Welcome!

Southwest Electrical & Computer Engineering Department Heads Association

SWECEDHA Annual Meeting

November 13, 2004
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<td>Welcome to LUEE</td>
<td>Harley Myler, LU</td>
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<td>ECEDHA Report</td>
<td>Jon Bredeson, TT</td>
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<td>Whither goeth EE Education?</td>
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<td>Dinner</td>
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Department Snapshot

- 7 faculty
- 2 Staff
- ~50 upper-division EE
- ~50 grad students (MSE, MSEE, DE)
- ~(10 MSE | 5 MSEE | 1 DE)/year
- Four teaching labs/Four research labs
- IEEE Beaumont Section (~200 members)
ECEDHA
Electrical and Computer Engineering Department Heads Association

Jon Bredeson
Secretary/Treasurer
Whither goeth Engineering Education?

An exploration of the reports:
• National Academy of Engineering (NAE) Committee on Engineering Education (CEE)
• Two-phase vision-casting initiative on engineering in the future and educating engineers to meet the needs of the new era.
• First phase -- The Engineer of 2020: Visions of Engineering in the New Century
• Published May 17, 2004.

• The National Science Board began its study of long-term trends and policies for the science and engineering (S&E) workforce in 2000, at the end of the longest peacetime economic expansion in US history.
• Published August 24, 2003.
The future strength of the US S&E workforce is imperiled by two long-term trends:

- Global competition for S&E talent is intensifying, such that the United States may not be able to rely on the international S&E labor market to fill unmet skill needs.
- The number of native-born S&E graduates entering the workforce is likely to decline unless the Nation intervenes to improve success in educating S&E students from all demographic groups, especially those that have been underrepresented in S&E careers.
Science?

- EE (43%)
- Other (26%)
- Math (14%)
- Science (11%)
- Engineering (6%)

LUEE
BSEE

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RECOMMENDED NATIONAL POLICY IMPERATIVE

The Federal Government and its agencies must step forward to ensure the adequacy of the US science and engineering workforce.

All stakeholders must mobilize and initiate efforts that increase the number of US citizens pursuing science and engineering studies and careers.
FINDINGS AND RECOMMENDATIONS

UNDERGRADUATE EDUCATION IN SCIENCE AND ENGINEERING

RECOMMENDATION:

The Federal Government must direct substantial new support to students and institutions in order to improve success in S&E study by American undergraduates from all demographic groups.

The Federal Government should:

- Ensure that scholarships and other forms of financial assistance are available to well-qualified students who otherwise would be unable to attend school full time to pursue an S&E major;

- Provide incentives to institutions to expand and improve the quality of their S&E programs in areas in which degree attainment nationwide is insufficient;

- Provide financial support to community colleges to increase the success of high-ability students in transferring to four-year S&E programs in colleges and universities; and

- Expand funding for programs that best succeed in graduating underrepresented minorities and women in S&E.
Knowledge Base on the Science and Engineering Workforce

Recommendation:

To support development of effective S&E workforce policies and strategies, the Federal Government must:

- Substantially raise its investment in research that advances the state of knowledge on international S&E workforce dynamics;

- Lead a national effort to build a base of information on:
  1. The current status of the S&E workforce,
  2. National S&E skill needs and utilization and
  3. Strategies that attract high-ability students and professionals to S&E careers.
US ENGAGEMENT IN THE INTERNATIONAL SCIENCE AND ENGINEERING WORKFORCE

RECOMMENDATION:

During the current reexamination of visa and other policies concerning the mobility of scientists and engineers, it is essential that future US policies:

- Strengthen the capacity of US research universities to sustain their leadership role in increasingly competitive international S&E education;

- Strongly support opportunities for American students and faculty to participate in international S&E education and research; and

- While enhancing our homeland and national security, maintain the ability of the United States to attract internationally competitive researchers, faculty and students.
Bachelor's degrees earned in selected S&E fields by U.S. citizens and permanent residents: Selected years, 1977-2000


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Ratio of NS&E First University Degrees to 24-year-old Population, 1975 and 1999

First university degrees per 100 24-year-olds

Notes: Natural sciences include physics, chemistry, astronomy, earth, atmospheric, ocean, biological, agricultural, as well as mathematics and computer sciences. The ratio is the number of natural science and engineering degrees to the 24-year-old population. China's data are for 1988 and 1998. Other locations' data are for 1975 and 1998 or 1999.22

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CONCLUSION

The United States has for many years benefited from minimal competition in the global labor market for S&E personnel. As our economy and high-technology industry grew, a fortuitous set of circumstances gave our Nation the benefit of some of the best minds in the world from other countries to help us build and sustain US world leadership in science and technology. The Federal Government has played a crucial role as sponsor of science and engineering research and advanced education, by means of which many foreign scholars and professionals have been drawn to our shores to study and work and many of our own students have pursued science and engineering degrees and careers.

The ready availability of outstanding science and engineering talent from other countries is no longer assured, as international competition for the science and engineering workforce grows. Threats to world peace and domestic security create additional constraints on employment of foreign nationals in the United States.

Moreover, demographic data indicate that participation of US students in science and engineering studies will decline if historical trends continue in S&E degree attainment by our college-age population. At the same time, retirements of scientists and engineers currently in the workforce will accelerate over the coming years.
What will or should engineering be like in 2020?"

Scenario-based planning:

(1) The Next Scientific Revolution,
(2) The Biotechnology Revolution in a Societal Context,
(3) The Natural World Interrupts the Technology Cycle and
(4) Global Conflict or Globalization?
The economy in which we will work will be strongly influenced by the global marketplace for engineering services, a growing need for interdisciplinary and system-based approaches, demands for customerization, and an increasingly diverse talent pool.
Attributes needed for the graduates of 2020: strong analytical skills, creativity, ingenuity, professionalism, and leadership.

This study suggests that if the engineering profession is to take the initiative in defining its own future, it must:

1. agree on an exciting vision for its future;
2. transform engineering education to help achieve the vision;
3. build a clear image of the new roles for engineers, including as broad-based technology leaders, in the mind of the public and prospective students who can replenish and improve the talent base of an aging engineering workforce;
4. accommodate innovative developments from nonengineering fields; and
5. find ways to focus the energies of the different disciplines of engineering toward common goals.
Engineering is a profoundly creative process. A most elegant description is that engineering is about design under constraint.

*Is art design without constraint?*

Technology is the outcome of engineering; it is rare that science translates directly to technology, just as it is not true that engineering is just applied science.

The speed and computing power of future desktop machines and software will enable design and simulation capabilities that will make the routine activities of contemporary engineers obsolete, thus freeing them for ever more creative tasks.
Everything will, in some sense, be “smart”; that is, every product, every service, and every bit of infrastructure will be attuned to the needs of the humans it serves and will adapt its behavior to those needs.

For engineering the imperative to accommodate connectivity establishes an integral role for core competencies related to electronics, electromagnetics, photonics, and the underlying discrete as well as continuous mathematics.

In the past, engineering responded to the explosion in knowledge by continually developing and spawning new areas of focus in the various engineering disciplines. As more of these areas arise, the depth of individual knowledge increases, but the breadth can dramatically decrease. This poses a challenge to an engineering future where interdisciplinarity will likely be critical to the solution of complex problems.
Since the late 19th century, when the major subdisciplines of engineering began to emerge, engineers have been aware that solutions to many societal problems lie at the interstices of subdisciplines.

Engineering education must avoid the cliché of teaching more and more about less and less, until it teaches everything about nothing.

The comfortable notion that a person learns all that he or she needs to know in a four-year engineering program just is not true and never was.

Engineers are going to have to accept responsibility for their own continual reeducation, and engineering schools are going to have to prepare engineers to do so by teaching them how to learn.
If current trends continue, Hispanic Americans will account for 17 percent of the U.S. population by 2020, and African Americans 12.8 percent. The percentage of whites will decline from the 2000 value of 75.6 percent to 63.7 percent. Looking further into the future, by 2050, almost half of the U.S. population will be non-white (U.S. Census Bureau, 2002). Thus, in 2020 and beyond, the engineering profession will need to develop solutions that are acceptable to an increasingly diverse population and will need to draw more students from sectors that traditionally have not been well represented in the engineering workforce.
The systems perspective is one that looks to achieve synergy and harmony among diverse components of a larger theme. Hence, there is a need for greater breadth so that broader requirements can be addressed. Many believe this necessitates new ways of doing engineering.
It is our aspiration that engineering educators and practicing engineers together undertake a proactive effort to prepare engineering education to address the technology and societal challenges and opportunities of the future. With appropriate thought and consideration, and using new strategic planning tools, we should reconstitute engineering curricula and related educational programs to prepare today’s engineers for the careers of the future, with due recognition of the rapid pace of change in the world and its intrinsic lack of predictability.
Our aspiration is to shape the engineering curriculum for 2020 so as to be responsive to the disparate learning styles of different student populations and attractive for all those seeking a full and well-rounded education that prepares a person for a creative and productive life and positions of leadership.
Berne Maxum