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Engineering Research and America's Future:
Meeting the Challenges of a Global Economy

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Report is available at:
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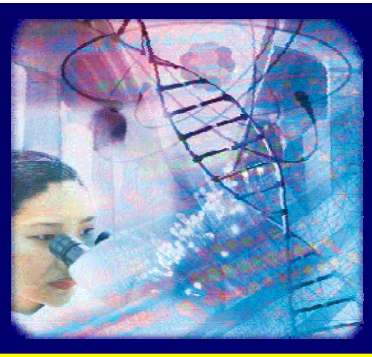

The Context

- Demographics, globalization, technological change
- Global, knowledge-driven economy
- Out-sourcing, off-shoring, inadequate diversity
- Importance of technological innovation to economic competitiveness and national security

The Charge

To conduct a "fast-track" evaluation of

1) the past and potential impact of the U.S. engineering research enterprise on the nation's economy, quality of life, security and global leadership; and

2) the adequacy of public and private investment to sustain U.S. preeminence in basic engineering research.

The Consensus Report Process

Summer 2004: Hearings and development of preliminary findings and recommendations

December 2004: Report is reviewed by panel of experts.

January 2005: Release of a public (reviewed) draft report for comment from the engineering community.

March – July 2005: Utilize feedback to re-draft report. Review again.

September 2005: Publication of Final Report

Note: Text in *BLUE* is not part of the normal report process and represents an additional and broader vetting of the recommendations presented.

Premise

- **Leadership in innovation is essential to U.S. prosperity and security.**
- **Pre-eminence in technological innovation requires leadership in all aspects of engineering: research, education, and practice.**

Moreover

- The U.S. culture – a diverse population, democratic values, free market practices, a predictable legal system – provides a fertile environment for innovation

- History has shown that significant public investment is necessary to produce the key ingredients for technological innovation:
  - New knowledge (research)
  - Human capital (education)
  - Infrastructure (physical, cyber)
  - Policies (tax, intellectual property)

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"Looking under the hood" – The National Economic Engine

Threats

- Stagnant federal support of phys science & engineering R&D
- Short-term nature of industrial R&D
- Imbalance in federal R&D support
- Budget weakness in states
- Weak domestic student STEM interest
- Weak minority/women presence
- Post 9-11 impact on flow of international STEM students
- Obsolete STEM curricula
- Increasing laboratory expenses
- Rapid escalation of cyber-infrastructure needs
- Inadequate federal R&D support in key areas
- Weakened state support

Elements

- New Knowledge (Research)
- Human Capital (Education)
- Infrastructure (Facilities, IT)
- Policies (Tax, IP, R&D)

Technological Innovation

Engineering
...Research
...Education
...Practice

Opportunities

National Priorities
- Economic Growth
- National and Homeland Security
- Public Health and Social Well-being

Global Challenges
- Global Sustainability
- Geopolitical Conflict

Opportunities
- Emerging Technologies
- Interdisciplinary Activities
- Complex, Large-scale Systems

Concerns

- Imbalance between federal investments in R&D in biomedical sciences and in physical sciences and engineering.
- Inadequate investment (both federal and industry) in long-term engineering research.
- Concern about human capital, in view of declining interest in science and engineering careers and increasing constraints on immigration.

Recommendations 1-8

1. Rebalance the Federal R&D portfolio by increasing funding for research in engineering and physical science
2. Design and implement tax incentives and other policy actions to stimulate increased industry investment in long-term engineering research
3. Increase public- and private-sector investment in engineering research infrastructure
4. Align the engineering curriculum and the engineering profession with the needs of a global, knowledge-driven economy
5. Increase efforts to encourage women and underrepresented minorities to pursue careers in engineering.
6. Establish a major federal fellowship-traineeship program in strategic areas similar to that of National Defense Ed Act.
7. Address immigration procedures to attract top scientific and engineering talent from around the world.
8. Expand and strengthen links between industry and research universities through a combination of tax incentives and federal grants.

Final Recommendation: Be Bold!

- At other critical times in the nation's history, bold steps were taken to address national needs:
  - The land-grant acts of the 19th century
  - The G.I. Bill and government-university research partnership following WWII
  - The National Defense Education Act in the 1960s.
- Such a bold step is needed today to sustain a competitive capacity in technological innovation.

Discovery-Innovation Institutes

CAMPUS LINKAGES
- Sciences
- Professional Schools

PRIVATE SECTOR LINKAGES
- Industry Partnerships
- Entrepreneur participation

PUBLIC SECTOR LINKAGES
- Federal agencies
- National laboratories
- States

DISCOVERY-INNOVATION INSTITUTES

Link scientific discovery with societal applications

Educate and train innovators, entrepreneurs, and engineers

Build infrastructure (laboratories, cybersystems, etc.)

Analogous to agriculture experiment stations and academic medical centers

NATIONAL PRIORITIES
- Economic competitiveness
- National and homeland security
- Public health and social well-being

GLOBAL CHALLENGES
- Global sustainability
- Geopolitical conflict

OPPORTUNITIES
- Emerging technologies
- Interdisciplinary activities
- Complex large-scale systems

SUPPORT
- Core federal support (e.g., Hatch Act)
- State participation (physical facilities)
- Industry participation
- Entrepreneur participation
- University participation
  - Co-investment
  - Policies (e.g., for intellectual property)

Discovery-Innovation Institutes

- Like agricultural experiment stations, they would be responsive to societal priorities.
- Like academic medical centers they would bring together research, education, and practice.
- Like corp R&D laboratories, they would link fundamental discoveries with the engineering research necessary to yield innovative products, services, and systems, but while also educating the next generation technical workforce.

Discovery-Innovation Institutes

- Although primarily centered in engineering schools, DIIs would partner with other professional schools (e.g., business, medicine, law) and academic disciplines.
- To ensure the necessary transformative impact, the DII program should be funded at levels comparable to other major federal initiatives such as biomedicine and manned spaceflight, e.g., building to several billion dollars per year and distributed broadly through an interagency competitive grants program.

DII Summary

- DIIs would be engines of innovation that would transform institutions, policy, and culture and enable our nation to solve critical problems and maintain leadership in a global, knowledge-driven society.
- These are put forward not as a definite prescription but rather to illustrate the bold character and significant funding level we believe necessary to secure the nation's leadership in technological innovation.

One DII Example

- Institutes linking engineering, business, and public policy programs with biomedical sciences programs to develop drugs, medical procedures, protocols, and policies to address the health care needs and complex societal choices for an aging population.