The Urgency of Globalizing Engineering Education

Discussion points (not sorted for importance):

The world is changing (rapidly)!

- Rapid industrialization, economic development, and innovation in geographically large, heavily populated, and developing regions of the world – e.g. Brazil, Russia, India, China (BRIC countries) – changes international dynamics.
  - Changes in supply and demand of professional engineers and educators.

- Federalization of Europe increased economic and intellectual mobility; this was a development guided by European-wide funding opportunities; local economic “miracles” draw industry and technology & innovation talent to underdeveloped European countries (e.g. Ireland in 2000).

- Slow (but steady) democratization of Africa creates opportunity and need of rebuilding advanced education infrastructure, followed by technological development.
  - Increasing demand of engineers.

- Global problems are emerging that require global solutions. Originating nations are not necessarily the recipient / affected nations.
  - Global warming and air pollution traveling across the globe are global problems with engineering solutions.
  - Realities and shifts in energy demand and supply affect international relations.

- The internet revolution has led and continues to lead to a globalization of real-time information.

- International students have many more options to gain top-quality education; e.g. Asian students studying in Europe, Japan, Australia rather than in the U.S..

The U.S. are changing!

- U.S. population is changing, becoming more diverse, international, and multi-cultural through immigration and global mobility.

- Many-year war spending has led to stagnating NSF and other basic science budgets; and it shows.
  - Need to recruit international talent to meet national demand.
K-12 education through No-Child-Left-Behind (NCLB) does not improve students’ preparation for higher education; U.S. students rank lower than international students, are loosing ground.

Recent economic downturn needs swift action, including domestic investments.
  - New focus on energy independence.
  - New focus on domestic infrastructure enhancement.
  - Expect less attrition of engineering graduates to financial sectors.

Expected shift in political landscape in 01/2009 should affect fundamental research foci going forward.

The times are changing!

- The century (20th) of “new physics” is over; we are done reaping the easy discoveries of quantum mechanics.

- We enter a century of “new engineering”, of what can and should be done; putting insights into action. Engineering takes more minds & hands than physics (using physics here as a sample discipline; similar considerations extend to biology – DNA discovery, and other disciplines).

- High performance computing and the PC have simplified the math, creating a necessity and opportunity to catch up with experimental research and realistic hard-ware and systems.

Short and long term problems:

There are urgent global problems – both short and long term – that can and should be addressed by engineers, ideally engineers with global training.

- Deep new understanding, insights, and breakthroughs in the disciplines, e.g. physics, require increasingly expensive, high-tech experiments (e.g. ITER, controlled fusion, gravitational waves, …). These undertakings are by nature international with shared budgets and shared research teams. These research endeavors require global engineers able to collaborate in and lead international, multi-cultural teams.

- The population of space – the space race – has become more international; a peaceful exploitation of space (lacking natural boundaries such as seas, mountains, ...) must be done by global teams, if it be done efficiently (e.g. American astronauts getting rides on Russian spacecraft to the International Space Station).
o Anthropogenic climate change is a long-term – potentially irreversible – and global problem. Often, the most heavily polluting nations export pollution and hence climate change to other nations.

o Sustainable development of the under-developed regions of the world needs to be one of avoiding errors of the developed world – e.g. wireline/wireless communication; resource & waste management; public transportation vs. personal mobility; ...
  - Need to avoid exploitation, paternalism, cultural insensitivity.

o Recent history (fear of terrorism, anti-immigration rhetorik) has shown that the U.S. could be vulnerable to closing its borders for international student and researcher influx. This can be mitigated by the existence and active participation in global networks and teams.

o Outsourcing of manufacturing has significantly diminished job opportunities and depressed domestic regions; outsourcing of high tech engineering jobs may be starting; engineers need to be able to go where the jobs are, even abroad.

o Sales is global, markets are global; engineers working global sales need to be versed in local and global customs.

o Dangerous attitude “problem” of overestimating U.S. engineering prowess; arrogance leading to laziness; e.g. U.S. based students w/o pass-port, turning down offers to study abroad even for short times.

o Perception of U.S. abroad has changed; options for young engineers abroad have increased; this leads to less talent flux to U.S., together with stronger “pull-back” programs from Europe & Asia (starting).

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**Justification for the globalization of engineering education:**

o Globalization – industrial / commercial / innovation
  - U.S. firms are increasingly multi-national; they need educated talent that willingly moves abroad and lives within the local culture to lead and train local teams with cross-cultural sensitivity and effectiveness

o Globalization – intellectual / scientific
Global emerging technological societies still look to U.S. model for innovation; provide more and more increasingly welcoming and interesting research environment themselves that is structured after U.S.

- Dearth of U.S. citizens and residents to move into science and engineering
- U.S. needs to keep open access to the global market of engineering talent
- Different global regions place different emphasis on engineering education: specialization and depth (Europe), fundamentals and basics (Asia), breadth and universality (U.S.); need to learn from each model and adapt best practices
- Globally mobile individuals self-select for risk-taking, self-reliance, dedication; i.e. internationalization is another selection process.

**Current, not to miss opportunities:**

- Engineering as a recession proof career

**Actions needed:**

- Change of attitude: study abroad is desirable; teaches risk-taking, self-reliance, ...
- Development of curricular that require
- Teaching of respect for other cultures
- Civilization of science & engineering
- Teaching international relations, culture, norms, ...
- Cultural immersion

*Are we as a nation currently at a disadvantage relative to the education of engineers in the rest of the world?*
*What is the urgency today compelling us to prepare our engineering students for the global perspective?*
*How competitive are our engineering students today?*
*How prepared are our engineering students to work and live outside the U.S.?*
*How prepared are our engineering students to work effectively with international students inside the U.S.?
What are the demands of the future engineering workforce?

a) insist that our students do what they need to do to become technically competent, and

b) offer students the opportunity to develop a world view through whatever means fit local conditions.

Language requirements,

opportunity for time overseas,

international cooperation on design courses,

courses designed to raise awareness of globalization

(1) More than anything else, being from the most powerful country in the world, our students need to develop an attitude and an aptitude to treat others as equal, as people from whom we can learn something useful and interesting, just like we would like them to think that we too have something to offer them.

(2) There is no better way to learn about a country and its culture than to read books written by its people, even if the books are translated works. U.S. students are finding themselves challenged by competing and increasing demands on their time, but they are missing something if they do not read books by such authors as Tolstoy, Dumas, Tagore, Bajin, Nabokov, Solzhenitsyn, etc.

(3) Even though there is available a vast amount of free, first rate information from domestic U.S. news organizations, we cannot underestimate the benefit of having regular access to a reliable foreign source of information on current events. An example is the website http://www.bbcnews.com which I have found to be immensely useful and relatively unbiased. As an example, see: http://www.bbc.co.uk/blogs/thereporters/NickBryant/2008/08/losing_to_the_brits.html

Are we as a nation currently at a disadvantage relative to the education of engineers in the rest of the world?

Language requirement – lazy
students need to learn better how to appreciate and communicate with peoples from different cultures.

What is the urgency today compelling us to prepare our engineering students for the global perspective?

“Global competence or a strong interest in becoming globally competent is a clear differentiator in an engineer’s ability to progress in their career. Gone are the days when someone could be U.S. centric and reach a senior leadership position or even have a relatively secure job…Those that have the interest and capability to move abroad significantly expand their long term career opportunities. In the chemical industry, for example, there are tens of thousands of Chinese engineering graduates every year. These engineers have an incredible drive to succeed so they can achieve “Western standards of living”. Engineers in more developed countries need to realize who their future competition is and respond accordingly.”

need to view themselves as “citizens of the world” as well as citizens from a particular country.

They will need to understand these problems in a societal, cultural context and work with others, from many nations, to solve them.

How competitive are our engineering students today?

Good technically, but relatively poorly prepared in terms of global issues.

How prepared are our engineering students to work and live outside the U.S.?

In general, I feel only a fraction of our students have any preparation at all.