Emily, Amelia, et al.:
Who Are These Women and Why Should You Care?

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Emily Roebling and Amelia Earhart were women whose contributions to engineering were extraordinary. Despite the roadblocks that confronted women in their time, they accomplished remarkable feats – feats that have bettered our profession and our world. If we are to truly promote engineering as a choice career, we must remember Emily, Amelia, and the hundreds of others like them and communicate their stories to young people. They serve as important role models.

Emily Roebling was the first woman construction manager in the United States and the first woman to address ASCE. It was her passion and ability that helped ensure the completion of the Brooklyn Bridge when her husband, Washington Augustus Roebling, the bridge's chief engineer, became too ill to work at the site. To shield her husband from criticism and keep the Roebling name at the forefront of the Brooklyn Bridge project, Emily effectively assumed the work of chief engineer and performed so brilliantly that a board of inquiry convened by ASCE to determine whether her husband should be removed from the project concluded that the Roeblings should continue to oversee the work.

Amelia Earhart was a woman who changed the way we think about aviation. Although she disappeared during an attempt to fly around the world, she energized those who wanted to fly. And she understood that flight is as much about the plane as the pilot. She succeeded in increasing interest in aeronautical engineering on the part of both men and women. One of the women she influenced was Katherine Stinson, who became the first female aeronautical engineer with the Federal Aviation Administration and helped found the Society of Women Engineers.

What does any of this have to do with you? Well, as William A. Wulf, the president of the National Academy of Engineering, has put it, "To the extent that engineering is a pale male profession, which it largely is, it is impoverished."

Consider the following:

- Not even 2 percent of high school graduates will earn engineering degrees,

- Colleges and universities are having difficulty recruiting women engineering students,
- A mere 20 percent of today's graduate engineering students are women,
- Many women who obtain engineering degrees leave the profession to pursue different careers.

Perhaps even more disheartening is the fact that women account for less that 10 percent of the engineering workforce.

As the pace of globalization increases, the impoverishment of our "pale male" profession becomes more pronounced. In a speech delivered at Rice University on November 2, 2003, Joe Bordogna, the deputy director of the National Science Foundation described the problem very simply:

> First, it is not about the total number of engineers…the nation may or not need. We seem to be stymied and distracted from out diversity goals by questions about trends and statistic…It is about the need to include a larger proportion of women, underrepresented minorities, and persons with disabilities in the scientific workforce. [Broadening participation] is about fully developing our domestic talents. Although we are doing better that we did thirty years ago, we have not yet seriously tapped our nation's competitive "ace in the hole" domestic women, underrepresented minorities, and persons with disabilities. Now we are playing catch-up in a very competitive world. It is about educating scientists and engineers with a competitive edge to be on the frontier of discovery and in the vanguard of innovation requires new capabilities and skills that are qualitatively different [from] production-line education that turn students into commodities bought on the global marketplace. It is about providing students with additional capabilities that will enable them to work across boundaries, to handle ambiguity, to integrate, to innovate, to communicate and to cooperate. The differences in race, ethnicity, and gender that abound in our society are [positive forces] to engender this creativity and dynamism. Broadening participation is about working together. We will realize our goals sooner if we all work together in harmony.

So significant is this problem that in October 2998 President Clinton established the Presidential Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development (CAWMSET) to "research and recommend ways to improve the recruitment, retention, and representation of women, underrepresented minorities…and persons with disabilities in science, engineering, and technology (SET) education and employment." The preamble to the CAWMSET report puts it this way:

> Today's U.S. economy depends more than ever on the talents of skilled, high-tech workers. To sustain America's preeminence we must take drastic steps to change the way we develop our workforce. An increasingly large proportion of the workforce consists of women, underrepresented minorities and persons with disabilities – groups not well represented in science, engineering and technology (SET). Unless the SET labor market becomes more representative of the general U.S. workforce, the nation may likely face severe shortages in SET workers, such as those already seen in many computer-related occupations…If, on the other hand, the United States continues failing to prepare citizens from all

> population groups for participation in the new technology-driven economy, our nation will risk losing its economic and intellectual preeminence. It is time to move beyond a mere description of the problem toward implementation of a national agenda that will take us where we must go, so that our nation can thrive now, and in the years to come. It is also time to establish clear lines of responsibility and to define effective accountability mechanisms.

That report was issued in September 2000. The term of the commission has now expired, and in the more than three years that have elapsed since then no action has been taken on those recommendations.

Today, young people – especially girls – require role models and mentors to give them the hands-on guidance and encouragement that will help them consider and engineering career. Do you remember having a role model who inspired you to become an engineer? Perhaps a childhood hero, a teacher, or a parent was an engineer. Did you have a mentor during the early years of your career?

According to a study conducted in 2002 by the Educational Development Center, which is headquartered in Boston, programs for girls that combined hands-on activities with role models lead to increased self-confidence and greater interest in engineering, science and technology courses and careers. Moreover, these programs constitute a vital step in educating all students about the benefits of a diverse engineering workforce.

Author Pat McNees illustrates the crucial need for new methods to teach girls in her book *New Formulas for America's Workforce: Girls in Science and Engineering* (Arlington, Virginia: National Science Foundation, 2003). McNees points out that girls need more than basic classroom exercises to become fully engaged in a course of study or career that, with no 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 indispensible 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.

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

1. We must change the 'face' of engineering today to reflect the 'face' of the public.
2. We must change the way in which we communicate to the public what engineering is and what engineers do – improve the quality of life for everyone.
3. We must determine why more students are not choosing engineering programs. We must strive to ensure that today's young students have the skills needed to thrive in a competitive global marketplace driven by innovation and rapid technology changes.
4. We must determine why girls in particular do not choose engineering as a career, even when they have decided to pursue a technology-based career option.
5. We must determine what attracts young women to engineering and what keeps them there; the latter being of particular importance since the number of women remaining in engineering after graduation falls off sharply.
6. We need to provide role models and ensure that stories of success are told and retold. Role models, mentors, and leaders are of cardinal importance in producing future generations of engineers. Not only do they inspire young people; they also support others wanting to advance their careers.

7. We must better prepare our teachers and university faculty members so that they not only impart information but also inspire and challenge their students.

Increasing diversity in the engineering profession and attracting women are matters of national importance and brook no delay.

Kris' Blog:

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Mega Projects, Politics, and Investment – Are These Concepts Mutually Exclusive?

Public Infrastructure and Energy Infrastructure require some of the largest engineering and construction investments. These so-called Mega Projects (today nominally $1 Billion and up) are essential to support economies, improve the quality of lives, and enable constant improvement for our productive endeavors. In 2008 the global recessions led to the tremendous effort to re-ignite economic growth from the paralysis that was caused by the financial pandemic that had swept around the world. Virtually all governments subsequently announced "stimulus packages" and the need for funds to enable resumption of trade for their individual economies, whether they could afford the cost of stimulus programs or not.

Last year we saw massive public spending in the US. As we changed administrations, politicians lauded a new era of infrastructure investment and proposed many Mega Projects. For example, in the Electric Utility sub-sector, politicians and utilities alike promised power generation facilities (including renewable sources) and a smart grid to replace aging plants and old distribution systems. These goals were to be accomplished in addition to the goal of reducing carbon emissions. These are very lofty and worthy goals indeed. Goals which would take years to accomplish – one of the very characteristics of Mega Projects. Now as we begin 2010, political rhetoric has turned from eloquent sounding goals to one aimed at the mid term elections of 2010. The US public now realizes that the stimulus funds were not spent on these goals and the Mega Projects that were promised and which are necessary. The US public is leery of the huge debt the country has amassed. This week it rose to an all time high! Politicians now talk of no further or at least a curtailment of public spending for infrastructure and the Energy sector is bearing the brunt of this political wind.

As I noted last year in an address before the Society for Social Managements Systems, the *Harvard Business Review* in its November 2006 issue said

> *Few things are more fragile than institutional memory. We build amnesia in to our processes – wiping our computers' memories and shredding our files or entombing them in distant warehouses. The very psychology is business people are memory adverse. Executives who can quote chapter and verse of next year's plans struggle to remember the rationale behind last year's goals. Managers would rather scan the horizon than look back…**it dooms us to unproductive repetition of our predecessors' blunders.*** **[Emphasis Added]**

Like businesses, so politicians deflect this paucity of investment for the future by finding a “whipping boy” or a “sacrificial lamb” and hope the public is deflected in their thinking by addressing the “current issue.” They repeat the blunders of their political predecessors, just like businesses.

For instance, Deutsche Bank analysts last month stated with regards to the Oil & Gas sub-segment of the Energy Industry:

> *For 2010, the biggest risk for oil companies emerging from DC for oil and gas companies is tax….The pressure on President Obama to limit additions to the budget deficit while also advancing key job and social programs is enormous, which necessitates finding new sources of revenue without directly raising voters’ taxes. Oil and gas producers remain tremendously unpopular with the public – again, go to the polls, and find that oil and gas is consistently the most unpopular industry, even this year far outscoring banks (mid range) and are thus an easy target for increased taxation…The key tax threats are*
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> - *Repeal Section 199 manufacturing tax deduction for oil and gas companies. For 2009 the deduction was frozen at 6%, could be fully eliminated for [producers]. Under the budget, that would be worth $13.3 billion between 2010 and 2019.*
> - *Changes to the Gulf of Mexico royalty and leasing regime. Democratic energy*
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> *staffer: “Question is, are we getting a fair return on our asset leases in the Gulf of Mexico.” The legal success by Anadarko in winning back tax is seen as a short term victory, a long term potential defeat, and furthermore raising Gulf of Mexico taxes was cited as a process started under the Bush administration. Under the budget, that would be worth $5.3 billion between 2010 and 2019.*
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> - *Reinstate superfund taxes for the industry. If reinstated in 2010, it would apply to 2011 tax year.*
> - *Restriction of dual capacity tax creditability to instances of foreign income tax thus eliminating creditability for other trade or business taxes. This is a massive threat to [producers], given their huge foreign income; the offset to this threat has been the argument that it will disadvantage US oil companies relative to major foreign oils, European majors such as Shell and BP, but also Chinese or other majors. That argument has been sufficient to offset the risk so far.*
> - *Repeal of the intangible drilling costs deduction; more likely headline threat than reality because of the stronger political power of gas [producers], and support.*
> - *Repeal LIFO inventory accounting. This change now appears unlikely, but would cost the industry approximately $24bn in one fell swoop (depending on the prevailing oil price).*

Politicians will turn eventually to private investment concepts as the solution to not burdening the public with debt, but this requires an investment environment that is positive for investors. Taxing the Energy sector is not the answer. Private investment requires commitment to creating and maintaining a “predictable and stable” climate for their investments.

Likewise, in another Energy sub-sector, one the purposes for public commissions in regulated private industries, like electric utilities, is to create a balance between long term investment needs and the public's capacity to pay for electricity in an atmosphere that assures long term service maintenance and improvement. Utility Mega Projects in the Energy sector require a combination of public investment and private investment which will require a favorable investment climate. Commissions must not allow themselves to create an investment disincentive by being pressured by politicians with a short term focus. Mega Project investment requires a predictable and stable environment over the long periods.

The key to "predictability" for all stakeholders, not only management, is the concept that underlies investment. The public interest will be furthered by infrastructure Mega Projects. Short sighted political agendas result in an investment climate that does not enable the required balance so that we can accomplish Mega Projects. For the time being the three concepts appear mutually exclusive. I sincerely hope that private investors and the public will prevail over the politicians and their political agendas.