The Need for Women in Engineering

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1―INTRODUCTION

While women comprise 46% of the total labor force in the U.S., only 12% are employed in the Science and Engineering workforce.[1] According to the U.S. Census Bureau from 1995-2000, in 1983, only 5.8% of the engineers in the U.S. were women. Almost two decades later, in 1999, the percentage of women in the engineering in the U.S. universities had risen to just over 19%, however, women engineers in the U.S. workforce has only increased to only 10.6%.[2] However, at a National Academy of Engineering (NAE) Summit meeting in May 2005 held in Washington, DC, an alarming decrease has occurred relative to women engineering students. In 2004, the enrollment of women in engineering at U.S. Universities was only 16.3%. Women engineers in the workforce have risen to only 11%.

While statistics were not easily gathered for the overall women in engineering generally in Japan, the statistics relative to women in civil engineering per data from JSCE showed a low percentage of women in engineering. In 2005, of the 39,842 members of JSCE, 1,025 are women, or 2.5%. Of the Regular members, there are 30,761 which only 520 are women. Of Student Membership, there are 5,473 members of which 502 are women. Of Fellow Membership, there are 2,268 fellows of which only 3 are women.

All of the demographics described above will have a significant impact on the way managers must approach topics in their respective businesses and many of the corporate policies on how we do business will need to be revised. The demographics will lead to greater workforce diversity.

2―WOMEN IN ENGINEERING

2.1 The Career Woman Engineer

With respect to women, many ask why more young girls are not attracted to the field of engineering and why so many leave the profession even though they are educated and trained just as their male counterparts. Little research has been done to answer this question. However, it is the suspicion amongst many women engineer professionals that the answers lie in similar answers to those of young women who leave the engineering profession. Catalyst, an organization that conducts studies on women in a variety of fields, indicated in a 1999 report the following regarding why women chose to leave the engineering profession: [3]

- Female graduate students in the sciences remain uninformed about potential careers in business.
- Academia is viewed by many as unwelcoming to women scientists.
- Absence of female role models
- Isolation
- Risk-averse supervisors and stereotypes
- Differences in style
- Exclusion from informal networks
- Lack of mentoring
- Lack of line or general management experience
- Work/life balance

While it is a task at hand to get more younger individuals interested in engineering as a career, it is hard enough to keep girls in particular interested in math and science so as to retain them in the technical fields when they enter high

school. However, it is even more difficult to attract young girls to the area of engineering when they are in high school. Thus, as a consequence, there are a disproportionately low number of women in engineering studies at the universities as compared to other professions such as medical, legal, and accounting. Further more, statistics show that an even larger number of women do not stay in engineering once they have received their degree. As a consequence, women advance at a snail's pace to the senior ranks and leadership positions in industry, business, academia, and government careers. And, of course, society as a whole suffers the setbacks of a diminished science and engineering workforce, fewer high-level leaders and innovators, and a citizenry that is far less literate than it ought to be at a time when technological innovation is the force carrying society forward.

2.2 Young Girls: How Does the Engineering Profession Attract Them?

One of the big questions that must be answered is why, after so many years of trying and so much activity throughout the engineering community, we've been unsuccessful in attracting more women. Engaging the public and teens in particular, with a message about engineering is not easy. Even if we could convince the producers of a popular television program to write an engineer into the script, in the world of television drama it would be difficult to impart a positive and meaningful message about engineering. We need to fundamentally shift the way engineering is portrayed.

Traditionally, we've emphasized math and science, and the rigor of the engineering profession in describing what we do to students and to the public at large. Everyone knows we're smart, in fact they believe we're not just smart, we're 'super smart.' But they have no idea how what we do connects to things they most care about, or how engineering allows us to pursue other interests, whether those interests are personal or professional. They don't understand that engineering today is a collaborative profession - that today's engineering is a team sport. And they have no idea how vast and varied the world of engineering is.

They don't believe that *someone like them* would like *to be someone like us*.

I firmly believe, on the other hand, that engineering offers benefits in each of the areas that girls cite as key career motivators. I personally believe that engineering can compete favorably with law, business or medicine as a career choice for any academically prepared girl.

But we need to market engineering in a new and different way. We need to give girls, and the parents and educators that most influence their career choices, a reason to take a fresh look at engineering. Image has been demonstrated to have a profound affect on young women. The lack of role models in the engineering industry has contributed to the flat growth of women engineers in the profession. As a consequence, women advance at a snail's pace to the senior ranks and leadership positions in industry, business, academia, and government careers. And, of course, society as a whole suffers the setbacks of a diminished science and engineering workforce, fewer high-level leaders and innovators, and a citizenry that is far less literate than it ought to be at a time when technological innovation is the force carrying society forward.

Today, young people-especially girls-require role models and mentors to give them the hands-on guidance and encouragement that will help them consider an engineering career. Author Pat McNees illustrates the crucial need for new methods to reach girls in her book *New Formulas for America's Workforce*: Girls in Science and Engineering.[4] McNees points out that girls need more than basic classroom exercises to become fully engaged in a course of study or career that, with its imposing edifice of mathematics, may appear unduly abstract. Hands-on learning is a proven tool for improving learning on the part of *all* students and is indispensable in giving girls self-confidence and stimulating their interest in science and engineering. Supplemental programs that combine hands-on activities with exposure to female role models are necessary to attract young women to engineering and sustain their interest.

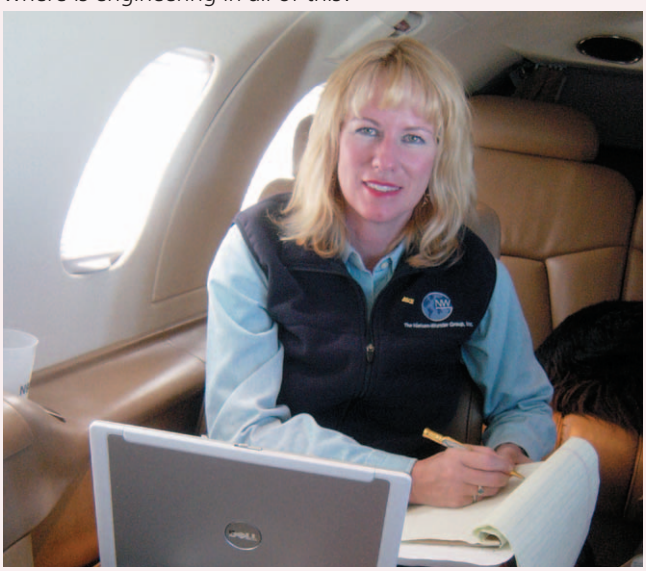
Why aren't girls enrolling in college engineering degree programs and going on to pursue engineering careers in larger numbers? According to a study conducted in 2000, the problem is not one of ability. Contrary to long-held perceptions, many girls express high interest in math and science and perform as well as or better than their male peers in these subjects. Researchers Huang, Taddese, and Walter found that girls are taking high school science and math courses at approximately the same rate as boys: 94% of girls and 91% of boys take biology, 64% of girls and 57% of boys take chemistry, 26% of girls and 32% of boys take physics, and 64% of girls and 60% of boys take algebra II. [5]

Yet, few girls choose to pursue an education and subsequent career in engineering. There is much speculation as to why girls are not choosing engineering. Explanations often include

that high school girls:

- Do not see many women in engineering and thus few role models exist, [6)]
- Are not aware of what a career in engineering entails, and
- See engineering as a place for geeks and nerds[7)] .
- Perceive engineering to be a man's profession
- Do not see engineering as a good working environment where they can make a good salary and have flexibility.

These explanations were confirmed by a May 2005 Final Report entitled "Extraordinary Women Engineers" funded by the U.S. National Science Foundation which researched and evaluated why girls age 14-17 were not choosing engineering.[8)] High school girls are not alone in their limited understanding of the nature and benefits of an engineering education and career. It is our premise that the problem is one of perception. Girls and the people who influence them-teachers, guidance counselors, parents, peers, and the media-do not understand what a career in engineering looks like. The 2005 NSF Extraordinary Women Engineers Final Report noted that science and math teachers and school counselors agreed with the girls. People have a vague sense of engineering as in "I'm not worried about global water supply; engineers will fix that problem."But does the general public understand what's involved in engineering? Do they have an accurate picture of what an engineer's day looks like? Our personal interactions regularly bring us in contact with doctors, teachers, lawyers, and firefighters. In addition, the media presents us with multiple and varied images of these professions through television programs, commercials, newspaper columns, and more. But where is engineering in all of this?



A Harris Interactive Poll of American adults conducted in 2003 found that most would be extremely pleased if their children pursued a career in engineering, yet just one-third of those same adults considered themselves well-informed about engineers and engineering. All too often the very people parents and students rely on to share the opportunities and realities about careers such as engineering-teachers and guidance counselors-are also woefully uninformed.

In 2002, for the first time in history, the top elected leaders of four of the five oldest U.S. engineering societies, ASCE, NSPE, ASME, IEEE-USA were women-a feat unmatched previously by even the legal and medical professions. Women were also at the helm, as president, president-elect, or past president, of an additional seven engineering organizations. While this unique accomplishment clearly demonstrated that women have shattered the glass ceiling of professional achievement within the engineering profession, it also called into stark contrast statistics regarding the low number of young women entering the profession.

ASCE has taken pro-active steps in encouraging women in engineering and the profession by its Board standing committee on Diversity and Women in Civil Engineering where issues regarding women in engineering are discussed, including how to both attract and retain women in the profession as well as serving as a network to allow women to meet each other and share their experiences. ASCE, by its encouragement of women in the profession has also seen an increase in the women who hold leadership positions in their local chapters and sections. Women ASCE Section Presidents are reaching a level of almost 30%!! As women begin to recognize that ASCE is a place where they can demonstrate their abilities, meet other engineers and learn and grow professionally, they will also be able to transition these skills into their own personal work environments and job positions. Being involved in professional activities will in turn benefit not only the woman engineer, but the employer who supported her.

WGBH-who is the television producer of NOVA, Building Big and Zoom into Engineering, AAES, and a coalition of over 80 engineering and related associations (where ASCE is the secretariat and I am the Chair of the Steering Committee) have committed in the EXTRAORDINARY WOMEN IN ENGINEERING initiative to:

- Mobilize the 8 million engineers around the U.S. in actively reaching out to educators and girls to encourage participation in engineering education and careers;

- Provide compelling role models of women actively engaged in fulfilling engineering careers;
- Help high school science, math, and technology teachers and guidance and career counselors to better understand the nature of engineering, the academic background needed by students pursuing engineering, and the career paths available in engineering; and
- Equip high school teachers and counselors to share this information with students, especially girls.

The starting point of the project was the project's flagship publication, the book *Changing Our World-The Stories of Women Engineers,* which was released in February 2006 in conjunction with Engineer's Week, hosted in 2006 by the Society of Women Engineers (SWE). This book will be supplemented with educational materials, a television documentary, and national outreach programs during 2006-2007.

3—NEXT STEPS FORWARD

So, what do we as engineers need to do? I believe the steps are straightforward:

- We must change the "face" of engineers today to reflect the "face" of the public.
- We must change how we communicate to the public about what engineering is and what engineers do - improving the quality of life for the public.
- We must determine why more students are not choosing to pursue engineering programs. We must strive to ensure that our young students of today have the skills needed to thrive in the competitive global marketplace driven by innovation and rapid technology changes.
- We must determine why young girls, in particular, do not choose engineering as their career choice, even though they have decided to pursue a technology based career option.
- We must determine what attracts and retains young women to stay in the engineering profession since the numbers demonstrate a sharp decline in the engineering workforce once they have graduated.
- We need to provide role models and tell our stories of success. Role models, mentors and leaders are critical for the future generations of engineers. They not only inspire, but they can support others wanting to continue and advance in their careers.
- We must better prepare our K-12 teachers and higher education faculty to inspire and challenge their students.

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Diversity and women in engineering is a matter of national importance and of national urgency no matter in what nation one resides. We as engineering societies, have an opportunity to work together as partners, together as one voice to better our profession and to capture the intellectual capital that is standing at our doorstep. We can stand up and we can make this happen. Let's take the challenge of the U.S. National Science Foundation-Let's follow through on what the great leaders of our great countries have been saying for years-Let's make a difference. Be proud that you are an engineer and be proud of the accomplishments not just that we have made, but what is to come given the diverse work force we have today and can use of the engineers of tomorrow. If we do not encourage individuals from all diverse groups to enter into the complex and dynamic field of engineering, we will then lose the opportunity to maximize the potential of intellectual capital. Let's learn from the past and Let's not as philosopher George Santayana once said: "*Those who cannot remember the past are doomed to repeat it.*"

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