women in the electrical engineering profession also shows that women are leaving the discipline at extremely high rates. Women are a valuable untapped resource that makes up 50% of the world's workforce. This, coupled with the fact that there are so few women pursuing engineering, is evidence that a problem exists and demands action. Furthermore, we often forget that places in the world still exist where women are not allowed to pursue education, never mind the possibility of pursuing an engineering career. There are countries that have IEEE chapters, yet women are still not permitted to present their work due to cultural issues. IEEE WIE is committed to overcoming the barriers that have kept women from pursuing and advancing in their careers.

Another common question I am often asked as the chair of the IEEE WIE Committee is whether we are doing women a disservice by having an organization that seemingly excludes men. People are surprised to discover that WIE has over 2,700 male members. This is not unusual considering that our mission is to foster a community of women and men that supports their mothers, daughters, sisters, and wives to pursue engineering and science careers that will inevitably lead to enriching lives within the global community and the environment. They are even more surprised that every WIE-sponsored event has attracted an equal number of male and female attendees, regardless of the country in which the event was held.

Remember, WIE is pronounced "WE," and only together as a community of women and men can we change the way nations perceive women in engineering and help initiate the changes necessary to finally tap into that 50% of the world's most valuable resource, brainpower.

Karen A. Panetta

—Karen A. Panetta
Editor-in-Chief

IEEE Women in Engineering Magazine



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Current Affairs from Around the World

Women engineers fight numbers lag

Impact is felt across the globe

A Tribute to Clementina

Pioneer for WIE left a lasting impression

You can kill a man, but you cannot kill his legacy.”

This adage holds true for Clementina Saduwa. An engineer for Ericsson, a telecommunications supplier in Nigeria, chair of IEEE Women In Engineering (WIE) in Nigeria, and regional coordinator for Region 8's (Europe, Middle East, and Africa) IEEE WIE, Clementina leaves behind a rich legacy to those who were privileged enough to know her. She died on 23 January 2007 after she was attacked in her car on the Apogbon on her way home from work.

“Clementina was a wonderful representation of IEEE and IEEE WIE. She was always so pleasant, friendly, supportive, and dedicated. She was an achiever who inspired those around her and was an all-around wonderful mother, wife, and friend. Her presence was always warm and genuine,” says Keyana N. Tennant, program administrator for WIE in the IEEE Educational Activities Department.

As the pioneer coordinator for WIE in Europe, the Middle East, and Africa, Clementina focused on helping young women make informed decisions about their careers. Under her leadership,

programs were organized to pair female engineers as mentors to young Nigerian girls.

A Little History

Clementina was born on 26 February 1977 to Chief Vincent Uvieghara and Theresa Uvieghara of Odedogho. She is the only girl and the youngest of three children. Tina, as she is popularly called, was known as a God-fearing, lively, and jovial person who loved to sing.

She finished her primary education with distinction from Oharisi Primary School, in Ughelli, Nigeria, and was accepted into the Federal Government College, in Ijanikin Lagos, Nigeria. While in school, she participated in sports and church activities. She came out on top in all her classes except in her Yoruba language class where she never received an “A” but eventually was able to understand and speak it fluently. Her integrity earned her the admiration of the school, and she was selected “school head” in her last year of high school. She finished her secondary education in 1995 and went on to study electrical engineering at the University of Nigeria, Nsukka.

While in Nsukka, she joined the St. Peter's choir in the school's Catholic Chapel. She was an active member of the B-KADD, an electronic design

group, and also joined the IEEE in 1999 as a student member. She became the pioneer chair of the University of Nigeria Student Branch of the IEEE.

After graduating with an honors distinction in 2002, she formed the WIE Affinity Group in Nigeria, which was the first in Africa. During her tenure as WIE coordinator of the Nigeria section, she organized career seminars for secondary school girls. In 2004, she was appointed regional coordinator for WIE in Region 8. She was financial secretary of the Nigeria section of IEEE and vice chair of IEEE Graduates of the Last Decade (GOLD). She also served in various IEEE committees in Nigeria.

She joined Ericsson in 2003 as an engineer in the customer solutions department and in 2006 was appointed assistant technical manager of new accounts where she worked on closing multimillion-dollar

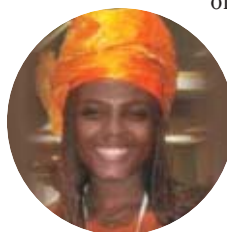
deals. During her stay in the department, she displayed leadership qualities and initiative.

“Clementina was an extraordinary lady. She was intelligent, professional, a caring friend, a loving wife and mother, beautiful and elegant. She was instrumental in leveraging Ericsson's business in Nigeria. She was also very proud of being able to serve IEEE WIE both in her section and in Region 8. She really was instrumental for WIE development in Region 8,” says Magdalena Salazar Palma, IEEE WIE member.

In 2003 Clementina married Victor Saduwa. The couple had a baby girl, who is now two years old.

Although her death is heartbreaking for many, Clementina will not be forgotten.

“Her enthusiasm for the work she did, her wonderful smile, and her capabilities as a skilled speaker left lasting impressions on me,” says Anita Thomas,



Clementina's involvement spurred WIE in both Nigeria and Region 8.

U.N. representative for the World Association of Girl Guides and Girl Scouts.

You can say that again.

—Nancy Salim

I'll Always Have Paris

Following in the footsteps of Clementina

Life comes at you like a flying torpedo, and before you know it, you must make vital decisions that will determine your future path. Some people are lucky enough to discover their calling in time to make it happen. I am one of those lucky people that have a goal. Thanks to IEEE Women in Engineering (WIE), a division of the global organization IEEE, I've embarked on a journey of self-discovery.



Clementina (right) continues to inspire women like Michel'le to pursue engineering.

When I boarded a flight to Paris during the summer of 2006, the last thing on my mind was engineering. I was simply the little sister who got to tag along on an overseas field trip. My eldest sister was working with WIE, coordinating their annual meeting in Paris.

Upon arrival, all of the engineers met in the hotel lobby, exchanged greetings, and conversed about their latest studies. I was the outcast, standing there among a sea of women from 42 different countries: Nigeria, the United Arab Emirates, Spain, and even Kuwait. Not until Clementina, an engineer from Nigeria, approached, did my trip begin to mean so much more.

As we waited for the rest of the women to arrive, Clementina and I sat in the lobby discussing our hobbies. She thought I was already in school studying engineering, and she questioned me about my studies. I informed her that I was not in the field but simply accompanying my sister. We talked about our families, our ethnicities, our favorite subjects, and other topics to pass the time. I brought up my grandfather, who had both his legs amputated and has been living in a wheelchair for as long as I could remember. She informed me that biomedical engineers, some of the women with whom I was sitting, were the people that made prosthetic legs. I was floored! My family had been working so hard to afford legs for my grandfather, and here I was sitting with the people who made them. A remarkable feeling crept over me.

I continued traveling with the engineers instead of touring alone in Paris, which had been my original plan. Throughout my stay, I became more interested in engineering, and I was surprised to discover that I had much in common with these women. We all shared the innate desire to help, had logical minds, and strove to be successful. Clementina and I would sit in the meeting halls putting together foam puzzles, “working like real engineers,” she would say.

When WIE took its next trip to Orlando, Florida, in the summer of 2007, I accompanied them, this time not as the little sister but as a prospective engineer. Unfortunately, Clementina was not able to join us, for she had been tragically killed during a robbery in her country. This news crushed me. I can remember sitting in my high school cafeteria and getting a phone call from WIE. Tears rushed down my face, but I knew deep inside that it was my time to step up and follow in her remarkable footsteps.

Clementina and all of the women involved in WIE have been extraordinary role models, and because of them I can confidently say that I want to be a woman in engineering and I will make everyone that has supported me very proud.

—Michel'le Forrest

A Nation in Desperation

Education and inspiration need to continue

How often do we see international events that inspire organizations into action to stop atrocities? For instance, saving the rain forests or stopping the poaching of endangered animals. To those of us who live in industrialized countries, these acts may seem unthinkable, but consider this: If you or your children were starving and dying, would you steal to feed them? Would you chop down trees in a rain forest to earn money if that was the only job you could find? How desperate would you have to be before you would rob and take the life of another human being to survive?

In Nigeria, a nation faced with such devastating poverty, individuals will stop at nothing to survive, including murder. For many of us, this reality is something hidden away in the news and secondary to the many wars and turbulent conflicts our world now faces.

IEEE WIE was thrust into this reality when one of our own members, Clementina Saduwa, was murdered in her country of Nigeria on her way home from work. Bandits blocked her vehicle on the bridge she was crossing and robbed her. Clementina was 30 years old, married, and the mother of a young daughter.

By all accounts, Clementina was an example of a young woman who beat all the odds. She was a young black woman from Nigeria with a passion for education and helping others. Even if students in Nigeria manage to attend college and graduate, the majority of them are met with high unemployment rates and little prospect of finding a job.

Clementina pursued electrical engineering at the University of Nigeria, Nsukka, knowing that she could contribute to building her country's technology infrastructure and use engineering to improve the lives of members in her community. She spoke four languages and was an expert in communications and networking systems. She secured a position at Ericsson as an engineer and was so well respected that she was chosen to present at the United Nations.

Clementina recognized early on, while she was a student, that joining the IEEE was a way for her to reach beyond the geographic boundaries and turmoil of her country and connect with the world. She joined the IEEE and quickly became recognized as a wonderful volunteer, a strong leader, and a world role model for all women.

She formed the first WIE Nigeria Affinity Group and formed the IEEE University of Nigeria Nsukka Student Branch Section. She was the regional coordinator for IEEE WIE Region 8 and was excited to be named the WIE newsletter editor in December 2006.

She represented the voices of all Nigerians who could not represent themselves, and on January 2007 those same desperate individuals that Clementina had hoped to inspire and encourage to pursue a better way of life silenced her voice.

One has to wonder if these individuals will ever know or feel remorse for her loss or for the small child who will grow up without a mother. We have no way of knowing if the individuals responsible for this atrocity were driven out of desperation or just plain cruelty. In any case, the world has lost a living star of hope.

We dedicate the IEEE *Women in Engineering Magazine* to Clementina and will continue to be her voice and let her star continue to shine. To this end, IEEE WIE has created the Clementina Saduwa Memorial Scholarship for IEEE African Women (see page 2). We shall continue her mission to inspire and encourage all individuals to achieve unimaginable possibilities.

—Karen Panetta

Engineering a Solution

Why is it taboo for many Indian girls?

I remember, about two years back, at the coaching institute I attended for engineering, that my first day out there was nothing short of a nightmare! Coming from a typical all-girls, disciplined convent environment, all I saw in that classroom were about 40 odd heads crammed into the dingy classroom—of which 39 were male! I was beyond myself with surprise! Maybe it was just my class.... Nope! Class after class, institute after institute, same story! "Hey I just have one girl in my class!" or worse, "I'm the only one in mine!" Did that mean I was among a privileged few whose parents had let them take engineering as a dream career for themselves?

When I walked into Indira Gandhi Institute of Technology (IGIT), an all-girls engineering institute, a government initiative, and the first of its kind in India, my classmates had almost similar stories. What was worse was possibly the fact that most of them from co-ed schools had faced a two-girls per 50-boys ratio even in their science stream classrooms at school!

When I really started thinking about why girls were just hallucinations in engineering, I stumbled upon a number of hidden sentiments deep down within my mind, which I'd overlooked before and suddenly became so obvious. Simple things. Like attending the workshop practice. My neighbor said something like—"Oh my god! Girls welding and sawing and doing metal work! These things, smithy and all, that isn't a woman's job. That's stuff men are born to do!" to which I could only say "Oh please!" but really deep down that is what most parents feel. The entire issue of few women in engineering as compared to mass female enrollment in architecture or medicine is not simply a matter of

preferred professions but, to a large extent, a profession is determined by the social setup of the region.

In a society infested by dowry, female foeticide/infanticide, and sexual discrimination, a number of factors would make conventional parents think twice about putting their daughters into an engineering course. I say parents "putting" because in India most kids take up courses of their parents' choices.

The first factor is that engineering is quite an expensive affair. To guardians interested in getting rid of "an accident" (read: daughter), spending so much on her, when there's already the expense of dowry itself, is just not worthwhile. So instead, a graduation course would be just adequate for getting a good groom.

Wait, let me contradict myself somewhat. These days, many urban parents prefer to keep their daughters in a professional course. That is to say, they believe that girls can earn their dowry themselves.

Engineering happens to be the easiest way to earn in the shortest span of time possible. Then why the meager female enrollment figures? That brings us to the second problem that parents have with engineering.

Architecture, medical fields like gynecology, or law don't take a woman beyond her little cubicle with men and don't require a woman to give in hours of her precious family time to the office whereas most of the hardcore engineering fields like civil or mechanical do. Also, most of the other professions are not predominantly male oriented as is engineering. Basically, most engineering jobs are not marriage compatible and that, to parents, isn't exactly acceptable.

Another very valid concern that parents have about their girls is the increased chances of sexual harassment that are identifiable with the corporate sector. They feel, and rightly so, that most if not all corporate houses have little or no provision for ensuring the safety of female employees. Right from the parking lot of the building to the manager's office, there is no

Most engineering jobs are not marriage compatible and that, to parents, isn't exactly acceptable.

such haven for a woman should she be a victim of such unprecedented acts by fellow colleagues or seniors. To top it all, the loopholes in the Indian legal system are too many to ensure justice in case of such incidents.

Of course there is the ultimate drawback for girls: the negative psychology that they experience and the underestimation that they face from home to school, right through class 12. Your brother is better than you, you are too delicate to handle this, you can't travel this far, you can't compromise your health. The can'ts are too many.

Freelancer Prachi Patel-Predd writes in "A League of Extraordinary Women" [*IEEE Spectrum*, October 2005], "All too few girls consider engineering as a career, and the profession is the poorer for it, as talented individuals seek vocations elsewhere. But a new program is in the works in the United States to attract young women to engineering and to keep them in the career."

Prachi was talking of the United States, where a number of professional engineering societies, including ASCE, the IEEE, and the National Academy of Engineering, are carrying forth a nationwide program: Extraordinary Women Engineers Project or EWEP. This program encourages women to take up engineering as a career, through counseling and telling teenage girls how lucrative this profession can be. The pioneer of this movement is Patricia D. Galloway, whose motivation had been the falling enrollment rates of women in engineering.

The percentage of women graduates in engineering in the United States as of October 2005 was 23%. In India, the figure in some of our advanced regions is just a third of this—about 7.9% at I.I.T. (Indian Institute of Technology), Mumbai. In Tamil Nadu, however, the percentage of women graduates in engineering was 10.1%, slightly more, possibly because of the numerous private institutions that have

The percentage of women graduates in engineering in the United States as of October 2005 was 23%. In India, the figure in some of our advanced regions is just a third of this—about 7.9%.

sprung up all over. However, statistics show that while almost all regions are almost at par, northern India still has to catch up with the rest in number of female engineer graduates.

Still, there is a silver lining to every cloud.

At least we have an uphill enrollment rate, not downhill. The situation obviously has to be improved. How, is the million-dollar question.

I guess the first step would be to counsel parents of girls to motivate them to send their daughters to engineering colleges. Side by side we need to step up enforcement of our laws that safeguard women, particularly in workplaces and for this we need the support of NGOs on a national scale. In addition what we need is assurance from faculty and staff in educational institutions of their belief that girls can be successful engineers if they so desire.

And then of course, an indispensable prerequisite is the "never say die" spirit in girls themselves. It's up to us to decide what's best for us, and live up to our own expectations as engineers.

—Anwasha Bhattacharjee

Major Malfunction

Number of women engineers lag in the household robotics era

Domestic robots for vacuuming and lawn mowing are mobile units that use autonomous mobile robotics technology, with the aim of reducing household time and costs for the owner [1]. In this context, it is difficult to imagine women as "domestic slaves." Nowadays, the image of women's roles in the realm of science, technology, and engineering becomes more and more clear. Unfortunately, the under-representation of women in science and technology, especially in senior and leadership positions, remains a worldwide phenomenon [2].

In the excellent report on women for science, published in June 2006 by Inter-Academy Council [2], it has been stated that in developing countries the women are denied access at the grassroots levels. In developed countries such as those in Europe, things are not much as expected—the women are given access but not much support in a career pursuit in engineering. An overview of the situation of the number of women in engineering in Europe in general, and Belgium in particular, is presented in this contribution. Several directions to improve the number of women in engineering are also detailed.

The Situation in Europe and Belgium

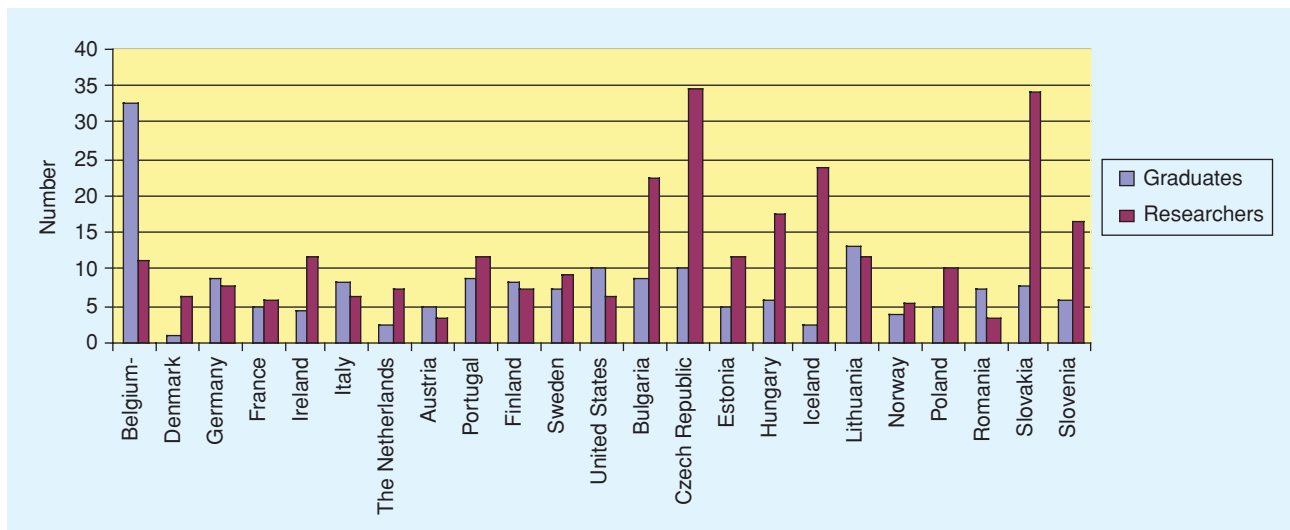
Figure 1 depicts statistical results [3], noting the female distribution of student graduates and researchers in Europe. Some countries such as Bulgaria, Czech Republic, Hungary, Iceland, and Slovakia are clearly leading in the percentage of female researchers in the field of engineering compared to the total number of female researchers in science. Similarly, of the total number of female graduates, Belgium has the most female student graduates in engineering.

In comparison with other European universities, the Ghent Alma Mater is relatively young (www.UGent.be). The institution was inaugurated on 9 October 1817, after King William I, in the preceding year, had proclaimed the establishment of three universities in the Southern Netherlands and lectures started on 3 November.

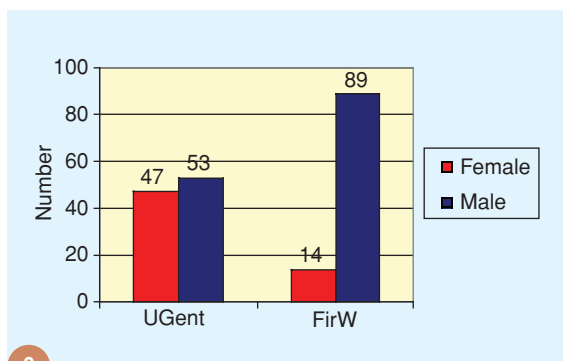
Two events had a decisive influence on the University's history: the political separation from the Netherlands in 1830 and the introduction of Dutch as the official language in 1930.

The first professorial staff had 16 members, including nine foreigners, mainly Northern Dutch and Germans. In 1817, a total of 190 students were registered in the four faculties: Arts, Law, Medicine, and Sciences.

A systematic and thorough modernization of higher education in Ghent took place after the Laws of 1876 and 1890 were passed, granting universities the power to award academic degrees, which enabled scientific development. Due to the relaxed entrance requirements for



1 The female distribution of student graduates and researchers in Europe.



2 The distribution of the women-students within UGent and FirW. The percentage is calculated from the total number of UGent students, and total number of FirW students respectively.

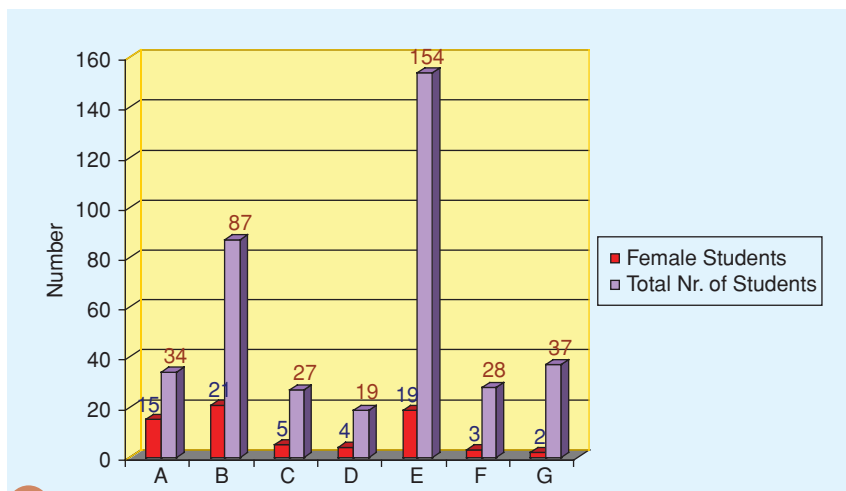
university studies, female students gained access to higher education. The first woman came to study in Ghent in 1882, and she opted to study Sciences. Laboratory exercises and laboratory research work got their start in this period, and research assistants were also appointed.

The current outlook regarding the female students ratio at UGent and at FirW (Faculty of Engineering) is shown in Fig-

ure 2. The high female percentage is a result of the elevated number of female students in Faculties, which includes: Law, Medicine, Arts and Philosophy, Psychology, and Economics.

The percentage of female students in the first year at FirW is approximately 14% (50 female students out of a total number of 344 students enrolled for an engineering degree). Figure 3 depicts the distribution of these female students according to the degree/specialization.

At the end of 2002, Ghent University employed 4,606 people, equivalent to 3,979 full-time positions. The overall distribution of female professors and assistant is given in Figure 4.



3 The distribution of the 14% women-students within FirW degrees (normalized as a distribution of 100%). Engineering degrees: (A) chemical and material, (B) architecture, (C) applied physics, (D) civil, (E) computer sciences, (F) electronic, and (G) electrical and mechanical.

Constructive Efforts

Over the last couple of decades, it has been observed that women prefer sciences to engineering, and in today's context of cross-disciplinary education, the thematic network ESTIA-Net [4] proposed bringing forward a complete set of women-friendly course programs. After deep investigations on the female percentages in engineering and the reasons that make it difficult for women to cope with an engineering career, the program has reached its completion. The network aimed to create awareness about gender bias issues in education, information, and motivation for young women, leading them to their educational and career paths.

The network also created a new interdisciplinary-based postgraduate curriculum, based on feedback from women regarding their future education and career, women executives with postgraduate training in new technologies, women starting a new career, and women immigrants. The main activities initiated by this network include research regarding the number of women students and professors, of which important parts were presented in this contribution; building relationships with career women; developing a mentor's curriculum, mentor's seminars, information days, Web site-based information; and the design of a women-friendly postgraduate curriculum. All this information can be freely accessed as previously referred [4], including information on conferences such as ICIE 2007 Third International Conference on Interdisciplinarity in Education and MULTI FORUM 2007 International Forum for multiculturalism, multiethnicity, and multidisciplinary in European Higher Education and Research.

It is worth noting that the key to the successful increase in the percentage of women in engineering studies and careers is addressing women at their early decision points in time. Therefore, it is important to attract, motivate, and guide young women toward engineering and technology. The most attractive way to do this is to embody both sciences and engineering in interdisciplinary courses. In nearly every prestigious university such curricula exists at the level of master's degree, graduate, and even permanent education courses. A very simple example is biomedical engineering, which successfully combines medicine with (control) engineering. A manifold of applications where an increased number of

female engineers are involved can be summarized under the title of modeling and control in biomedical applications [5], drug-dosing control in anesthesia and diabetes, rehabilitation systems for gait and motion control, artificial ventilation, and diagnosis-based modeling of the respiratory system. One may only take a good look around to realize that in most of these applications women play a key role.

Another important aspect in higher education is to offer equal mobility opportunities to women and men. Although there is no difference when it comes to grant evaluation, there should be special student exchange grants with courses or research programs that are both attractive and accessible to women. For example, women tend to be more interested in combining medical and control engineering sciences than engineering alone; another example is the combination of economics with modeling and control in decision-making systems and supply chain management. In this way, cross disciplinary is ensured, and women can enjoy both the nontechnical aspects in medicine and economics and the abstract-technical background of control.

Looking Forward to the Bright Future

As a young woman working toward her Ph.D. degree in the cross-disciplinary topic of biomedical engineering at UGent, I found great pleasure in finding that most of the issues discussed in [6] were helpful hints and encouraging thoughts. There is no one path to ensure a successful career for women in engineering, but there are a manifold of guidelines waiting to be considered.

Acknowledgments

I would like to thank Prof. Robin De Keyser Chairman of Internationalisation at Ghent University, Belgium, for being such a dedicated mentor and a striving promoter of several projects involving female students and female researchers in Engineering.

Read More About It

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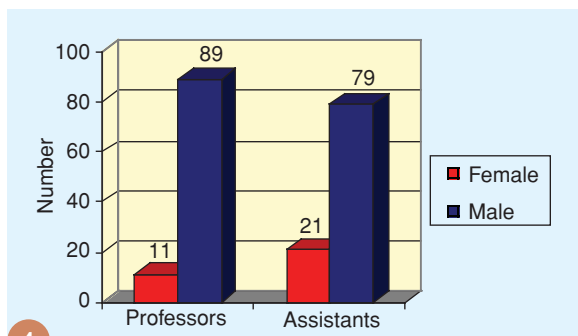


IEEE WIE "BEST COMPANIES" AWARD

IEEE WIE is accepting nominations for its "Best Companies for Women to Work" award. We want to hear what makes your company the best work environment for women. Include examples of programs, support groups or initiatives that the company has instituted to make the work environment more inclusive for its employees. The nominations should include employee and/or student intern testimonials. Companies that employ engineers and/or scientists are eligible.

The nomination essay should consist of no more than 1,500 words and should include the name and address of the company being nominated and the nominator's mailing address, email, phone and fax number. Send nominations to: wie-research@ieee.org.

Applications will be judged by a panel of national experts in workforce diversity and by engineering and science leaders from various science, technology, engineering and math (STEM) disciplines. The top ten companies will be announced in the June 2008 issue of the IEEE Women in Engineering Magazine. The award will be presented at a special IEEE WIE event to honor the winners and the winning company will be profiled in the magazine. The deadline for nominations is 1 March 2008.



Overall staff gender-distribution at FirW in 2004.

Women to Watch

Nancy Salim

Building the House of Mouse

Disney imagineers bring park attractions to life

If creating an iconic image of a duck in a sailor suit seems impressive, consider meshing the creativity of imagination with the technical nature of engineering into what is known as “imagineering.” A large part of being an engineer requires creativity. Especially if you work as an employee of Walt Disney Imagineering.

Almost all imagineers work at the corporate headquarters in Glendale, California, developing ideas and attractions for Disney parks. During the construction of a major project, imagineers are often deployed to work onsite for six months to a year. Imagineers can be artists, writers, architects, landscape architects, engineers, model builders, construction managers, technicians, designers, and a whole range of others.

Walt Disney formed Walt Disney Imagineering on 16 December 1952 as WED Enterprises to develop plans for a theme park and to manage Disney’s personal assets. It was originally an independent, private company, owned by Walt Disney, but on 3 February 1965 it was merged into Walt Disney Productions. It is currently known as Walt Disney Imagineering (WDI), Disney Imagineering, or simply Imagineering.

WDI is well known today for designing and building Walt Disney parks and resorts all over the world, including Disney Resort in Anaheim, California, Walt Disney World Resort in Lake Buena Vista, Florida, and Tokyo Disney Resort in Urayasu, Chiba, Japan, among others.



Maureen Hart says that while the goal is opening the attraction, engineering is about good communication and observation.

WDI is now the research and development arm of Walt Disney Parks and Resorts, no longer a division of Walt Disney Productions. Imagineering also includes Walt Disney Creative Entertainment, the company that utilizes Imagineering techniques to create shows, fireworks displays, and parades at the Disney theme parks.

To get a better understanding of what imagineers do we talked with three Disney-Imagineers.

Be Our Guest

Maureen Hart, principal mechanical engineer at Walt Disney Imagineering, describes herself as “short and bossy,” but her passion shows through her work to enhance guests’ experiences at the company’s theme parks.

Q: Tell us about yourself.

Hart: I’m a principal mechanical engineer at Walt Disney Imagineering in Glendale, California. I have a bachelor’s and a master’s degree in mechanical engineering. I grew up in Minnesota, and after I earned my bachelor’s degree from Stanford University, Palo Alto, California, I decided to stay in California. The energy crisis in the 1970s sparked my interest in engineering and alternative energy. I still remember it being Christmas with no Christmas lights because we all were trying to save energy. My first job was in thermal analysis at Rockwell’s Alternative Energy division in El Segundo, California. At the risk of dating myself, my first calculator was an HP 35, and I assembled my first computer from a Heathkit. I follow Formula 1 racing and have a daughter in high school and a son in middle school.

Q: What made you decide to become an imagineer?

Hart: Working for Disney, I am able to share what I do with my friends and family. I work on a variety of engineering projects and always like a challenge.

Q: What is a typical day for you at work?

Hart: I’m currently working on global accessibility and safety to improve our guests’ experiences at our parks.

Q: What do you like best about your job? What do you like least or what is most challenging?

Hart: I really like the people I work with and the variety of engineering I do. At Imagineering, everyone on a project team is focused on the goal of opening the attraction to guests in our park. The teamwork and “can do” attitude of our project teams make for a great work environment. Another bonus is the instant recognition and interest in my work that I receive from people. The hardest part of my job is juggling multiple tasks, but that’s also what makes it interesting.

Q: What advice would you give to others who want to become imagineers?

Hart: Pay attention to people. Observe how they interact with their environment and with others. Remember, successful engineers are good observers and good communicators. I’d also like to remind younger women that engineering really is about people. Engineers develop and apply technology to better the human condition. I’ve noticed recently that engineering recruiters focus on science and math and tend to ignore the people aspects of the field.

Two Worlds

Molly Kistler, a software engineer at Walt Disney Imagineering, says she’s not your typical engineer. Whether it is days in the field testing rides or writing code at her desk, the position has proven to be both challenging and rewarding.

Q: Tell us about yourself.

Kistler: I grew up in Bethlehem, Pennsylvania. In high school I excelled in math and science and spent a lot of time playing with our home computer. I went to the University of Southern California, in Los Angeles, and earned my bachelor’s degree in computer science with a minor in neuroscience. I stayed in school for an extra year to earn my master’s in computer science, intelligent robotics. I interned at Walt Disney Imagineering during my master’s program. During my last semester of school I accepted a position starting in January 2004 at Disney



With Molly Kistler there’s never a dull moment, whether it’s meeting with review groups, writing code or days of testing park rides.

Imagineering. I am currently a software engineer in the Ride Engineering division at Walt Disney Imagineering.

Q: What made you decide to become an imagineer?

Kistler: I had been to the parks growing up but didn’t really know that “imagineers” existed. The night before my internship interview I was searching the Web to find out information about the company I was about to interview with. I quickly learned that we don’t have official information about imagineering out there on the Web, but I found enough information to be prepared. I enjoyed the summer internship, and the following semester I had to make the decision between imagineering and another competing offer. Job satisfaction was important to me when making the decision, and I was excited about the idea of producing a product that my friends and family could enjoy—something that I could point to and say I helped create.

“I was excited about the idea of producing a product that my friends and family could enjoy.”

Q: What is a typical day for you at work?

Kistler: There isn’t a typical day for an imagineer. Some days I spend at my desk in front of a computer writing system documents or writing and testing code. Other days I meet with review groups, operations and maintenance groups from the parks, outside vendors, or with our project team. Days in the field are long

days full of ride testing but can actually be a lot of fun. When you get back from the field you tend to experience a post-field lull, because you are so used to the fast pace and exciting new challenges every day. As a software engineer for the ride system, I am designing the system and writing the code that controls the ride portion of an attraction.

Q: What do you like best about your job? What do you like least or what is most challenging?

Kistler: I love working with other talented and knowledgeable imagineers. There are good days and bad days at any job, but my coworkers are what keep me coming back every morning. And again, there is something so neat about being able to point to a well-known attraction and say, “I worked on that.” Watching guests enjoy the first attraction I installed was the most rewarding experience, and it made all of the hard work, long days and sacrifice worth it. There isn’t much I don’t enjoy about my job. You have to remember that it is like every other job with both its benefits and its hassles. The greatest downside might be that my friends always want me to take them to Disneyland! Most computer programmers spend their days sitting at a desk in their air-conditioned office—my greatest challenge so far has probably been working on a laptop, outside, in the

heat, with a light drizzle and without a steady work surface while in the field in Hong Kong. It certainly wasn't your typical work environment!

Q: What advice would you give to others who want to become imagineers?

Kistler: It wasn't until I was at my job for a while that I discovered the large number of individuals who would love to work at Imagineering. With so much supply and a low demand for imagineers, it isn't that easy to get a position here. For an entry-level engineer I would recommend applying for an internship with our division. Internships give us an opportunity to assess the individual and give them a chance to see what we are really all about. Most of our young engineering imagineers all came through the internship program.

Under the Sea

Kristin Jones, an electronics engineer at Walt Disney Imagineering, is like most people in that she became acquainted with Disney through the theme parks but it was a college design competition that ultimately landed her at the company.

Q: Tell us about yourself.

Jones: I grew up near Chicago and earned a bachelor's degree in electrical engineering in 2005 from the University of Illinois at Urbana-Champaign. After graduation I packed up, moved out to Glendale, California, and have been an electronics engineer with Walt

Disney Imagineering ever since. I love Chicago-style, deep-dish pizza, dabbling in artistic hobbies like drawing and painting, and almost always have a laptop open at home so I can read the latest technology news.

Q: What made you decide to become an imagineer?

Jones: I went on family vacations to Walt Disney World as a kid and thought that building Disney rides had to be a pretty cool job. In college I found out about Walt Disney Imagineering's ImagiNations Design Competition. The competition invites people from universities and organizations with a passion for integrating creativity and technology to present projects to imagineers. I submitted my entry for a *Finding Nemo*-themed underwater safari and was invited to present my concept as a finalist. With a lot of drawing, modeling clay, and a little luck, I ended up with a first-place trophy and an internship at Walt Disney Imagineering.

Q: What is a typical day for you at work?

Jones: I design and implement show control systems for Disney attractions. The show control system ties together all of the animated figures, special effects, and audio/video that combine to tell a seamless story through Disney magic. As

an engineer I enjoy the opportunity to work through the entire design process from conceptualization through production, installation, and eventually test and adjust. Test and adjust is the fun part, where the designs leap off the paper and become a real working system.

On a typical installation, I can usually be found with laptop in hand, hidden somewhere in the attraction's scenery trying to make the big effect go "kaboom!"

I recently finished working on the *Finding Nemo* submarine voyage at Disneyland. Shortly after the attraction opened to the public, I rode with a group of guests that erupted into cheers and applause when the sub returned to the dock. I enjoy being a part of the team that gives people wonderful and memorable experiences.

Q: What do you like best about your job? What do you like least or what is most challenging?

Jones: I feel very lucky to have my dream job. Perhaps the most exciting and challenging aspect of the job is trying to figure out how to bring some of the more radical and creative ideas into reality. It's a lot of fun to take an idea for an effect and go to the drawing board to figure out just how the thing is going to work. Challenges can occur when relating the limitations of a system to an art director, for example, who wants the jellyfish to go up and down faster than it can currently go.

Q: What advice would you give to others who want to become imagineers?

Jones: Find something you are passionate about and really immerse yourself in it. With a bit of determination you can make your dreams into reality. In college, broaden your focus by taking classes outside of your major and take on leadership roles in student organizations. Check out the Walt Disney Imagineering ImagiNations Design Competition and apply for internship opportunities.



"I enjoy being a part of the team that gives people wonderful and memorable experiences."



Disneyland is all about memorable experiences, and Kristin Jones has contributed to a number of them, including the *Finding Nemo* submarine voyage.

The Good, the Bad, & the Ugly
Engineering FACTS

Karen Panetta

Leveling the Playing Field

No skirting the fact that Title IX is a two-way street

We often hear the tales of women trying to break the barriers in a man's world. This story tells the tale of the reverse situation, a young man trying to break into a culturally female dominated sport in the United States and the resistance he met.

Title IX is a law in the United States that states that public schools must offer the same services to both genders. Specifically it states that "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal Financial assistance." Typically, Title IX is most readily seen applied to sports. For example, if a school has a soccer team for boys, and there are girls that want to play soccer, then the school must provide the girls with the opportunity to play soccer. This means that the school either needs to provide a soccer team for just girls or allow the girls to play on the boys' team.

Title IX strikes fear in the heart of administrators, for like many other laws, it provides schools with a mandate to fulfill, but no funding to implement it. Funding boys and girls teams for every sport is a major dilemma especially today, when schools have trouble funding teachers. However, as painful as it is to implement, it forces schools to "do the right thing" and attempts to ensure that gender equity is maintained.

Nate Coolidge is a member of the United States men's field hockey squad, a

sport that in Europe is acceptable for men, but in the United States is considered a sport only for girls. In the United States, a man playing field hockey has the stigma of not being considered masculine like other athletes such as American football or basketball players.

How any sport, where the players carry sticks and can propel a hard moving object at you at high speeds, can be considered a sport only for the "delicate" remains a mystery. How Nate overcame this barrier to reach the level he is at today is a story of determination and persistence.

Nate tried to join the field hockey team in his Massachusetts hometown when he was in the seventh grade, only to find out that he was not welcome. Why? Because there was no team for boys, only a girls team. By the rules of Title IX, in the absence of any boys' field hockey team, the school had to allow Nate to play on the girls' team.

Administrators tried to dissuade the young man by threatening that he would have to wear a skirt while playing. The young man pursued, wore the skirt, and integrated well with his coach and teammates.

The response from some opposing team players, parents, and opposing teams' coaches was not as welcoming. Spectators who attended the games constantly heckled Nate. One opposing team's coach even yelled for Nate to be removed from the field, while other coaches refused to have

their teams play Nate's school team. One former opposing coach reported in the *Boston Globe* that the issue was that by the time Nate was a senior in high school, Nate was the biggest and toughest player out there. So, was Nate's offense that he grew up into a muscular man? If he had remained under 100 pounds, would this have changed the situation and made it OK for him to play on the team? Would a 200-pound, six-foot female be prevented from playing on the girls' team if she were the biggest, toughest player? Most likely, this would not be an issue.

Women are applauded for breaking barriers, especially in sports. In Winthrop, Massachusetts, a small coastal town, a girl named Tracy Vaccaro was the first girl to play soccer on the boys' soccer team in the 1980s.

In all sports, it is always recommended to train with players better than one's self to help improve skill levels. Tracy was a petite girl, much smaller than all the boys on the team, but she had an agility that helped her outmaneuver even the biggest and toughest male opponent. When the school formed a girls' team, Tracy was by far the best player in the girls' league.

It was also common to have members of the boys' team show up to practice with the girls' team. The two teams used to even play against each other for practice. This integrated environment set an example that boys and girls can work and learn together and consider each other as equal teammates.

So, the real issue is not that boys and girls can't play and work together. Perhaps the real issue is the people that keep telling girls and boys that that they can't.

Thank goodness for people like Nate and Tracy who held steadfast and pursued their goals despite the negative comments. Most of all, thank goodness for Nate's parents for allowing him to wear the skirt.



BY
JULIA C. KELLER

From Pet Shop to Pilot

NASA'S DEBBIE MARTÍNEZ SHOOTS FOR THE MOON

NASA engineer Debbie Martínez spent most of her childhood in her mother's pet store in the Bronx. "I started out thinking, 'Maybe I'll be a veterinarian,'" she says, adding that in the shop, "I had been bitten by all kinds of animals." Now, Martínez is a computer engineer who has cut her teeth on flight simulation technology and is currently on assignment in the Space Operations Program Office at NASA's Langley Research Center (LaRC).

Martínez gained a lot of experience with math and numbers while working with customers in the pet shop that she helped her mother run. Her mother, a widow, brought up her daughter in a time when single moms "didn't really exist," she says. When Martínez was 12, she and her mom moved to Caguas, Puerto Rico, where she learned to read and write Spanish, the language she had heard growing up in her New York home. After graduating from high school, Martínez says she wasn't sure what her next steps would be, but "not going to school was never an option," according to her mother's philosophy. "She knew that with education what you could accomplish was the key to success in life," says Martínez. "My mom always told me that power was in education—no one could ever take your education away."

Martínez knew she wanted to return to the United States, and she applied to university programs in marine biology and computer science, two seemingly disparate passions. "It always amazes me when I think what my life would be like if I got my application for a marine biologist approved first," she says. As it turned out, she first received an acceptance letter from Embry-Riddle Aeronautical University in Daytona Beach, Florida. Though she has since worked on various types of NASA aircraft and is a licensed private pilot herself, Martínez didn't originally expect to work with planes. "I didn't really know much about airplanes then," she says. "In college, I wasn't very interested in airplanes."

After graduating in 1987, she landed a job as a simulation analyst developing weapon simulator trainers for an army contractor in Orlando, Florida. There she gained a love of simulation and acquired the experience necessary to work on other simulation-to-flight projects when she joined NASA's LaRC.

She had often been the only woman in her college classes, never mind the only Latina woman, an experience she says prepared her for what could have been a culture shock at NASA. "Coming to work here, there was only one other woman engineer out of a staff of 25," she says. "I'm very comfortable with it. It becomes second nature, and you don't even see it anymore." Yet, in 1994, a presidential executive order was established to help advance educational and career opportunities for Hispanics. With the resultant



PHOTO COURTESY OF NASA AND SANDY GIBBS

Martínez was often the only woman in her college classes, an experience that prepared her for the male-dominated environment at NASA.

Hispanic Employee Program, or HEP, Martínez has played an active role in bolstering the Latino presence within the LaRC and NASA as a whole. “I’d love to attract more Hispanics, but my goal is to encourage girls’ interest in pursuing a science or technology career with NASA. The more girls I can encourage in science and engineering, the better.”

Winging It

For 15 years, Martínez worked on flight simulation technology projects as part of LaRC’s simulation development and analysis branch. As a simulation systems engineer, Martínez assisted projects such as the high speed civil transport, a supersonic passenger jet developed as part of NASA’s high-speed research program. She also was involved in the blended wing body project, which looked at radical changes in plane-body design to increase fuel efficiency by reducing drag and maximizing lift. “These are advanced aircraft concepts that may not necessarily be feasible given the state of technology at the time,” said Martínez, “but what they learned is still applicable to any high-speed aircraft.”

Many of the flight simulation projects with which Martínez has been involved attempt to combat issues of flying in inclement weather or poor visibility conditions since “weather is a major safety concern in aviation,” she says. She helped test synthetic vision systems, or SynVis, in single-engine, fixed landing gear Cessna planes. Even in pitch-black conditions or severe weather, the technology offers the pilot a three dimensional picture of the environment. “So when you couldn’t normally see out the window, you still can see the terrain and land the aircraft,” said Martínez.

After working for a time as a simulation systems engineer, Martínez decided to actually get into the cockpit of a real plane and earn her wings. “I went to my boss and said, ‘I’m flying these things in the simulator, and I’m pretty good at it. But it would be kind of cool if I knew how

to fly for real,” she says. “What do you think of sending me to flight school?” Her supervisor agreed and paid for Martínez to put in her hours of stick time at Langley Aero Club to earn her private pilot’s license. The experience was invaluable, she says. “When the researchers would come to run their models, I would have already test flown the simulation and we could focus on the details of their study.” Her simulation and real-world flight experience allowed her to serve as a flight operations engineer in other flight research projects as well.

many young Latina girls looking for a motivated and positive role model. But, she qualifies, “You have to give yourself some leeway to change that direction to increase your options.”

Martínez was featured in a children’s book geared toward Latina girls called, *Ay, Mija! Why Do You Want to Be an Engineer?* by Edna Campos Gravenhorst. Of the ten engineers Gravenhorst wrote about, three were NASA women. When Martínez signed copies of the book at the planetarium at the University of Texas at Arlington, “classrooms of children came



Martínez is not just a master of flight sims. She’s also earned her private pilot’s license.

PHOTO COURTESY OF NASA AND SANDY GIBBS

At the time she was earning her pilot’s degree, Martínez was also six months pregnant with her first of three children, Alexander. Like his mom, Alexander loves airplanes. “I tell him that must be because he was bouncing all over the runway before he was born,” she says. Though Martínez says she doesn’t pressure her children to follow in her footsteps, she does want them to dream big and tries to expose them to educational events to encourage their interest. “You gotta have a goal. Without a goal, you can’t tell what you are aiming for,” she tells her kids, just as she tells the

out to see us in person and that was cool,” she says. “They got to see real Latina engineers and ask us questions.”

She also says that maintaining the Web sites for Latina Women of NASA, LWON, and HEP@NASA LaRC is key. “The LWON site provides profiles about Hispanic women working at NASA that was never there when I was growing up,” she says. “Any young girl, could look at this Web site and say ‘Hey, her background is similar to mine—maybe I could accomplish that too’.”

—Julia C. Keller is a freelance science writer living in Boston.



BY
LESLIE PRIVES

Top Copy

NEWSWOMAN'S CAREER FIRMLY ANCHORED IN ENGINEERING

The typical television news broadcast has an outline that can be broken down into categories including national, regional, and local news as well as areas of interest including weather, sports, and entertainment. While many of the personalities that bring us the news come from a traditional journalism background, Fox News Chicago Reporter and fill-in Anchor Michelle Gielan has taken the road less traveled, with a degree in computer engineering, to arrive at her current spot on television.

Gielan was born in New York but her father, a computer consultant, moved his family to Bethesda, Maryland, before his daughter entered middle school. Once there, she attended Holton-Arms, an all-girls private school, which she says was “really helpful in teaching me self-confidence.” After high school, she went off to Tufts University in Medford, Massachusetts, to study chemical engineering.

However, she soon found that chemistry wasn't for her, recalling that she was really “no good at it” and switched her focus to computers, with which she had always felt comfortable. Excited about the transition, Michelle explains, “Computer engineering combines electrical engineering—which I love—with programming and computer science classes, which are all really creative. So that was a perfect fit for me.”

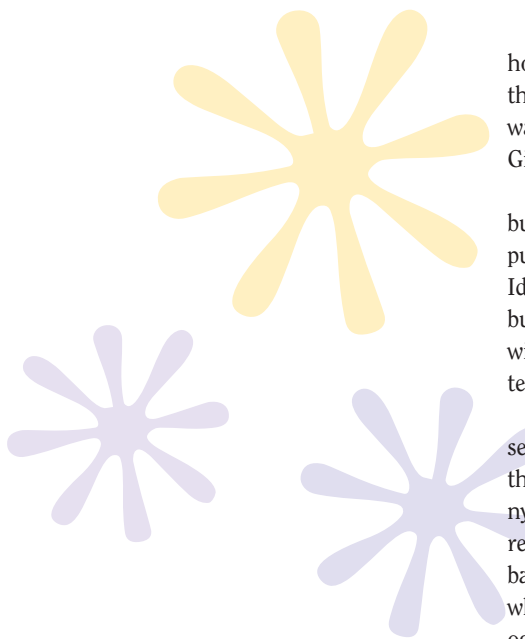
Gielan has always recognized the value in engineering degrees since they teach one how to think and problem solve. “I learned a lot of ‘stuff’ like language and code, but I think the best thing was that no matter what problem was in front of me, I knew there was a way to solve it. That helps you in business, in relationships, in everything,” Gielan says.

Following her college graduation, she already knew the possibilities were endless but looked for a career that, like her studies, afforded her an opportunity to use computers and her creativity. She was hired as a consultant and software developer with Idealab, a “think tank” company that develops Internet-based companies and helps build their Web sites. But, says Gielan, “I ended up doing some contract negotiations with other companies. Since I'm social and outgoing, that kind of work suited me better than programming by myself behind a computer.”

Looking for a change, Gielan decided to embrace her dream of wanting to live overseas. Combining her technology expertise with her love of interacting with people, she thought to try software sales. She moved to London and took a position with a company that deals in software for traders and banks. “That job was really interesting,” she recalls, “because it was challenging to sell to clients and I got to use my technology background.” At the time, the British government only granted a work visa to people who were considered “highly skilled.” Gielan fell into that category due to her technology background and was awarded a visa.

Michelle Gielan's technology background often proves valuable when reporting for Fox News Chicago.

PHOTO COURTESY OF MICHELLE GIELAN



Jonesing for Journalism

After a year in London, Gielan felt that she still hadn't found her ideal career. She researched various options and talked to scores of people ("probably 100!" she adds) with different types of jobs. Her parents, wanting her to be self-sufficient and happy, had advised her early on that, "If you're going to leave engineering, make sure you're going to something that you really like because there's a lot of job security and money in engineering." But the outgoing and creative Gielan wanted to take a leap and chose to break away from a more traditional technical career.

When she saw an online ad for an opening for an anchor/reporter at Channel One News in Los Angeles—a station that creates a short daily broadcast on national and world news for millions of students across the country—Gielan took the "call for audition tapes" as a sign that it was time to make her move. Ever the traveler, she flew off to Los Angeles and signed up for some basic journalism classes at UCLA. After a semester, she decided to shoot a video of herself to use as an audition tape.

"I made it in my living room and it was a minute-and-a-half long," she says. "I talked about why I would be great for this job; I had to just show my personality because I didn't have any work experience. Then I called human resources every week for about three months asking, 'Have you seen my tape?' and 'Do you mind if I call back next week to check again?' Finally, I just called and said, 'Listen, can I just come in? I have a few questions and would like to meet with you.' The person in charge of H.R. was really nice, and she said that would be fine."

The day Gielan went down to the station, the show was hosting a town hall forum and, planting herself in the studio audience, she introduced herself to all the station executives during commercial breaks. A week later, she had a call to come audition and was soon hired as a freelancer for Channel One News.

Reel Appeal

Gielan used "the high-quality tape" from Channel One to put together a reel and got a full-time job in El Paso, Tex. Hired as a reporter, she was soon promoted to the position of morning anchor. After two years in El Paso, she decided to try for a job in a larger market and applied to jobs in many of the major cities. When the first call, interview, and offer came from FOX News Chicago, "I was sold," declares Gielan. "I love this city."

Currently, Gielan serves as a reporter and fill-in anchor for FOX News Chicago. Though there is no "typical" day, "In the morning, I either bring my own ideas for a story or I get an assignment. They pair me with a camera man and then we go out to wherever the story is. Once I get all the information—sound and video—I come back to the station, go through the tape, pick out the pieces that I want to include, and then sit down and write the story. I write everything from the introduction by the anchor all the way to the end. Once the script is approved by a managing editor, I pass it off to an editor. Then I voice the track, and the editor puts it all together. In total, the story is usually about two minutes."

One of her favorite things about the job is that every day is different. "One day I can be at a press conference with the mayor, and the next day I'm with a family of a five-year-old boy who was shot, talking about how they are coping." She also cites live shows and breaking news as really exciting because of the time pressure to get as much accurate information as you can on air as soon as possible.

But how can someone who likes practical problem solving deal with the stress of not knowing what will come to her each day? According to Gielan, "Engineering is very task-oriented and, in essence, so is my job now. When you are doing a problem set, you have to go from problem 1 to problem 10 and work through them all. In journalism, you have to get all the information and put it together in a certain way. And the cre-

ativity in journalism is much like the creativity in programming."

While creativity plays its part, "It's good to have studied something other than journalism because I can ask educated questions about certain subjects and be answered more thoroughly. Then I'm able to explain those answers better to everyone else," she adds. Gielan recalls the story she covered on Google's expansion in Chicago as a time when her understanding of technology proved valuable. With the worlds of science and technology becoming more innovative each minute, we can almost be certain to see something engineering-related in the news each day. Who would be better to report on the results of modern science than someone who knows which questions to ask?

Gielan has become an example of how an education in engineering can open all types of doors. "I really believe that with an engineering degree, you can't go wrong," she says encouragingly. "There are so many opportunities, some that you might not even dream up, but having an engineering degree will help you with anything you want to do. It tells people right away that you're capable and you can think things through. Most people don't get engineering degrees, especially not women, so it shows that you're a hard worker, up for a challenge, and you have a good educational background."

With that sort of reputation, it seems an engineer might never have to settle for one thing. Even as successful and happy as she is in Chicago, she continues to dream big for the future.

"I would like to stick around," she explains, "but it depends on my career. New York is the place to be if you want to do national news. Eventually, I would love to be a part of the team at *60 Minutes*. I have a lot of respect for the work that they do."

—Leslie Prives is a freelance writer living in New York City.



BY
LESLIE PRIVES

A Force of Nature

PETRYSZYN ENERGIZES FUTURE FEMALE ENGINEERS

The most rudimentary science course will tell you that hydrogen is the most abundant element in the universe and water is a copious compound. Early mathematics teaches that $2+2=4$. The beginning stages of both math and science lay the framework for problem solving, an art which Mary Petryszyn, vice president of civil security and response programs at Raytheon in Waltham, Massachusetts, has become quite adept.

Petryszyn is a model for girls since her childhood love of math and science has led to a career as a celebrated engineer for a top defense company. “My career choices trace back to my interests in math and science and being able to create solutions from those basics,” explains Petryszyn. “That’s what I still do, only from a broader perspective.”

As an executive at Raytheon, Petryszyn leads a business area focused on helping companies develop homeland security systems that join different types of services together. “There is really a need to ensure that we’re protecting our homeland,” she says, “and services really have to interact with one another.” As customers reorganize themselves, Petryszyn and her team aid in security by integrating solutions across all service lines.

With her involvement in the GESET Conference, Mary Petryszyn continues to nurture the next generation of women engineers.

PHOTO COURTESY OF RAYTHEON INTEGRATED DEFENSE SYSTEMS



Down on the Farm

Growing up on a farm in upstate New York, Petryszyn spent time creating solutions in her garden. Fascinated by how things worked—she would pull Mother Nature’s elements apart and then put them back together—she realized she wanted to pursue a future in engineering. She took a few years off after high school and then returned to study engineering science at a two-year college.

“This gave me a foundation as well as some flexibility to see which type of engineering I liked best,” she recalls. Choosing electrical engineering as her strong point due to its basis in mathematics, Petryszyn went on to finish a four-year degree at Clarkson University in Potsdam, New York. With her background in engineering science tucked under her belt, she was able to enter the school’s co-op program, working and earning money toward school while not in class. Petryszyn credits this hands-on experience with helping her pick the elective classes that best suited her interests and expertise.

After graduation, Petryszyn began work with Link Flight Simulation focusing on simulators for various aircraft and helicopters. Her seven-year tenure provided a well-rounded understanding of the completion of all phases of a major engineering project right through to delivering the product to the customer.

"I had a pretty competitive nature," she describes. "I really focused on getting stuff done first and was pretty well known as a go-to person." As a trusted employee, Petryszyn often interfaced with the customer and, finding that she enjoyed those interactions, switched into program management. As a manager, she would have more opportunities to use her technical background to help the customer develop the best solution.

Petryszyn's rise as a female engineering powerhouse came soon after. She received the Upward Mobility Award from the Society of Women Engineers, which recognizes women who progress in their careers while keeping a focus on the technical aspects of engineering ("it shows that women can do this sort of thing," clarifies Petryszyn). The ceremony, which she describes as "really humbling," was an eye-opener for Petryszyn. Touched to be included in a group of women who have done really incredible things with their careers and lives, she became aware of just how important the people in her life were who had helped her to achieve her accomplishments.

"What I needed to do was recognize and thank the people that had inspired me and helped me to keep my energy and focus to do the things that I'm passionate about," she says. "Those people that pick you up when you're stressed or think that there's something you can't do."

Ready, GESET, Go

Fitting, then, is that Petryszyn herself has become an inspiring mentor to girls interested in engineering. She helps run the GESET (Girls Exploring Science, Engineering and Technology) Conference, which holds events to provide girls with hands-on experience about technical careers. The last event was held 10 April 2007, in Denver, Colorado, where 1,467 girls attended. It consisted of 50 workshops of which participants could choose to attend two long sessions or three short ones. Each workshop provided an interactive environment where girls learned about different fields of science and technology. Petryszyn lists "a CSI crime scene workshop to veterinary science to earth and space science to robotics and computer workshops" as areas of interest that girls could explore. "They really get so energized by the end of their time there," she says happily.

"If you're passionate about something, stick with it. I think the real imperative is not so much keeping girls interested but getting teachers and guidance counselors to recognize this."

Sponsored and run by a coalition of industry companies such as Raytheon and the Society of Women Engineers, the entire event is free to the girls.

The GESET Conference represents an important issue facing female science fanatics: the fact that engineering is still seen as a "male field." Petryszyn thinks the trend stems from students being unaware of the unique things they can do with their math and science skills. That's why she brings in industry leaders to teach the girls about the various options. She advises, "If you're passionate about something, stick with it. I think the real imperative is not so much keeping girls interested but getting teachers and guidance counselors to recognize this. There's such a variety of things you can do (with technical skills). That's something we need to focus on—how to get teachers to engage with the material and bring it into their classrooms."

When not inspiring adolescents, receiving awards, or planning the next GESET Conference (she hasn't decided if it will stay in April or move to October of next year), Petryszyn still revels in the wonders of her work at Raytheon. "One of the most recent things we've been working on involves nuclear detectors," she shares. "Because of my background in math and science, I'm able to use my experiences in a new way with new technology and still understand it pretty easily. It shows that having a foundation for knowledge, you can use skills in all kinds of ways."

Thankfully, no gardens have been hurt in the process.

—Leslie Prives is a freelance writer living in New York City.



Touched by seeing women making great strides in engineering, Petryszyn (pictured here with WIE Program Administrator Keyana Tennant) continues to revel in her work at Raytheon.

PHOTO COURTESY OF KEYANA TENNANT

BY
LESLIE PRIVES

Extra Sensory Perception

IN THE LAB OR FIELD APL'S CARR IS MAKING THE COUNTRY SAFER

At first glance, Alison Carr appears to have a little bit of Sydney Bristow in her. Both women are bright and have worked for the Central Intelligence Agency (CIA), albeit in a fictional capacity for Bristow in the hit show *Alias*. But rather than beating on the bad guys, Carr's career has followed more along the lines of the show's resident techno-guru, Marshall Flinkman—using satellites, sensors, and lasers to produce new technologies.

Her curiosity was cultivated while growing up in northern Virginia, where Carr and her younger brother often stayed by their engineer father's side, handing him tools and listening to his explanations about the things he was fixing. "I really liked to take things apart as a kid. My mom got a little frustrated when she came home and I had taken the phone apart," Carr laughs. "But I liked to play with my hands. I think I had a lot more LEGOs than Barbies."

Her mother was a strong female role model from the beginning, serving as a nurse in the U.S. Army while Carr's father worked for the government.

Though Carr admittedly was a "science person" from the time she was very young, it was her mother who talked her into becoming an engineer over a chemist. "My mother is very practical," says Carr. "She really wanted to instill in me that women should be able to take care of themselves."



Engineering began at a young age with the disassembly of a phone, much to the chagrin of Carr's mother.

PHOTO COURTESY OF ALISON CARR

In the Know

Since engineering is "not about what we know," as Carr says, "but about what we can do with what we know," it seemed to be the right practical career for someone who enjoyed learning about how things ticked. Carr chose to attend Virginia Tech to study electrical engineering.

During her junior and senior years she was provided with a great opportunity as part of a co-op program to work for the CIA. Though work for the CIA is often top secret, Carr shares that she conducted research and reconnaissance using satellites that were up in orbit. "I actually got to go to a rocket launch," she recalls. "It was pretty cool getting to see something you worked on go up in a rocket and *not* explode. My work there showed me that I wanted to do research and work on cutting-edge developments." So, she ultimately stayed on at Virginia Tech to earn her master's degree in electrical engineering as well.

After seeing representatives at a job fair on campus, Carr accepted a position at the Johns Hopkins University Applied Physics Lab (APL). "I think what I loved about the



organization,” she says, “is that these are the people you go to when you have a really tough problem and you don’t know how to solve it. It was really appealing to me to have a tough job, where every day would be different and challenging.”

Working in an optical lab, she performs remote sensing research, which uses ambient light or lasers to determine how various sensors might operate when they are being used. As a field



Working in the CIA’s co-op program by day, student by night, Carr (center) conducted research and reconnaissance using satellites while at the agency.

PHOTO COURTESY OF ALISON CARR

test specialist, she works on a small team of engineers who consult with programs that build these various sensors, helping people gather the information they need to know so that the sensors will operate correctly. One project in particular will explain to government employees how a sensor that is designed to protect soldiers against a chemical attack might fare when uti-

lized out in the field. “With warfare, the threat of weapons of mass destruction, and the terrorist scares, what I do is extremely relevant,” Carr says.

Even with such an important research position, no two days are ever really alike. “I get to meet all kinds of people,” she says, “from the army private who is in the field with the sensor to the professor with a Ph.D. in environmental science who is an expert on the physics of the problem.” She has also spent time in Kuwait taking measurements on the environment there and has visited various desert locales to do various research tasks “I spend May through September on the road,” she explains.

Occasionally, she will even detonate items just to see what happens.

Ultimately, her research results help a larger team make computer simulations of what the sensor should look like and how it would perform.

Many do not realize that engineering work often uses skills beyond math and science, and Carr’s career at the APL is a perfect example of this. “You do have to be good at science, but you also have to have really strong communications and organization skills,” she says. “I do a lot of writing, which I love.” She is currently writing a journal article on her research findings that will get published as new knowledge in the field. “That really validates the work that we’ve done,” she says excitedly.

Not that her work and knowledge have gone unnoticed. Carr was recently asked to sit on a board as an expert consultant to the government. “The government thinks our work went so well that they are going to take our project and scale it up about 100-fold,” she explains modestly. “They’ve asked me to consult with the contractor to provide them with

the info they need to reproduce and potentially improve our results.”

As many engineers learn, the opportunities for jobs are endless, and she is aware that she could pretty much pack up and move anywhere without the threat of unemployment. While Carr says she gets “an immense amount of satisfaction from helping people and making the country safer,” she’s also content with the security of knowing that her skills are portable. She could do some more writing or, taking advantage of her location near Washington, D.C., she could enter public policy. “I would really like to help the government help the public get the most out of what technology has to offer,” says Carr. Of course, science person that she is, even a field change wouldn’t get her mind off of technology.

Revenge of the Nerds

Carr’s focus on her love of science is something of which she’s proud and

(Continued on page 24)

AN ALUMNA REMEMBERS

On 16 April 2007, the Virginia Tech campus in Blacksburg, Virginia, was rocked when a student went on a shooting rampage that left 33 people dead including the gunman.

The Carr family is well acquainted with Virginia Tech, as both Alison, an electrical engineer, and her younger brother, a civil engineer, are alumni of the institution. As with much of the country, the events of that day continue to linger with Alison.

“It’s really sad and frightening from a point of view that you go to this college town in the middle of nowhere and you really think that nothing bad can happen. And then when that just changes, I think it really hits you. My brother had graduated just a year earlier but had he stayed, he would have been right there. One of his professors was killed, so that really hit home. However, the sense of community at Virginia Tech is so strong, I don’t think that they will let this change the campus for the worse.”

BY
JULIA C. KELLER

Chip Off the Old Block

IBM'S LISA SU GETS HER GAME ON

Take heart all you Tiger Woods-wannabe golf hackers out there; Lisa Su can commiserate with you.

"I'm not an expert gamer, but I like to play," says Su, senior vice president and chief technology officer for Freescale Semiconductor and former vice president of the semiconductor research and development center at IBM. "I play Tiger Woods [PGA Tour]," she adds, qualifying that despite owning two Sony PlayStation3 consoles and being video games' technology queen, "I can't compete with these teenagers."

Of course, the majority of teens do not possess Su's skills in overseeing the development of the chip microprocessor technology that brings Tiger and PS3 to gamers. The journey from blank-slate idea to full-blown PlayStation action has been one of the most rewarding of her career.

"I've seen it through the whole process from when there was nothing on the piece of paper to when we're making tens of millions of chips," says Su. Though the cell microprocessor chip is rewarding from a technological standpoint, Su says teamwork is the most gratifying aspect of the five-year, US\$400 million collaboration between IBM, Sony Computer Entertainment, and Toshiba.

"We put together a team of three companies that, when we started, each had our own hat," explains Su. "The team really came together and put out something that no one company could have done. The sum is better than each of its parts."

Synergy skills are just a part of the overall package that makes Su a leader in microprocessor chip technology. She also has the science skills to back it up.

A summer internship making chips for X-ray lithography spurred Su's interest in semiconductors.

PHOTO COURTESY OF FREESCALE SEMICONDUCTOR



X-Ray Vision

Su's parents fostered her interest in science and math. Growing up in Queens, New York, as the older of two children, Su says her father, a mathematician, encouraged her to ground herself in some "hard skills" in math and science. "When I was a kid, my father used to quiz me on my multiplication tables," says Su. Parental influence is key in developing skills, says Su, "They can't make you do well, but they can certainly encourage you to do well." Her parents' encouragement and support fostered her as she took classes at the magnet school, Bronx High School of Science.

From the Bronx, Su left New York for Massachusetts Institute of Technology. "I didn't know exactly what I wanted to do, but I knew that if you were going to MIT you should do something in engineering," Su says.

But class wasn't the motivator for Su, who admits she was never a straight-A student. Instead, her hands-on work as a summer intern making chips for X-ray lithography galvanized her interest in semiconductors. "I knew nothing about semiconductors," says Su

of her freshman research with MIT's Hank Smith. "The lab was unlike book learning. I enjoyed and excelled at the experimental and applied part of engineering, being in the lab and seeing the cause and effect."

In Smith's lab, Su was bitten by the chip bug and went on to complete her master's and doctoral degrees at MIT. Her doctoral work with Dimitri Antoniadis taught her another valuable lesson about mentoring and opportunities. Getting a doctorate isn't about job training, says Su. "It's about gaining confidence in yourself and becoming a world-class researcher. You start in a field where you know a whole lot more than what's written in books and papers, and you feel like the world's expert in the area."

Sizing Up SOI Tech

Through her graduate studies, Su became an expert in silicon-on-insulator, or SOI, technology—"a technique that, at that time, was very experimental," Su says. Layering an insulator between the transistor and the silicon reduces the energy absorbed and makes a stronger signal between a microchip's transistors, improving performance by more than 30%, according to Su. Boosting the chip's signal using essentially the same density of transistors extended Moore's Law. "As you make these devices smaller and smaller, it's hard to make them go faster," she says, and the SOI technique allowed for more possibilities.

In 1994, leaving MIT as a world-class SOI researcher, and a woman, was even more unique. Coming from an undergraduate class that was one-third female, the lack of women engineering grads was noticeable, Su says. "There's no question that there's fewer women than men. The only thing that's important is that you feel like you're treated the same," says Su, adding that her mentors like Antoniadis and Smith treated her equally despite her gender. As a grad student, she adds, "You get the same treatment good and bad and the same opportunities, good and bad."

Though Su had a short stint working with semiconductors at Texas Instruments, Inc., the East Coast called her home to New York and IBM. At first, IBM didn't seem like quite the right fit, Su says. "IBM was such a large company, I was wondering how I could make a difference," she says. "After considering it for a while, I decided I was going to get over it." This approach was the same Su took to tackle IBM's gender divide as well. "When I came to IBM, I was the only woman engineer in a room of 20 men who were much more senior and experienced," Su says. "It was intimidating." To "get over it," she put her nose to the grindstone and began churning out ideas of which the engineering veterans hadn't thought. "I wasn't just this young whipper-snapper," says Su. "I was proving that I could contribute."

Su's initial project was getting the first copper microprocessor chip into production. Until the late 1990s, engineers used aluminum semiconductors, but the industry goal was switching to quicker copper connections. Su put her knowledge and her team-building skills to the test. "It was new for me, seeing things in a real industrial environment; the scale was completely different," she says. Coming from the grad school world "you're used to five or six people and now you're in a group of 50 people."

In her five years in research and development, Su rose to the challenge and her people skills excelled. "I got to interact a lot with the product folks, I could see how the work I was doing was going to end up in something that my mom would buy," Su says, adding that at the time, her group was working on microprocessors for Apple computers. "You could just go to the store and buy one of those. You felt a real sense of connection between the product and the people."

Su helped broker the marriage between IBM, Sony, and Toshiba to produce a proposal for the next-generation gaming machines.

Business acumen and next-gen

Though getting products to people interested Su, she says she knew the business aspect was as important. By luck, Su says, she was given the opportunity to work with Lou Gerstner, IBM's then chairman and CEO. Her nine-month assignment with IBM's top dog allowed Gerstner to learn more about the technology's leading edge. In return, Gerstner gave Su an "eye-opening" view of "how my little chip land fit into the bigger IBM world," she says. "Now the 300,000-person company looked a lot more manageable to me."

Motivated by the synergy between Big Blue's business and her tech savvy, Su formed IBM's emerging products group. "It was like running a start-up within a big company," says Su. "They wanted new ideas for how to grow our semiconductor products." Su's new idea was getting IBM into gaming. "The way the games were getting more and more sophisticated, you could tell that the processing power that you needed in games was faster than what you found in computers at the time."

Su helped broker the marriage between IBM, Sony, and Toshiba to produce a proposal for the next-generation gaming machines. The group's microprocessor design came from a "clean sheet of paper," says Su. "Not many times in engineering do you have that opportunity—you have some kind of technical legacy that you're trying to take care of." Su broke down technical barriers and built up a unique business model.

In all of this, Su was IBM's go-to gal for negotiations. Su says others may have wondered what this lab coat researcher was doing in a business suit. "Why would they let her do that? She doesn't know anything about those things." Opportunities like that, Su says, have been integral to her success. "What

has really helped me in my career is that I've had many experiences that have given me confidence in myself," says Su. "I think that's what women in engineering need. They have unique talents but need the confidence and opportunity to use them." As a result, Su is applying her talents not only to the next generation of chip design but also to the next generation of chip designers.

"My philosophy is taking chances on people, really trying to give people opportunities that stretch and grow them," says Su, adding that she's felt added responsibility to give those chances to women, specifically Asian women. "My role now is more of an enabler and advisor. I've been given the chance to grow, and now it's my responsibility to grow the next generation of engineers."

—Julia C. Keller is a freelance science writer in Boston.



Extra Sensory Perception

(continued from page 21)

encourages other girls to adopt, if that love is there. "Don't be afraid to try anything at least once," she advises. "I think girls have this mentality that they'll be labeled as the math or science nerd and that that's what you'll be forever. But don't be afraid to pursue what you really enjoy. You're the one who has to get up and go to that job every day."

Despite her busy schedule, Carr is sure to make time for outside interests. "Having a professional career is no excuse to get boring!" she declares. She and her husband absolutely love to cook and are self-described "big food people." Growing up, she danced ballet for ten years and played the piano so "I joined a local theater group in college. I also got into music and I had friends that were DJs, so I've tried to keep

going on with those things." Living in Baltimore, the opportunities for concerts, museums, and other enjoyable activities abound, which only adds to Carr's prospects for her future. "I don't think my family ever spent three years in any one place, so the fact that I've now been [in Baltimore] for four and we just bought a house is amazing to me," she marvels.

While she loves being an engineer, one needs only to look at her accomplishments with writing and communications to see what she means when she says that a career doesn't have to define a person. "Doing what you're good at doesn't mean you can't be good at other things too. It's just one aspect of who you are."

—Leslie Prives is a freelance writer living in New York City.



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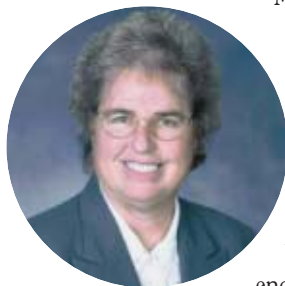
BY
JULIA C. KELLER

Looking at the Big Picture

JOAN "JPEG" MITCHELL BATTLES THE GENDER DIVIDE

Mitchell's unplanned attendance at a lecture on data compression was a precursor to her work on JPEG standards.

PHOTO COURTESY OF BENKO PHOTOGRAPHICS



"I think I know the trigger why women leave math and science. Do you want to know what it is?"

When such an intriguing offer is presented by Dr. Joan Mitchell, an IBM fellow, inventor with more than 70 patents, and an algorithm master engineer, who is perhaps best known as the "mother" of JPEG technology, one tends to lend an ear.

"Think of a movie you've seen recently," says Mitchell, speaking from her office at IBM's Printing Systems Division in Boulder, Colorado. "Movies aren't the first thing I connect to retention of women in science, but nevertheless the movie *Babel* starring Brad Pitt and Cate Blanchett rushes into my head. Now, speed it up in your mind. Images flash by of desolate Middle Eastern deserts, bustling downtown Tokyo, and a Mexican wedding's red and white decorations. Do you see images? Can you hear dialogue?"

Many people don't realize they are picturing a silent movie until Mitchell asks.

"See? You're thinking in high bandwidth," she says. "You're looking at the big picture."

Mitchell believes women tend to think and learn in "big picture" ways. "It's not gender specific, just gender biased," says Mitchell. She adds that most teachers lose sight of the big picture and as a result, science and math lose women.

"What is the way most math and science teachers teach? They teach dull, boring facts," says Mitchell. "You've been sailing along, you love math and science and you hit this teacher that won't give you the big picture. First you get bored, then you can't learn it and then you think you have no talent for learning it and that's the end of you for math and science."

Similarly, Mitchell explains that she wasn't an A+ student until she reached sixth grade when she changed her approach to learning. "I can vividly remember the day," she says. She was sitting in math class studying fractions, trying to puzzle out how least common denominators worked. Nothing seemed to make sense until she realized that a better teacher—her grandmother—already had taught her about least common denominators.

Mitchell's grandmother had been tutoring a college student who couldn't pass his math exams. Every night for two weeks, Mitchell listened in on the lessons. "I had kinda big ears," she says. After her grandmother's visit, she forgot about denominators until the late-night lessons came flooding back to her in a rush. "In the middle of class I thought, 'That's what grandmother taught me!' From that point on, I was looking for principles behind my math, looking for the foundation to understand it, rather than trying to memorize," she says.

Spurred By Sputnik

Mitchell was fortunate to have a wealth of other valuable family mentors. As the second of five children growing up in Modesto, California, Mitchell might have been overlooked when it came to schooling. Not so with Mitchell's family, who had a long tradition of collegians, male and female. Mitchell says her parents "assumed you were going away to college." In addition to a loving and supportive family, Mitchell's success was due, in part, to timing.

Mitchell, born in 1947, went to school at a time when any child, boy or girl, was encouraged to go into math and science. She calls herself a "Sputnik baby" because after the Russians launched the first space satellite in 1957, the United States was in a frenzy to churn out scientists to win the space race. "After Sputnik, we were going to save the world from the Russians," says Mitchell. "It was OK for girls to be smart." The window of scientific opportunity slammed shut for her younger siblings, who went through the school system after the Apollo missions and successful landing on the moon, and weren't as encouraged to go into the sciences.

In 1969, Mitchell graduated from Stanford University in Palo Alto, California, her father's alma mater, with an honors degree in physics. She went on to earn her master's and doctoral degrees from the University of Illinois at Urbana-Champaign in 1971 and 1974. With her Ph.D. in hand, Mitchell began interviewing for jobs and found her way to IBM, but not before she had bumped her head against the glass ceiling. Mitchell interviewed at a national research lab at the same time as a male colleague. "I couldn't get them to listen to me all day, even though they didn't know the first thing about what I did in my research," Mitchell recalls of her interviewers, who hung on every word her colleague said.

The environment at IBM was distinctly different. "I was absolutely aware that everybody shook my hand," she said. Though women were in short supply in 1974 at IBM, it wasn't the gender divide that gave Mitchell pause. During her

"After Sputnik, we were going to save the world from the Russians. It was OK for girls to be smart."

interview she met with ten people, none of who had been at IBM less than 15 years. "This set off alarm bells in my mind. I didn't see new people there," she said. "I was not ready to get hired into my life's work."

Mitchell need not have worried. In more than 30 years with IBM, she has moved around often. Her first job with the Exploratory Printing Technologies group was to "invent ways to leave marks on paper." Though Mitchell enjoyed the challenge of thinking about new printing concepts and design, she thought no one else in IBM or the outside world was working in her specific area. As a result, she said she felt isolated by the tasks in which her managers wanted her to work.

Image Immortality

After a year, Mitchell's unplanned attendance at a lecture on data compression catapulted her creativity and career. Concerns the lecturer raised about data compression gnawed at Mitchell for months afterward. She got up the courage to ask her manager if she could work on the problem of compressing images. Like her moment of clarity in sixth-grade math, Mitchell's change in her approach to the problem had set her free. "I had made a decision to dance in the halls if I wanted to," said Mitchell. "I did things like bring in a beach towel and lie under the trees if I wanted to."

Mitchell soon put her initial research forays into data compression to use. Another IBM group was putting the finishing touches on the standards for image compression in black and white for fax technology. Not long thereafter, the United Nations' International Telephone and Telegraph Consultative Committee (CCITT), which helped develop international telecommunication standards, wanted to outline the standards

A COOL COMPRESS

"JPEG" stands for Joint Photographic Experts Group, the name of the committee that created the standard for how an image can be compressed into numerical representation, or bytes, and decompressed back into an image. We now use the word "jpeg" to refer to the compressed image itself. Image quality is lost depending on the algorithmic strength used to compress the image; the higher this "lossy" compression ratio, the sharper the image.

Images are broken into blocks of pixels that are then described by an algorithm called a forward discrete cosine transform matrix. Each number in this matrix describes a pixel, which is then divided by a constant and rounded to the nearest integer. This quantization process takes large amounts of information and reduces the numbers to zero, or small positive or negative numbers, allowing a large image to be stored in fewer bits. This ratio is the main "lossy" step in the compression process. To get the image back (with some loss in quality), the original discrete cosine transform matrix is multiplied by the quantization matrix.

Fortunately, the human eye isn't great at distinguishing the brightness of an image in detail, which allows computer engineers to design algorithms to compress images without a noticeable loss in overall quality. Our eyes can't tell the difference between an initial image and one compressed ten times.

The JPEG group—a joint committee of Joan Mitchell's IBM group, the International Standards Organization, and the ITU Telecommunication Standardization Sector (formerly, CCITT)—was organized in 1986 and issued the standard in 1992, which was approved in 1994.

for grayscale and color data compression as well. From 1987–1994, Mitchell worked with the Joint Photographic Experts Group, or JPEG, to standardize the color-image, data compression algorithm. These images that every gamer, blogger, and Web surfer know, are a direct result of IBM’s marriage with CCITT and the International Standards Organization.

After the JPEG standard was secured, Mitchell took a two-year leave of absence from IBM during which she was a visiting professor at her graduate alma mater, the University of Illinois, for six months. Once again, the ugly specter of gender discrimination made her rethink all the award-winning work she had done. An acquaintance at the university suggested IBM had only hired her in the 1970s as part of affirmative action and the femi-

nist movement. “I was horrified,” Mitchell says, “though it was probably true. There was a hiring freeze on and that year IBM only hired ten people, not 100 people.”

The Magic’s in the Mentoring

The antidote to discrimination, in part, is mentoring, says Mitchell. In one capacity or another, Mitchell has always spent a significant part of her time mentoring others—meaning hands-on work for her students and hands-off work for Mitchell, who since 2001 has been one of eight women IBM has bestowed the distinction of “Fellow.” Now Mitchell acts as a mentor for about 20 different projects at a time. “They’re in charge, they have to do the write-ups—all the work’s on their side,” she says. “If they do nothing, nothing happens and that’s OK.” But when

her advisees buckle down and work, Mitchell says, “they shine and they know that they deserve the credit. I’m always amazed. I just sit there and cheer.”

Recently, Mitchell has published a new book that is the culmination of many e-mail ruminations with her father. *Dr. Joan’s Mentoring Book* is chock-full of her accumulated wisdom as a diligent worker, an inspirational woman engineer, and a “high-bandwidth” thinker.

Mitchell says that in writing the book and continuing her mentoring of others, “I consciously said I want to be the giant on whose shoulders you’ve stood. I’ve made a difference to people—maybe not a lot—but a few people, and that’s very satisfying.”

—Julia C. Keller is a freelance science writer living in Boston.



Notice of Upcoming Call for Proposals

Real-World Engineering Projects: Electrical Engineering, Computer Engineering, and Computer Science Curricula Development for First-Year Undergraduate Students

Discovery-Based Projects in IEEE Fields of Interest

The IEEE is continuing with a second year of funding for a program to develop curricula in the IEEE fields of interest for use with first-year students studying electrical engineering, computer engineering, and computer science. The program seeks high quality, hands-on, team-based projects that focus on real-world problems whose solutions benefit society. The projects are expected to make electrical engineering, computer engineering and computer science more relevant to first-year students and to illustrate how the work of engineers and computer scientists directly impacts society. The ideal project will allow students to discover the importance of a contemporary problem and excite their interest in creative solutions. It will demonstrate how and why technical methods work, rather than simply providing a recipe for a solution. It will allow the students to discover underlying complex engineering and science principles and provide motivation for further study and engagement.

Completed projects will be disseminated by the IEEE for use by faculty in the development of first-year courses. Projects should be stand-alone modules requiring a combined 10–30 hours of lecture and laboratory instruction, and should be easily replicated at institutions worldwide with reasonable cost and effort. Authors of completed projects will receive an honorarium from the IEEE. Please watch for the full call for proposals in the Spring of 2008; information will also be posted at: <http://www.ieee.org/web/education/university/RealWorldEngineering>

Career Advisor

Experiences from the Real World

Involvement and interaction are essential for growth

Listen up and don't be afraid to join in

Practical Tips from a Mega-Mentor

Johnson & Johnson's Sorensen makes an investment in people

For many people, the end of the work-week is trumpeted by a popular theme for Friday. There are casual Fridays, the ever-popular pizza Fridays, and Friday summer hours. For Karan Sorensen, CIO and vice president of information management, Johnson & Johnson (J&J) Pharmaceutical Research & Development, LLC, in Raritan, New Jersey, Fridays are also about enhancing employees' morale, sans the Ragu and mozzarella but with a pinch of mentoring.

A newly minted CIO who also is pursuing her Ph.D. in technology management and has a second job as a single mother of three teenagers, Sorensen still finds time—or “makes time” as she puts it—to mentor 35 people. Every Friday, for the entire day, Sorensen mentors J&J employees. While some are technical like she, others are in business functions such as finance, sales or marketing. Going far beyond what most J&J mentors take on, Sorensen also mentors additional employees informally as well as in group mentoring sessions. She says, “It’s a great way to kick off the weekend!”

J&J’s commitment to employee development supports Sorensen’s mentoring activities. She explains that, “Employee

development is a pervasive part of the J&J culture, part of the DNA here. Our philosophy is to invest in people and success will follow. Through our succession planning process, we identify, coach, and develop high potential employees, to be the best that they can be, fully engaged. As a result, employee retention is exceptionally high. I’ve been here for four years, but I’m still the ‘new kid on the block’ because there are so many people who have been here for 20 or 30 years.”

Grooming the Next Generation

Why does she do it? “I feel that mentoring is the most important thing I can do for the company,” Sorensen explains. “I’m developing the next generation of leaders. As a mentor, it is more rewarding for you than you would ever expect. And it’s amazing how fast the organization will recognize the value.”

What’s more, mentoring yields results. We’ve all heard that most successful leaders have a series of mentors throughout their professional lives. Sorensen sees evidence of this everyday. “Mentoring empowers people to give breakthrough performance, to achieve what they would not have before. People sometimes need someone to believe in them before they believe in themselves.”

“Or they just need a kick in the pants. I have seen so many people just blossom, from good to great to ‘next practices.’ They become leaders among leaders.”

More concretely, she has seen sales people significantly increase their sales

and other employees receive awards, recognition, and monetary benefits subsequent to being mentored by her. Sorensen attributes their success—at least in part—to mentoring.

Mentors Versus Managers

What do people talk about with their mentors, that they can’t talk to their managers about? Actually, Sorensen does mentor her direct reports, meeting with each of them weekly to talk explicitly about them, not about their projects. In this way she ensures that she spends quality time with her staff.

However, some employees seek confidential assistance with things that they just can’t talk about with their managers. Sorensen explains, “We have an understanding that mentoring conversations are confidential. It’s a safe harbor, non-judgmental, and we can talk about anything. The only exception is if I hear about anything illegal or unethical, which is rare. Then I point the person to the appropriate support structures in the company for follow-up.”

Mentoring conversations can cover many different subjects. According to Sorensen, “You never know where you’re going to go in these conversations. You’ll talk about their hopes and dreams and how to get there, their yellow brick road.”

Employees regularly seek mentoring from her in the following areas:

- ▶ reviewing performance self-appraisals before they are submitted
- ▶ preparing for performance review, promotion, and raise conversations with their managers
- ▶ discovering answers to questions such as “What am I doing that makes me be seen as a manager and not a director? What are they looking for?”
- ▶ dealing with staff performance problems

- ▶ becoming a kinder, more empathetic manager without being seen as weak
- ▶ developing executive presence and confidence.

Choosing a Mentor

Given that Sorensen is an experienced and dedicated mentor, I asked her for advice on how to develop successful mentoring relationships. She offers the ten tips below.

TIP 1. “Never force an employee to be mentored—it’s just a waste of time!” Talk to the employee about his or her career goals and development needs to see if mentoring is appropriate and welcome. If the employee would like to have a mentor, work together to find a good match in terms of development needs and personality.

TIP 2. Employees should look for mentors who are two levels above them in the organization, someone not too far away but not in their direct management chain.

TIP 3. Ask the employee to observe a few mentor candidates. “Who makes you feel comfortable with their approach? Who are you drawn to and why? You want to respect and trust them, but not feel afraid of them or idolize them. Look for someone you want to be like, not someone you want to be. There needs to be good chemistry, because you want to feel comfortable talking with your mentor about difficult subjects.”

The First Meeting

TIP 4. Once an interested and appropriate mentor is identified, the mentor and the employee meet to see if it is a good match. Sorensen suggests focusing on getting to know each other, possibly not even talking about work during this meeting. “I’ll spend 60-90 minutes in the first meeting. I ask thought-provoking questions, such as “What’s fun for you?” or ‘If this wasn’t your job, what would you

choose to do?’ It gets them thinking away from work and about themselves—not what they’ve done, but who they are.”

TIP 5. “Don’t waste time mentoring someone who is trying to use you politically. Sometimes they just want to find out how to get their next promotion and are looking for help and influence in doing that. Make your expectations clear. Mentoring does not mean going out and promoting them to others. These conversations are for their development. Being a mentor means a long-term investment in them, a true commitment.”

Making It All Worthwhile

TIP 6. Don’t set up regularly scheduled mentoring meetings. Sorensen encourages employees to ask for what they need when they need it, so that when they request a meeting she knows that the time will be focused and well spent. She also knows that the need may be urgent, so she makes an extra effort to make herself available, even outside of work hours if necessary.

TIP 7. Encourage the people you mentor to become mentors themselves. “They’ll gain a better understanding of how to make the most of our meetings, and they’ll see themselves differently.” They may mentor employees from other business disciplines, for additional learning.

TIP 8. Here’s an exercise for helping employees develop executive presence and confidence: “I go through employees’ resumes with them, and ask about the meaning, impact, and significance that they have usually omitted from the work descriptions. Based on our discussions, I create my own version to share with them. This helps employees gain a whole different level of appreciation and respect for what they’ve done. Then the executive presence starts to show up but it’s all based on their accomplish-

ments, not inflated ego. They start seeing themselves at the level they aspire to.”

TIP 9. Know when to end the mentoring relationship. “It’s the mentor’s responsibility to be cognizant of what the employee needs and to provide a graceful way to exit the relationship when it’s no longer adding value. You need to know when to pass the baton. When I feel I can no longer be of use to an employee, I may say ‘I don’t know that there is anything I can give you besides support. You’ve grown beyond me.’ Then I point them to another mentor for what they need next.”

TIP 10. Ask for feedback on how you are doing as a mentor, so that you are constantly improving. Sorensen notes that mentors need to really welcome and be receptive to feedback, not just go through the motions. She jokes, “Just don’t tell me I’m dumb, fat, or ugly. You’ll hurt my feelings. Other than that, I’m open to it.”

Just Do It

For managers and engineers who are new to mentoring, Sorensen offers these final words of advice: “If you’ve never mentored or had a mentor, try it out. Be honest and say that you’re new to it. The rewards are so much greater than the anxiety of not knowing what it’s about.”

—Sue Dorward (sue@sudocoaching.com) is a tech management coach specializing in coaching high-potential employees. She is based in New Jersey.

Fellow the Leader

IEEE Fellows land among the elite

“Becoming an IEEE Fellow increased my visibility within the community and provided me with leadership opportunities I probably would not have had otherwise. It certainly opens more doors,” says Sarah A. Rajala, who in 2001 became a Fellow. Rajala holds the James Worth

Bagley Endowed Chair in the Department of Electrical and Computer Engineering at Mississippi State University, in Starkville, and is the department head. She believes more women who have made significant contributions should become IEEE Fellows.

Currently, Regions 1–6 (United States) boast the highest number of female Fellows with 116, compared with 4,135 male Fellows. Region 10 (Asia) has ten female Fellows and 757 male Fellows; Region 8 (Europe) has 15 female Fellows and 710 male Fellows; Region 7 (Canada) has five female Fellows and 234 male Fellows; and Region 9 (South America) has no female Fellows and 29 male Fellows. The total number of male Fellows is 5,865, compared with 146 female Fellows. In 2007, 268 members became Fellows, 18 of which were female. The top two Societies with female Fellows are the IEEE Computer Society and the IEEE Communication Society.

But to boost the number of female Fellows, first they have to get nominated.

The Nominees Please

Rosann Marosy, senior administrator of Fellow activities, and Bruce McClung, Fellow chair, explain the nomination process.

First and most important, self-nominations are not accepted. If you want to become a Fellow, focus on doing your work to the best of your ability. Get involved in IEEE activities, become active in one or more technical societies, volunteer for local conferences, develop professional contacts, network with peers, write and present technical papers, or author a book on some special field of electrotechnology.

Ideally, your nominator should know you well enough to be able to determine if you're qualified to become a Fellow. They must be able to list your accomplishments, your IEEE activities, awards, and society and committee memberships. Nominators should only nominate individuals if they have contributed significantly to the advancement or application of electrotechnology.

McClung and Marosy say the biggest mistake nominators make on the appli-

cation is using superfluous words or phrases like "gigantic," "extremely," "immeasurable," "the only one to ever achieve," or "the world would be a different place without the work of the [nominee]," to describe the technical accomplishments of the nominee. Lengthy attachments to the application are also discouraged.

If you find out you've been nominated, do not contact the IEEE Fellow committee members or staff directly for information regarding your application status. Your nominator should be the only liaison you have into the Fellow process. If you're a Senior Member, it's best to get involved in IEEE activities to get recognized by coworkers or peers, who can then nominate you for Fellow status.

For She's a Jolly Good Fellow

Rajala says she was nominated for Fellow status by a colleague while teaching at North Carolina State University, in Raleigh. During her 27 years there, she was a full-time professor, a director of the Center for Advanced Computing and Communication, a university cooperative research center, and an associate dean for both academic affairs and research and graduate programs.

So how did Rajala get nominated?

"My contributions to engineering education got me recognized and nominated. Especially my efforts to improve the quality of the educational experience for undergraduate students, especially for women and minorities in engineering."

Rajala led an initiative to develop and implement a new team-based active learning introduction to engineering courses at North Carolina State for over a thousand incoming freshmen, which helped students work in teams and improved their communication skills. At North Carolina State's College of Engineering, she established the Women in Engineering program, which supports women students in engineering and the K–12 Outreach program, which aims to educate students and teachers in elementary, middle, and high schools about engineering. She also formed an engineering faculty development program

designed to help faculty succeed in teaching and research. In addition to her educational contributions, Rajala is an active researcher with technical contributions in the areas of image and video processing.

Prathima Agrawal, who in 1989 became the first female from Asia to become a Fellow, is chairperson of the IEEE committee that selects Fellows from every IEEE Society and Council. She is currently the Samuel Ginn Distinguished Professor and director of the Wireless Engineering Research and Education Center, which is a new undergraduate program for students earning a bachelor's degree in Wireless Engineering at Auburn University, in Alabama.

Agrawal says to become a Fellow you should gain exposure in the engineering field. For example, publish your work in IEEE publications, develop patents or publicly available software or hardware systems. Agrawal says she got her name out there by getting a few papers published in IEEE transactions and conference proceedings.

"I came up with new ideas that advanced the state of the art in VLSI design," Agrawal explains. "These ideas were adopted in the company I worked for, AT&T Bell Labs, in designing large VLSI circuits with greater accuracy and efficiency than before. They were captured in several publications and patents."

Agrawal says she also gave many talks on her ideas in major universities such as Massachusetts Institute of Technology, in Cambridge, Stanford University, in Palo Alto, California, and the University of Illinois at Urbana-Champaign, among others. She took part in several major conferences such as the IEEE/ACM Design Automation Conference and the International Conference on Computer Aided Design. She advises those wishing to become Fellows to take part in committee representations, editorial boards, conferences, and seminars.

According to Agrawal, if you work in academia or industry, especially industrial research organizations, becoming a Fellow will enhance your career. "Even in corporations that are more linked to

technological development, becoming an IEEE Fellow will place you among the elite group of employees and will contribute to further recognition in the corporation—higher position, better pay, more autonomy and independence,” she says. “I would encourage other women to aspire to be IEEE fellows.”

For more information on how to become a Fellow, visit www.ieee.org/fellows or email fellows@ieee.org.

—Julia C. Keller

Building Your Own Community

IEEE president advises strengthening technical and professional skills

“It’s incredibly important to increase the number and success of women in engineering. It’s a great career and I would like young women to feel it’s a welcoming career for them,” says Leah Jamieson, 2007 president of the IEEE.

As the second woman to be elected IEEE president, Jamieson, an IEEE Fellow, is the Ransburg Distinguished Professor of Electrical and Computer Engineering and the John A. Edwardson Dean of Engineering for undergraduate education at Purdue University, in West Lafayette, Indiana, where she has been a faculty member since 1976. She was the 2005 vice president of IEEE Publication Services and Products Board and was chair of the IEEE Technical Activities Board Periodicals Committee as well as the 2003 vice president of Technical Activities.

But how do we increase the number of women in engineering? One way, Jamieson says, is to educate the public about engineering.

“There lacks a deep public understanding of engineering for both girls and everyone in general. Many girls don’t consider engineering because of this and also partly because girls don’t have enough engineering role models or mentors,” says Jamieson. “There are a lot of misconceptions about what engineering is and what engineers do. This works

against encouraging women to pursue engineering. We need to change this.”

But how can we do that?

IEEE Women in Engineering (WIE) is one way. With increased networking, mentoring, public outreach programs, and career advancement opportunities, women engineers can reach out into the public arena to shed light on career possibilities in the engineering field.

As a student, Jamieson says she did not have any mentors who were female engineers. She didn’t even decide right away that engineering would be her major. She earned her bachelor’s degree in mathematics from the Massachusetts Institute of Technology in Cambridge, and master’s and doctoral degrees in electrical engineering and computer science from Princeton University in New Jersey.

“Initially, math was my undergraduate major, then I switched to computer science, then I went on to engineering. So it was a slow evolution. I was looking for something more tangible so I decided on engineering,” she says. “Although I didn’t have women engineers who were mentors, I believe we all need role models and people to help us.”

Before finding a mentor, Jamieson tells students to take time to choose the right career path.

“It’s critical to step back and make sure you’re doing something you’re passionate about. Ask yourself, ‘do I love what I’m doing and if not, what can I do to change that?’”

Jamieson knows a lot about the feeling of fulfillment that comes with doing something for which you are passionate. At Purdue, Jamieson cofounded and is a director of the Engineering Projects in Community Service (EPICS) undergraduate engineering design program, which was initiated at Purdue and adopted by 17 universities. EPICS matches teams of engineering students with local community-service programs to design, build, test, and support projects that improve the community. For Jamieson’s work with EPICS, she was the corecipient of the 2005 Bernard M. Gordon Prize given by the U.S. National Academy of Engineering to recognize innovation in engineering technology education.

So how does Jamieson have time to serve as president at the IEEE? As an engineer, an educator, a mother, a wife, and president of a huge organization, Jamieson has a lot on her plate. But she says timing was on her side.

“I have a husband who is an engineer and an 18-year-old daughter in college, which made it easier for me to pursue my career. But there’s always a challenge

to have balance. I consider myself lucky that things worked out the way they did.”



Leah Jamieson

Aside from work/life balance, Jamieson says the biggest challenge throughout her

life was feeling a sense of isolation.

“Being one of few women in my field, I would listen to conversations around me and think, ‘I don’t want to talk about these things!’ I would ask myself, ‘Why am I here?’ I had those thoughts as a student, and they continued with me throughout my career, although they are less now. Now I tell myself, ‘I’m still different, but that’s ok.’ It gets better because with experience comes confidence,” says Jamieson.

Jamieson agrees that almost every woman in engineering has experienced a time when someone has made her feel like she doesn’t belong. To combat this feeling, Jamieson suggests building a community of friends, colleagues and family. Most importantly, she says, pay attention to nurturing relationships.

“Volunteering helped me build a strong community. Take life into your own hands. Build your own community. That’s how you stay feeling connected.”

What if you’ve been out of the loop for months or maybe years? Maybe you took time to start a family and want to jump back into your career—how do you make a smooth transition?

“It’s never easy to leave and come back,” says Jamieson. And that’s because with engineering, technology changes quickly, she explains. But there are key things to make the transition easier.

(Continued on page 42)

Pipelining

Attractive Programs for Women

Building a strong foundation for the future

Monkeys, machines, and museums all playing a part in education

Packaging Girlhood

Beyond sugar and spice and everything nice

Ever wonder why girls love pink and gossiping about boys? Maybe the media are to blame. Sharon Lamb and Lyn Mikel Brown explore how “girl power” has been packaged to express a girl’s right to sexy clothing in their new book, *Packaging Girlhood: Rescuing Our Daughters from Marketers’ Schemes* (St. Martin’s 2006).

“We wanted to show how the media and marketers bombard girls with harmful stereotypes about what it means to be a girl,” says Lamb, a practicing clinical psychologist and professor of psychology at Saint Michael’s College in Vermont. To that end, Lamb and Brown conducted interviews with over 600 girls to see what they love and why they love it. The results? Disturbing. It seems the media perpetuates stereotypes about boy-crazy, shopping-obsessed, diva princesses by portraying these characteristics and few others. More information can be found at www.packaginggirlhood.com.

One of the most harrowing effects of this media trend is that girls are taught to be more aggressive toward one another. According to Brown’s research, “Girls learn so much about how and why to compete, and fight, with other girls through the media. It’s rare to see a magazine, chick lit novel, PG or PG-13 movie that doesn’t

have a girlfight or mean girls as a key subplot these days.”

And these “girl-power” images are often misleading. “Those paths that are about being girly or sexy give short-lived attention and a very limited power to girls,” Lamb explains.

So what are we girls to do? Girls are encouraged to pursue their passions, as long as they are doing it for the right reasons. Lamb and Brown advise girls to take themselves seriously as people who are intelligent, creative, and capable. Parents can help.

“We suggest that parents open up different avenues and create lots of options for expressing power and creativity, that they introduce their daughters to ideas, activities, relationships, and realities that counter the hype and give girls the understanding that they can follow their real interests,” says Brown, professor of education and human development at Colby College in Maine and founder of Hardy Girls Healthy Women, a nonprofit organization that supports the healthy development of girls.

Of course, Lamb and Brown maintain that girls can still enjoy their favorite media as long as they recognize the images that are being portrayed and acknowledge that girls do not have to agree with them.

So go ahead girls, feel free to wear pink and have a crush on the boy next door, as long as you do so because you want to, and not as the result of any outside pressure.

—Leslie Prives

It Takes a Village To Inspire an Engineer

How Techbridge is introducing girls to engineering

If you ask most girls to describe an engineer you might hear words like “nerdy,” “super smart,” “boring,” or “boys.” Ask the girls in Techbridge, a program of Chabot Space & Science Center in Oakland, California, and you’ll hear a different story. After working on design projects and meeting role models, the Techbridge girls know that anyone who is creative and interested in helping people and the environment can be an engineer.

Traditionally, girls have not been encouraged to pursue engineering. Unlike their brothers, most girls haven’t been encouraged to tinker with tools or build with blocks. They haven’t experienced the rewards of repairing a toy or appliance and may not understand how a career in engineering can be rewarding. In addition, we hear from girls that they want to make the world a better place but most don’t see the connection between their people- and society-oriented values and careers in engineering.

Imagine that there was a program designed just for girls. We did and developed the Techbridge program to introduce girls to engineering, technology, and science. We talked to girls to find out what kinds of projects appealed to them. They had lots of ideas: addressing problems at school and in the neighborhood, working with tools, taking field trips, and meeting role models. They were also very enthusiastic about a program just for girls.

All “Hands-On” Deck

With support from the National Science Foundation, Techbridge was launched in 2000 to help increase and diversify the

pipeline in technology, science, and engineering. Techbridge has directly served over 1,500 girls in primarily underserved communities in its after-school and summer programs. The program is hosted in elementary, middle, and high schools in Oakland, California, and surrounding communities. Techbridge not only introduces hands-on activities to make technology, science, and engineering engaging for girls but also provides role models and field trips that expose girls to many more career options to help them see how careers in these fields can be compatible with their life goals and personal values. Techbridge offers professional development and training for teachers and role models and resources for families to help them support and make informed choices for girls.

Through hands-on projects, students learn skills that go beyond the traditional math and science curriculum taught in school. Girls get a chance to work with tools, read schematics, and follow directions, troubleshoot, and tinker. Projects include studying renewable energy by building solar-powered LEGO cars, practicing the engineering design process through a toy design challenge, and learning about electronics and circuitry by building telephones and soldering kits.

Projects frequently include a service-learning component, teaching girls the value of giving back to the community and protecting our environment. Career-exploration activities such as writing resumes, conducting Internet research, and creating career calendars give students the tools they need to make informed—and inspired—decisions regarding academic and career options.

Engaging Results

Techbridge has a seven-year record of success in engaging girls in scientific and technical fields. The program has increased girls' technical skills, confidence, and interest in engineering, technology, and science and has also positively increased their interest in careers in these fields. Evaluation



Techbridge's summer academy for girls introduces subjects including "Cars and Engines" and "Kites and Design."

results show that girls have a better understanding of what engineers, scientists, and people who work in technology do and have been encouraged to pursue careers in science, technology, and engineering.

These gains translate into positive impacts on girls' career aspirations. In the evaluation of the 2005–2006 after-school Techbridge programs, 88% of the girls reported that they were more interested in careers in engineering, technology, and science. Among the students interviewed to date in our longitudinal study, 75% indicated interest in pursuing engineering, technology, or science in college.

Up Close and Personal

Women comprise just 11% of today's engineering workforce. Techbridge is working to change this statistic. Techbridge hosts a summer academy with an engineering focus. "Kites and Design" introduced girls to the physics of flight and the engineering design process. With "Cars and Engines," Techbridge girls got the chance to learn how four-stroke engines work by taking apart lawn mowers and putting them back together again. They learned how to perform basic car maintenance and created animation clips that demonstrated their understanding of moving parts in a car, such as manual car windows and windshield wiper systems.

Role models and field trips complement the activities and allow the girls to see rewarding careers in engineering. For many of the girls, it's their first time meeting engineers and learning about the different fields. The curriculum developed in the

Techbridge summer academy is introduced during the school year to hundreds of students (from fifth graders through 12th graders) in our after-school programs.

We are encouraged how our curriculum, along with role models, inspires girls to find their passion in engineering. We've also rolled out new curriculum—the Green Design Project—that has been particularly successful in inspiring girls to enter the engineering pipeline.

Seeking Greener Pastures

The Green Design Project helps Techbridge girls discover that engineering can be compatible with their desire to make the world a better place. In this



Girls have the opportunity to work in teams, go on field trips, and learn about career options.

project, the girls had the chance to work in teams to design and construct a two-story dollhouse that incorporated green design. They learned a new software program that allowed them to draw their floor plans, which transformed their ideas into three-dimensional models. The project was considerable fun but also quite challenging in scope: creating a floor plan,



Role models often help shape girls' career vision and goals.

constructing the house, wiring lights, designing the landscape, and decorating while keeping the green theme in mind. The girls learned about project management and put their time management and teamwork skills into practice.

The dollhouses needed to meet green standards. The girls learned that materials such as bamboo, cork, recycled plastic, and rubber could be used to make floors, walls, and furniture. They discovered that building choices such as solar panels and low-flow faucets are ways to use resources efficiently. They thoughtfully incorporated environmentally friendly features into their designs, using bamboo and resource-efficient cork flooring, low VOC paint, clothes lines, sunflower seed cabinets, blue jean insulation, recycled carpet, and energy-efficient appliances.

In conjunction with building their green dollhouses, the girls had the opportunity to see green design and construction in practice. The girls visited the construction site of the San Francisco Federal Building and saw first hand how a green building is built. They learned how windows could be configured to reduce the need for heating and air conditioning and how the use of natural lighting can greatly reduce energy costs.

On a visit to the Gordon and Betty Moore Foundation, the girls were impressed with the way that the work environment reflects the mission of the Foundation—environmental conservation. The girls saw cabinets made of sunflower seeds, chairs made of corrugated cardboard, and a conference table made from a felled tree. They saw how giving new life to old things could have beautiful results.

The Green Design Project, which incorporates hands-on learning with environmental awareness, allows girls to be creative and work on a project that they truly can take pride in. It also gives girls the opportunity to think about how they can make the world a better

place and to meet people whose careers allow them to do just that.

Reversing the Field

“Can I really take it apart? Is it all right to break it?” One of the middle school girls in Techbridge wanted the reassurance before she took apart a hair dryer. Her mother hadn’t been too pleased when the student previously tried to figure out what made a curling iron work by taking it apart at home. Tavy Wade and Lyn Gomes with Carollo Engineers in Walnut Creek, California, used this hands-on activity as a way to introduce the girls to engineering. The girls learned about the different kinds of engineers who help design and build hair dryers. They also discovered the joy of reverse engineering to figure out how things work. By the end of the afternoon the girls learned that household appliances, like a hair dryer, aren’t as complicated as they imagined and that engineering can be a very rewarding career.

The role models and field trips that are part of the Techbridge experience are key to the success of our career exploration. They introduce girls to new career options and inspire them to want to study engineering. We are especially pleased to find that role model visits and field trips have a long-term impact. Several girls have told us how role models from past years have changed their goals.

For example, one of our high school students wants to be a product design engineer. How many girls know what product design entails let alone have it as a career goal? This student attributes her career aspiration to a visit to design firm IDEO three years ago. In her evaluation, she reflected, “I walked in and I knew that’s where I wanted to work.”

Role models can combat stereotyped images and communicate information about their work and the steps needed to prepare for a career in engineering. Role models are an example that engineers

are problem solvers who use creativity to work on projects that benefit people and the environment.

Take Action

We hope you’re inspired to work with girls in your community. Make a promise to get involved. Here are some ideas to help get you started:

- ▶ Look for a local Girl Scout group and volunteer an afternoon of your time to share your personal story and lead a hands-on activity: <http://www.girlscouts.org/>.
- ▶ Offer to organize a job shadow during National Engineers Week so that girls can visit your office and meet and see engineers in action: <http://www.eweek.org/>.
- ▶ If there is a local Expanding Your Horizons program, volunteer to be a role model and lead a workshop for middle schools students: <http://www.expandingyourhorizons.org/>.
- ▶ Organize a group of coworkers and adopt a local high school. During National Engineers Week, organize a panel discussion about women in engineering making a difference.
- ▶ Sponsor internships for high school and college students. Getting the chance to “test the waters” can help girls see that there is a place for them in engineering.
- ▶ Buy a set of biographies of women engineers and scientists for the library at your local public school. The Women’s Adventures in Science series are a great read: <http://www.nap.edu/catalog/was/>.

You can have a significant and lasting impact on girls—inspiring their interest in engineering. By sharing your passion for your work you can help the next generation of engineers become more diverse, reflecting the talents and promise that girls can contribute.

—Linda Kekelis (lkekelis@chabot-space.org) is director of Techbridge, a program of Chabot Space & Science Center.

December Martin (dmartin@chabot-space.org) is a program coordinator for Techbridge.

In conjunction with building their green dollhouses, the girls had the opportunity to see green design and construction in practice.

Rebecca Wepsic Ancheta (beckyancheta@sbcglobal.net) conducts qualitative evaluation research for the Techbridge Program.

I, Robot

Battlecry competition strengthens bonds among BUA robotics team

This is the last time that Diya, Laurel, Amy, Sarah, and Maddie will compete together. It is the end of their season, with Sarah and Maddie off to college in the fall. In fact, their college choices were influenced by their experiences on the team. No, they are not the starting five on a basketball team but members of the Boston University Academy (BUA) robotics team.

The cold June day began at 5 a.m. in the basement of the College of Engineering at Boston University, as they loaded their robot and several bins full of power tools and materials into a minivan. A group of 12 boys and girls then ventured on a 45-minute trip to compete at Worcester Polytechnic Institute for the Battlecry competition. Forty-eight teams competed with the same robots from the F.I.R.S.T. (For Inspiration and Recognition of Science and Technology) robotics competition.

For the girls, this was not just a day to drive, score points, get their hands dirty in the pit fixing the robot, and to cheer on their team. This was a day of finality, the end of a mentoring experience between seniors and younger girls.



PHOTO COURTESY OF THE BOSTON UNIVERSITY ACADEMY

The ladies of Boston University Academy's robotics team take a moment to relax during the Battlecry competition. From left: Laurel Desrosier, Diya Kazmi, Amy Katuska, Madeline Hickman, and Sarah Esterquest.

Laurel fondly remembers, "Sarah and Maddie had such great determination and love for the team...They showed me that I could also make good contributions and be a leader in the field of engineering in the future."

This was a farewell as Sarah was going on to pursue aeronautical engineering at Rensselaer Polytechnic Institute and Maddie was focusing on mechanical engineering at the Massachusetts Institute of Technology.

The BUA Robotics Team competes in several contests, including the F.I.R.S.T. robotics competition. Each year, high school students are presented with a new game and only six weeks to design and build a robot from scratch. They are given a kit of parts with a uniform set of motors, electronics, and batteries, but beyond that, the design and manufacturing is up to the students (within certain weight, size, and safety guidelines). Professional engineers and college students mentor and guide the students in the engineering process. Local companies sponsor the team, similar to many local sports teams, except the budget for a team can range from US\$10,000 to US\$50,000. The BUA team is sponsored by the Boston University College of Engineering, Radio Shack, and Quantia.

Ladies F.I.R.S.T.

In September, Laurel and Diya joined the team, not quite knowing what to

expect. Laurel recalls, "I previously had little to no exposure to hands-on engineering projects, so I never really thought about engineering as a big option for me. This year, the team has shown me a new passion for inventing and then building, and surprised me that I could really be part of making some complicated and awesome creations."

In the fall, they learned how to safely use power tools, the lathe, and the milling machine. Their daily language consisted of words such as gear ratios, idlers, bearings, couplings, keyway, and set screws. The girls were never intimidated.

"I never had any sort of defeatist attitude with regard to my gender when it came to tools and fabrication," Sarah said. "I honestly think the boys were more surprised than I was, especially when I destroyed our playing field with a reciprocating saw. Girls 'aren't supposed to do that,' which I think is absolute nonsense."

They learned about wire gauges, relays, motors, circuit breakers, quick disconnects, and crimping. Years before they will get a driver's license, they drove robots around an obstacle course and used the robot to pick up balls. The fall semester culminated with designing and building a bread box-sized robot for the BotBowl competition at M.I.T. The team designed a robot to line track, then used a pneumatic piston to "bowl" tennis balls at plastic soda bottle "10 pins." Laurel and Diya, who are also on the school's cheerleading squad, realized that it is just as much fun to dress up and cheer for their robot as it is for a sports team, only the robot is one which they built.



PHOTO COURTESY OF THE BOSTON UNIVERSITY ACADEMY

The Team 246 Robot (RoboRhett) picks up a torroid at the Battlecry Competition.

The fall was not limited to learning, building, and driving robots. They spent time walking door to door on Commonwealth Avenue asking local vendors to sponsor the team. With ambitions of raising enough money to attend the F.I.R.S.T. championship competition in Atlanta, Georgia, they needed to raise US\$50,000. They also needed to design the banners, T-shirts, and stickers that would recognize those sponsors.

A large part of the F.I.R.S.T. experience is doing outreach to spread the engineering message to students not on the team. They went to the local middle school once a week to mentor a LEGO League Robotics team. Once a week they produced a podcast with engineering “Tips and Tricks for a Successful Robotics Season,” which was posted on iTunes. Sarah cowrote and delivered two professional development workshops for teachers from local Boston Schools. All of this paled in comparison to the time commitment preceding the six-week winter “build season.”

The build season kicked off the first Saturday in January. Over 1,000 teams from around the world watched the live broadcast of the announcement of this year’s game in Manchester, New Hampshire, via NASA television. This year, the game consisted of picking up inflatable swimming pool tires and placing them on a tree-like PVC pipe structure. In the 120-second competition rounds, an alliance of three randomly selected robots would compete against an opposing triumvirate. Lifting your alliance partner’s robots at least 12 inches into the air at the end of the round could score additional points.

For six weeks, the girls gathered every day to accomplish this task. They began

by debating a game strategy and came up with several designs and prototypes. They decided to build a robot that would lift the tires with an arm controlled by a motor and a claw controlled by a pneumatic piston. They ambitiously decided to build a six-foot-long lifting platform with four large pneumatic pistons in the corners. The 100-pound weight restriction caused a change of material for the platform and a change in design.

The last weekend, several local Boston high schools set up camp at B.U. to get help finishing their robots. Amy recalls she was “trusted to show newer members how to use tools and was able to help them learn how to brainstorm, design, and then build a final product.” The girls gleamed with confidence as they realized how much they actually knew.

At the end of the build season, they presented their robots to the public in a joint press conference featuring several Boston teams. Several of the girls were featured on local television and radio stations. After that, the robot was placed into a crate and a delivery truck took the it to the competition.

Inspiring Performance

At the end of March, the team arrived at the Boston Regional Competition. Mascots, pep bands, engineers, CEOs, and the governor showed up to cheer on the teams. The announcer for the Boston Red Sox introduced the competitors.

Rock music shook the auditorium as the girls watched the robots compete and listened to the play-by-play announcements of the rounds.

The true adrenaline rush was in the maintenance pits. During the first day, the robots underwent a rigorous set



Madeline Hickman and Sam Roberts drive the robot, coached by Mentor Brandon Mensing (undergraduate at Boston University).

PHOTO COURTESY OF THE BOSTON UNIVERSITY ACADEMY

of safety inspections and were measured for weight and size restrictions. The previous year, the robot was almost 30 pounds overweight, so they did not want a repeat experience. The robot competed in about a dozen rounds in the three days. Maddie was the copilot this year, controlling the robot’s arms and lifter. Coordinating the game play with two other robots takes strategy and an ability to quickly respond. But repairing the robot after each round of play was almost as much fun.

Although their robot did not make it into the final rounds based on game play, the team received an award just as gratifying. For all their outreach work during the preceding months, the podcasts, workshops, and mentoring of new teams, they earned the Engineering Inspiration Award, the second highest award one can earn in a F.I.R.S.T. competition, which qualified them to move on to compete in the national competition.

In April, the girls boarded a plane for Atlanta where more than 400 teams gathered at the Georgia Dome. The energy was astonishing. The best teams in the world gathered and showed off their engineering prowess. After five days of bonding on the road, the girls returned to their studies in Boston. Many of the students prepared to spend the summer working in science and engineering laboratories. Diya was off to Harvard to study genetics. Sarah designed satellites at B.U. In their spare time, they made the final repairs to prepare the robot for Battlecry.

The day in Worcester provided great closure for an intense year. Maddie finally got to drive in the semifinal round of a

Michela Meister uses a drill press to make a part for the robot.



PHOTO COURTESY OF THE BOSTON UNIVERSITY ACADEMY

competition and the younger girls had a chance to say their fond farewells to Sarah and Maddie.

Diya remembers, “My opinion about engineering was affected when I saw Sarah and Maddie working for the team. They are both so independent, and such an inspiration when one sees what a vital part of the team they are. They have really shown me what a large role women can and do play in science.”

If you are interested in sponsoring or mentoring a local F.I.R.S.T team, visit www.usfirst.org. To sponsor or work with the Boston University Academy team, visit www.burobotics.org.

—Gary Garber

A Place for Us

Museum exhibits bring women's achievements to life

In downtown Attleboro, Massachusetts, a bus full of tourists makes a stop in front of an old mill building. As tourists browse through the quaint shops and view the beautiful brick buildings and stone bridges, they are surprised to find that the old mill building in front of them is the home to the Women at Work Museum, a place dedicated to honoring the achievements of women throughout history and around the world.

Since opening on 18 October 2003, with the support of hundreds of collaborators, the museum has launched six major exhibits and presented more than 40 free programs open to the public. Exhibits showcase national and international programs that support achievement.

Full participation in most endeavors in the 21st century requires at least a basic knowledge of science, technology, engineering, and mathematics (STEM). For businesses today, being able to compete in the global economy is increasingly driven by innovation and invention, which is often made possible by advances in technology. The museum fosters the attitudes and behaviors necessary to support STEM literacy education and raises

the awareness of families, educators, businesses, and public policy makers about the significant role STEM skills play in expanding career opportunities for individuals and sustaining a robust national economy.

History Beyond the Books

Paintings, paper illustrations, quilts, photographs, and other creative endeavors reinforce the themes of each exhibit. Living history presentations and performing artists bring to life the women honored in the museum and interactive activities engage visitors of all ages in exploring issues of interest. Girls and boys, as well as women and men, participate and produce a variety of innovative and creative representations of what they learn at the museum including stories, self-portraits, designs for dream museums, mathematical origami, and plans for future travel in space.

While the women featured in the museum may not be listed in history books, this in no way diminishes their real role in history, their commitment to intellectual challenges, and their contributions to the community in which they lived and worked.

For instance, the “Women Who Fly” exhibit, on display from November 2005 to October 2006, featured pilots, astronauts, artists, dancers, and athletes such as Marla Runyan. Legally blind in both eyes, U.S. Olympian Runyan is a middle distance runner and often speaks to youth encouraging them to “Believe in yourself, and show others what you can do. Only you can find your potential.” At the 2000 Summer Olympics in Sydney, Australia, she proved to be the eighth-fastest 1,500-meter female runner in the world. Along with other women in the exhibit, Runyan illustrated the power of determination and courage and inspired people of all ages who visited the Museum.

Events are held monthly and designed to appeal to a variety of interests. For example, on 13 June 2006, in

conjunction with area schools and the American Legion, the Reach for the Stars program was presented and featured Grace Corrigan, Challenger crew member Christa McAuliffe’s mother; Lucy Young, naval jet pilot; and Dr. Karen Panetta, IEEE Women in Engineering committee chair. In April, the Clara Barton Tea was a great success with those who enjoy history and meeting Civil War enactors.

Changes in Time and Space

Other successful endeavors include the “Defining Decades” exhibit, launched on 4 November 2006, a series of discussions about defining moments in history and how decades and eras are defined by the actions of individuals, organizations, and nations.

In 2007, programs such as “Black Holes and Exploding Stars” involved youth and adults in exploring the importance of space science and using computers to link to telescopes in space. Presented by the Smithsonian Astrophysical Observatory and the MIT Kavli Institute for Astrophysics and Space Research, the program is an example of the level of collaboration that has made outstanding programming possible at the museum.

Collaboration is the cornerstone of the museum’s success. Working among organizations with mutual goals such as the Women’s Memorial Foundation and IEEE, the museum develops exciting and engaging programs that inform, entertain, and inspire while maximizing its limited resources.

November 2007 saw the opening of the exhibit “Initiating and Sustaining Change,” which presents a historical and futuristic perspective of individuals and organizations that have, and will, initiate and sustain change. International and national issues are explored and connected to local and state initiatives.

Along with chambers of commerce, schools, government officials, and cultural organizations, I look forward to the

Since 1993, the museum has launched six major exhibits and 40 free programs.

opportunity to work with IEEE to showcase members and IEEE programs as part of displays including Innovative Environments, the STEM Pipeline, Emerging Technology, Philanthropy, and Envision 2020.

Let the Record Show

Circa 1990, a question sparked my journey of discovery that continues today. The question was simply, “Why is it that many girls who do well in math and science in elementary and middle school do not go on to further studies or careers in those areas?” Having taught science for seven years in middle school, I was surprised by the question, and in my quest for answers I found a myriad of factors including nature, nurture, setting expectations, socialization, rewards, and role models. Over the years, I created children’s books, developed educational programs, and organized the Women at Work Photography Exhibit to encourage girls to pursue studies and careers in math and science.

Along with teaching science, I also taught history for ten years. Many of the women I uncovered in my research were never mentioned in my classroom because their stories were buried in archives or not fully recorded. My contribution to the success of the museum’s development is linked to skills in marketing, organizational and program development, technology, and fostering collaborative relationships. These skills have been developed over the past 40 years in my work as a classroom teacher, business owner, and a community activist.

As the director of the Women at Work Museum, I continue to work to ensure that women have their historians. The museum’s history is rich and is supported by an extensive base of collaborators and a cadre of professionals providing in-kind services. We are ready to move this incredible institution to a worldwide arena with the help of IEEE members.

Pacing and developing a community vision are significant challenges. We spent the first three years developing a rich history of programming. There is a

great deal of enthusiastic support and I have to carefully consider each new effort and ensure we have the resources to respond in a professional and timely manner. Each success builds credibility and maintains ongoing support.

We are now entering a new phase in the museum’s development and are working with collaborators and Verner Johnson & Associates to develop a community vision for the museum. The vision will be reflected in a master plan, which will describe how space will be used in the museum’s permanent location. The challenge lies in the fact that the museum’s community is local, national, and international. Input from the community is essential if we are going to develop a museum that matters to the immediate community and serves the interests of visitors from across the United States and around the world.

A Vision of the Future

Some design principles include exploring a green building, creating a model for the use of alternative energy sources, and supporting pre-K–12 and higher education goals, in particular increasing the number of students who participate in programs that support careers in STEM. Along with exhibit areas, key components include:

- ▶ Library & Archives—repository of information and artifacts on women at work throughout history.
- ▶ Permanent Exhibit—“People at Work—Women at Work” exhibits would interest tourists from the United States and around the world, incorporate advanced technology, art and music, offer STEM and financial literacy activities, and feature women and men working throughout history.
- ▶ Design Technology Center—develop planning skills, promote career awareness, exploration and development, and illustrate how skills in STEM expand career opportunities.

Be a Prime Mover

If you have the time to share your thoughts, you could make a significant contribution to the museum’s develop-

ment. Individuals, families, and organizations that support the museum during the Foundation Campaign (2005–2010) will be noted as prime movers on signage that will be a permanent part of the museum.

You can also help by develop a display for the “Initiating and Sustaining Change” exhibit, joining the Master Plan Development Committee or by simply becoming a member.

I look forward to collaborating with IEEE members to build the foundation for the museum, an educational center that improves the technological literacy of society from childhood through adulthood.

For more information, contact Katherine Honey, director, at +1 508 222 4430 or at khoney@comcast.net.

—Katherine Honey

Engineers STEM from Women of TI Fund

Number of female engineers is at a “national crisis” level

There’s a concerted effort nationwide to see more Ashleys and Olivias sitting alongside the Michaels and Williams in high school and college physics classes, as well as other advanced mathematics and technology courses. One effort to encourage girls to pursue classes in science, technology, engineering, and mathematics (STEM) is beginning to take shape, thanks in part to a group of forward-thinking women at Texas Instruments.

“The low number of women in engineering is a national crisis and we decided as a group to be proactive and to do something about it,” says Tegwin Pulley, TI vice president, Workforce Diversity and WorkLife Strategies.

In 2002, TI women ranging from officers and engineers to the wife of a TI founder, each contributed US\$5,000 or more of their own money to form the Women of TI Fund (WTIF), a donor-advised fund through the Dallas Women’s Foundation. As membership

has grown to more than 60, the WTIF charter remains the same as it was that first day—to expand STEM education for girls. Their goal is to increase the number of women eligible to enter a university-level, STEM-related degree program upon graduation from high school.

To date, the fund has raised more than US\$350,000, with a goal of US\$500,000. As the effort has gained momentum, TI men also have joined the fund and contributed.

In 2003, the Texas Instruments Foundation was made aware of the gender gap in high school physics and began funding programs championed by the Women of TI Fund.

“For the United States to prosper and compete in the global economy, we must enlarge the pipeline of students, and in particular girls, who are motivated and prepared to pursue careers in the STEM fields,” says Pulley. “Our aim is to offer programs and assistance to help fill the projected shortage of engineers by targeting women, an underrepresented population in this profession.”

That underrepresentation is evident since:

- ▶ Over the past eight years, the number of engineering degrees awarded to women in the United States has remained stagnant.
- ▶ In 2006, only 9% of SAT takers indicated an interest in pursuing an engineering degree in college. Of that, only 16% were women.
- ▶ Today in the United States, only one in four engineering students is a woman. Law and medicine schools have achieved gender equity, but not engineering.

“When you look at the statistics, it doesn’t take an engineer to figure out changes must be made, not only for girls but for the overall future competitiveness of our nation,” says Pulley.

Three-Tier Approach

The Women of TI Fund focuses its efforts on three major audiences: students, high school counselors, and high school teachers.

LACK OF GENDER EQUITY IS AN EYE OPENER

Daniel Brown, 11th grade physics teacher at Hillcrest High School in Dallas, remembers feeling a little insulted when he got received an invitation to participate in a DISD gender equity in-service workshop two years ago.

“I made a conscious effort to always treat everyone in my classroom equally...or so I thought,” he says. Brown reluctantly signed up and was immediately treated to two slides comparing AP physics passing score results between girls and boys with equal math aptitude abilities.

“Boys were passing at a rate of about 30 percentage points more,” he recalls. “The scientist in me knew something was driving the data, and the answer was in the classroom. It was definitely an eye-opening moment for me.” Now Brown understands the classroom gender issues very well and is conducting classes on gender equity for other DISD teachers.

“Of course we all want to be equal, but in reality it’s subtle things that make a difference,” he says. “I tell workshop attendees that sex is what you’re born with and gender is what you learn. When girls learn at an early age that engineering and science are not for them, they don’t go into those fields...it’s the messages we send our students that make the difference.”

He points to his own examples. “I learned through videotapes of my classroom that I asked follow-up questions more to the guys. I even called on boys more often,” which until he saw on video, he didn’t think he did. “When a boy would interrupt a girl in class, I allowed it. This sends a message to girls that their thoughts aren’t as important as their male counterparts.”

Brown says his job is to teach and build confidence in all students. “Students with potential need to know it and be encouraged. They may need an extra boost—whatever it takes to keep them going. It doesn’t take any extra work or preparation.”

He now sees a difference in his own classroom. “Girls participate more, they speak up and support each other. In 2006, the state of Texas graduated 2,800 engineers—400 were female. I think we can double that number in four years just by mentoring four girls each semester. We’re making real inroads.”

—Alesia Ritenour

For students, the WTIF reviewed Advanced Placement (AP) test information on boys and girls with similar PSAT scores in 2002. “The percent of boys who passed the AP high school physics exam was 30 percentage points higher than the pass rate of girls. That’s an alarming gap,” says Melendy Lovett, TI senior vice president and president, Education Technology, a division of TI. Lovett is a founder of WTIF.

As a result of these findings, four years ago the group began funding a two-week summer camp to prepare Dallas Independent School District (DISD) girls for physics class. The camp is offered to all girls in ten DISD schools who are part of the AP program. The only requirement is that they have signed up to take physics during the upcoming

school year and meet the prerequisites for the course.

“Not only do the girls get hands-on training, they also receive career counseling,” says Lovett. “Many of these girls ask what they can do with physics—they want to know what career options are available to them. The girls also get a lot of positive reinforcement at camp. “Many adolescent girls go through changes that can negatively affect their self-confidence,” Lovett says. “As a result, they often refrain from either asking questions or sharing answers. Low self-confidence can also deter girls from enrolling in higher level STEM courses.”

The Women of TI Fund has fostered a number of programs to encourage girls in the Dallas Independent School District to pursue STEM classes, including a summer camp for physics prep and the High Heel, High Tech workshop.



Lovett saw this to some degree with her own daughter, now a high school senior. “Beginning in middle school, I saw her self-confidence affect her opinion of how well she could do in math,” says Lovett. “Without my encouragement, I think it would have been easy for her to take courses requiring less critical thinking skills. Girls and others who may not have as much self-confidence oftentimes opt out of math and science. I think by doing so, they’re missing out on some exciting and fast-growing career opportunities.”

For counselors and teachers, the WTIF initiated a High Heels, High Tech workshop in 2004. High Heels, High Tech is a two-day program for DISD counselors and select math and science teachers. Its purpose is to build awareness and coach attendees on STEM careers and what courses students need in order to prepare for those careers.

That same year, the group commissioned national gender equity expert Jo Sanders to develop and lead gender equity training sessions for 18 DISD AP math and science teachers. The program expanded this year when the WTIF Fund partnered with the College of Education at The University of Texas at Arlington (UTA) to launch a STEM Gender Equity Institute. The plan is to move existing gender equity programs from the incubation stage to a mature university program for growth and development, integrating both teacher education and in-service training with the goal of systematic change. Dr. Jeanne Gerlach, UTA’s College of Education dean, oversees the program.

“The ultimate goal is to get teachers and administrators working hand in hand to drive culture changes in their schools,” says Gerlach. “The teachers in

the program meet monthly to learn new teaching strategies. They also carry out significant and original school-based gender research. The program works by creating leadership teams of classroom teachers and administrators at DISD, training in-service teachers, influencing curriculums and ultimately increasing the number of girls going into STEM career paths.”

“It’s sometimes as simple as sprinkling in examples of famous women scientists,” adds Lovett. “In some of our first workshops, many science teachers couldn’t name an accomplished woman scientist. Just like boys, girls need mentors and role models to follow.”

Early Results

While the group considers their work to be in the early stages, they are seeing positive results within the Dallas school district. Here are a few metrics and early findings:

- ▶ In 2000, the AP physics pass rate was more than 30 percentage points below boys (11% versus 46%). In 2006, girls whose teachers participated in the gender equity training and attended the physics summer camps passed at the same rate as boys.
- ▶ The number of girls taking AP physics exams has increased over 100% (57 in 2000 versus 117 in 2006).

Pulley says the group is confident in its work thus far and will continue to focus efforts on existing programs. “We continue to monitor and measure results such as AP enrollments and exam scores,” she says. “Ultimately, we’d like to develop proven programs that can be reproduced across the country. And of course, we’d love to have some of

the women who were inspired and encouraged by their early involvement in our programs show interest in becoming engineers for TI.”

—Alesia Ritenour is a freelance writer based in Dallas.

Monkey See, Monkey Do

Interdisciplinary projects capture students’ imagination

Engineers get to work on some pretty interesting science- and technology-related tasks but how many people realize that being an engineer equips one to make a six-legged love connection, race cars, and train monkeys?

Electrical engineers Matthew Heller and Richard Colombo have worked on these types of projects. As mentors and project instructors to Tufts University students in Medford, Massachusetts, the two innovators bring interdisciplinary project opportunities to engineering undergraduates. The students, mostly seniors completing projects required to graduate, partner with Heller and Colombo to work on various assignments. With their guidance, the students are able to find creative solutions to some pretty interesting problems.

In one instance, the university’s biology department was conducting a study on fireflies and was looking to mimic the male firefly’s “blinking” pattern. The solution? “I helped some students design a device that imitated a male’s flash patterns, and all the female fireflies came over and tried to mate with it,” explains Heller.

Another project had Heller, Colombo, and some students convert the entire Thatcher Island (off the coast of Rockport, Massachusetts) to solar power after a pesky cable kept breaking.

“We took a really dynamic group of students out to the island over the summer,” recalls Colombo. “We put down 18 solar panels and two inverters that provide power to the houses out there.”

Valery Thompson, a senior when she worked on the project, was responsible

MORE INFORMATION ON WOMEN’S FUNDING

The Dallas Women’s Foundation (DWF), created in 1985, has contributed more than US\$7.5 million in grants to nearly 700 programs serving women and girls in Dallas, Denton and Collin counties. For more information, visit www.dallaswomensfoundation.org.

DWF is part of the Women’s Funding Network (WFN), which has 120 member funds worldwide. Last year, the WFN collectively invested more than US\$50 million in grants to advance women and girls.

If you’re interested in information about other women’s funds that offer similar programs, contact the WFN at www.wfn.org.

for the maximum power point tracker.

“This component ensured that the system would receive the right amount of power from the solar panels at all times of the day,” she explains. “It eliminated the dependency of the system on the intensity of sunlight at a given time of day.” She received direction to complete this portion of the project from her male mentors, saying that, “They would stay for hours working with us one-on-one to help us solve issues that we encountered.”

Heller and Colombo are again working with solar power to engineer and build their own car, which Colombo says, “we are going to eventually race in the American Solar Challenge.”

Curious Jill

They have also applied inventive engineering techniques to help the physically challenged in their partnership with Helping Hands: Monkey Helpers for the Disabled. The organization, a nonprofit started in 1979 and based in Boston, partners trained capuchin monkeys with patients who have severe physical disabilities, encouraging the monkeys to provide assistance with everyday tasks. When Jill Siebeking, occupational therapist and placement specialist for the group, reached out to local colleges for help with an unforeseen problem, Heller and Colombo saw an opportunity to put their skills to use.

The monkeys, who are appreciated servants and companions to their patients, were feeling a bit cooped up. Since most monkey recipients have severe physical limitations that hinder them from manipulating the cage locks, letting the monkeys in and out of their cages became a heavy source of frustration. Siebeking needed a creative and effective course of action.

Thompson was interested in working on the project as well, recognizing that the

Matthew Heller guided Valery Thompson through a number of projects during her academic career at Tufts University, including converting Massachusetts' Thatcher Island to solar power.



PHOTO COURTESY OF TUFTS UNIVERSITY

issues with the cage doors affected the success of the entire operation. “A trainer was often needed to intervene, which defies the purpose of owning a monkey in the first place,” Thompson shares. “They are there to help the individual do things without the help of a caretaker.”

Heller and Colombo noticed that most patients had laptops and Internet access, so, with a group of students, they created a voice recognition Web site system, enabling technology to open and close the cage doors on the command of the patient. “I think the prototype we created can better the lives of monkey owners around the nation,” affirms Thompson.

“I’ve seen the prototype and it works well,” says Siebeking. “I was very impressed.” Next up, Siebeking has an idea to reward the monkeys through the use of a peanut butter treat dispenser, a project Heller and Colombo intend to get a group of students working on as well.

The monkeys certainly do deserve their peanut butter. “We saw a demonstration where a monkey put water in a mug, put the mug in the microwave, and warmed up the beverage for the patient,” says Heller. “Another one flipped magazine pages.” Bred in a closed colony so as to avoid contact with potentially diseased animals, the monkeys are specifically educated to become service providers.

Helping Hands has placed approximately 122 monkeys throughout the country. Monkeys are only placed with debilitated patients after an informative application and interview process, necessary to determine that a particular monkey is a good match for a patient.

“We take a lot of things into consideration,” details Siebeking. “The monkeys vary in intelligence, demeanor, and personality, so we have to find the right ‘monkey match’ for each potential recipient.” With the receipt of over 100 applications a year, and an extensive placement process, it is no wonder that the organization calls on volunteers like Heller and Colombo.

Meeting of the Minds

Heller, an alumnus of Tufts, began volunteering to work with students on their projects because he felt it would “be beneficial to students to have someone within the industry helping them.” A resident of Peabody, Massachusetts, Heller works

Matthew Heller (right) and Richard Colombo (second from right) provide the students with hands-on, real-world design experiences.



PHOTO COURTESY OF TUFTS UNIVERSITY

full-time for Aastra Technologies designing and creating Internet telephony products. He and Colombo met while working together at Nortel in 1999.

ing with Tufts. “I like working with people, and it’s rewarding when you see that look on their faces that things are starting to make sense,” explains Colombo.

“We don’t actually teach classes, but we do spend small-group time with each student going over how the project is progressing,” clarifies Heller. “We’ll give suggestions for an alternative course of action or guidance on how to proceed.”

Thompson maintains that she “cannot say enough” about the value of having instructors who hold jobs outside of the classroom. “The learning is different with tutoring by professionals like Matthew and Rick,” she describes. “They work with you to make you understand what the theoretical aspects you learn in a classroom really mean, and how you can apply those lessons to produce solutions like a solar energy system or a monkey door. It would have been hard to accomplish what we did without them.”

A 2007 graduate of Tufts with a degree in electrical and biomedical engineering, Thompson is now a systems engineer with Raytheon. She looks back fondly on her experiences with Heller and Colombo, citing her interaction and work with them as the highlight of her college experience at Tufts.

Worthy of note is the fact that about 80% of the students who work with Heller and Colombo have been women. Observes Heller: “The women have all kinds of varied interests and backgrounds. They tend to work best in groups, whereas the male students seem to prefer working individually.”

However a student chooses to work, it all comes down to the opportunity to do something innovative and tangible.

“All of these projects are to get the students involved with design,” says Colombo. “It is just a lot of hands-on work, so the student will be able to go out in the real world and say ‘I’ve actually touched this stuff.’”

Siebeking agrees, confirming that, “this is an awesome opportunity for the students. It’s something for which they can really see results.”

With all of the creative projects being dreamed up by Heller and Colombo, who knows what these students will get their hands on next?

—Karen Panetta is the editor-in-chief of IEEE Women in Engineering Magazine.

In conjunction with the nonprofit organization Helping Hands: Monkey Helpers, students helped to create a voice recognition Web site system that allows patients to free professionally trained monkeys so that they may receive assistance with their daily tasks.



PHOTO COURTESY OF TUFTS UNIVERSITY

“It was my first job out of college, and Rick was very good to me,” recalls Heller. “He took the time to show me the ropes. So I wanted to get him involved in working with the students.”

“When Matthew asked me to help, I thought it would be a great idea,” confirms Colombo. A graduate of the University of Massachusetts, Colombo lives in Gardner, Massachusetts, and works in defense technology at Impact Science and Technology.

Both men cite the ability to work with the students as the reward for participat-

“I learn from the students as much as they learn from me,” adds Heller. “And the projects are fun. I get a budget to work on things that I wouldn’t normally get to do through my work.”

Having helped approximately 150 participants over the last five years, Heller and Colombo have honed the mentoring process. While students often have difficulty originating project ideas, Heller and Colombo can come up with the mission and structure in such a way that the students can then do the work.

Career Advisor

(continued from page 31)

“Build technical and professional strengths. Professionally, continue to build relationships, collaborate with others in the field and network,” she says. “On the technical side, keep reading, stay abreast of new technologies, and stay engaged in the field. Stay connected. Connection is key,” she says.

Jamieson herself will be going through a career transition when her term ends in December. What will she take on next?

“I will stay deeply engaged with the IEEE. I will continue to work on strategic planning initiatives—the perception of disability among the public and how to improve this perception is one initia-

tive I am working on. I will continue to work on issues related to IEEE WIE as well as explore the future of engineering careers.”

Most importantly, Jamieson says she plans on looking at how the IEEE can play a larger role in society and around the world.

“Many problems locally and globally can be solved by engineering,” she says. “Engineers can make a difference in the quality of life for people around the world. We will find more ways for the IEEE to help make this difference.”

—Nancy Salim



Modern day role models

Girls need not look far for inspiration

Among the Stars

Kalpana Chawla's memory serves as a beacon for girls in India

It was 8:53 a.m. on 1 February 2003 at the Kennedy Space Center in Florida, but a little after seven in the evening in India when I tuned in to a news channel providing regular updates on the space shuttle Columbia's return journey to earth. The shuttle was reentering the atmosphere after a 16-day scientific mission and NASA lost radio contact only minutes before the expected landing. Video recordings showed the spacecraft breaking up in flames over Texas at an altitude of approximately 63 km and a speed of 5.6 km/s.

Photographs in newspapers around the world displayed the shiny shards of Columbia streaking across a clear blue sky. All crewmembers had perished on reentry. In the months following the tragedy, NASA scientists determined that a hole was punctured in the leading edge on one of Columbia's wings, made of carbon-carbon composite. The hole had formed due to a piece of insulation foam from the external fuel tank that peeled

off during the launch. Hot gases penetrated the interior of the wing, destroying the support structure and causing the rest of the shuttle to break apart during the intense heat of reentry.

Kalpana Chawla was an Indian-born American astronaut and one of the seven crewmembers aboard the space shuttle.

Chawla's story has been inspiring to youth like myself. She has strengthened my commitment to achieve my dreams, to live and die being what one really wants to be.

Chawla excelled in a field where India had no markers. Although India has a strong tradition of science teaching and learning, there are hardly any women who have made it to the top in our scientific establishments. Those who have made it can speak

of the struggle to balance home and family commitments with the strong demands on time required by science.

Her life was like an absolute fairy tale. It's the story of a small town girl who dreamed big and held the self-confidence and perseverance to chase the dream. She followed it halfway across the globe and lived it. But fairy tales are not supposed to have a tragic end; they always have a happy finale.



Chawla became the first Indian-born woman and the second person of Indian origin to fly in space following cosmonaut Rakesh Sharma in 1984.

PHOTO COURTESY OF NASA

Taking Flight

Chawla was born on 1 July 1961 in Karnal, Haryana, in India. Her father Banarsi Das had to flee Pakistan during the partition and built a thriving tire business from scratch, from which he taught his daughter, "You could not lose by working hard."

She completed her schooling from Tagore Bal Niketan School, Karnal, in 1976 and earned a bachelor of science degree in aeronautical engineering from Punjab Engineering College in 1982. She soon added her master of science degree in aerospace engineering in 1984 from the University of Texas and moved on to Colorado University to work on her doctorate of philosophy in aerospace engineering, which she completed in 1988. She then joined the NASA Ames Research Center, working in the area of powered lift computational fluid dynamics.

In 1993, Chawla joined Overset Methods Inc., Los Altos, California, as vice-president and research scientist, to form a team specializing in the simulation of moving multiple body problems. She was responsible for development and implementation of efficient techniques to perform aerodynamic optimization.

The following year she was selected by NASA, and in March 1995, she joined the NASA astronaut corps as a candidate in the 15th group of astronauts. After completing a year of training and evaluation she was assigned as a crew representative to work on technical issues for the

HONORABLE LEGACY

Kalpana Chawla has been posthumously awarded

- Congressional Space Medal of Honor
- NASA Space Flight Medal
- NASA Distinguished Service Medal
- Defense Distinguished Service Medal (DDSM)



PHOTO COURTESY OF NASA

During her time at NASA, Chawla worked on the development of Robotic Situational Awareness Displays and tested space shuttle control software.

astronaut office EVA/Robotics and computer branches. Her assignments included work on development of Robotic Situational Awareness Displays and testing space shuttle control software in the Shuttle Avionics Integration Laboratory.

It was in November 1996 that Chawla was assigned as mission specialist and prime robotic arm operator on STS-87. She was the first Indian-born woman and the second person of Indian origin to fly in space following cosmonaut Rakesh Sharma in 1984. STS-87 focused on experiments designed to study how the weightless environment of space affects various physical processes and to observe the sun's outer atmospheric layers. She logged more than 375 hours in space and approximately 252 orbits of the earth.

In 1998, she was assigned as crew representative for shuttle and station flight crew equipment. Subsequently she was assigned as the lead for the astronaut office's crew systems and habitability section until, in 2000, she was selected for her second flight as part of

the crew of STS-107. On 16 January 2003 she went into space as a mission specialist aboard Columbia on the ill-fated STS-107.

The Journey Matters

Throughout Chawla's determination to achieve her dreams, her indomitable spirit stands out. While growing up in India she often slept in the courtyard and gazed at the stars. Her strong will to reach for those stars convinced her parents to let her go to the United

States for higher studies.

Today, girls have more choices than Chawla's generation and yet the pressure from family and society to conform remains. The moment you begin approaching the age where you must choose subjects in college there is pressure. "Do home science and learn to be a good wife" or "Do commerce and join the family business" or "Do medicine and join the family business."

Parents try to coax their children to make a so-called "safe" career choice or, if you have supportive parents, your conservative relatives try to dictate your life's decisions. They would rather see you married and settled down. In such families, only the gutsy manage to stick to the course they have chosen for themselves. The majority of young adults quietly fall in line.

This is the reason why Chawla's story has inspired many young girls, not just those who have chosen a similar field of study, but those who never aspired to be an astronaut or fly a plane. Through her example she has succeeded in igniting

an extraordinary desire and confidence in many young women, most of whom she had never met, to fulfill their dreams. For a multitude of Indians fed on a diet of anorexic beauty queens who mouth well-worn platitudes, we are starved for a role model. We are thirsty for people we can aspire to be like.

Chawla was not one of the dollar-obsessed techies of this age. In one of her interviews, when asked for a message for Indian children she said, "Material interests are not the only guiding light. It is something you'd enjoy doing in the long run. Take time to figure out how to get there. The quickest way may not necessarily be the best. The journey matters as much as the goal."

Quoting philosopher Seneca, Chawla always said, "I was not born for one corner; the whole world is my native land." We may have lost her to the stars but she leaves behind her a legacy that most certainly will motivate others like her to follow their dreams.

As they say "A candle that burns twice as bright, burns half as long."

—Chaitri Aroskar

WIE Make a Difference

Support and advice for the next generation

Getting to the crux of what's real in today's society is more than a little tricky. MTV annually rolls out *The Real World*, a show where the cast is carefully handpicked to create conflict. In sports, boxing's Evander "The Real Deal" Holyfield is 20 years past his prime and regularly defeated. As for the real truth, it's an inconvenient one if you're Al Gore and there's variations of it for Dick Cheney.

Panetta passing on her real world experiences

Fortunately, IEEE WIE Committee Chair Karen Panetta's version of "keeping it real" is more effective. It's all about taking her real world experience and passing it on to other engineers and students.

Panetta serves as the associate professor of electrical and computer engineering and director of the Simulation Research Laboratory at Tufts University in Medford,



Karen Panetta



PHOTO COURTESY OF NASA

Chawla was among the crew members that perished on the ill-fated space shuttle Columbia.

Massachusetts. She is also the cofounder of BA Logix Inc., where she works as the company's chief research scientist. Panetta believes that real world experience is critical for engineering education, which is why she maintains consulting positions in the industry and brings her experiences back to the classroom. She is a design consultant for Tyco electronics, M/A-Com Inc., and consults for the Massachusetts school systems and science museums across the United States to inspire engineering and technology education.

After earning her bachelor's degree in computer engineering from Boston University, she joined Digital Equipment Corporation after graduation and began designing computers. Panetta completed both her master's degree and Ph.D. from Northeastern University while working full time.

"As I spent more years in industry, I saw more of my female colleagues leaving the profession and saw even less women in my graduate classes," Panetta recalls. "I became a professor purely by my desire to teach and encourage young students to become engineers. My years as an educator and professional consultant in several diverse industries showed me how interdisciplinary and valuable my skills were. This opened many new exciting engineering opportunities for me. These are the things I wish to convey to students early in their education so that they understand the value of engineering and what engineers do for society."

As a product of her dedication to promoting women in engineering, Panetta created the "Nerd Girls" program, where undergraduate engineers research renewable energy topics and serve as role models for younger students. The program is aimed at breaking down the barriers that prevent women from entering the engineering disciplines and bridging the gap between attracting girls into engineering and sustaining them through their engineering curriculum. It strives to help undergraduate students build confidence in their skills, while preparing them for professional careers.

The Nerd Girl program has successfully promoted engineering to students,

educators, and government officials. Panetta's team has presented its work to over 8,000 Massachusetts school children and educators and she is proud to be able to "interact and reach so many people and hear firsthand the concerns that parents, educators and young children have about engineering.

Reaching out to children is important since Panetta recognizes that her strongest engineering asset was fostered as a child—her imagination. It was important to be able to support herself and to make her parents proud of their investment in her education, she says. Her parents noted that their daughter had no trouble with math and science in school and encouraged Panetta to pursue engineering despite the fact that she "had no idea what engineers did," she adds.

In many cases, people rise and fall with self-confidence and it's important to have faith in yourself, Panetta says.

"When someone tells you that you are not good enough or will never be able to accomplish your goals, you can have one of two reactions. One reaction is to believe them and give up. The other reaction is to realize that no one knows you better than yourself and that you will find such joy in proving them wrong. I am proud to say I always take the latter approach."

Bell Chimes In on Benefits of Design Teams and Student Groups

Amy Bell is the 2007 Engineering Activities Board liaison to WIE. She received her Ph.D. in electrical engineering from the University of Michigan in 1997. Currently, she is an associate professor in the Electrical and Computer Engineering Department at Virginia Tech and director of the Digital Signal Processing and Communications Lab. Bell conducts research in sensor array algorithms, cellular imaging analysis, wavelet image compression, and engineering education.

Bell says that in high school, she didn't know anything about engineering, but she knew what she liked and was good at: math, physics, reading, writing, music, and the outdoors. She learned that math

and science were a good fit with a career in engineering after listening to a visiting counselor from a nearby university.

During her first year at college, she learned more about the various engineering areas; talking with other students and attending meetings of the engineering student groups were two of her best sources of information. At that point, Bell realized that engineering was a good choice since it allowed her to combine her interests and strengths with a career that provided financial stability.

Bell advocates engineering as a career choice to young adults because engineering is very important to people and society.

"Engineers are responsible for people's safety, health, and happiness by designing safer cars that are also environment friendly, more accurate medical diagnostic equipment, and search-and-rescue robots that locate trapped victims in confined spaces after a building collapse," she says. Most people do not associate these advances with engineering.

She encourages young adults to get involved with student groups and design teams, to find an interesting summer internship with a company, and to do independent research with an engineering professor to help experience the full excitement of engineering.

Bell is the recipient of two awards for teaching excellence and the 2005–2006 IEEE Outstanding Student Branch Counselor Award. She is married to Sanjay Raman, who is also an electrical engineering professor. They live in Blacksburg, Virginia, with their two young sons.

Patel Advises Young Adults to Learn from Setbacks

Nita Patel, an IEEE Senior Member, is the 2006–2007 Region 5 WIE Coordinator. She graduated from Southern Methodist University with a B.S. in mathematics and a B.S.E.E. in electrical engineering in 1995 and then completed an M.S. in computer engineering in 1998.



Nita Patel

Patel currently works for RS Information Systems as a chief engineer. At RSIS, Patel supervises engineering team members to design and integrate signal processing and receiver upgrades for the National Weather Service's NEXRAD WSR-88D Doppler Radar Network.

Previously, Patel worked for Insight Technology in Manchester, New Hampshire, as an electrical engineer. Nita designed, wrote and integrated embedded C software for fused infrared systems, I2 goggles, laser aiming devices, grenade launchers, and laser rangefinders. Patel started her career at TI Defense Systems in McKinney, Texas, designing C and LabWindows/CVI software for automated acceptance, environmental, and diagnostics test systems for military infrared tracking and fire control systems.

Patel became an engineer because she was always fascinated by how mechanical

and electronic devices worked, she says. She enjoys the challenge of encountering a problem and then finding a solution with whatever tools and knowledge she can gather.

Patel advises young adults to "try everything and anything that you find interesting, fascinating, and/or exciting."

Engineering requires countless calculated risks, experiments and tests, some of which might result in an unexpected response or failure. Patel encourages everyone to embrace each unsuccessful attempt and learn from it. She advises, "Don't think in terms of failure OR success; think failure AND success. They are not exclusive of each other and a slight change in perspective might change a failure into an unexpected success."

Ng Immersed in Mentoring

Jennifer Ng, an IEEE Senior Member, is the 2007 Chair of the WIE New Hamp-

shire (NH) Affinity Group. In 2006, she was the recipient of the Young Engineer Award for the NH Section and spearheaded the formation of the NH WIE Affinity Group.

Ng obtained her bachelor of electrical engineering degree from McGill University, Montréal, Canada. She also completed her management certificate from the Boston University Corporate Center in 2004.

She is currently employed at Visage Imaging, Inc, a subsidiary of Mercury Computer Systems, Inc. in Chelmsford, Massachusetts, where she is the quality systems manager and interim quality management representative. Currently, her responsibilities include ensuring compliance for ISO standards (ISO 9001:2000 and ISO 13485:2003) as well as CDMCAS (Canadian Medical Devices Conformity Assessment System) and MDD (Medical Device Directive) for the CIV Quality Management Systems and products.

She started her career as a software engineer at Curtiss-Wright Embedded Computing Controls (formerly Dy4 Systems Inc., Ottawa, Canada) where she developed VxWorks/Tornado board support packages for single board computers) and wrote firmware diagnostics.

She is very involved in mentoring students through the McGill Mentor Program as well as IEEE members with MentorNet and is active in the start-up of the section's TISP (Teacher-In-Service-Program). Ng current resides in Merrimack, New Hampshire, with her husband, who is also an electrical engineer, and their two sons.

Chung Follows Her Instincts

Pau-Choo (Julia) Chung is the 2007 liaison from the IEEE Circuits and Systems (CAS) Society to WIE. Chung received her B.S. and M.S. degrees in electrical engineering from National Cheng Kung University, Taiwan, Republic of China, in 1981 and 1983, respectively. She received her Ph.D. degree in electrical engineering from Texas Tech University in 1991.

Chung was appointed full professor in the Department of Electrical Engineer-



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ing, National Cheng Kung University in 1996. She was the vice director in 2001 and currently serves as the director of the Center for Research of E-life Digital Technology, National Cheng Kung University. She was selected as a distinguished professor of National Cheng Kung University in 2005. She is also currently serving as the director of electrical laboratory, National Cheng Kung University.

At National Cheng Kung University, Chung works with the university's medical school and hospital by applying her doctoral work in neural network modeling to medical image analysis. Recently, she has been working on applying image analysis techniques and neural network models to medical image analysis. She is conducting research in applications of video analysis for home care.

Chung hesitated about whether she should attend a teacher's college or an engineering college. "My instinct told me that I am a person who loves to think, do analysis, and discover things, so I pursued engineering," she says.

Engineering gave her an area where she could come up with new ideas, thereby bringing variation and excitement to her life. Chung has one son and one daughter, with whom she loves to play logic games and puzzles. She advises young girls considering engineering, math or science fields to "always give yourself a chance to explore and do not underestimate your abilities."

Cotorogea: Engineering Shapes the World

Maria Cotorogea, an IEEE Senior Member, is the 2007 IEEE Power Electronics Society (PELS) liaison to WIE. She received the Dipl.-Ing. degree in electrical engineering from the Technical University of Dresden, Germany, in 1990 and her Ph.D. in electrical engineering from the Technical University of Berlin, Germany, in 1993.

Cotorogea has been with the National Center of Research and Technological Development (CENIDET) in Cuernavaca, Mexico, where she has been an associate professor in the Electronics Department since 1996. Currently, Cotorogea is on

her sabbatical stay at Infineon Technologies in Munich, Germany. She has published more than 40 papers in international journals and prestigious conferences. Her research interests include modeling and simulation of power systems, physical modeling, simulation and characterization of power semiconductor devices, as well as power quality and power converters for wind energy conversion systems.

Although, Cotorogea says that she had no special interest in technical issues, she felt it was natural to pursue engineering since her father, uncle, and cousins were engineers. She decided to pursue the same field as her father, electrical engineering, and became fascinated in semiconductor manufacturing and devices.

Cotorogea encourages young adults to pursue engineering because no other profession has impacted or shaped the world in which we live as much as the engineering profession. She says that to understand how much engineering impacts the world, you have to experience it first hand.

Cotorogea is proud to be a woman in the field of engineering and to have been a part of the technical revolution that has affected the world around us. She encourages girls to pursue engineering to contribute to the diversity and plurality necessary for evolution and progress in all fields.

"Being a woman in engineering is different from being a man in engineering," she says. "Not better, not worse, just different. For this reason, women have very much to contribute to engineering, their under-representation means a huge potential that has to be exploited in the future."

Hirt Helps Women Contribute

Evelyn Hirt, an IEEE Senior Member, is the 2007 Region 6 WIE Coordinator. Evelyn received a bachelor of electrical engineering degree, cum laude, from the University of Detroit and a master's in engineering management from Washington State University (WSU) in Pullman, Washington. She was awarded a certificate in project management from WSU and

has completed the Pacific Northwest National Laboratory (PNNL) three-year management skills development program.

Hirt is currently the principal professional and engineer at Pacific Northwest National Laboratory, which is operated by Battelle for the U.S. Department of Energy in Richland, Washington. She has published works in the application of laser ablation, test program requirements management, fault-tree-generation methodology, and time dissemination using the global positioning system (GPS). Although her career in engineering has been multidisciplinary, bridging the technical, government and academic communities, her interests center on systems and controls and engineering management.

Even though Hirt was interested in math, science, and creating things, she initially planned to go into a skilled trade since her family did not have a tradition of attending college. However, with the encouragement of her secondary school counselors, her mother and a wonderful university advisor, Dr. Wayne Panyan, she became the first family member to obtain a university degree. At that time, she was one of only ten women to graduate from the University of Detroit with an engineering degree in the university's nearly 100-year history.

Hirt encourages all young adults, with an inquisitive mind to pursue engineering even if they may not completely understand it. She strongly recommends that everyone seek out a mentor to help better understand different aspects of engineering and to act as a guide through the education process.

Jessop Leads Through IEEE Membership

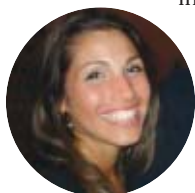
Jennifer Jessop is the 2007 Region 7 WIE Coordinator and an engineer at Manitoba Hydro. In October 2006, Jessop joined the Project Support Section, in Manitoba Hydro's Power Supply Business Unit, where she is responsible for project management services related to new hydroelectric development. Jessop says that, "the support of her company, and the IEEE, continue to encourage me to develop to my full potential."

Jessop encourages everyone to get a mentor and mentor others. Jessop mentored Michelle Carriere, a graduate of the "Building the Circle" Aboriginal Girls Summer Camp, a pilot project sponsored by Manitoba Hydro. This camp was designed to promote Engineering, Technology & Trades to female aboriginal girls.

According to Jessop, "Mentoring is a leading benefit of IEEE membership."

Jones Shows Internships Are Key

Lauren Jones is currently pursuing a master's degree in engineering at the University of California, Berkeley, focusing on integrated circuit design. Jones has worked with the Center for Educational Engineering Outreach teaching elementary and middle school students engineering through in-school and after-school programs. She has also served on the Nerd Girls research team as the Electrical Engineering team lead on the design of a Solar Vehicle.



Lauren Jones

Jones previously completed a summer internship at Lockheed Martin Missiles and Fire Control in Dallas, Texas, working with the Software Test team on High Mobility Artillery Rocket Systems in 2005. She then transitioned to Microsoft in Seattle, Washington, as a Software Development Engineer in Test Intern on the Hardware Team in 2006. At Microsoft she developed a software tool to emulate Microsoft Hardware products, allowing the test cycle to begin before hardware prototypes were available. Jones recently completed a third internship at NVIDIA in Santa Clara, California, working on the GPU products team.

As a 2007 graduate of Tufts University with a degree in computer engineering, Jones knows the academic challenges facing girls at all academic levels.

"I vividly remember attending a computer science camp in early elementary school, where we were being taught to program a turtle to navigate its way through a maze," she recalls. "I remembered my shock as I walked into to the room, only to be surrounded by boys. I enjoyed the class, and wondered why so few girls were involved."

Jones entered college as an engineer and soon migrated into electrical engineering and computer science after taking mandatory engineering electives. "I realized that in my lifetime, the advancements made in digital computing are not only aggressive, but have profoundly impacted our lives," she says. "I can't explain why I have always been drawn to computing, but I have stayed to contribute to an exciting and ever changing industry, to face challenging problems, and to always evoke shock and awe when I reveal that my area of expertise is engineering."

To those girls looking to get into engineering, Jones' advice is succinct. "Surround yourself with intelligent people, and you will always be learning. Surround yourself with people who support and encourage you, so you never forget your potential."






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