

**Position Paper Offering Input to the
SECRETARY'S COMMISSION ON THE FUTURE OF HIGHER EDUCATION**

We are thrilled to learn of the creation of this Commission. As individuals deeply concerned about the preparation of the domestic workforce to meet the challenges of national security and the 21st Century's global economy, we urge the Commission to enunciate clear implementation steps that will advance our National capacity and competitiveness. In particular, we encourage the Commission to build on key recommendations made by other distinguished bodies:

1. Recognize that the value of engineering and science education includes providing a "liberal" foundation base of relevant and real-world critical systems thinking and design approaches to those students who wish to use it as a springboard for pursuing careers in other professions such as education, business, medicine or law.
2. Strengthen support for education research within engineering and science disciplines.
3. Encourage institutions, departments, and individual faculty to develop and implement assessments of student learning and instructional quality that can be used to guide course and curriculum development as well as to communicate the value added by education to students, parents, and other stakeholders of the academic enterprise.
4. Exploit innovative instructional technologies in order to enhance the affordability of, and access to, collegiate study in engineering and science for all students especially members of groups not yet fully participating in these fields such as underrepresented minorities, women, and persons with disabilities.
5. Facilitate student transitions from community colleges to baccalaureate programs.

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- 1. Recognize that the value of an engineering and science education includes providing a “liberal” foundation base of relevant and real-world critical systems thinking and design approaches to those students who wish to use it as a springboard for pursuing careers in other professions such as education, business, medicine or law.**

"Quality education in the humanities and social sciences is essential in a world made increasingly 'smaller' by advances in communication and in global commerce. But education in science, mathematics, and engineering has special relevance for the future of U.S. national security, for America's ability to lead depends particularly on the depth and breadth of its scientific and technical communities."-Hart-Rudman 2001, p. 39

Hart-Rudman Commission. *Roadmap for National Security: Imperative for Change*. The Phase III Report of the U.S. Commission on National Security/21st Century. January, 31st 2001.
<http://www.au.af.mil/au/awc/awcgate/nssg/phaseIIIfr.pdf>

"In the information age we have already, no college educated person can expect to be fully equipped for a job or career without at least a working knowledge of modern scientific theory and a modicum of technical competence and know how. This will require our colleges and universities to revisit the general curriculum and revise the requirements to ensure that their students are prepared. This will not happen without the enlightened leadership of scientists and other academics." – NSF 1998, P. 34

National Science Board (2003). *The Science and Engineering Workforce: Realizing America's Potential*. Arlington, VA (NSB 03-69)
<http://www.nsf.gov/nsb/documents/2003/nsb0369/nsb0369.pdf>

"Today, however, as the U.S. economy becomes even more reliant on workers with greater knowledge and technological expertise, the domestic supply of qualified workers is not keeping up with the skill demands. Employers are increasingly interested in hiring people who not only can execute well but also can create the next wave of innovation." – Business Roundtable 2005, p.6

Business Roundtable. *Tapping America's Potential: The Education for Innovation Initiative*. Washington, DC (2005).
http://www.uschamber.com/NR/rdonlyres/epivg5lni4pxype7by6h3gl5kpkbr3hyief6oxhvb4dgodcj4kmizkva2oe542sdaq2cx33sxce36i3jgwmflzf2q6b/050727_tapstatement.pdf

"America's undergraduates - all of them - must attain a higher level of competence in science, mathematics, engineering, and technology. America's institutions of higher education must expect all students to learn more SME&T, must no longer see study in these fields solely as narrow preparation for one specialized career, but must accept them as important to every student. America's SME&T faculty must actively engage those students preparing to become K-12 teachers; technicians; professional scientists, mathematicians, or engineers; business or public leaders; and other types of 'knowledge workers' and knowledgeable citizen". – NSF 1996, p 2

National Science Foundation (1996). *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* Arlington, VA (NSF 96-139).
<http://www.nsf.gov/pubs/stis1996/nsf96139/nsf96139.txt>

2. Strengthen support for education research within engineering and science disciplines.

“Colleges and universities should endorse research in engineering education as a valued and rewarded activity for engineering faculty and should develop new standards for faculty qualification.” – NAE 2005, p.2

NAE (2005). *Educating the Engineer of 2020: Adapting Engineering Education to the New Century*. Committee on the Engineer of 2020, Phase II, Committee on Engineering Education, National Academy of Engineering. Washington, DC: National Academy Press.
<http://www.nap.edu/books/0309096499/html/>

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.*

NSF 1998, P. 30

National Science Board (2003). *The Science and Engineering Workforce: Realizing America's Potential*. Arlington, VA (NSB 03-69) <http://www.nsf.gov/pubs/1998/nsf98128/nsf98128.htm>

Faculty should be more engaged in the intellectually exciting questions about how students learn; institutions should foster that engagement and support research, both discipline specific and discipline independent, about human learning.

Professional societies must provide forums for research results in learning and for dissemination and adoption of sound educational practice.

[State governments and state higher education boards] Support broad-based, sound, peer-reviewed research on human learning (both discipline-specific and more general), so more will become known about how undergraduates learn most effectively, and encourage cross-campus conversation about this topic.

National Science Foundation (1996). *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology*. Arlington, VA (NSF 96-139). <http://www.nsf.gov/pubs/stis1996/nsf96139/nsf96139.txt>

“Drawing on the experience of industry, the “practitioners” of higher education — college presidents, deans and department chairs — should create a community of practice promoting what works in higher education to nurture the talents of women, underrepresented minorities and students with disabilities.” – BEST 2004, p.34.

BEST (2004). *A Bridge For All: Higher Education Design Principles to Broaden Participation in Science, Technology, Engineering, and Mathematics*. Building Engineering and Science Talent. San Diego, CA
http://www.bestworkforce.org/PDFdocs/BEST_BridgeforAll_HighEdFINAL.pdf

3. Encourage institutions, departments, and individual faculty to develop and implement assessments of student learning and instructional quality that can be used to guide course and curriculum development as well as to communicate the value added by education to students, parents, and other stakeholders of the academic enterprise.

“Recognized exemplary instructional programs . . . [h]ave strategies for iterative evaluation. These strategies should include self-assessment by faculty of instruction and program effectiveness, mechanisms for identifying instructor expertise both conceptually and pedagogically, assessment of student learning, and procedures for learning from failure through formative evaluation. Exemplary programs often take risks, learn from failure, reevaluate, and try again. Summative evaluation is needed to demonstrate effectiveness to developers or institutions.” – NRC 2003, p. 30

McCray, Richard A., DeHaan, Robert L., and Julie Anne Schuck, Editors (2003). *Improving Undergraduate Instruction in Science, Technology, Engineering and Mathematics: A Report of a Workshop*. Committee on Undergraduate Science Education, National Research Council of the National Academies. Washington, DC: National Academy Press.
<http://www.nap.edu/books/0309089298/html/R1.html>

“Students will learn more if instruction and assessment are integrally related. In the classroom, providing students with information about particular qualities of their work and about what they can do to improve is crucial for maximizing learning. It is in the context of classroom assessment that theories of cognition and learning can be particularly helpful by providing a picture of intermediary states of student understanding on the pathway from novice to competent performer in a subject domain.” – NRC 2001, P.8

NRC (2001). *Knowing What Students Know: The Science and Design of Educational Assessment*. National Research Council. Washington, DC: National Academy Press.
<http://www.nap.edu/books/0309072727/html>

A new system of rewards and incentives requires the use of existing assessment techniques and the development of new assessment techniques for student learning as well as faculty teaching, advising, research, and service. Such techniques should:

- *provide feedback to students on what they are learning including problem formulation, problem solution, critical thinking, innovative design, and creative synthesis;*
- *motivate further student learning; and*
- *provide better metrics for assessment of teaching, advising, research, and service.*

NSF (1995). *Restructuring Engineering Education: A Focus on Change*,. Arlington, VA (NSF 95-65). <http://www.nsf.gov/pubs/stis1995/nsf9565/nsf9565.txt>

[Science, mathematics, engineering, and technology departments] in collaboration with other departments and with prospective employers, [should] set departmental goals for undergraduate learning. These goals must include clear expectations, the attainment of which is measurable, about what all students in the institution should learn.

NSF (1996). *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology*. Arlington, VA (NSF 96-139). <http://www.nsf.gov/pubs/stis1996/nsf96139/nsf96139.txt>

4. Exploit innovative instructional technologies in order to enhance the affordability of, and access to, collegiate study in engineering and science for all students especially members of groups not yet fully participating in these fields such as underrepresented minorities, women, and persons with disabilities.

“Rapid advancements in the years ahead could enable new learning environments using simulations, visualizations, immersive environments, game playing, intelligent tutors and avatars, networks of learners, reusable building blocks of content, and more. The technologies that are coming could create rich and compelling learning opportunities to meet all learners’ needs, and provide knowledge and training when and where it is needed, while boosting the productivity of learning and lowering its cost.” – Department of Commerce 2002, p. 3.

Cover letter by Donald Evans, Secretary of Commerce in *Visions 2020: Transforming Education and Training through Advanced Technologies*, U.S. Department of Commerce (2002), Technology Administration. <http://www.visions2020.gov/reports/TechPolicy/2020Visions.pdf>

“Collectively, [instructional and learning] technologies have the ability to provide access to world-wide resources; facilitate the accumulation and presentation of data; and enable communication, interaction, and collaboration among students and instructors to improve the practice of teaching and the experience of learning.” – NSF 1998, v

NSF (1998). *Information Technology: Its Impact on Undergraduate Education in Science, Mathematics, Engineering, and Technology: A Report on an NSF Workshop*. Arlington, VA (NSF 98-82). <http://www.nsf.gov/pubs/1998/nsf9882/nsf9882.pdf>

“Information technology, used both within classroom settings with well-educated and motivated teachers and by individuals, can provide access to world-class facilities and experiences. It has the potential for simultaneously providing many of the benefits of one-on one tutoring and group interactions.”
- PITAC 2001, p. 5

“Information technology has been applied successfully in industrial and military training contexts: it has been effective and reduced costs. In the military context alone, cost, effectiveness, and productivity improvements due to increased use of information technology in training could save hundreds of millions of dollars per year.” – PITAC 2001, p. 11

PITAC (2001). *Using Information Technology to Transform the Way We Learn*. President's Information Technology Advisory Committee, Panel on Transforming Learning. <http://www.nitrd.gov/pubs/pitac/pitac-tl-9feb01.pdf>

“From the earliest days of computing, experts have predicted that information technology held the potential to make major transformations in how people learn. Over the years, although the path into the schoolroom for computer technology has been tortuous at best, this belief has persisted, buttressed by research that hints of the powerful potential Underpinning this growing demand for educational use of computer technology is a phenomenal and ongoing technological change. . . . But, powerful as that social demand is and impressive as those technological capabilities are, we are just beginning to understand how to connect them seamlessly with the education process and with the actual needs of the students and the institutions responsible for their education.” CRA (1996) p. 1.

CRA (1996). *Setting a Computer Science Research Agenda for Educational Technology*. Washington, DC: Computer Research Association. <http://www.cra.org/reports/edtech.pdf>

5. Facilitate student transitions from community college to baccalaureate programs.

“The important role of community colleges in educating engineers is not well known to the public, or even to the engineering community. In fact, 20 percent of engineering degree holders began their academic careers with at least 10 credits from community colleges, and 40 percent of the recipients of engineering bachelor and masters degrees in 1999 and 2000 attended community colleges. In addition, community colleges offer unique opportunities for increasing diversity in the engineering workforce.” – NAE 2005, vii

“The retention rate and persistence to the B.S. degree of transfer students is likely to improve only when two- and four-year institutions have established partnerships that are driven by mutual interest and investment, as opposed to the personal interest and commitment of individual faculty members and administrators.” – NAE 2005, P.90

Mattis, Mary C. and John Sislin, editors (NAE 2005). *Enhancing the Community College Pathway to Engineering Careers*. National Academy of Engineering and National Research Council of the National Academies. Washington, DC: National Academy Press.
<http://www.nap.edu/books/0309095344/html/R1.html>

“Community colleges play a major role in the higher education of minority students. Both the transition from high school to community college and the transition from community college to a four-year college or university are important points in the education of these students. ... The wide variety in available resources and degree programs at undergraduate institutions can create disparities in student background that make this transition difficult.” – NSTC 2000, p. 28

NSTC (2000). *Ensuring a Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century*. National Science and Technology Council. Washington, DC
<http://www.ostp.gov/html/workforcerpt.pdf>

“Community college transfer students evidence strong preparation, with degree completion rates equivalent to those of 4-year college students. The transfers constitute 1/6th of the degrees awarded in engineering.”

Adelman, Clifford (1998). *Women and Men of the Engineering Path: A Model for Analysis of Undergraduate Careers*. Washington, DC: US Department of Education.
http://www.wcer.wisc.edu/archive/nise/Publications/Other_Publications/Adelman_Women_Men_Engineering_Path.html

“Among the most serious impediments [to student transfer to baccalaureate programs] is the lack of an effective counseling system to provide information, advice, and support appropriate to students' particular needs.”

California Council on Science and Technology (2002). *Critical Path Analysis of California's Science and Technology Science and Education System*.
<http://www.ccst.us/ccst/pubs/cpa/cpadex.html>