

10-12-06

Moving Forward to Improve Engineering Education
Workplan for a National Science Board Sponsored
Workshop on Engineering Education
November 7, 2006

With the support of the National Science Board (the Board) Committee on Education and Human Resources (EHR), the *ad hoc* group composed of Drs. G. Wayne Clough, Daniel E. Hastings, and Louis J. Lanzerotti have moved forward with plans for a second engineering education workshop to follow-up on the workshop held October 20, 2006 at MIT, entitled: *Engineering Workforce Issues and Engineering Education: What are the Linkages?* This follow-up workshop, scheduled for November 7, 2006 at Georgia Institute of Technology, will engage leading deans of engineering and elaborate on the issues raised at MIT, and examine how programs and activities at the National Science Foundation (NSF) may specifically address the issues raised by the National Academy of Engineering (NAE) *Educating the Engineer of 2020* report.

NSF is an important leadership agency for engineering education and needs to respond to pressing issues, including retention rates, the educational experience of engineering students, international education and workforce issues, the current perception of engineering, the faculty of the future, and the perspective of industry.

- a) Retention Rates: What is the role of the Foundation in understanding the issues associated with retention of students who enter universities to study engineering and in developing approaches to address these challenges?
- b) Educational Experience: What is the best way to create an educational experience for an engineering student that will allow for more well rounded graduates who have skill sets that will allow them to compete in a "flat world" economy? How may co-op and internship programs, student professional societies, volunteer activities, student government, and/or study abroad programs contribute to the educational experience of engineering students? Is there a unique role for NSF in supporting the efforts of colleges and universities to enhance the educational experience of engineering students?
- c) International Perspective: In a broad sense, what do the data on international engineering schools and graduates mean for American engineering programs, research, and careers? How can NSF further develop cooperative research and joint programs between American and international universities?
- d) Engineering Perceptions: What can NSF contribute to an understanding of the societal trends and industrial practices that may discourage students from pursuing engineering?
- e) Engineering Faculty: What is the role of the Foundation in preparing the faculty of the future, particularly given the need to educate engineering students more broadly and to address the challenges caused by rapid changes in technology?
- f) Industrial Perspective: How can the Foundation facilitate the consideration of the perspective of industry, and to encourage the support of industry, for innovative approaches to engineering education?

To prepare for this second activity, the *ad hoc* engineering education group will meet with NAE President, Dr. William A. Wulf, in August to discuss what the Academy plans to do following the Engineer of 2020 activity. The *ad hoc* group will also meet with the leadership of the NSF Engineering Directorate in an informal roundtable discussion in August to discuss NSF's current and potential role in engineering education and consider possible issues for discussion at the fall workshop.

After this second workshop, the engineering education group plans to submit a draft report of both workshops, which could potentially be submitted to the full Board to consider issuing some recommendations to guide engineering education reform.

Committee on Education and Human Resources
**Workshop on Engineering Workforce Issues and Engineering Education:
What are the Linkages?**

Purpose

An initial, single day NSB-sponsored workshop is proposed to focus on recent recommendations for changes in engineering education and implications for the engineering workforce. A foundation for workshop discussions will include the cross cutting issues in the recent National Academy of Engineering report, *The Engineer of 2020: Visions of Engineering in the New Century*, as well as the NSB reports that identified troublesome trends in the number of domestic engineering students, with potential impacts to U.S. preeminence in S&E based innovation and discovery. The major workshop objective is to move the national conversation on these issues forward in a productive way by calling attention to how engineering education must change in light of the changing workforce demographics and needs. The National Academy of Engineering (NAE), which sponsored the Engineer of 2020 study, has undertaken a Phase II study. The proposed NSB workshop would be in parallel to these NAE efforts. The NSB workshop would focus more substantially on the issues of the current and desired future engineering workforce in light of the Engineer of 2020 report.

Statutory basis

NATIONAL SCIENCE BOARD (42 U.S.C. Section 1863) SEC. 4 (j) (2) The Board shall render to the President for submission to the Congress reports on specific, individual policy matters related to science and engineering and education in science and engineering, as the Board, the President, or the Congress determines the need for such reports.

Link to National or NSF Policy Objective

It is widely recognized that our economy, national security, and indeed our everyday lives are increasingly dependent on scientific and technical innovation. Changes on a global scale are rapidly occurring for engineering, and Federal leadership is needed to respond quickly and informatively. The Board has issued several reports expressing concern about long-term trends that affect the U.S. workforce capabilities in engineering, including the dependence on international students and workers; the declining interest on the part of U.S. citizens in engineering studies and careers; weakness in the K-12 science, technology, engineering, and mathematics education system; and demographic trends that are unfavorable to increasing citizen participation rates in these fields. Engineers are the largest component of workers with college degrees in S&E occupations, with 39 percent of all S&E occupations in 1999. Almost half of S&Es in the labor force with bachelors' degrees as their highest-level degree are engineers. This field therefore has a huge impact on our national capabilities for S&T and deserves special attention.

There is a current high level of attention to engineering education from a variety of sources that converge to make engineering education an especially timely topic for the Board to address. These include the recent release of the National Academy of Engineering report, *The Engineer of 2020: Visions of Engineering in the New Century*, which calls for reform in engineering education; the National Science Board reports on unfavorable trends affecting long-term U.S. workforce capabilities in science and engineering and the need to address these trends along all points of the education pipeline; the concern of U.S. industry and the public sector in engineering capabilities in the workforce; and the poor progress in broadening participation in engineering.

Logistics

The NSB Office will be the focal point for providing all aspects of Board support in this NSB activity; coordinating NSF, other agencies and institutions involvement; and utilization of one or more NSB Office contractual agreement(s) to assist with meeting logistics. NSB/EHR will recommend full Board approval of the appointment of an *ad hoc* Task Group of EHR to provide oversight for, and actively engage in, this activity.

An agenda and a comprehensive list of potential participants in the event will be developed with input from Board Members, NSF management, contacts in other agencies, and the broader S&T research and industry community. Invitees would include young recently graduated engineers, more experienced engineers, a range of employers (spanning the range of engineering disciplines), university thought leaders on engineering, and experts on engineering demographics.

Timing: Fall/Winter 2005

Workshop Topics: A workshop on the linkages between workforce issues and engineering education would involve a large range of topics, such as:

- 1) What are different scenarios for engineering workforce development in the U.S.? What are the differences among engineering fields?
- 2) How successful have we been in predicting the engineering workforce needs in the past and what has happened to the engineers when we got it wrong?
- 3) What are the implications of the different scenarios for engineering education?
- 4) What are the roles of the different stakeholders in the development of the engineering workforce, particularly the professional societies, universities, working engineers (of differing ages) and employers?
- 5) What is a typical demographic for an engineer today, and what will it become? How do we broaden participation?
- 6) The past and future role of international students and engineers in the U.S. engineering workforce.
- 7) The changing role of engineering education in preparing for engineering workforce needs for the future, including graduate education and lifelong learning as career shifts occur, and the idea that engineering education might be to prepare students more broadly for employment in the public, nonprofit, academic, and industry sectors.
- 8) How do we ensure that the best and the brightest students pursue engineering studies and careers, and that their education quality, content, and teaching are of the highest caliber?

Workshop Product: The final output from the meeting will be a concise set of Board approved recommendations that tie back to what universities (with employers) and NSF can affect, published in paper and electronic formats.

Audiences: In addition to the President, Congress, and NSF:

- Engineering deans/departments/schools
- ABET
- Engineering thought leaders
- Leaders in technical industry and the public sector that employ engineers.