Engineer of 2020:
A high-risk, high-pay-off approach

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The premise

➤ Past: Engineering and engineering education were reactive, responding to change.

➤ Today: Rapid change signals that it is time to reverse the paradigm.

➤ Premise: If we anticipate the future and are proactive about changing the engineering and engineering education, we can shape a significant, dynamic role for our profession.

The process

➤ Phase I: Imagining the future and the challenges it will present to engineering.

➤ Phase II: Considering how engineering education should prepare for that future.

THE ENGINEER OF 2020

VISIONS OF ENGINEERING IN THE NEW CENTURY

NATIONAL ACADEMY OF ENGINEERING
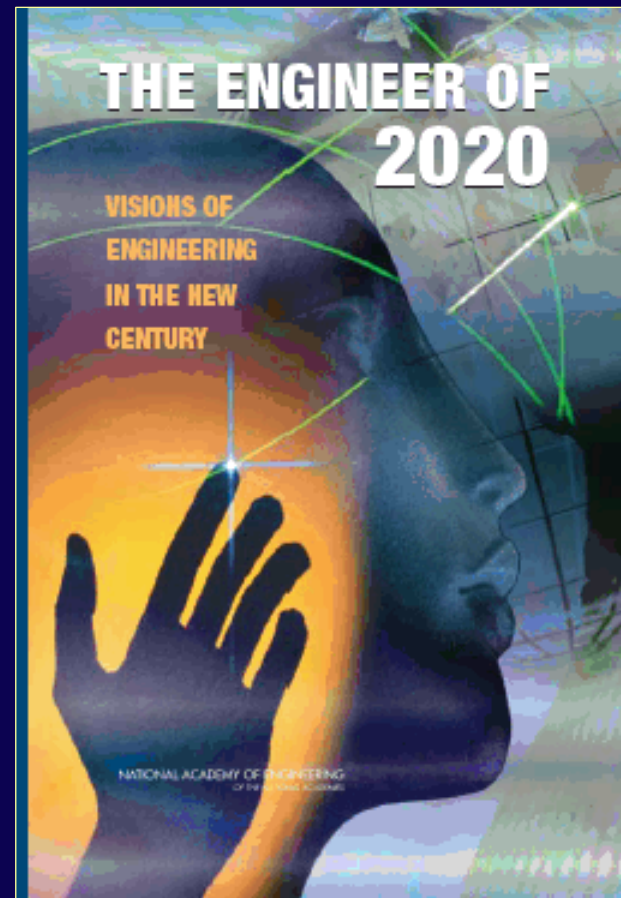
National Academy of Engineering

Context for engineering

- ➤ Breakthroughs in technology

- ➤ Demographics

- ➤ Challenges
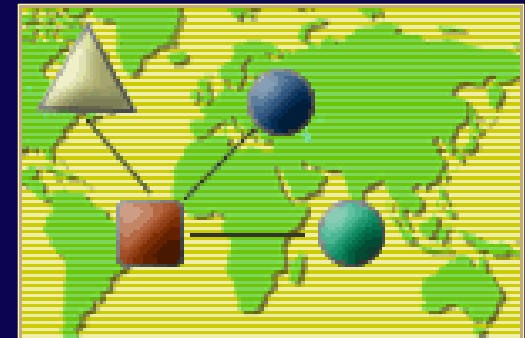
- ➤ Economic/societal forces

Demographics

➢ 8 billion people; a 25% increase since 2000.

➢ Balance tipped toward urbanization.

➢ Youth "bulge" in underdeveloped nations while developed nations age.

➢ If the world condensed to 100 people:

    ▷ 56 in Asia   ▷ 7 in Eastern Europe/Russia

    ▷ 16 in Africa   ▷ 4 in the United States

Challenges

➤ Fresh water shortages

➤ Aging infrastructure

➤ Energy demands

➤ Global warming

➤ New diseases

➤ Security

Economic/societal forces

➢ High speed communications / Internet

➢ Removal of trade barriers

➢ Terrorist attacks; wars in Iraq, Afghanistan

➢ Emergence of technology-based economies in other nations

➢ Sustained investment in higher education in countries like China, India

Social, global, and professional context of engineering practice

➢ Population is more diverse.

➢ Social, cultural, political forces will shape and affect the success of technological innovation.

➢ Consumers will demand higher quality, customization.

➢ Growing imperative for environmental sustainability.

➢ Increasing focus on managing risk and assessment with view to security, privacy, and safety.

Scenario-based planning

➢ Facilitated by Peter Schwartz, author of "The Art of the Long View"

➢ Scenarios considered:

▷ The Next Scientific Revolution

▷ The Biotechnology Revolution in a Societal Context

▷ The Natural World Interrupts the Technology

▷ Global Conflict/Globalization

Engineering's image

➢ Public that understands and appreciates the impact of engineering on socio-cultural systems.

➢ Public that recognizes engineering's ability to address the world's complex and changing challenges.

➢ Engineers who are well grounded in the humanities, social sciences, and economics as well as science and mathematics.

Engineering without boundaries

➢ Embrace potentialities offered by creativity, invention, and cross-disciplinary fertilization.

➢ Assume leadership positions that enable influence on public policy and the administration of government and industry.

➢ Recruit, nurture and welcome underrepresented groups to engineering.

Engineering a sustainable society

➢ Lead the way toward wise, informed, economical, and sustainable development.

➢ Assist in the creating of an ethical balance in standard of living for developing and developed countries alike.

Educating the engineer of 2020

➢ Reconstitute engineering curricula and related educational programs to prepare today's engineering students for the careers of the future.

➢ Create a well-rounded education that prepares students for positions of leadership and a creative and productive life.

Attributes of the engineer of 2020

➢ Strong analytical skills

➢ Practical ingenuity, creativity

➢ Good communication skills

➢ Business, management skills; leadership skills

➢ High ethical standards, professionalism

➢ Dynamic/agile/resilient/flexible

➢ Lifelong learner

➢ Able to put problems in their socio-technical and operational context

To succeed

➢ **Attract best and brightest**

➢ **Educate them to be ready:**

▷ To implement new technology

▷ To focus on innovation

▷ To understand global trends
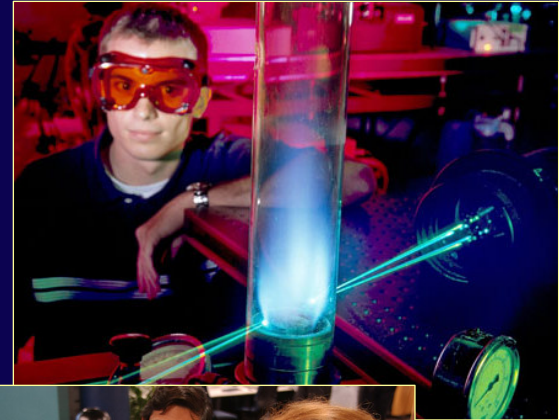
Thoughts from the summit

- Some needs have not changed:
  - A sound grounding in science
  - The learning experience of great lectures
  - Studio experiences with open-ended problem solving
- Other things have really changed:
  - Access to IT creates challenge of coupling deep learning with instant gratification
  - Means and ends of using computers to bring the world to campus and enrich learning
  - Design tools and sophisticated instruments that enable students to experience the excitement of engineering

Charles Vest

Thoughts from the summit

➢ Begin the curriculum with "grand challenges"

➢ Integrate more directly with the sciences

➢ Provide multiple entry points to the curriculum

➢ Build working interdisciplinary partnerships

➢ Give students self-confidence early on

➢ Stop tinkering around the edges and shake things up

Gretchen Kalonji

Thoughts from the summit

➢ Research/co-op experience with real problems

➢ Experience with real-world tools and teams

➢ Encourage and recognize diversity

➢ Social, ethical aspects of engineering

➢ What students learn instead of what we want to teach

➢ Creative and practical thinking

Arden Bement

Highlights from summit

➢ Break out of the present mold

➢ Education, not just curriculum

➢ Career, not just jobs

➢ Multiple models, not just one

➢ Leadership, not just teamwork

➢ More coordination with industry

➢ Cross-disciplinary emphasis
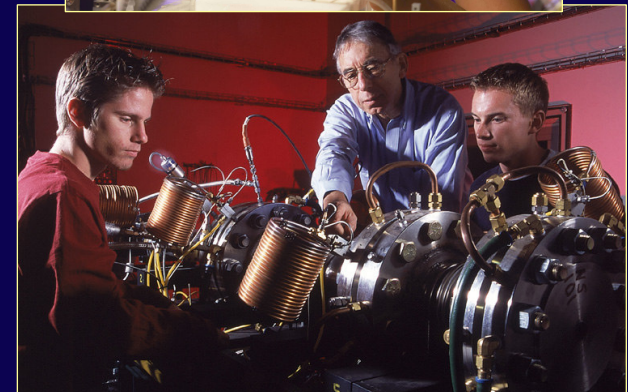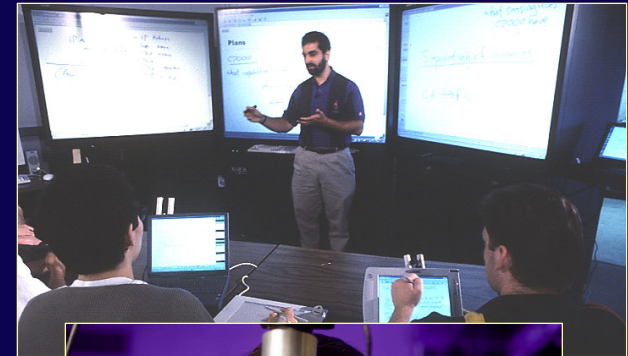
More highlights from summit

- Emphasis on innovation

- Systems approach

- Larger context for engineering and technology

- Non-engineering career tracks

- Global perspective

- Market forces, macroeconomics
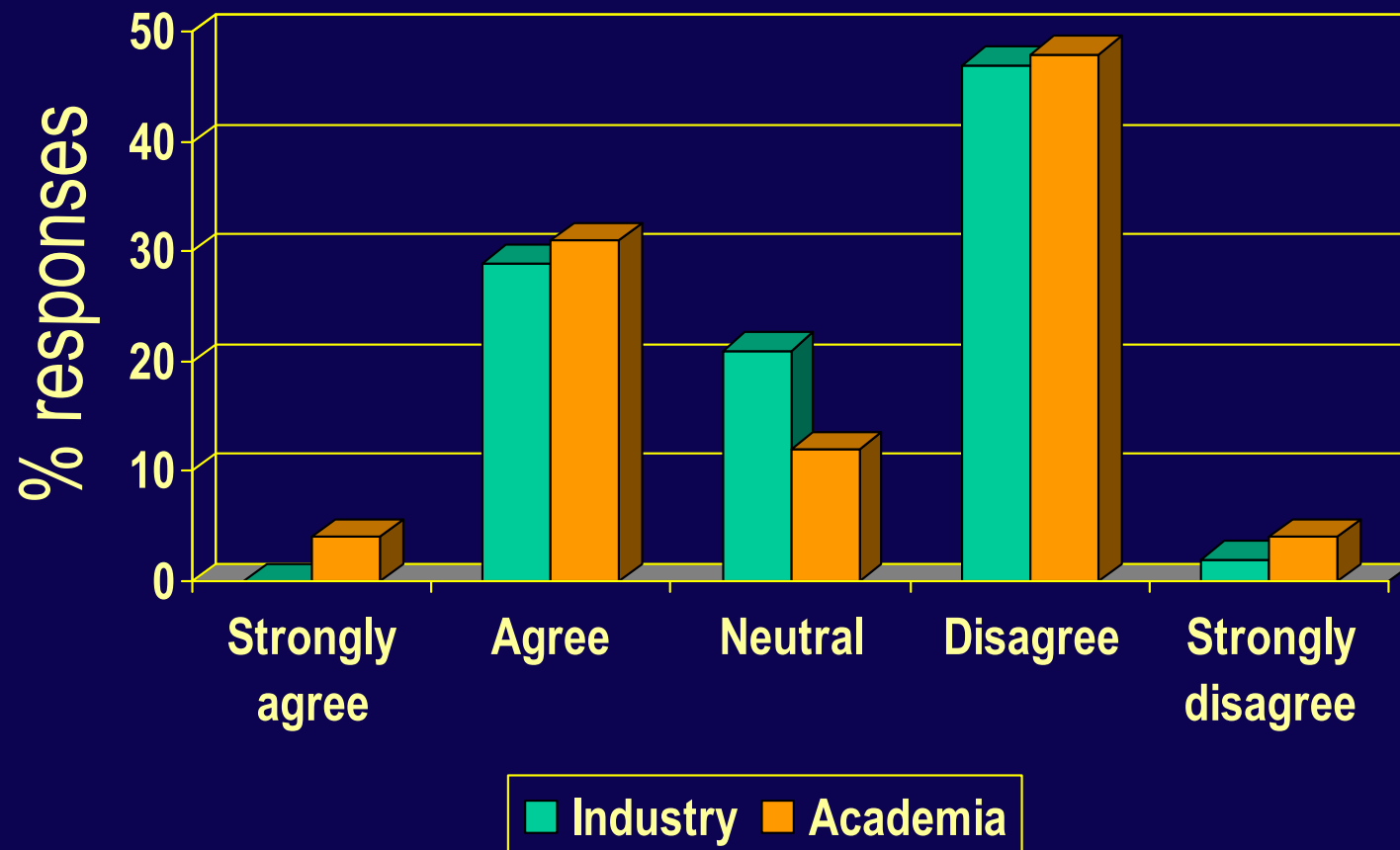
- Sense of urgency
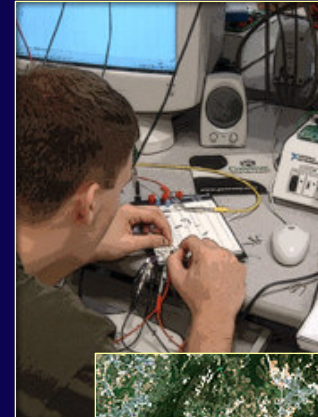
NAE Frontiers of Engineering survey

- Frontiers of Engineering participants:
  - Selected as future leaders in engineering.
  - Ages 30-45 (will still be active in 2020).
  - 61 respondents from academia, 44 from industry.
  - Have worked in field for over 10 years.
  - Involved in cutting-edge engineering topics.
- Intent: assess how well their education prepared them for issues they will face in practice in 2020.

NAE Frontiers of Engineering survey

Current undergraduate engineering education is sufficiently flexible to adequately meet the needs of 21st century engineers.

Concluding questions

➢ How do we stimulate real change – steps forward?

➢ How do we capitalize on the momentum generated by the Engineer of 2020 Project?

➢ How do we help the engineering profession create a meaningful place for itself in the broader, multidisciplinary approach required to solve society's problems?