

Future Directions for NSF Engineering Education Programs

2006 International Mechanical Engineering Education Conference

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Topics

The Context

Challenges for engineering graduate
programs

NSF programs in engineering education and
international study



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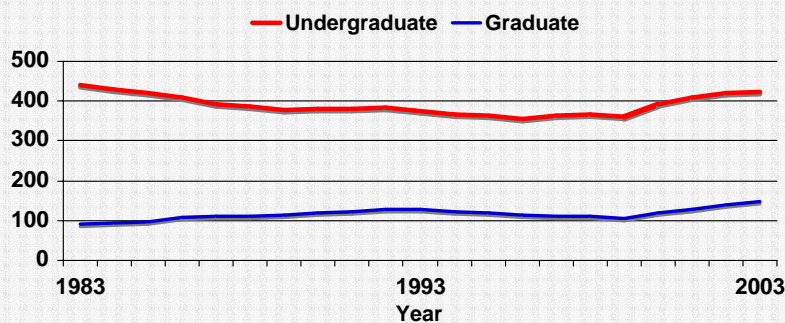
The Context..



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Engineering Enrollments are up..

US Engineering Enrollment by Level, 1983 - 2003



Note: Includes full and part-time students

Source: Engineering Workforce Commission, *Engineering & Technology Enrollments, Fall 2003*, American Association of Engineering Societies (2004)
Science and Engineering Indicators 2006

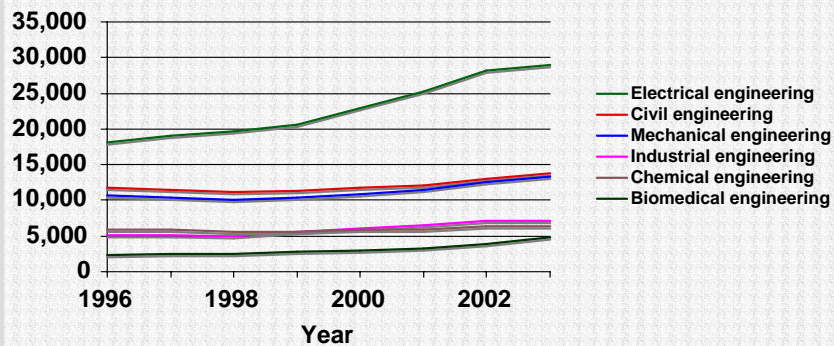


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Engineering Graduate Students

Full-time graduate students by field: 1996–2003



Source: Science and Engineering Indicators 2006

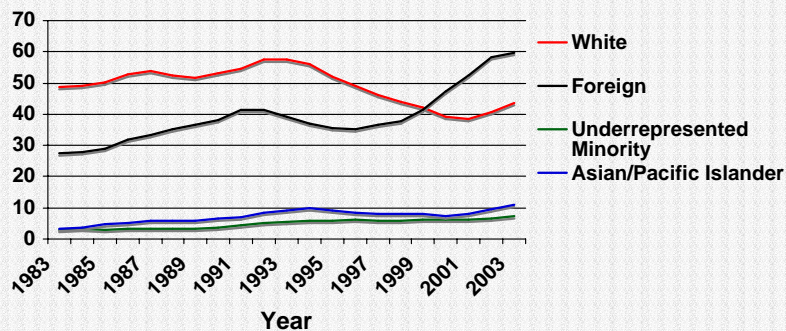


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Graduate enrollment trends

Graduate Enrollment in engineering by citizenship and race/ethnicity: 1983-2003



NOTES: Foreign includes temporary residents only. Race/ethnicity includes U.S. citizens and permanent residents. Underrepresented minority includes black, Hispanic, and American Indian/Alaska Native.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Graduate Students and Postdoctorates in Science and Engineering, WebCASPAR database, <http://webcaspar.nsf.gov>. See appendix table 2-15. *Science and Engineering Indicators 2006*

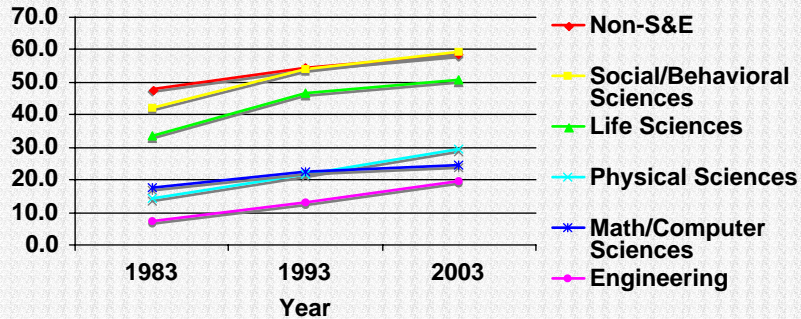


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Representation of Women still low..

Doctoral degrees earned by female U.S. citizens in U.S. institutions, by field: 1983, 1993, 2003



Source: Science and Engineering Indicators 2006

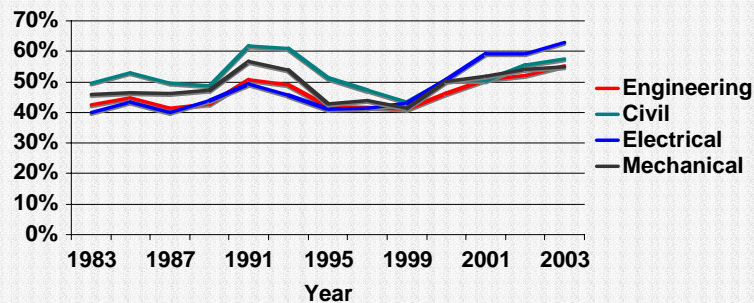


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Dependence on Foreign Students Continues

Percent Doctoral Recipients with Temporary Visas: 1983 - 2003



Source: Science and Engineering Indicators 2006



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The reports...

- *Engineering Research and America's Future* (NAE, 2005): Committee to Assess the Capacity of the U.S. Engineering Research Enterprise
- *The Engineer of 2020* (NAE, 2004) and *Educating the Engineer of 2020* (NAE, 2005)
- *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* (NRC/COSEPUP, 2005)
- *Innovate American: National Innovation Initiative Final Report* (Council on Competitiveness, 2005)



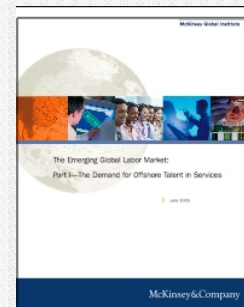
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Another report..

- Engineering occupations are the most amenable to remote location
- Offshore talent exceeds high-wage countries' potential by a factor of 2
- 17% of engineering talent in low-wage countries is suitable* for work in a multinational company.
- At current suitability rates, and an aggressive pace of adoption in demand, supply of engineers could be constrained by 2015.

"The Emerging Global Labor Market"



McKinsey & Company, 2005



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*Suitable = quality of education, location, domestic competition NATIONAL SCIENCE FOUNDATION 10

What seems to be clear..

- Knowledge and human capital have become key driving forces in a global economy.
- All countries, developing and industrialized, have a shortfall in S&E talent.
- Education has become one of the highest priorities for developing countries.
- Competition for S&E talent in the future is going to be a major global battleground.

Remarks by Arden Bement at NSB Workshop on Engineering Education



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The Challenge for Engineering Graduate Programs

1. Increasing participation in graduate study
2. Diversifying the engineering faculty



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NSF Graduate Engineering Strategic Emphases

- Expand participation in research experiences for undergraduates
- Sponsor Research on Graduate Education in Engineering
- Improve Support Networks and Mentoring for Graduate Students
- Require improved Mentoring and Advising of Graduate Students
- Improve Support Networks for Women and Minority Faculty



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Graduate Student vs. New Faculty Member: Teaching

Graduate Student

Teaching experience likely to vary (none, TA, labs/ discussion sections, independently taught a course)

Typically, graduate study provides no preparation for teaching

No advising responsibilities.

New Faculty Member

Expected to be “teaching ready”.

Now has responsibility for quality, course material, grading, student issues, office hours, and general course preparation.

Will be asked to advise and mentor students, both graduate and undergraduate.



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Graduate Student vs. New Faculty Member: Research

Graduate Student

- Research was only task
- Responsible for doing research
- Maybe no experience setting research agenda
- Proposal writing ability?
- Should be expert in field

New Faculty Member

- Research not their only responsibility
- Must now direct vs. perform research
- Must develop a research agenda
- Must recruit students
- Must publicize and sell their research



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Graduate Student vs. New Faculty Member: Service

Graduate Student

Likely none at all

New Faculty Member

- Must decide how to integrate service with other tasks
- Must become more actively involved with campus culture



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NSF Education Programs



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Engineering Education & Centers

Strategy 1.
Focus on research on how students learn engineering, UG and Grad.



Strategy II.
Focus on attracting more talented and diverse students to engineering, at all levels



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EEC Education Programs

- Engineering Education Program
- Research Experiences for Undergraduate Sites
- Research Experiences for Teachers Site
- Engineering Research Centers
- Bioengineering/Bioinformatics Summer Institutes



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NSF International Programs in S&E Education

- Purpose: To provide opportunities for faculty and students to *initiate* international *collaborations*
- Funding Mechanisms
 - Supplements to existing grants
 - *New Opportunity: International Research and Education for Engineering (ENG)*
 - REU's and IGERTS
 - NSF Graduate Fellowships
 - NSF Office of International Science & Engineering



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OISE Programs¹

- Developing Global Scientists & Engineers
 - International Research Experiences for Students
 - Doctoral Dissertation Enhancement Projects
- East Asia Pacific Summer Institutes (EAPSI)
- Pan-American Advanced Studies (PASI)
- International Research Fellowship Program (IRFP)
- Partnerships for International Research and Education



¹ <http://www.nsf.gov/div/index.jsp?div=OISE>

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Final thought

“As we think about the many challenges ahead, it is important to remember that students are driven by passion, curiosity, engagement, and dreams. ...

In the long run, making universities and engineering schools exciting, creative, adventurous, rigorous, demanding, and empowering milieus is more important than specifying curricular details.”

Charles M. Vest “Educating Engineers for 2020 and Beyond”
Educating the Engineer of 2020



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Thank you.



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