



Positioning the United States for a Global Knowledge Economy

- The National Innovation Initiative
- Engineering Research and America's Future
- Rising Above the Gathering Storm

National Innovation

NII Interim Report

Background Documents

Building Technical Talent

Regional Innovation

High Performance Computing

Global Initiatives

Competitiveness & Security

Benchmarking Competitiveness

World Class Workforce

Congressional Outreach

National Innovation

National Innovation Initiative

 [NII Working Group Web Portal](#)

Vision

Innovation fosters the new ideas, technologies, and processes that lead to better jobs, higher wages and a higher standard of living. For advanced industrial nations no longer able to compete on cost, the capacity to innovate is the most critical element in sustaining competitiveness.

The United States stands apart from the rest of the world in its record of sustained innovation over decades, across industries, and through economic cycles. Why? What has made the United States an engine of innovation? A number of structural and economic advantages help explain this performance, including:

- Ready access to natural resources and labor
- The skills and work ethic of American workers
- Strong capital markets, a long tradition of the rule of law, a deep commitment to property rights, and a culture that encourages and rewards risk-takers
- A unique system of cooperation and collaboration among the federal government, national and military labs, private-sector R&D efforts, research universities and entrepreneurs

News

October 1, 2004

NII Co-Chairs Share Innovation Vision with BusinessWeek

September 30, 2004

Associated Press -- National Innovation Initiative heads expect recommendations to set agenda

September 30, 2004

Professional science master's can fill gaps in federal scientific workforce, Sloan's Teitelbaum says

August 16, 2004

American Physical Society -- Workforce Issues Dominate Policy Briefing

July 30, 2004

California Computer News -- Innovate America...

July 22, 2004

Council On

ENGINEERING RESEARCH AND AMERICA'S FUTURE

MEETING THE CHALLENGES OF A GLOBAL ECONOMY

NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES

EXECUTIVE SUMMARY

Prepublication Copy

RISING ABOVE THE GATHERING STORM

*Energizing and
Employing America
for a Brighter
Economic Future*

NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, AND
INSTITUTE OF MEDICINE

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OF THE NATIONAL ACADEMIES



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



Dark clouds

- National Academies (COSEPUP)
- PCAST
- DOE (Vest Committee)
- National Science Board
- AAAS
- The Media



Dark clouds

- National Academies (COSEPUP)
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- The Media
- **The FY2006 Budget Request**



National Academies

- Massive shift of federal R&D toward biomedical sciences and away from physical sciences and engineering.
- Serious distortions are appearing in national R&D enterprise.
- Federal R&D has declined from 70% of national R&D activity in the 1970s to roughly 25% today...

Trends in Federal Research by Discipline

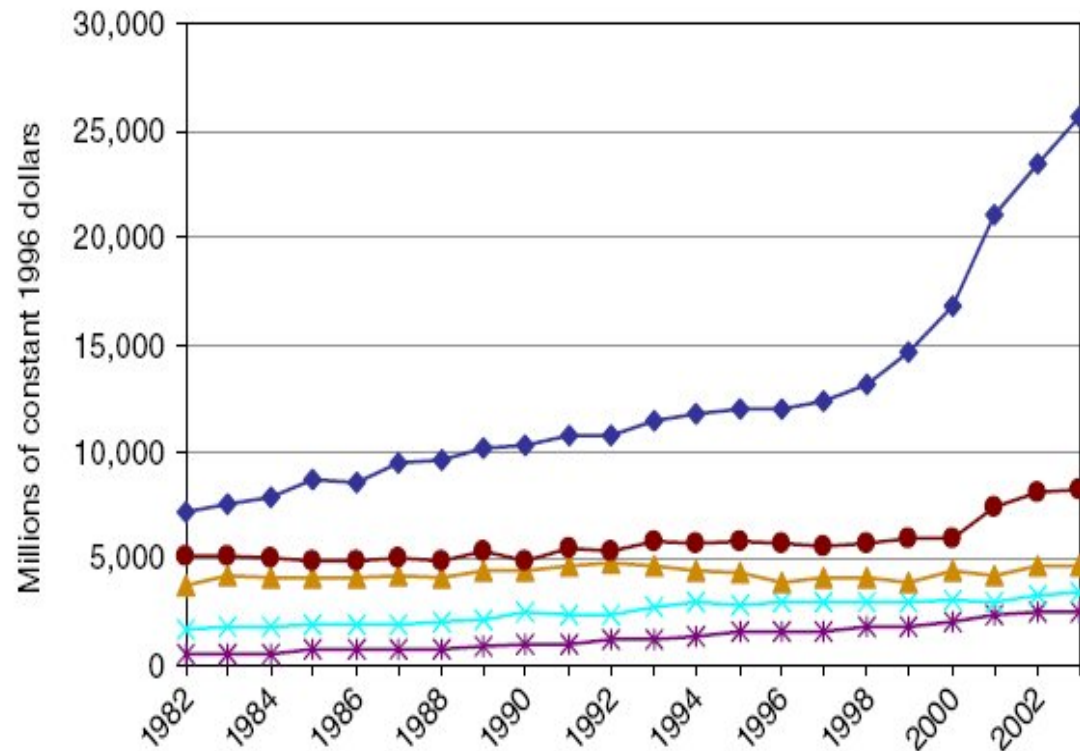
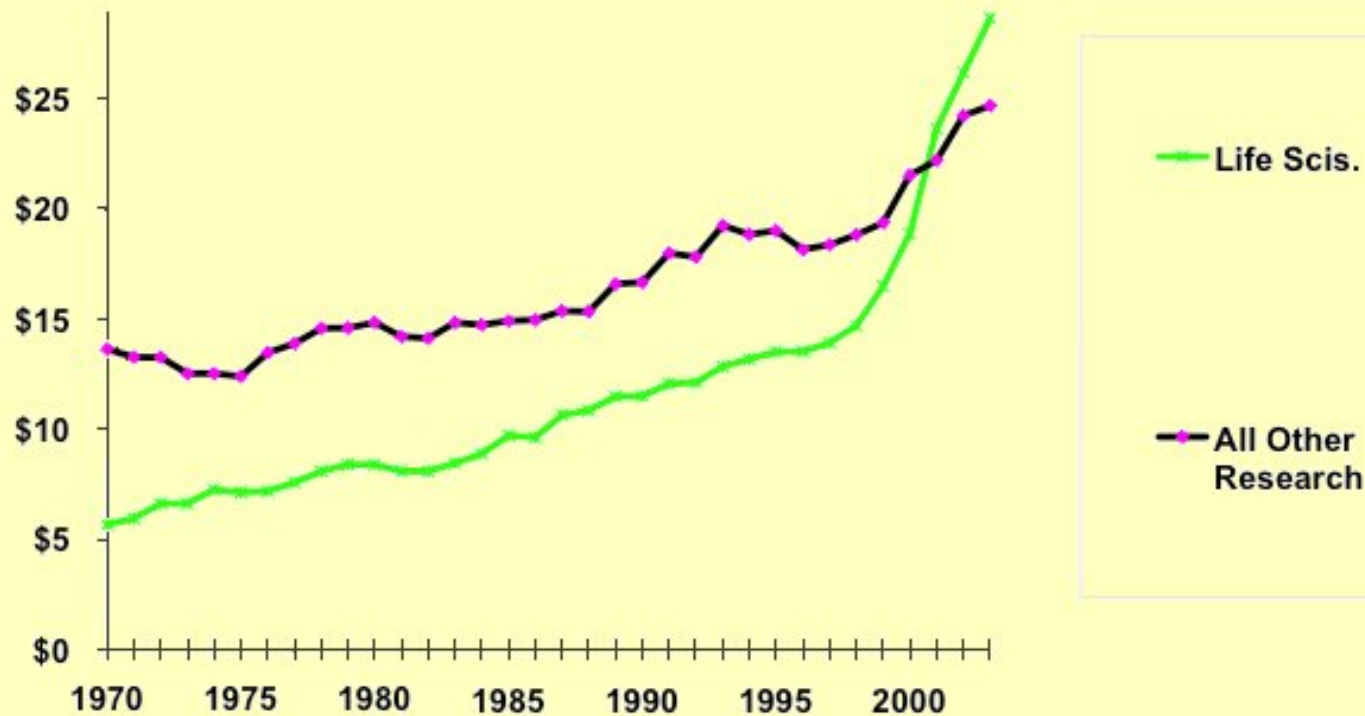


FIGURE 1 Federal funding for basic and applied research in all fields, 1982-2003.

- * Math and computer sciences
- × Environmental sciences
- ▲ Physical sciences
- Engineering
- ◆ Life sciences

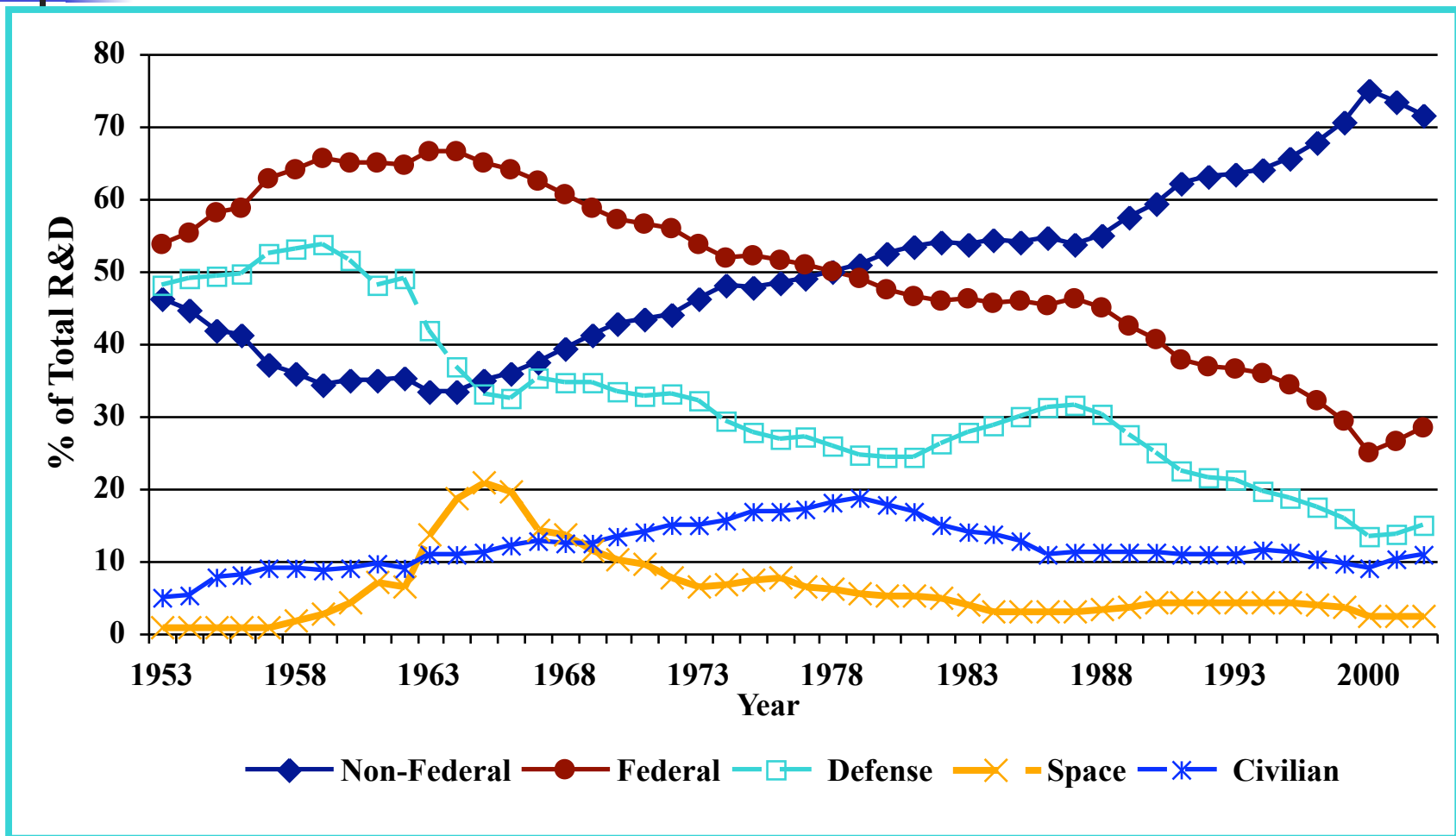
Source: NSF, 2003, 2004a.

Another way to look at Federal R&D Support

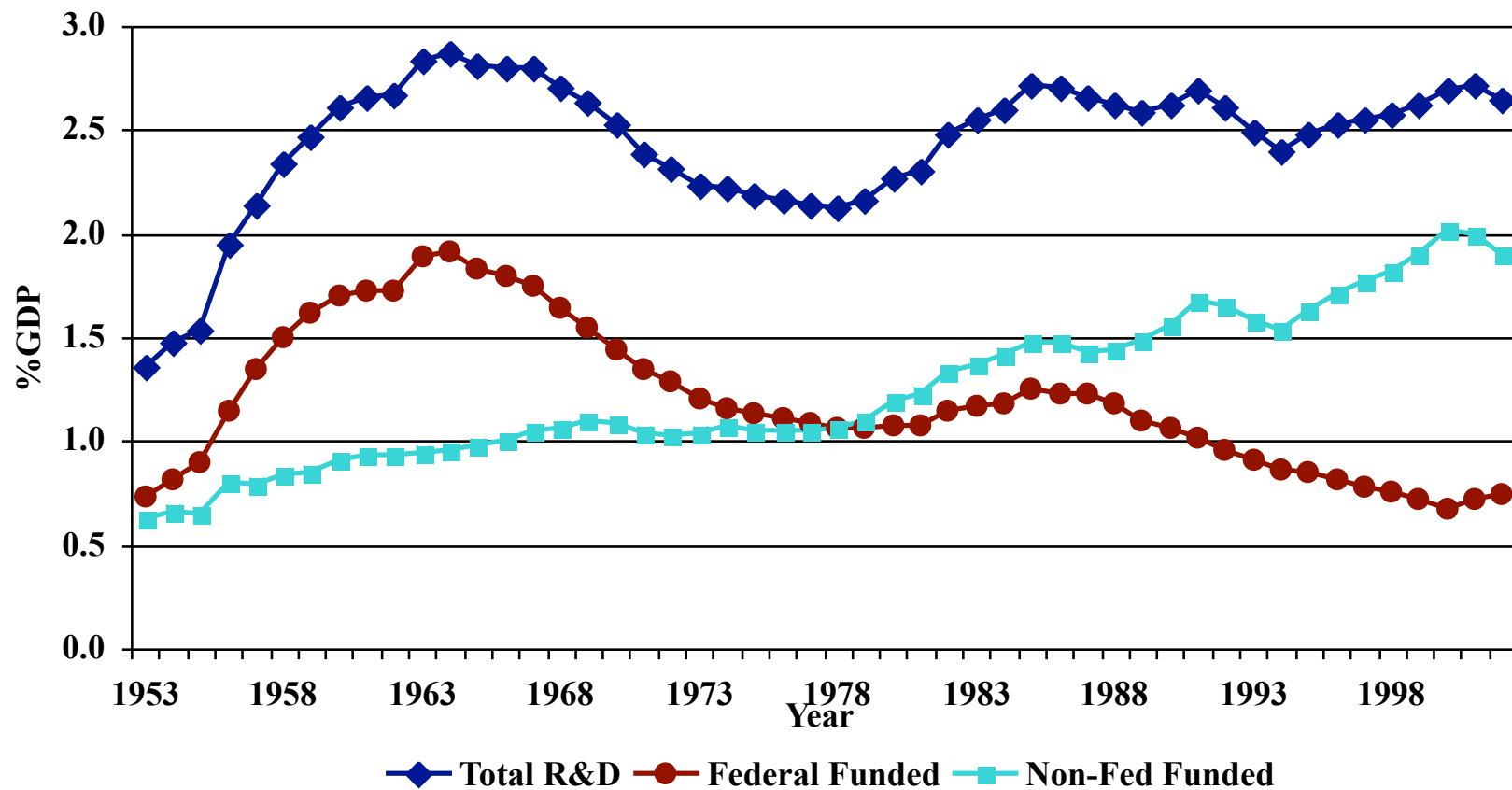


Source: National Science Foundation, *Federal Funds for Research and Development FY 2001, 2002, and 2003*, 2003. FY 2002 and 2003 data are preliminary. Constant-dollar conversions based on OMB's GDP deflators. AUGUST '03 © 2003 AAAS

Federal vs. Nonfederal R&D

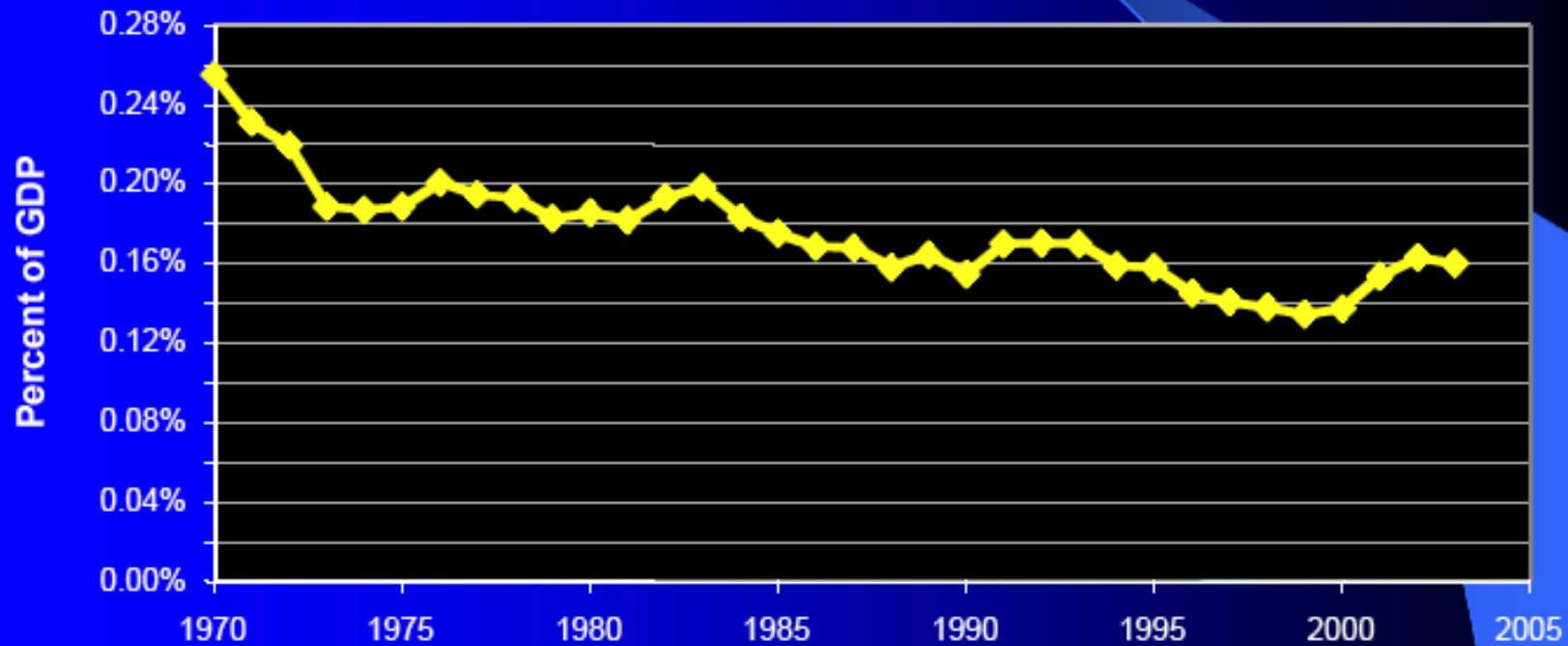


Federal vs. Nonfederal R&D as Percent of GDP



Another concern...

Ratio of Federal Funding for Physical, Mathematical Sciences and Engineering to GDP





- PCAST's studies have shown that from 1993 to 2000, federal support for the physical sciences and engineering remained relatively flat, and in some instances decreased.
- Federal support for science and engineering students enhances economic growth. Yet federal support for graduate support of students in physical science and engineering has declined significantly over the past two decades.

The logo graphic consists of a vertical black line intersecting a horizontal black line. To the left of the intersection, there are three overlapping squares: a yellow one at the top, a red one in the middle, and a blue one at the bottom. The word "PCAST" is written in a blue, sans-serif font to the right of the vertical line.

PCAST

- R&D “Innovation Ecosystems” critical to U.S. technological preeminence.
- Foreign inroads occurring and helped by foreign investment in R&D and S&E education.
- U.S. technological preeminence is not forever assured!



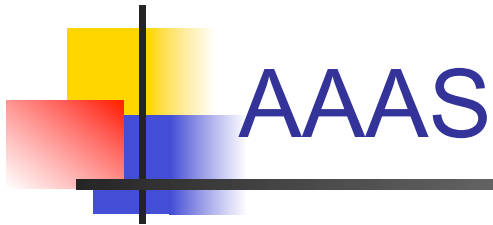
PCAST Recommendations

- Increase federal funding for physical science and engineering R&D.
- Reinvigorate a next generation “Bell Labs” model.
- Permanent R&D tax credit.
- Improve workforce skills.



DOE Science Priorities Committee

In 1970 physical science, engineering and life science each were funded at an annual level of approximately \$5 billion in 2002 dollars. Today, physical science and engineering research are funded at approximately \$5 billion and \$8 billion, respectively. The current funding for life science is about \$28 billion.

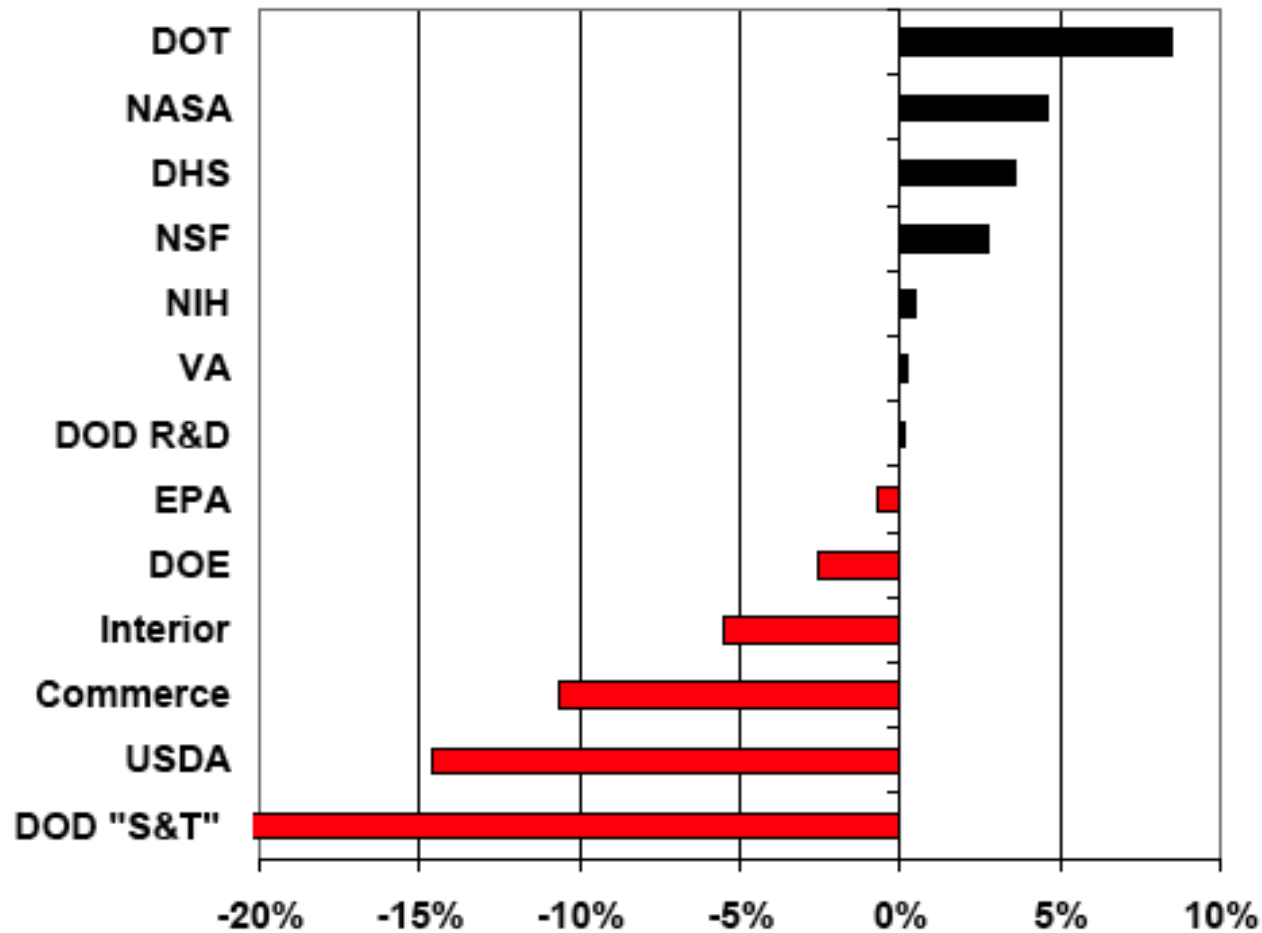


*“Federal R&D Investments Face Another Rough Year in 2006:
Cuts for Many R&D Programs, Gains for Space and Homeland
Security”*

While the R&D portfolio of \$134 billion would be essentially constant, total federal research investment (“FS&T”) would drop 1.4% to \$55 billion, with cuts to most R&D programs with the exception of modest increases for NASA, DHS, and NSF.

Particularly hard-hit by the proposed 21% cut in DOD and 4.5% cut in DOE research programs would be physical science and engineering research.

FY 2006 R&D Request Percent Change from FY 2005



Source: AAAS, based on OMB R&D Budget Data and agency estimates for FY 2006.

DOD "S&T" = DOD R&D in "6.1" through "6.3" categories plus medical research.

MARCH '05 REVISED @ 2005 AAAS





Some FY2006 Datapoints

- NSF(+2.4%), but most of this is a fund transfer from the Coast Guard to operate ice breakers.
- DOE Office of Science (- 4.5%)
- NASA: Universe (-0.1%), Earth-Sun (-4.3%; Aero (-5.9%); Ed (-23%); Exploration Systems (+ 17.9%)
- DOD: 6.1-6.2-6.3 (- 21%)

Pentagon Redirects Its Research Dollars



J. Emilio Flores for The New York Times

Leonard Kleinrock of U.C.L.A. declined Darpa money when he learned that his assistants had to be American citizens.

By [JOHN MARKOFF](#)

Published: April 2, 2005

SAN FRANCISCO, April 1 - The Defense Advanced Research Projects Agency at the Pentagon - which has long underwritten open-ended "blue sky" research by the nation's best computer scientists - is sharply cutting such spending at universities, researchers say, in favor of financing more classified work and narrowly defined projects that promise a more immediate payoff.

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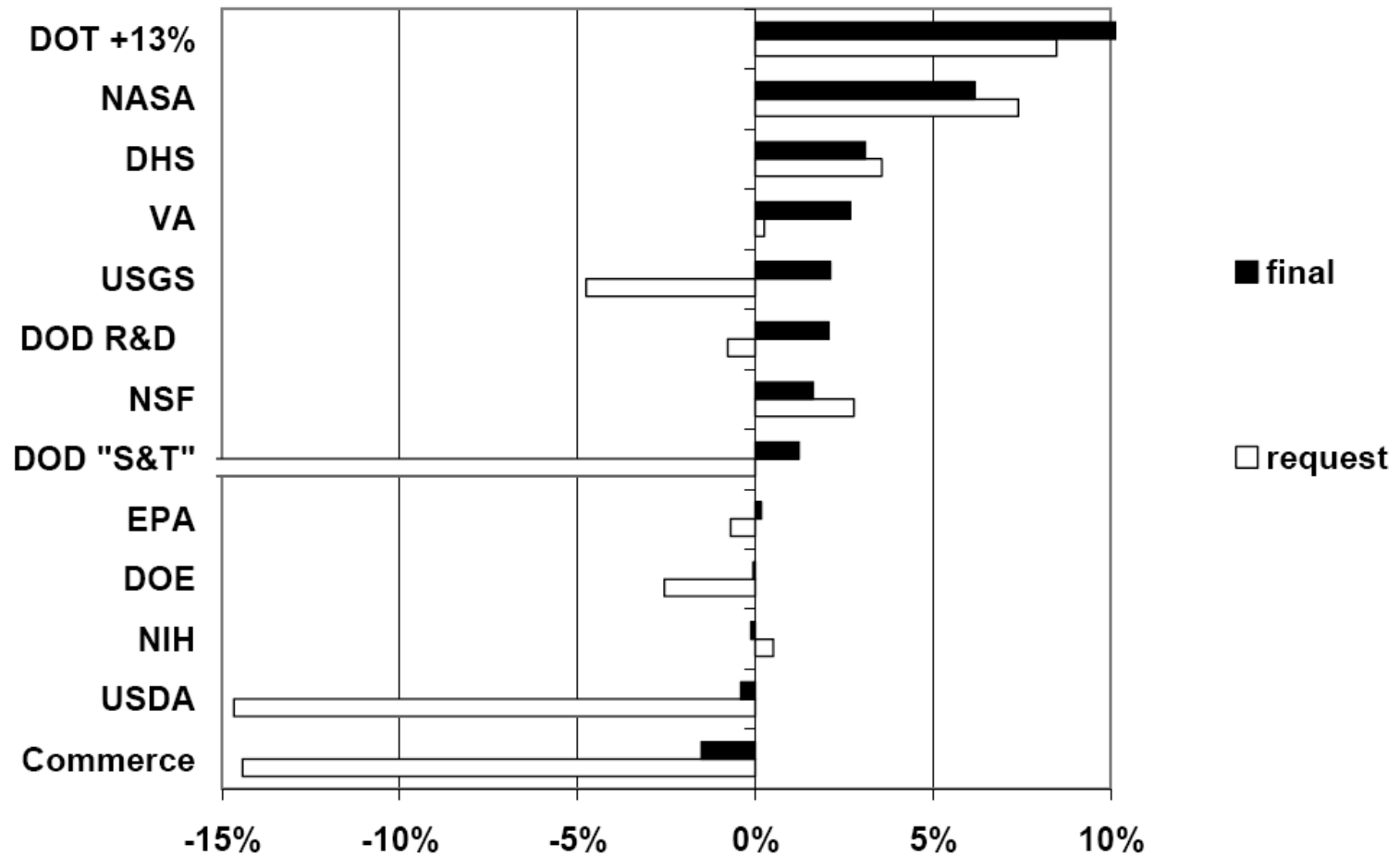
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FY 2006 R&D Appropriations (FINAL vs. Request)

Percent Change from FY 2005



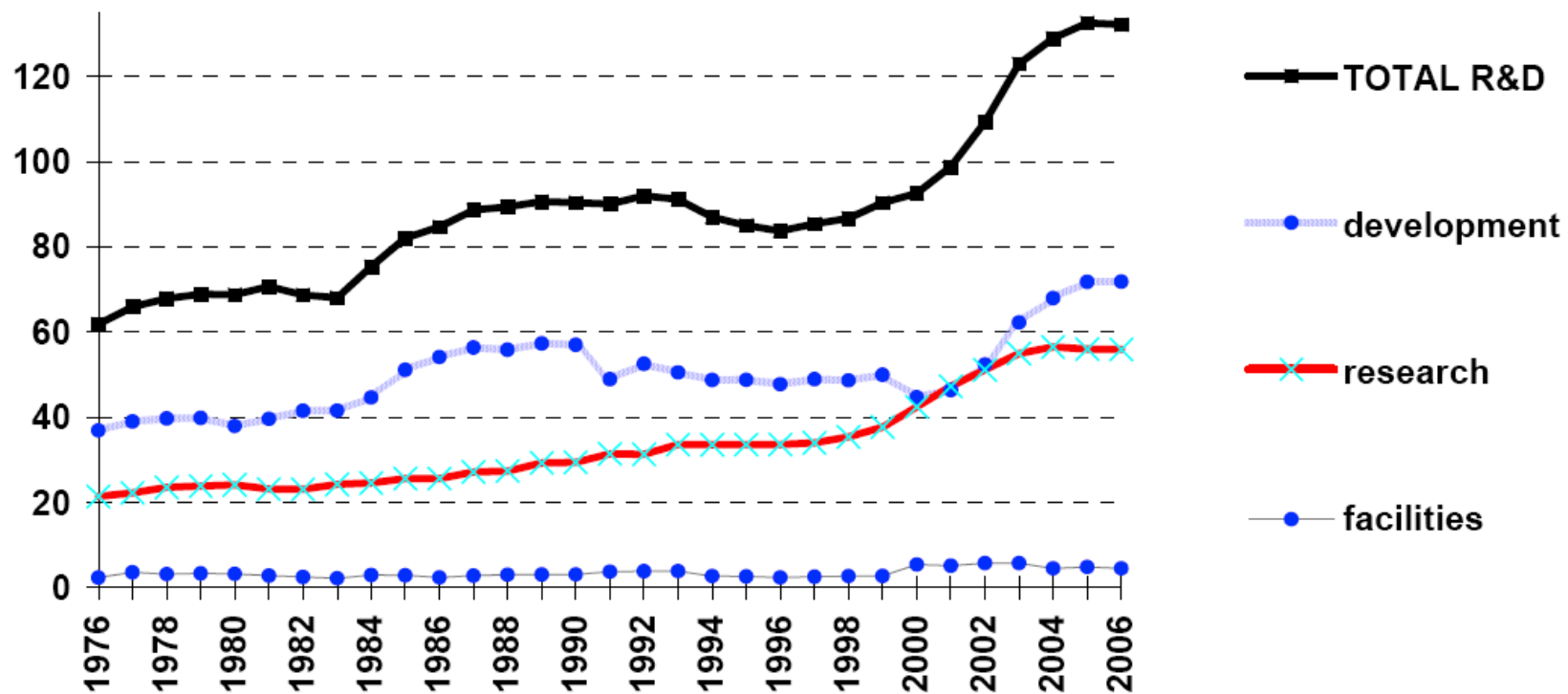
Source: AAAS estimates of R&D in FY 2006 final appropriations bills.
 DOD "S&T" = DOD R&D in "6.1" through "6.3" categories plus medical research.

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Trends in Federal R&D, FY 1976-2006

in billions of constant FY 2005 dollars

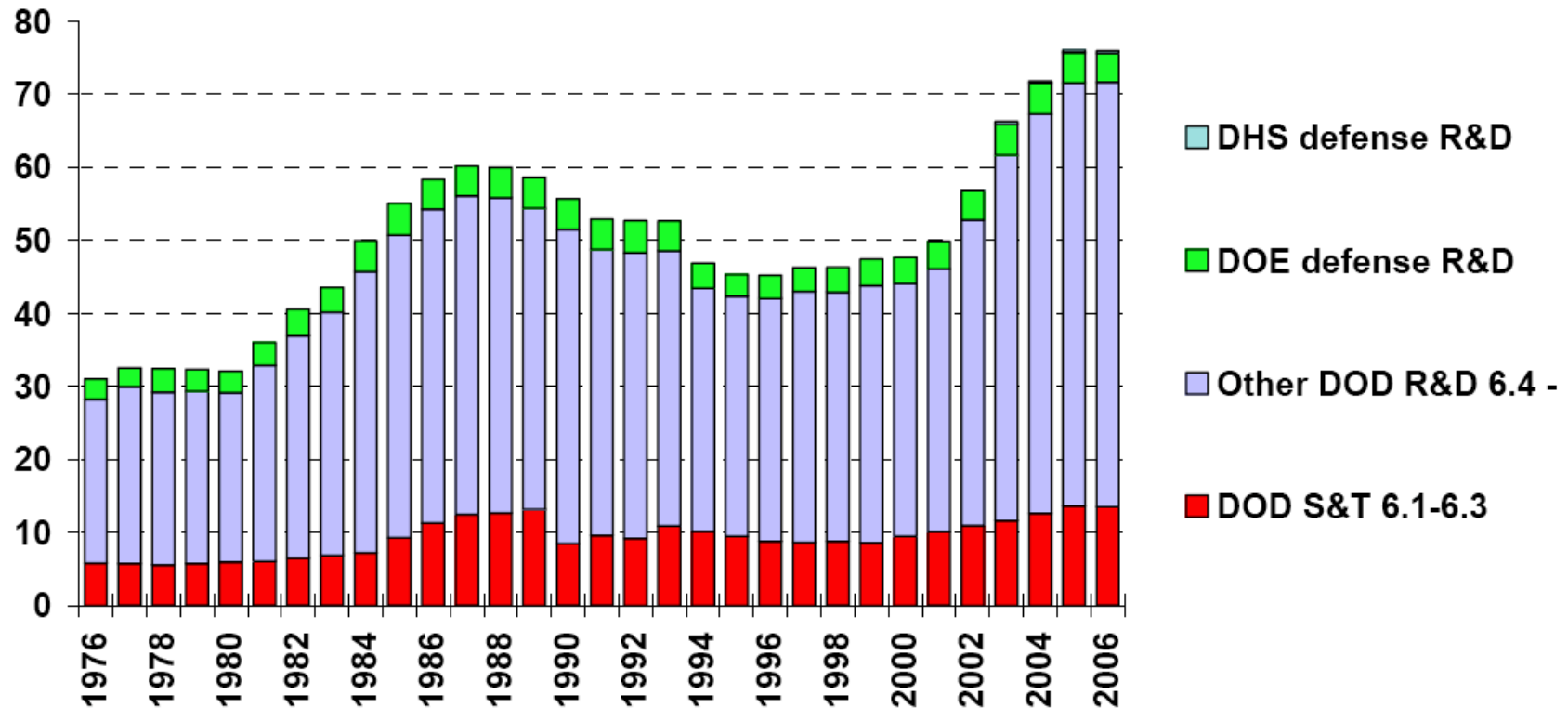


Source: AAAS analyses of R&D in annual AAAS R&D reports. FY 2006 figures are AAAS estimates of final FY 2006 appropriations. R&D includes conduct of R&D and R&D facilities. Data to 1984 are obligations from the NSF Federal Funds survey. Constant-dollar conversions use GDP deflators from OMB.
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Trends in Defense R&D, FY 1976-2006

in billions of constant FY 2005 dollars

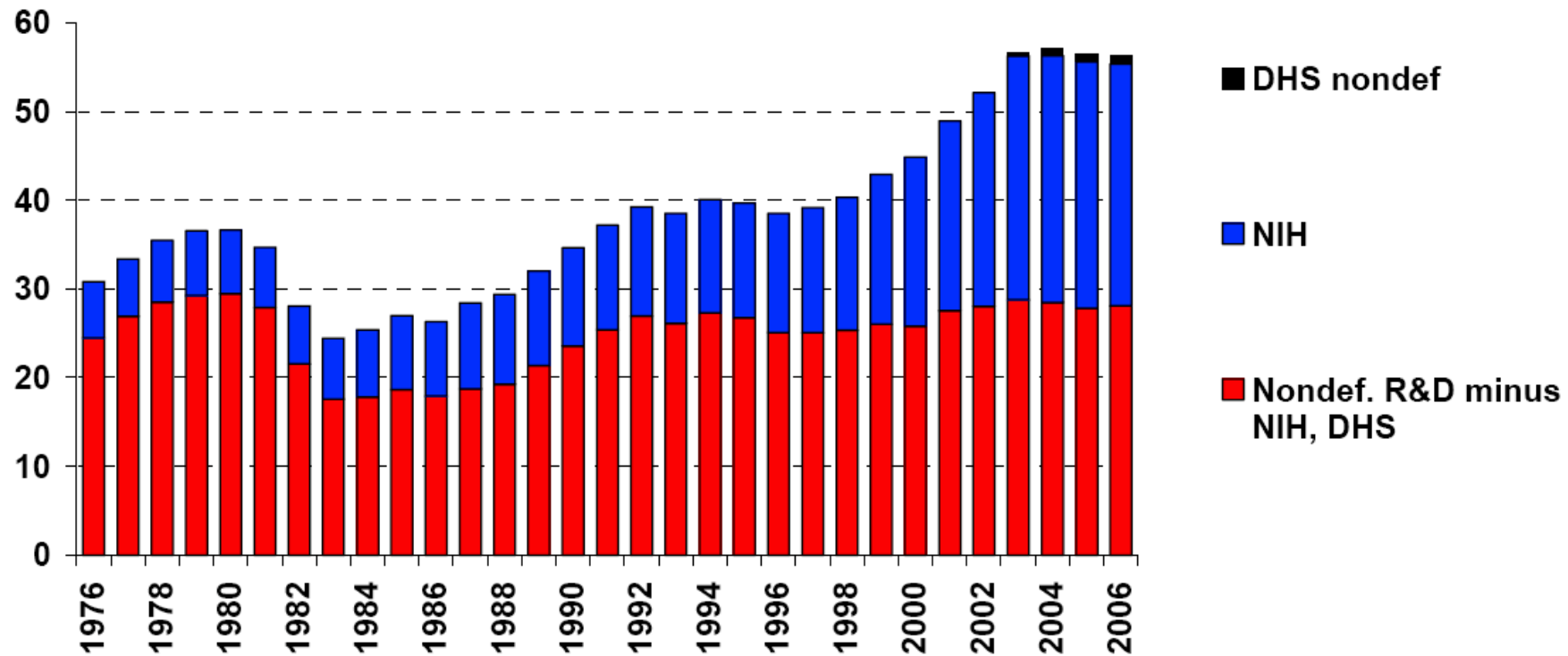


Source: AAAS analyses of R&D in AAAS Reports I-XXX.
 FY 2006 figures are AAAS estimates of final FY 2006 appropriations. DOD S&T figures are not strictly comparable for all years because of changing definitions.
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Selected Trends in Nondefense R&D, FY 1976-2006

in billions of constant FY 2005 dollars

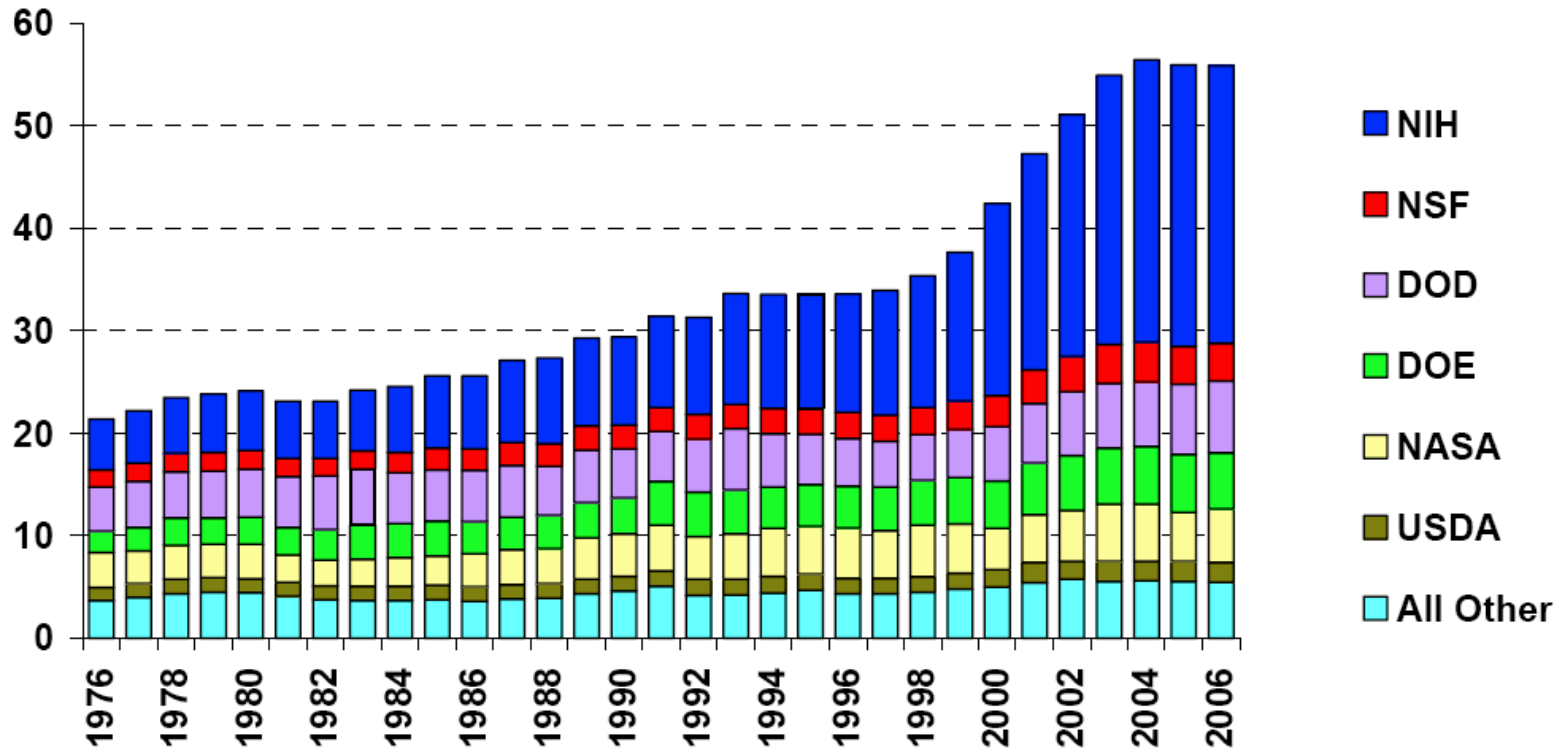


Source: AAAS analyses of R&D in AAAS Reports I-XXX. FY 2006 figures are AAAS estimates of final FY 2006 appropriations. R&D includes conduct of R&D and R&D facilities.
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Trends in Research by Agency, FY 1976-2006

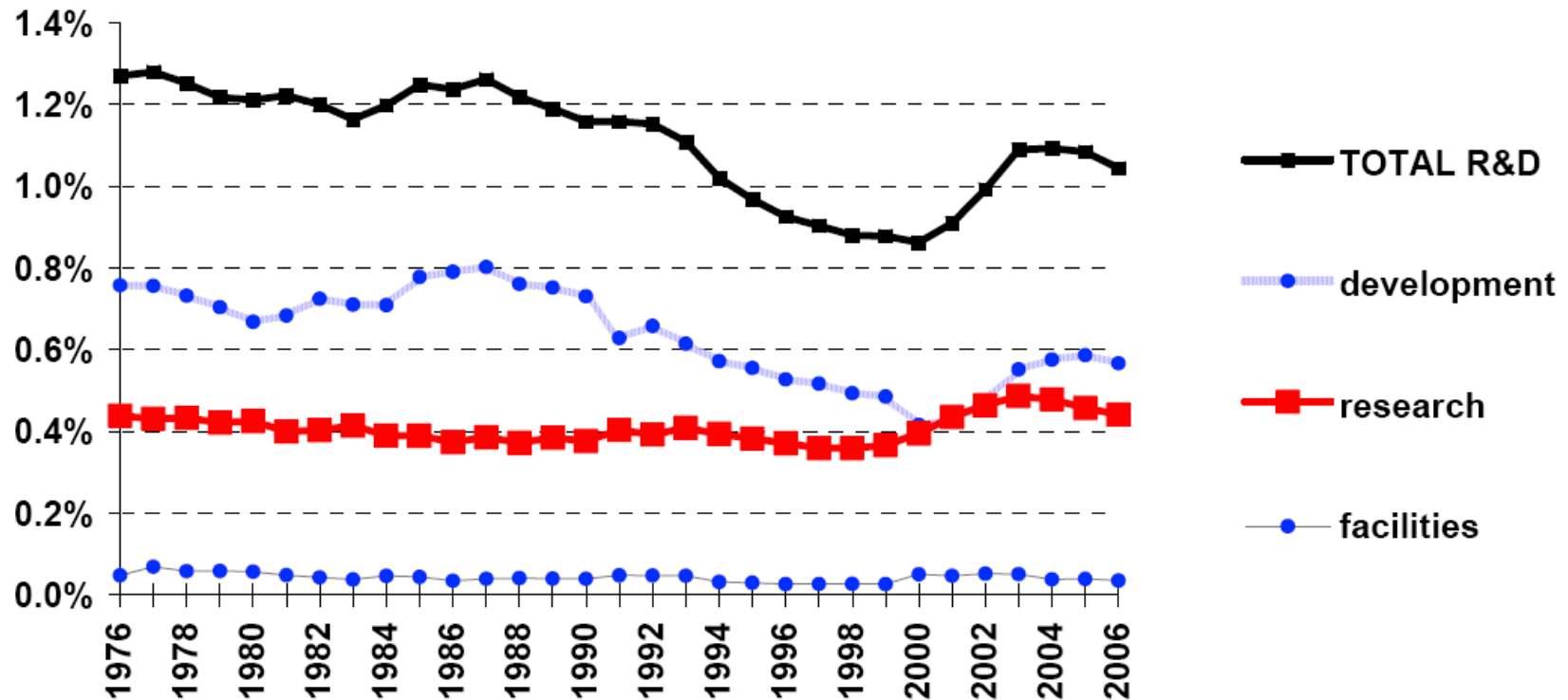
in billions of constant FY 2005 dollars



Source: AAAS analyses of R&D in annual AAAS R&D reports. FY 2006 figures are AAAS estimates of final appropriations. Research includes basic research and applied research. 1976-1994 figures are NSF data on obligations in the Federal Funds survey.
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Trends in Federal R&D as % of GDP, FY 1976-2006

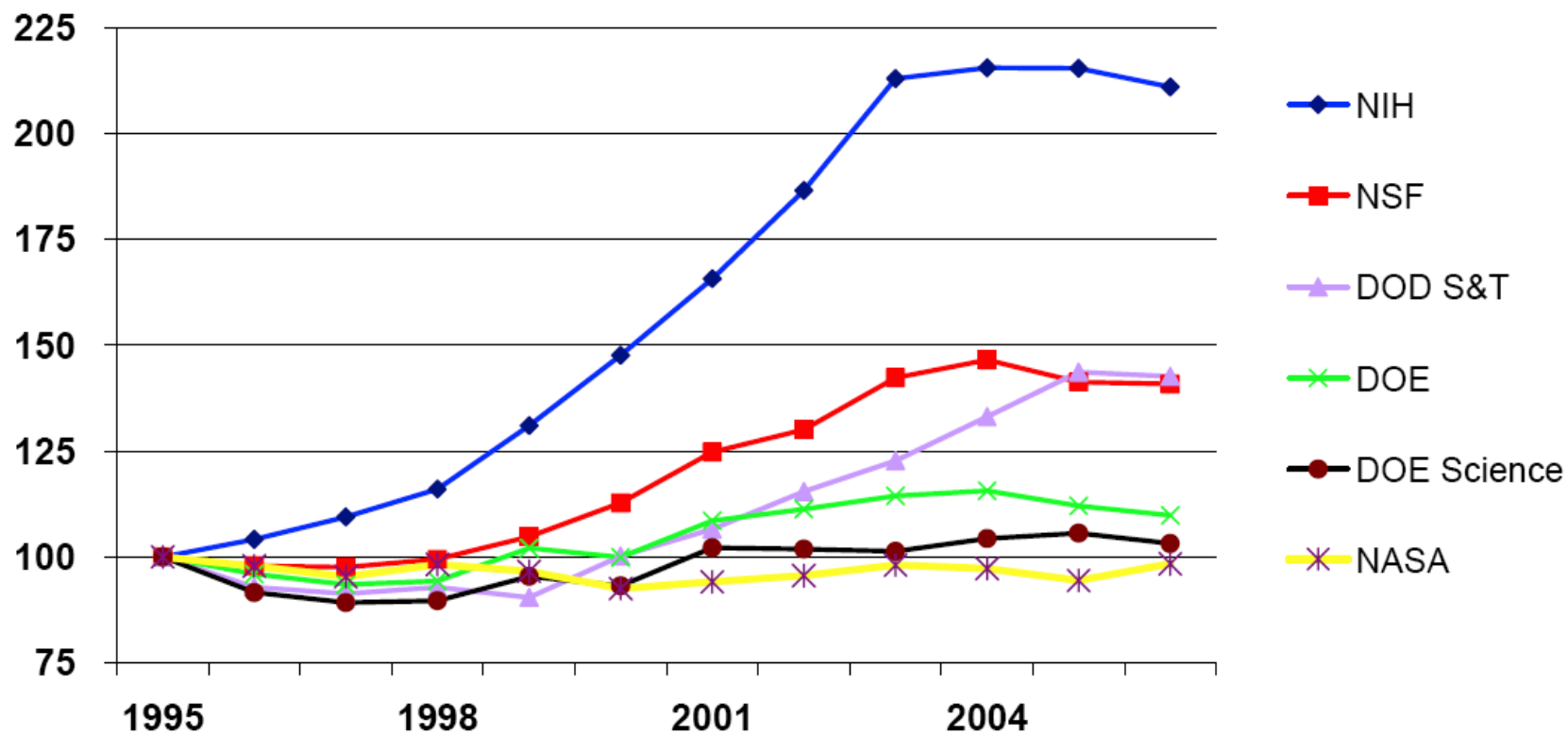


Source: AAAS analyses of R&D in annual AAAS R&D reports. FY 2006 figures are AAAS estimates of final FY 2006 appropriations. R&D includes conduct of R&D and R&D facilities. Data to 1984 are obligations from the NSF Federal Funds survey. GDP figures are from OMB, Budget of the U.S. Government FY 2006.
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Trends in Federal R&D, FY 1995-2006

selected agencies in constant dollars, FY 1995=100

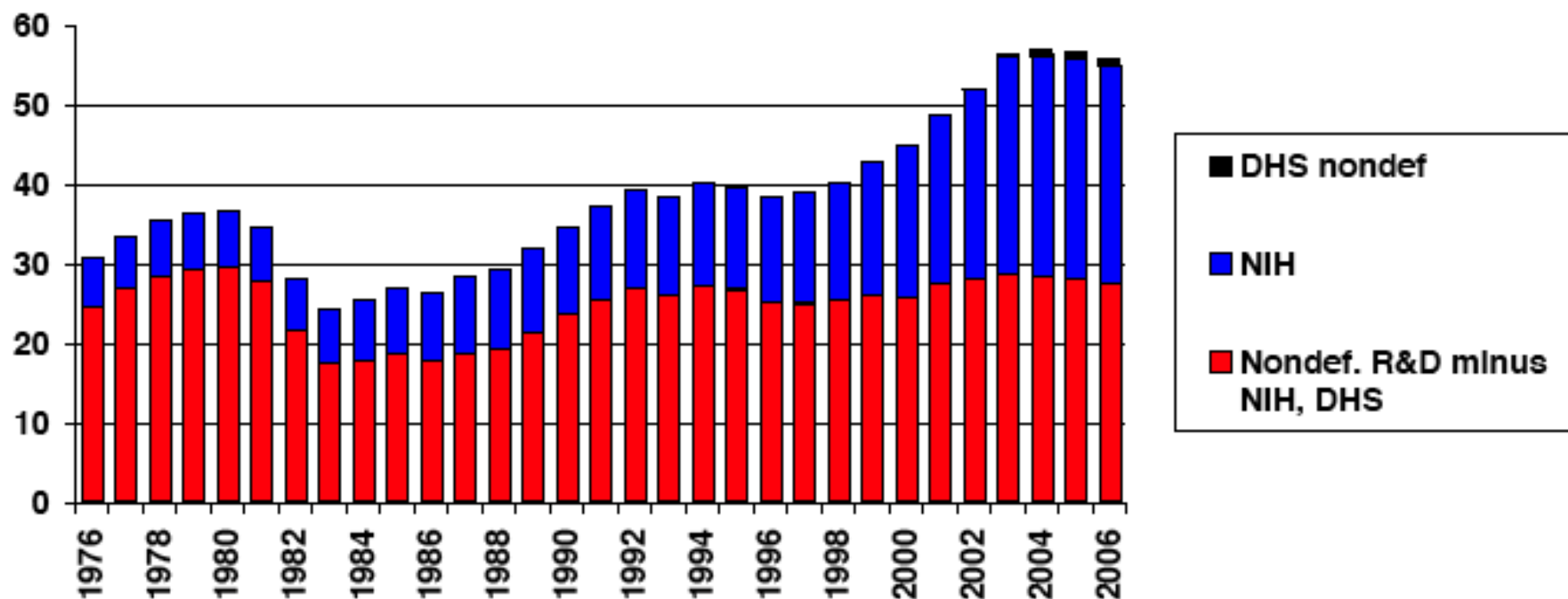


Source: AAAS analyses of R&D in *AAAS Reports VIII-XXX*. FY 2006 figures are AAAS estimates of final FY 2006 appropriations.
 R&D includes conduct of R&D and R&D facilities.
 DECEMBER '05 © 2005 AAAS



Selected Trends in Nondefense R&D, FY 1976-2006

In billions of constant FY 2005 dollars

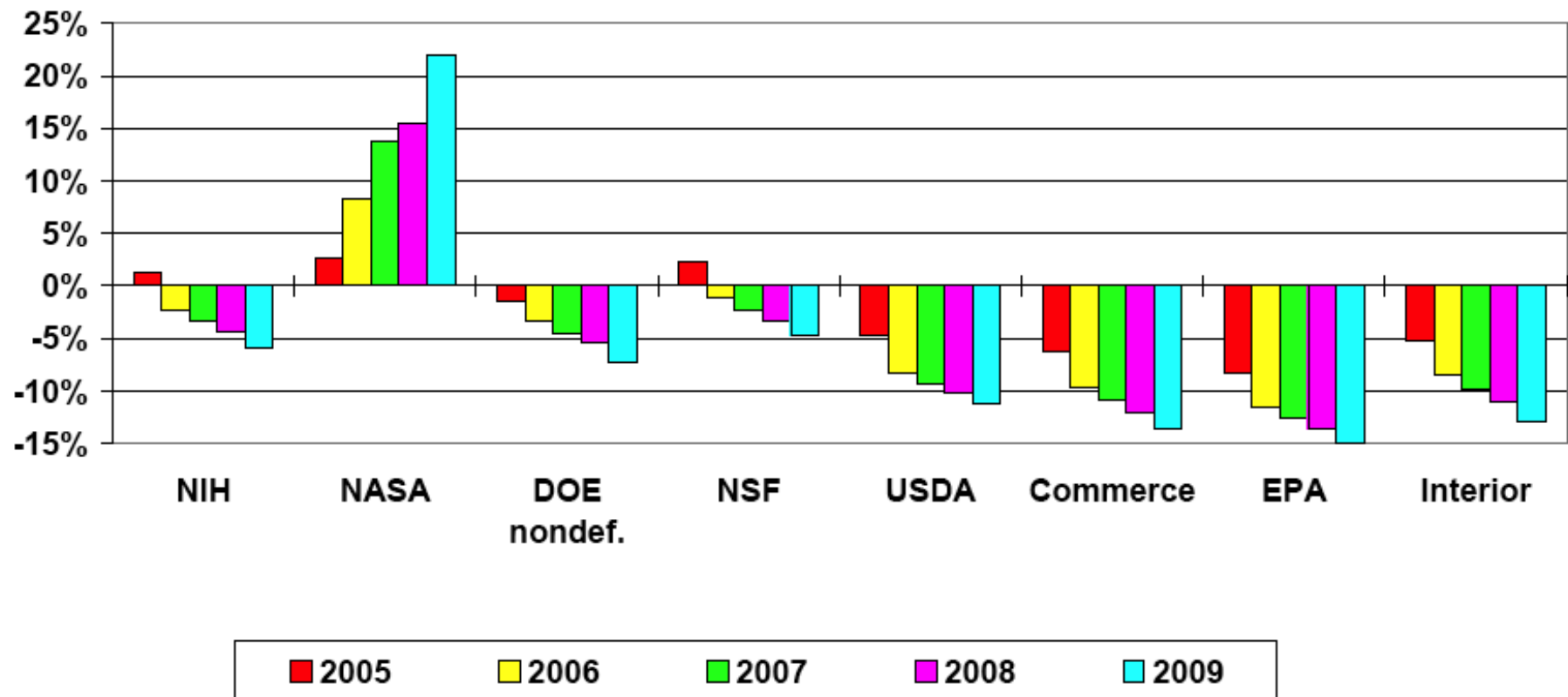


Source: AAAS analyses of R&D in *AAAS Reports VIII-XXX*. FY 2006 figures are President's request. R&D includes conduct of R&D and R&D facilities.
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Projected Nondefense R&D in the President's Budget, FY 2004-2009

% change from FY 2004 funding level in constant dollars



Source: AAAS analysis *Projected Effects of President's FY 2005 Budget on Nondefense R&D*
 APRIL '04 © 2004 AAAS





The Media: A Gathering Storm

- William Broad: “The US has started to lose its worldwide dominance in critical areas of science and innovation. Europe and Asia are making large investments in physical science and engineering research, while the US has been obsessed with biomedical research to the neglect of other areas.”
- Tom Friedman: “The US is not graduating the volume of scientists and engineers, we do not have a lock on the new ideas, and we are either flat-lining or cutting back our investments in physical science and engineering. We are losing our competitive edge vis-à-vis China, India, and other Asian tigers.”



Industry: Craig Barrett (Intel)

“The U.S. is not graduating the volume of scientists and engineers, we do not have a lock on the infrastructure, we do not have a lock on the new ideas, and we are either flat-lining, or in real dollars cutting back, our investments in physical science and engineering.

The only crisis the U.S. thinks it is in today is the war on terrorism. It's not!”



The World Is Flat

A BRIEF HISTORY OF
THE TWENTY-FIRST CENTURY

Thomas L. Friedman

The image features a blue-tinted view of Earth from space, showing the continents of North and South America. The background is a light blue gradient with a faint grid pattern. The text "The Age of Knowledge" is centered in a black, italicized font.

The Age of Knowledge

The Age of Knowledge



- A radically new system for creating wealth has evolved that depends upon the creation and application of new knowledge.
- In this "Age of Knowledge", the key strategic resource necessary for economic prosperity and national security has become knowledge itself—educated people and their ideas.

But...



- But unlike natural resources such as oil or iron that have driven earlier economic transformations, knowledge is inexhaustible. The more it is used, the more it multiplies and expands.
- But knowledge can be created, absorbed, and applied only by the educated mind.
- Hence the true wealth of nations in a global, knowledge-driven society has become human capital: educated people!



Globalization

Globalization



- "We see globalization—the growing interconnectedness reflected in the expanded flows of information, technology, capital, goods, services, and people throughout the world—as an overarching mega-trend, a force so ubiquitous that it will substantially shape all the other major trends in the world of 2020."
 - National Intelligence Council Project 2020



In 2020...

- China's GNP will exceed that of all individual western economic powers except for the U.S. India's GNP will be larger than European economies.
- Sheer size of China's and India's population (1.4 B and 1.3 B) along will make them powerful economies.
- The Asian mega-market—China, India, Russia, Korea, etc.—could become dominant—particular in human capital.

The Importance of Technology



"The greatest benefits of globalization will accrue to countries and groups that can access and adopt new technologies. Indeed, a nation's level of technological achievement generally will be defined in terms of its investment in integration and applying the new, globally available technologies."

"China and India are well-positioned to become technology leaders, particularly in the next revolution of high technology involving the convergence of info-, bio-, and nano-technology."



The Developed Nations

The transition to a global, knowledge-driven economy will not be painless, and it will hit the middle classes of the developed world in particular, bringing more rapid job turnover and requiring professional retooling. Outsourcing and off-shoring on a massive scale will be disruptive.

Example: Compensation levels in China and India for engineers are roughly one-fifth those in the U.S. How can American engineers produce FIVE TIMES the value-added necessary to be competitive in the global marketplace?





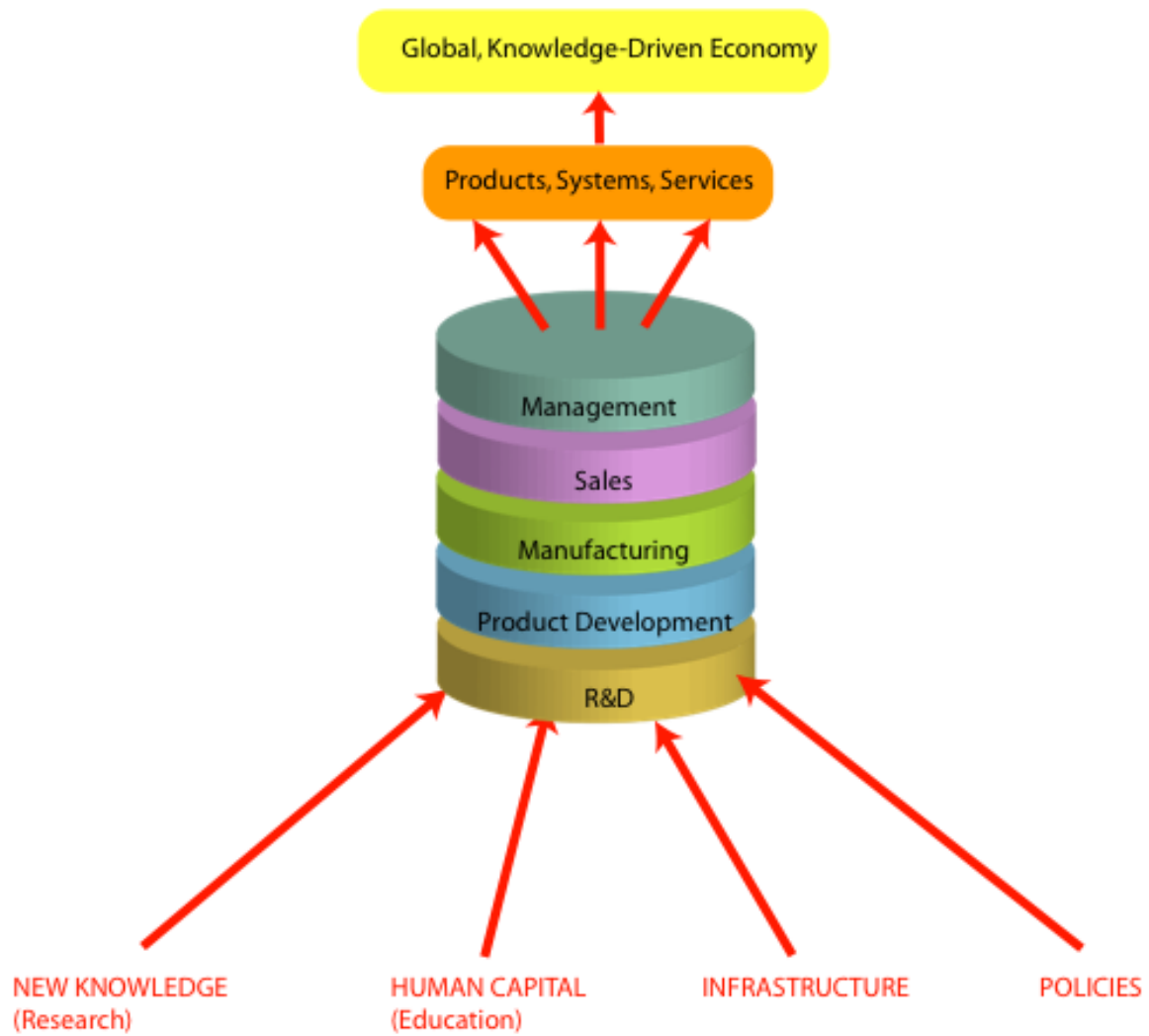


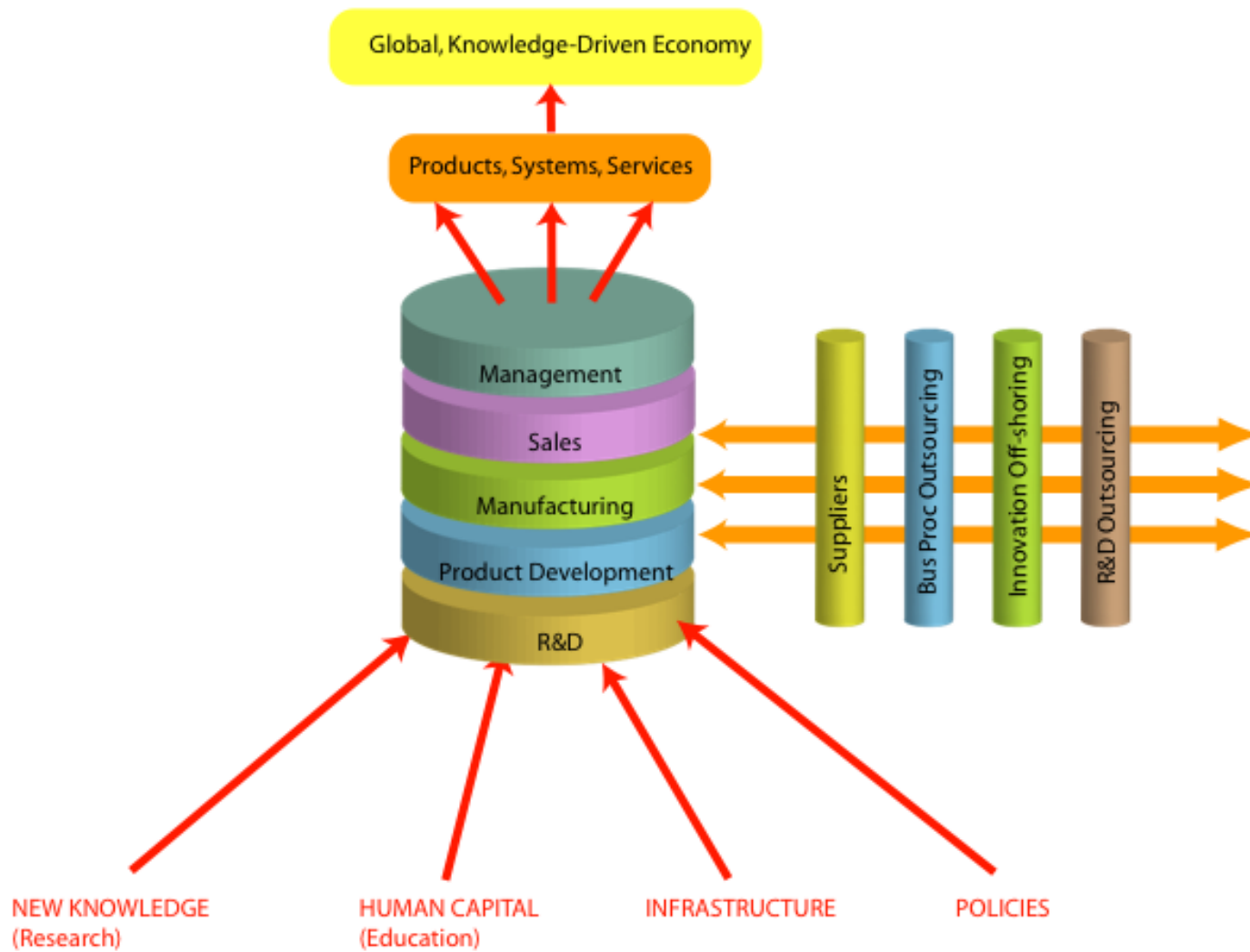


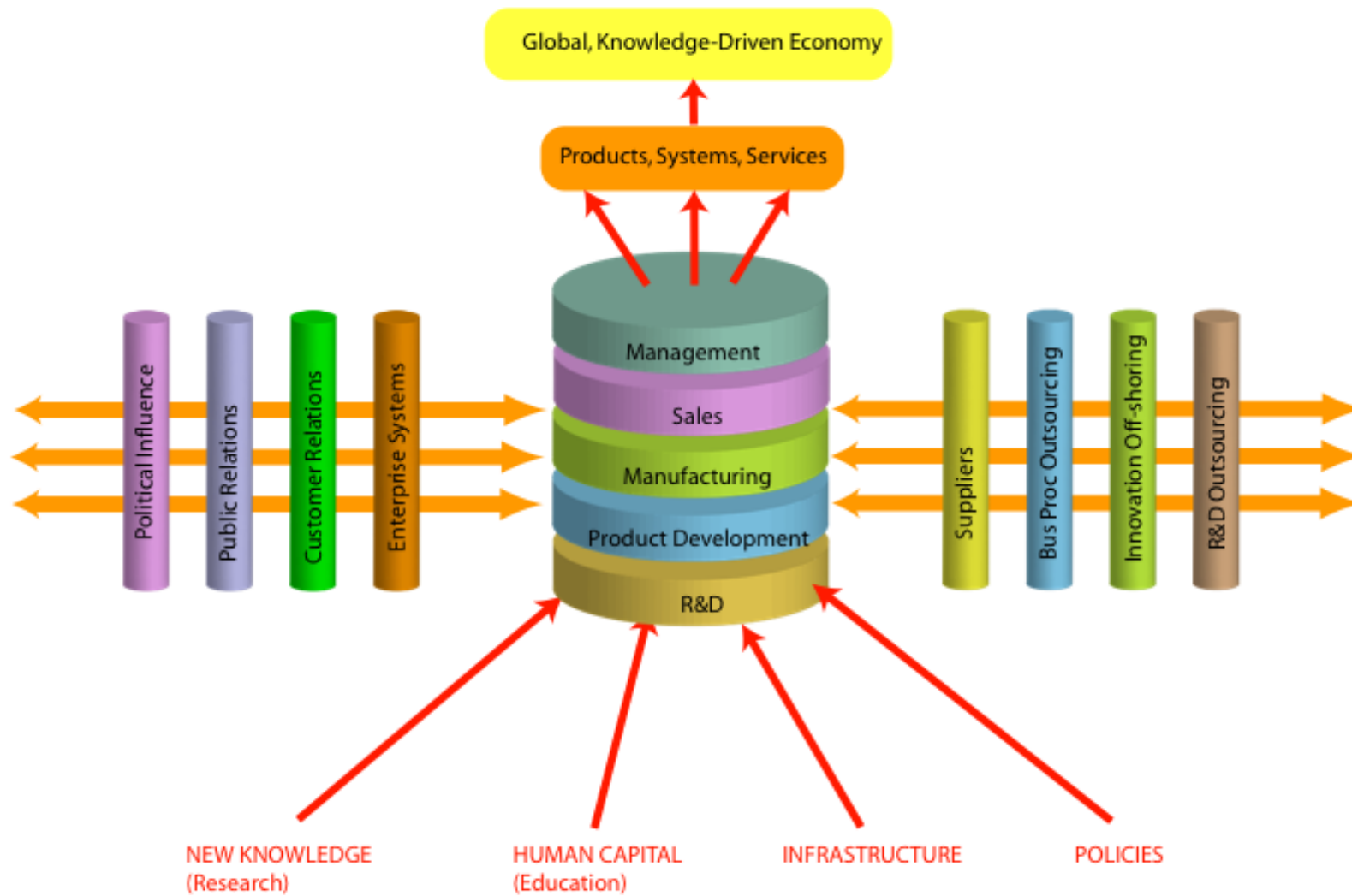
An Example: "Global Sourcing"

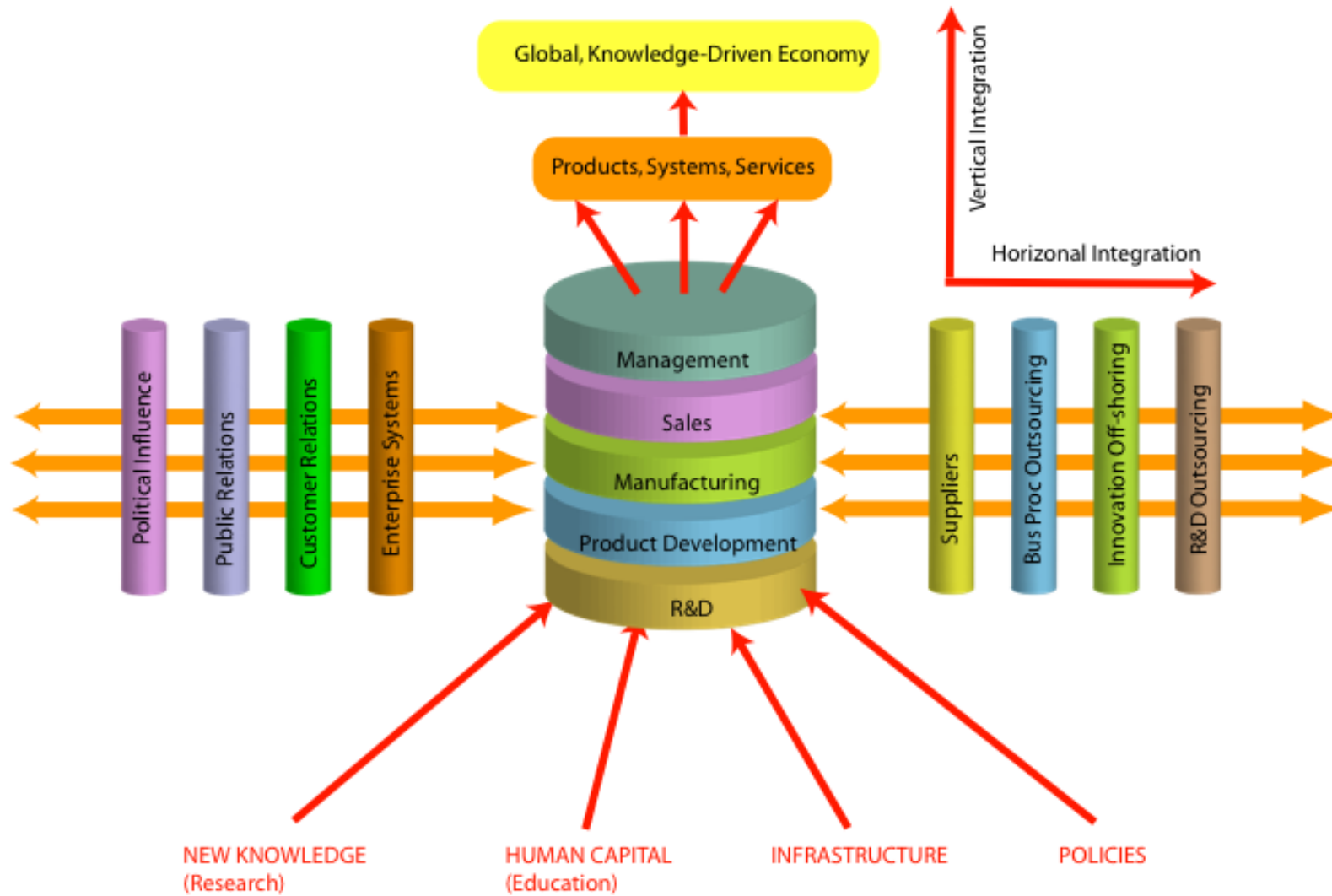


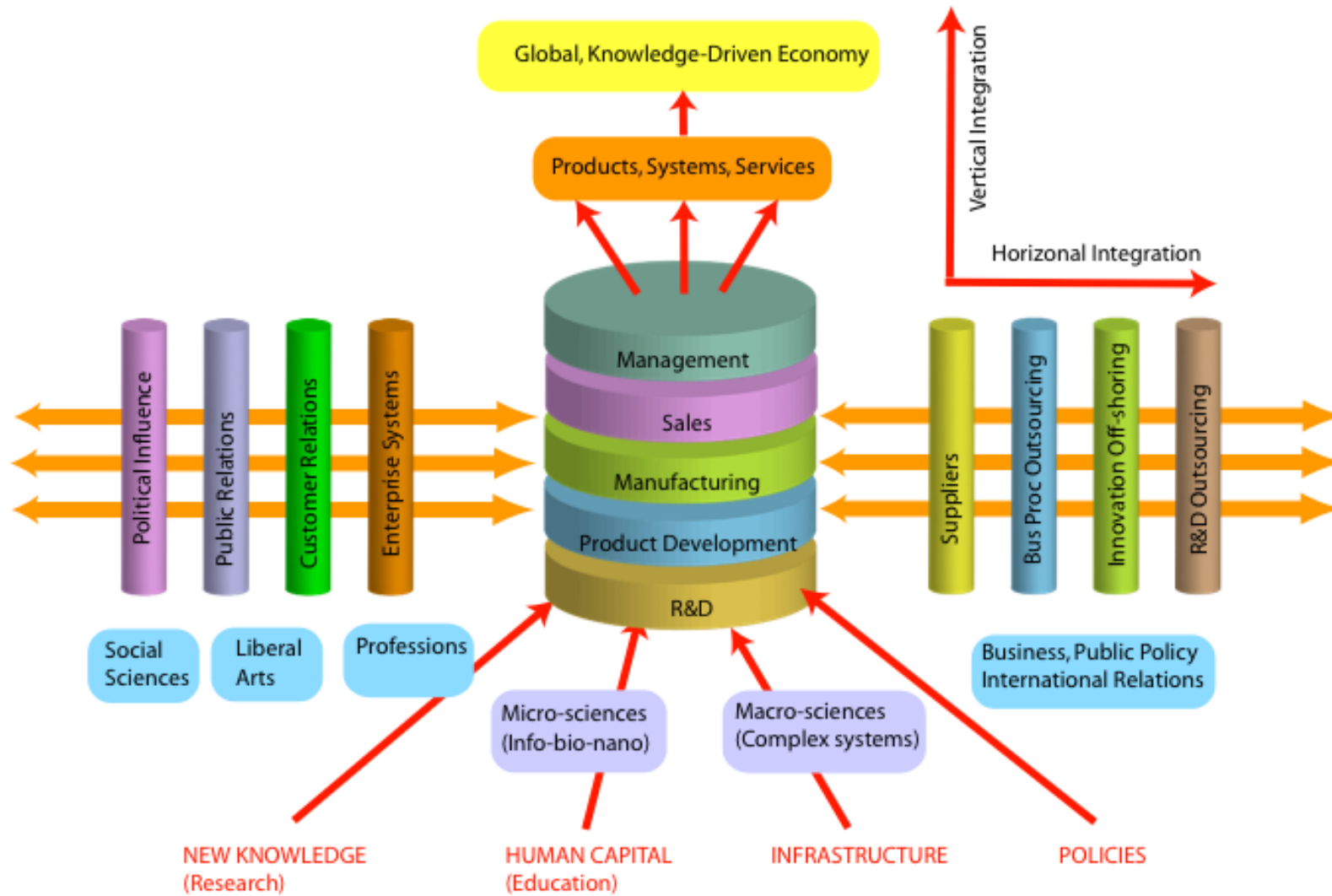
- U.S. has already lost most low skill, high pay jobs in manufacturing to Asia and Latin America ("out-sourcing")
- Today it is losing high tech jobs to India and China ("off-shoring")
- Tomorrow, the convergence of the gigantic source of human capital represented by India, China, and Russia threatens will have serious implications for sustaining our standard of living
- (We cannot maintain prosperity by just mowing each other's lawns...)













The World Is Flat

A BRIEF HISTORY OF
THE TWENTY-FIRST CENTURY

Thomas L. Friedman

Tom Friedman



“The playing field is being leveled. Some three billion people who were out of the game have walked and often ran onto a level playing field, from China, India, Russia, and Central Europe, nations with rich educational heritages. It is this convergence of new players, on a new playing field, developing new processes for horizontal collaboration, that I believe is the most important force shaping global economics and politics in the early 21st century.”



Demographics

An Aging Society



- Something unprecedented and irreversible is happening to humanity. This year or next, the proportion of people aged 60 or older will surpass the proportion of under-fives. For the rest of history there are unlikely to ever again be more toddlers than gray heads.
- Actually three trends:
 - Bulge in retirement over next decade
 - Widespread fall in fertility rates (below replacement value)
 - Earlier retirement, longer life expectancy
- Thus a larger generation of old folks than ever before will need support for longer than ever before from a population of working age that is shrinking in absolutely size for the first time since the Black Death. In a decade's time many countries thus start to face a huge problem: how to support a vastly larger population of old folks.

The Economist, March 2004



Aging Populations

- Over the next decade the percentage of the population over the age of 60 will grow to over 30% to 40% in the U.S., Europe, and parts of Asia.
- Half of the world's population lives in countries where fertility rates are not sufficient to replace their current populations.
- Aging populations and shrinking work forces will have a serious impact, particularly in Europe, Russia, and some Asian nations such as Japan, South Korea, and Singapore.



The United States

- The U.S. will be one of the few developed nations with a growing population, estimated to grow from 300 M to over 450 M by 2050 because of immigration from Latin America and Asia.
- Immigration will continue to diversify the American population with respect to race, ethnicity, and nationality, posing significant social and political challenges.
- Clearly the future of our nation depends on its capacity to draw strength from diversity, but political and economic barriers will continue to exist for many underrepresented populations.

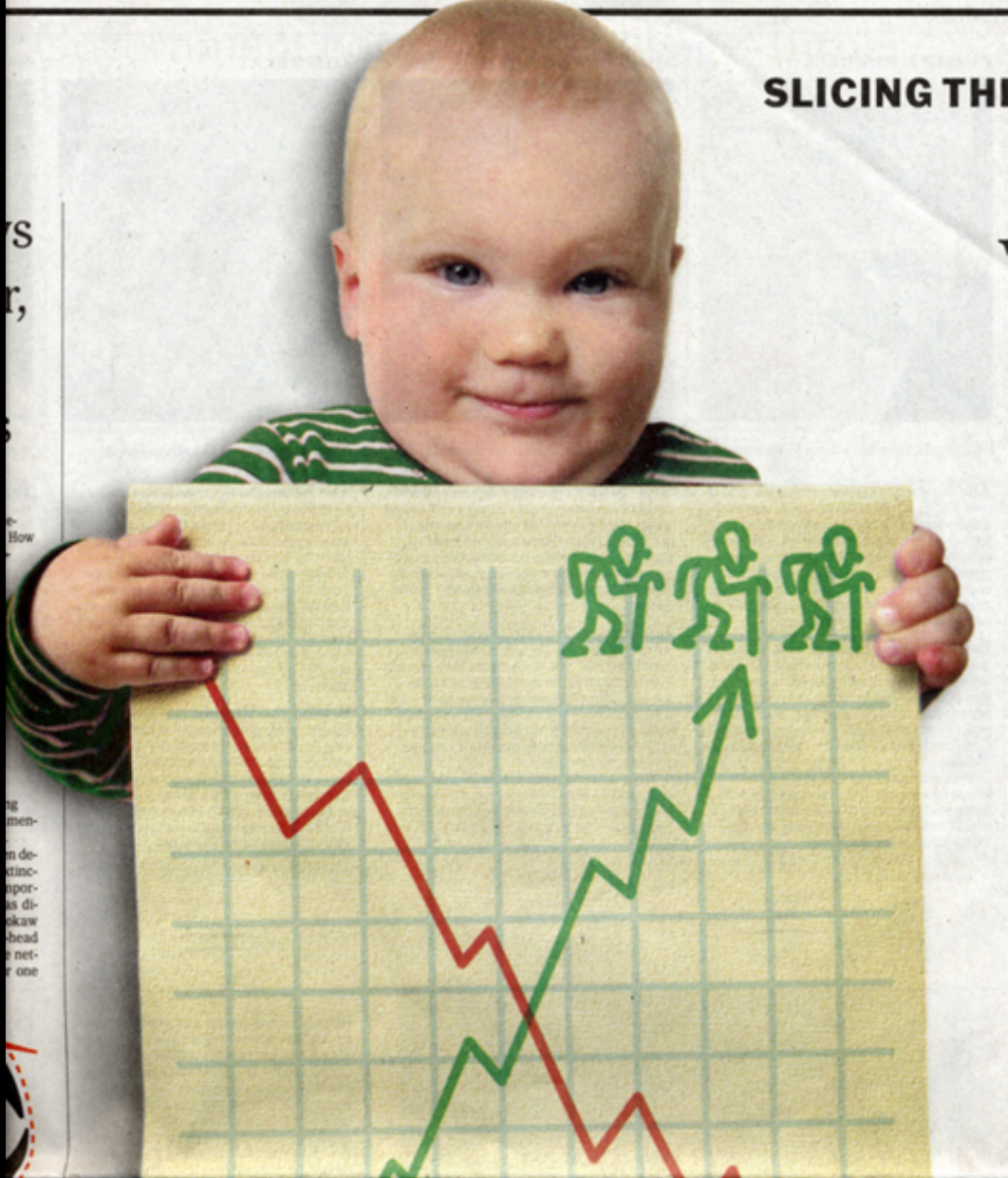
The United States (cont)



- However a growing population of aging voters will increasingly focus national priorities on the concerns of the elderly (e.g., health care, tax relief) rather than the needs of the young (e.g., education).

Week in Review

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The Impact of the Baby Boomers



- In the 1950s a culture of immediate gratification developed in reaction to the massive economic clout of the millions of children born after WWII.
- The boomers dropped out, turned on, and protested against the establishment in the 1960s.
- In the 1970s - 1990s this "me" generation dictated a consumer ethic in which consumption was far more important than savings.
- Today this generation has moved beyond the consumer state to an age in which maintaining what they have is more compelling than buying new toys...or looking to the future.

Today's Boomer Priorities



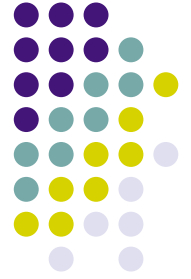
- Quality health care (no matter what it costs)
- Security from crime (more prisons)
- National and homeland security (no matter what it costs)
- Tax relief (although our taxes are already the lowest level among developed nations)

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Today's Boomer Priorities



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- National and homeland security (no matter what it costs)
- Tax relief (although our taxes are already the lowest level among developed nations)
- (...and to hell with the kids...and to hell with the future.)
- "Eat dessert first; life is uncertain!"



Worries (NYT 3-10-05)

- Social security spending is growing fast.
- The cost of Medicare is out of control.
- Companies across the country are buckling under weight of providing pensions and medical care to a growing pool of retirees.
- Cities are slashing public works budgets to deal with ballooning pension costs.
- "Are old people going to hog the resources, leaving children today with nothing but a few crumbs?"

The Baby Boomer Challenge



- How much will it cost to get the baby boomers through retirement and on to their happy hunting ground:
 - Social Security: \$11 trillion
 - Medicare: \$65 trillion

The Baby Boomer Challenge



- How much will it cost to get the baby boomers through retirement and on to their happy hunting ground:
 - Social Security: \$11 trillion
 - Medicare: \$65 trillion
- **NOTE: The total estimated worth of the United States is only \$25 trillion!**



The Elderly vs. the Kids

- Federal spending on people over 65 is 7 times the amount spent on kids under 18.
- Spending on Head Start is discretionary, at Congress's whim; spending on Social Security and Medicare is mandatory.
- 17.6% of children under 18 live in poverty; 10.2% of those over 64 live in poverty.
- Yet it is the elderly who received the \$600 billion Medicare prescription drug bill, while No Child Left Behind received only good intentions.

The Developing World



- Most population growth will occur in the developing world with high fertility rates—Africa, Latin America, Asia—where the average age is less than 20 (with over 2 B teenagers).
- Unless the world can provide this rapidly growing population with the education necessary to compete in and survive in a global economy, the resulting despair and hopelessness among the young will continue to feed the terrorism that so threatens our world today.



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- The skills and work ethic of American workers
- Strong capital markets, a long tradition of the rule of law, a deep commitment to property rights, and a culture that encourages and rewards risk-takers
- A unique system of cooperation and collaboration among the federal government, national and military labs, private-sector R&D efforts, research universities and entrepreneurs

News

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Professional science master's can fill gaps in federal scientific workforce, Sloan's Teitelbaum says

August 16, 2004

American Physical Society -- Workforce Issues Dominate Policy Briefing

July 30, 2004

California Computer News -- Innovate America...

July 22, 2004

Council On



National Innovation Initiative: Resolution

- Innovation will be the single most important factor in determining America's success throughout the 21st century.
- America's challenge is to unleash its innovation capacity to drive productivity, standard of living and leadership in global markets.
- For the past 25 years we have optimized our organizations for efficiency and quality. Over the next quarter century, we must optimize our entire society for innovation.



Note

Study after study (including Solow's 1957 Nobel Prize work) have linked over 50% of economic growth over the past 50 years to technological innovation.

BUT flat-lining research will hinder U.S. innovation and ultimately endangers both our standard of living and national security!



“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
- Budget weakness in states
- Imbalance in federal R&D support
- Budget weakness in states
- Weak minority/women presence
- Post 9-11 impact on flow of international STEM students
- Weak domestic student STEM interest
- Obsolete STEM curricula
- Post 9-11 impact on flow of international STEM students
- Rapid escalation of cyber-infrastructure needs
- Obsolete STEM curricula in key areas
- Weakened state support
- 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)

Opportunities

- National Priorities
 - Economic Competitiveness
 - National and Homeland Security
 - Public Health and Social Well-being
- Technological Innovation
 - Global Sustainability
 - Geopolitical Conflict
- Engineering Opportunities
 - Emerging Technologies
 - Interdisciplinary Activities
 - Complex, Large-scale Systems



The Ingredients of Innovation

- The U.S. culture—a diverse population, democratic values, free market practices— provide a fertile environment for innovation.
- But history has show that significant public investments is necessary to produce key ingredients for technological innovation:
 - New knowledge (research)
 - Human capital (education)
 - Infrastructure (physical, cyber)
 - Policies (tax, intellectual property)



Premise

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

Elements

New Knowledge
(Research)

Human Capital
(Education)

Infrastructure
(Facilities, IT)

Policies
(Tax, IP, R&D)

Technological
Innovation

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

The Foundation

Opportunities

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



Note:

- The roles of the federal government is essential!
- Corporations invest primarily in applied research tied to next generation product.
- The federal government supports most long-term research.
- And universities play a key role in basic research, supported primarily by the federal government.



Concerns

- Accelerating pace of discovery and application of new technologies
- Investments by other nations in R&D and human capital
- Increasingly competitive global economy.
- Stagnant federal investments in engineering research are no longer adequate.
- Imbalance between federal and private sector R&D



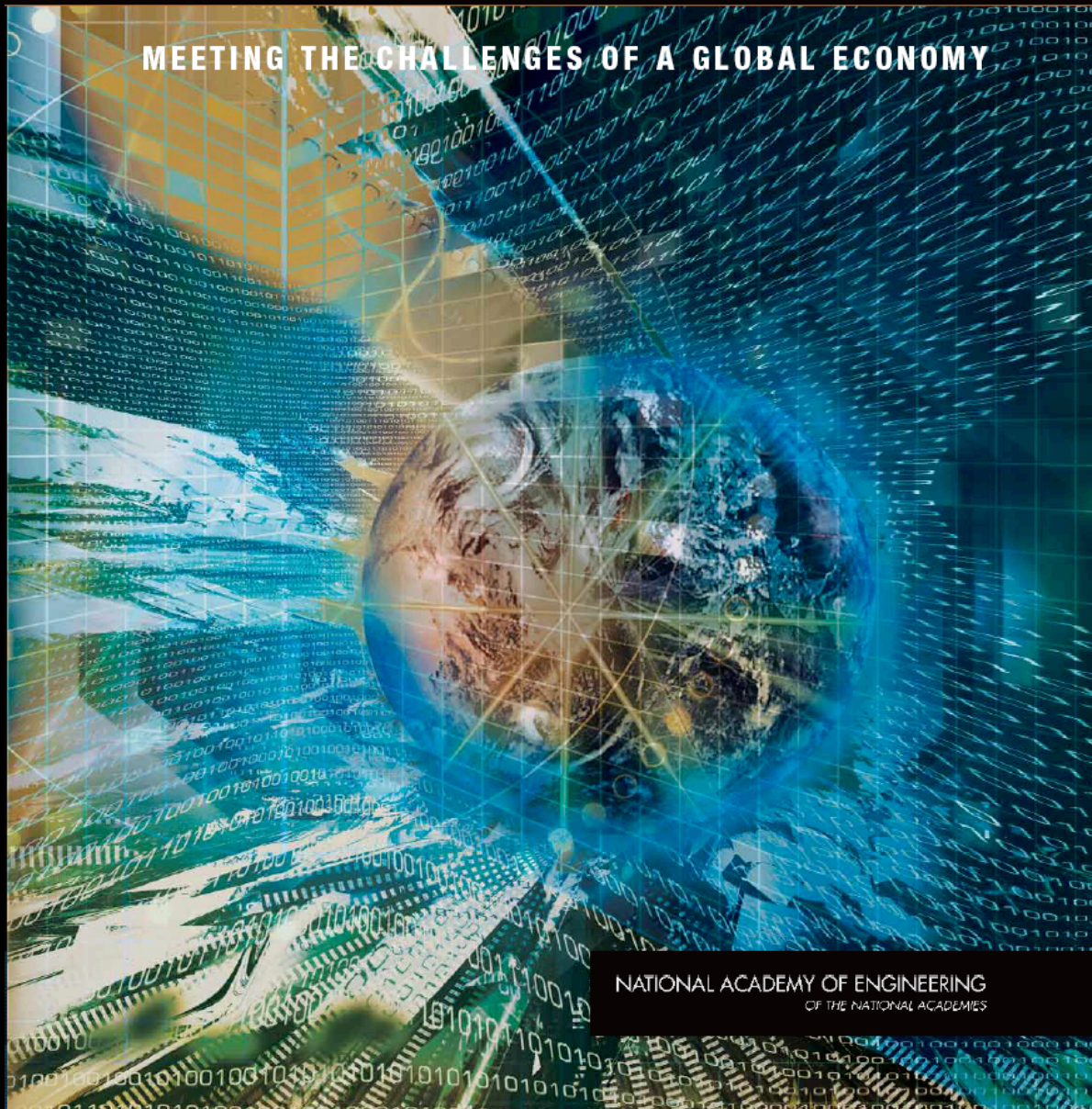
Concerns (continued)

- 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.

ENGINEERING RESEARCH AND AMERICA'S FUTURE

MEETING THE CHALLENGES OF A GLOBAL ECONOMY

NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES





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.



NAE Committee

- James J. Duderstadt
- Erich Bloch
- Ray M. Bowen
- Barry Horowitz
- Lee L. Huntsman
- James Johnson
- Kristina M. Johnson
- Linda Katehi
- David C. Mowery
- Cherry A. Murray
- Malcolm R. O'Neill
- George Scalise
- Ernie Smerdon
- Robert F. Sproull
- David Wormley
- Proctor P. Reid



The Process

- 2004: Hearings and development of preliminary findings and recommendations
- January 1, 2005: Release of a public draft report (reviewed) for comment from the engineering community
- March 2005: Utilize feedback to redraft report (again for review)
- April 2005: Publication of final report.



Findings

- In a global knowledge-driven economy, technological innovation is critical to economic competitiveness, the quality of life, and national security.
- Leadership in engineering research, education, and practice is a prerequisite to global leadership in technological innovation.



Findings (continued)

- U.S. leadership in technological innovation is seriously threatened by the accelerating pace of discovery, investments by other nations in R&D and technical workforce development, and an increasingly competitive global economy.
- Federal investment in engineering and physical science research has been stagnant for three decades. Long term research critical to innovation has not been adequately funded.



Findings (continued)

- Currently, most support for engineering research comes from federal mission agencies and NSF. Since NSF is uniquely situated to catalyze change in engineering research, education, and practice and to head a buildup of long-term fundamental engineering research at the nation's universities, it is especially important for linking basic engineering research and education to fundamental scientific discoveries in physical, natural, and social sciences.



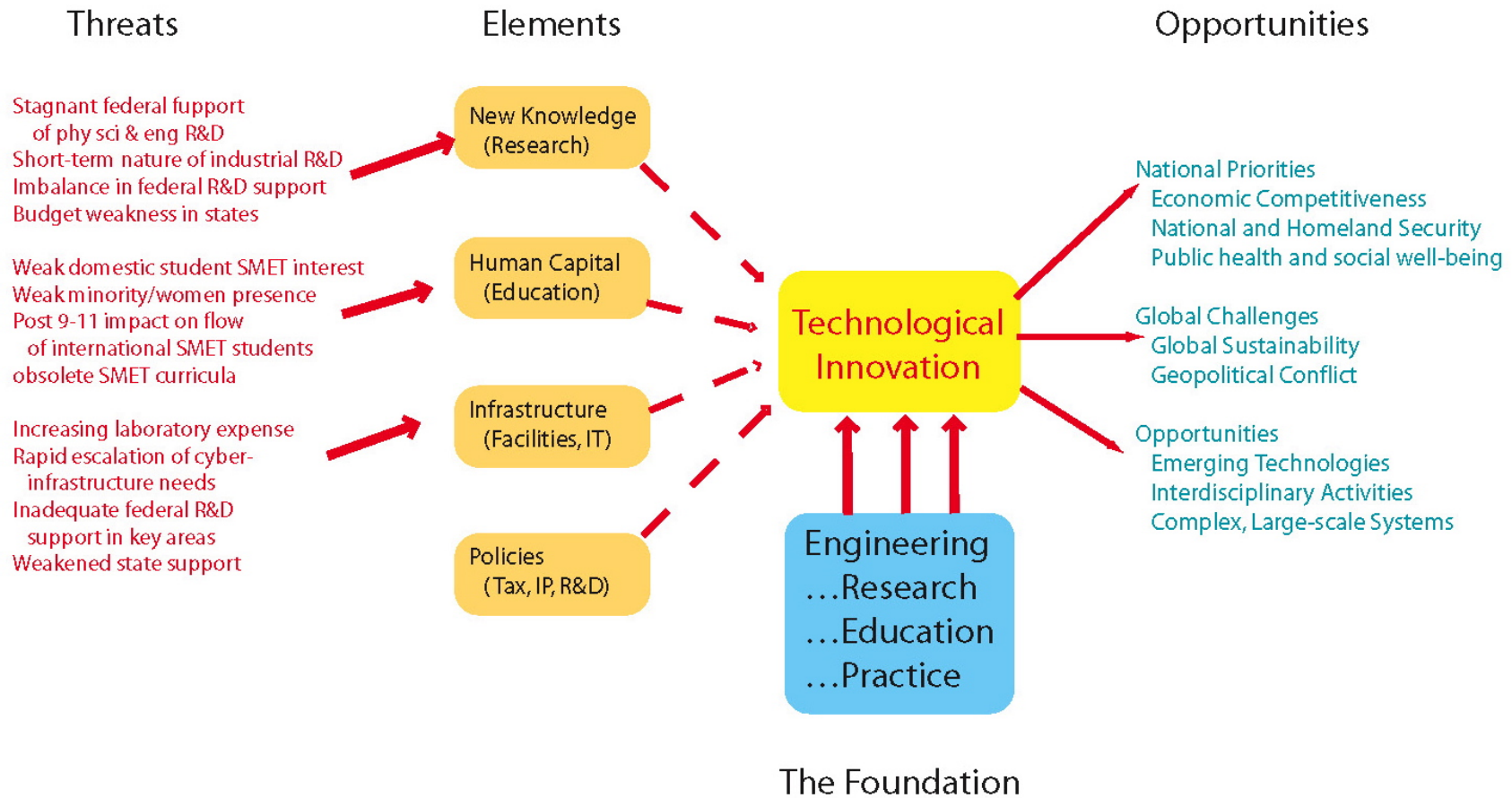
Findings (continued)

- The current federally funded R&D portfolio is inadequate to ensure national leadership in research areas of key strategic interest to the nation (e.g., national defense, homeland security, and the economic competitiveness of American industry).
- Although industry today accounts for almost 75% of the nation's R&D, its capacity to conduct long-term scientific and engineering research has been constrained by near-term financial earnings pressures and restructured markets.



Findings (continued)

- The changing nature of technological innovation—more rapid, global, systemic, and interdisciplinary—will require changes in engineering research, education, and practice.
- A technically skilled workforce is essential to an innovation-driven nation. This will likely require more U.S. citizens educated in engineering—particularly women and underrepresented minorities. It will also require that the U.S. retain the capacity to attract talented scientists and engineers from throughout the world.





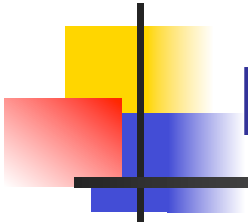
Recommendations

- Balancing Federal R&D Portfolio
- Re-establishing Basic Engineering Research As A Priority of Industry
- Strengthening Linkages Between Industry and Research Universities
- Human Capital
- Discovery-Innovation Institutes



Balancing Federal R&D Portfolio

The Committee strongly recommends a rebalancing of the federal R&D portfolio by increasing the funding of research in physical science and engineering to levels sufficient to support the nation's most urgent priorities such as national defense, homeland security, economic competitiveness, and energy security.



Federal R&D for National Priorities

Health Care



Biomedical
Research

\$28 B

National
Defense



Physical Sciences
Research

\$5 B

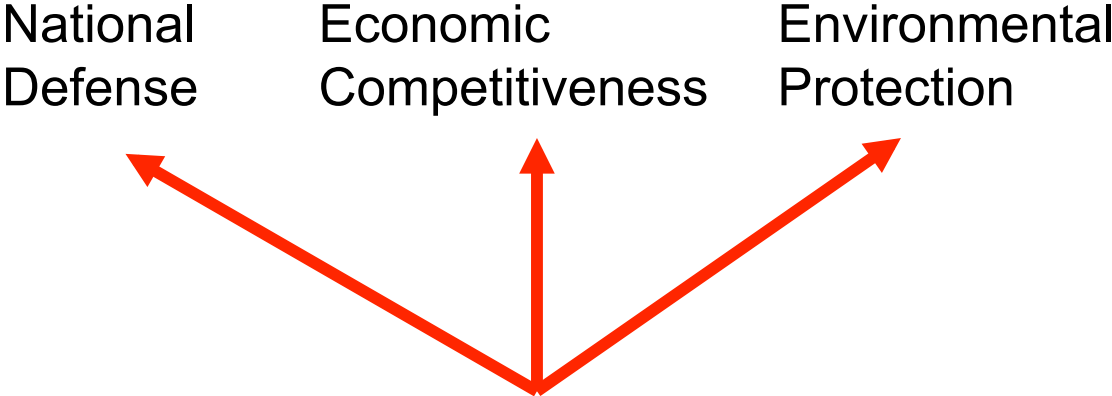
Economic
Competitiveness



Engineering
Research

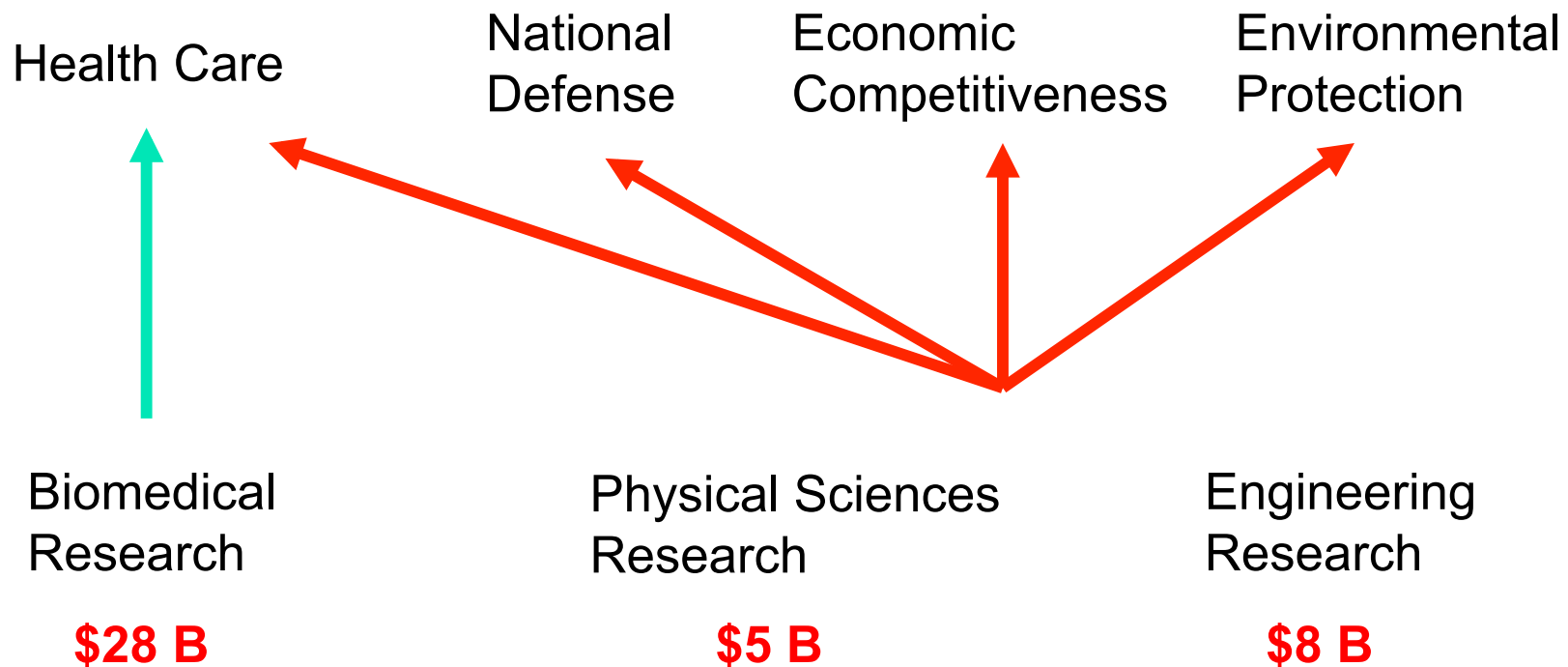
\$8 B

Environmental
Protection





Federal R&D for National Priorities





Rebalancing (continued)

This might occur through additional investments in research in these areas, for example, by moving ahead with the earlier Congressional authorization to double the budget of the National Science Foundation; or by reallocation within the existing federal R&D budget to achieve a better balance among disciplines and agencies; or by establishing a mandate through authorization language for increased support of research in physical science and engineering on the part of well-funded agencies such as NIH, DOD, DOE, and NASA, as necessary to sustain their overall research objectives).



Basic Research in Industry

The federal government should consider a broad series of actions to establish strong incentives for American companies to conduct long-term engineering research, including tax incentives, intellectual property policies, relaxation of anti-trust constraints on research consortia, and jointly funded industry-university-government laboratory partnerships.



Industry-University Linkages

Sustaining the nation's leadership in technological innovation requires far more robust ties between American industry and research universities.

Recommended actions include: joint initiatives such as the Discovery-Innovation Institutes; federal efforts to streamline and standardize intellectual property policies; programs to support industry scientists and engineers as visiting faculty and the placement of advanced graduate and postdoctoral students in corporate R&D laboratories.



Infrastructure

Federal and state governments and industry (through tax incentives) should invest more resources in upgrading and expanding laboratories, equipment, information technologies, and other infrastructural needs of research universities to ensure that the national capacity to conduct world-class engineering research is sufficient to address the technical challenges that lie ahead.



Quality of the Technical Workforce

A major effort should be made to increase the participation of American students in engineering. The Committee endorses the findings and recommendations of the NAE report, *Educating the Engineer of 2020*, which calls for systemic efforts by professional societies, industry, government, and educators to align the engineering curriculum and profession to the needs of a global knowledge-driven economy.



Technical Workforce Quality (cont)

All participants and stakeholders in the engineering community should place a high priority on encouraging women and underrepresented minorities to pursue careers in engineering. Although this is likely to require a very significant increase in investment from both public and private sources, increasing diversity is clearly essential to sustaining the capacity and quality of the U.S. scientific and engineering workforce.



Technical Workforce Quality (cont)

A major federal fellowship-traineeship program in strategic areas (e.g., energy, info- nano- and biotechnology, knowledge services), similar to the program created by the National Defense Education Act, should be established to ensure that the supply of next-generation scientists and engineers is adequate.



Technical Workforce Quality (cont)

Immigration policies and practices should be streamlined (without compromising homeland security) to restore the flow of talented students, engineers, and scientists from around the world into American universities and industries.



One More Recommendation...



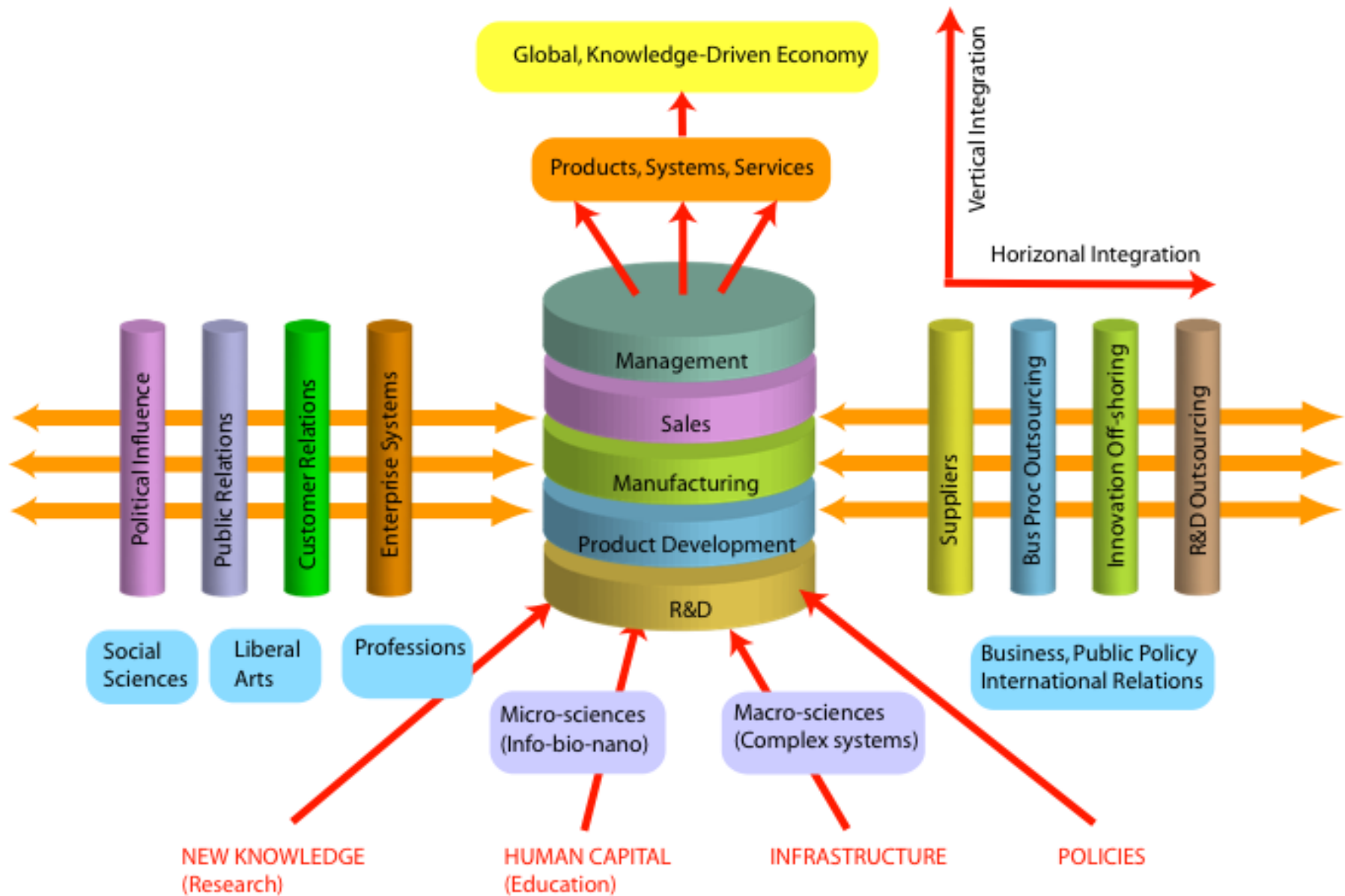
One More Recommendation

Discovery-Innovation Institutes



U.S. Leadership in Innovation will Require Changes

- In the way research is prioritized, funded, and conducted.
- In the education of engineers and scientists.
- In policies and legal structures such as intellectual property.
- In strategies to maximize contributions from institutions (universities, CR&D, federal agencies, national laboratories)





Discovery Innovation Institutes

To address the challenge of maintaining the nation's leadership in technological innovation, the committee is convinced that a bold, transformative initiative is required. To this end, we recommend the establishment of multidisciplinary Discovery-Innovation Institutes on university campuses designed to perform the engineering research that links fundamental scientific discovery with the technological innovation to create the products, processes, and services needed by society.



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

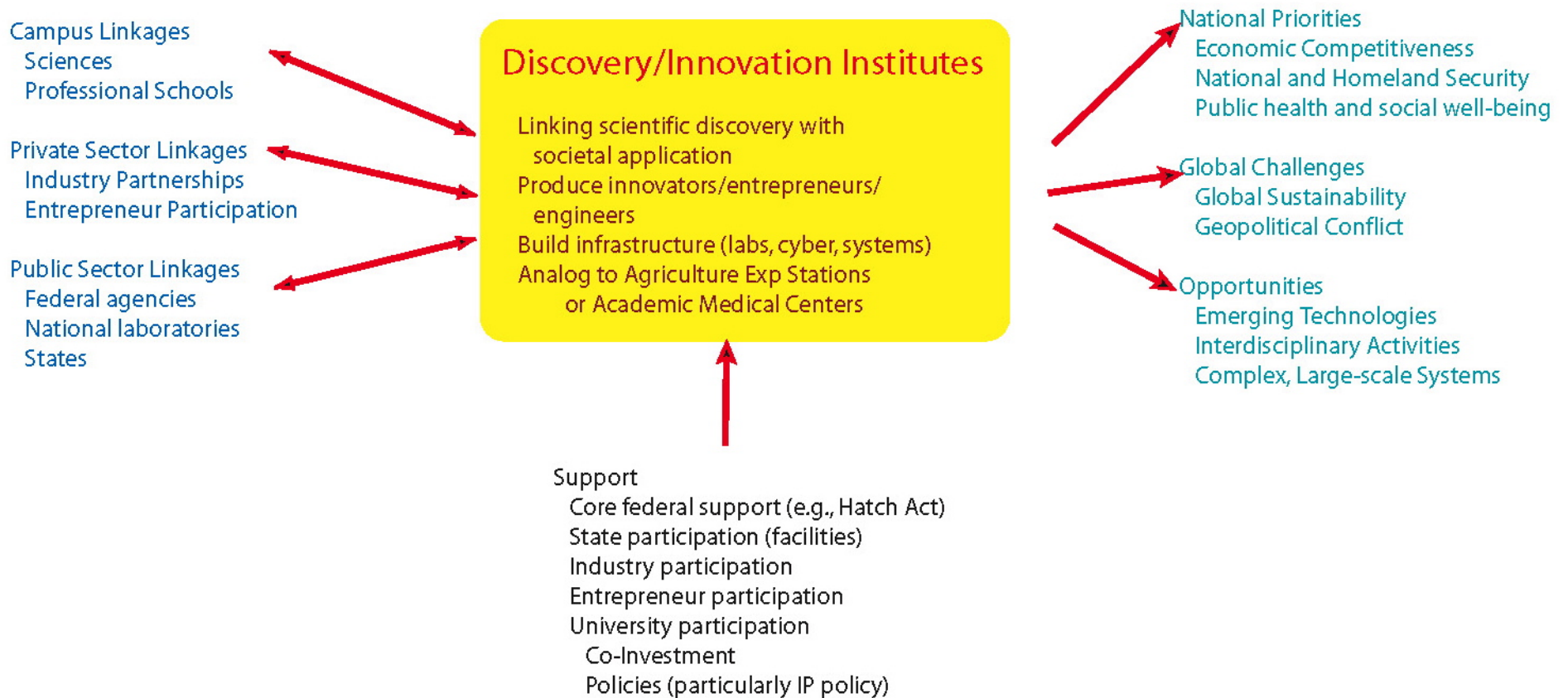
Emerging technologies
Interdisciplinary activities
Complex large-scale systems

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 CR&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.



Michigan Agricultural Experiment Station

Home Field Stations Initiatives News & Articles Proposals Publications Research Links



[Environmental Stewardship and Natural Resources Policy and Management](#)

(4.7 MB, PDF)

Environmental stewardship and natural resources policy and management is one of five target areas driving the MAES research agenda over the next

decade. It is a broad area, encompassing land use, air quality, soil conservation, waste management, landscape ecology, ecosystem management and water research. In this issue of Futures, we highlight just a small fraction of the MAES research being done in these areas.

The MAES is conducting a national search for a director. For more information, please visit the [MAES Director Search](#) web page.



- [MSUE Director Named](#)
- [MAES Scientists Honored at Founders' Day Celebration](#)
- [MAES Welcomes New Scientist](#)
- [U.S.-Canada Forestry Symposium to Address Trade](#)
- [March Water Policy Workshops Focus on River Science and Drinking Water](#)
- [Understanding Pesticides in Tree Fruit Is Topic of March Workshop](#)
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Bell Labs Innovations



Bell Labs—Lucent Technologies' **innovation engine**—is taking the lead in shaping tomorrow's networks and helping customers solve their most critical communications challenges.



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Discovery-Innovation Institutes

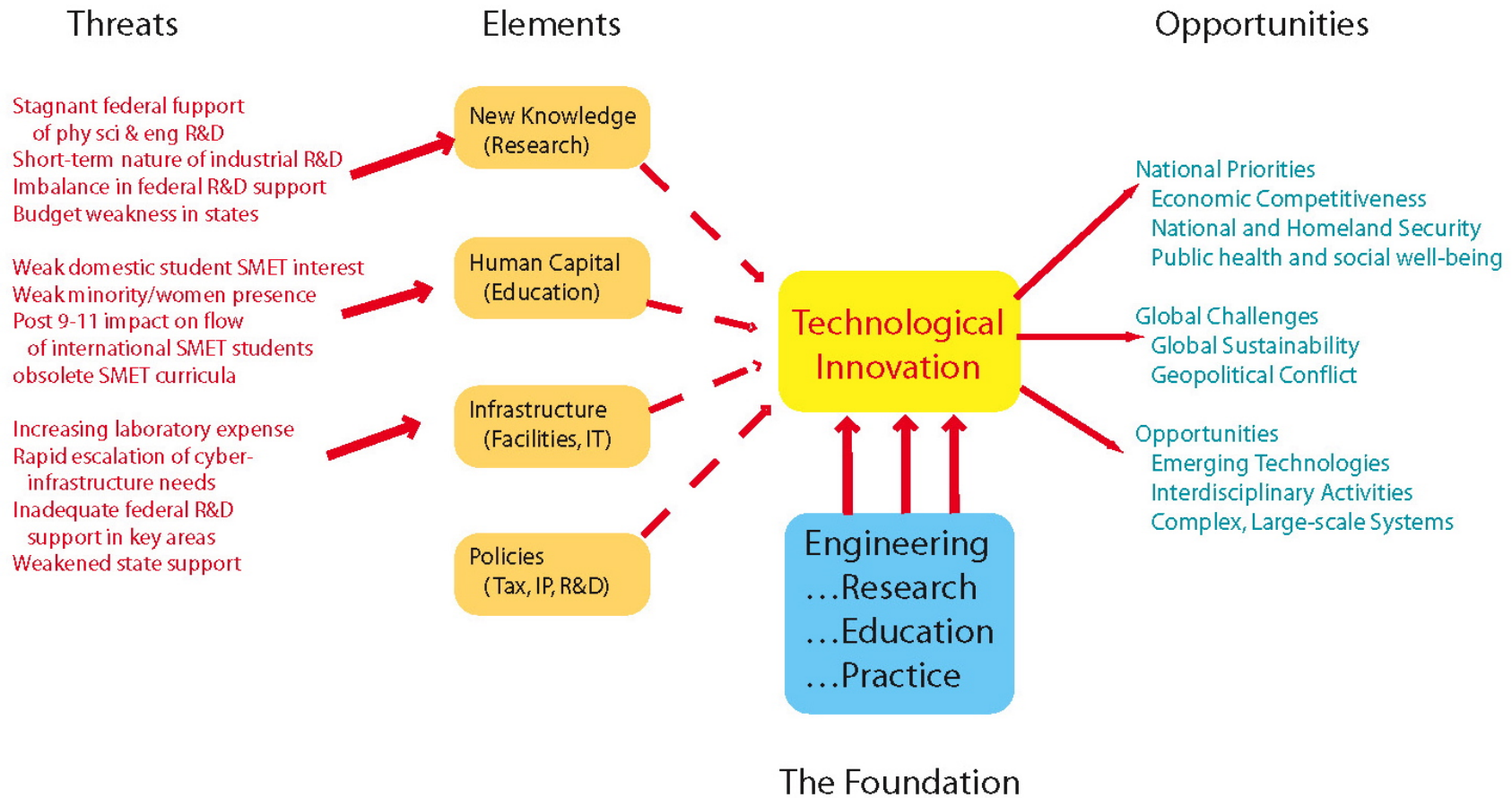
- Although primarily associated with engineering schools, DIIs would partner with other professional schools (e.g., business, medicine, law) and academic disciplines.
- To ensure the necessary transformative impact, the DII program should be funded at levels comparable to other major federal initiatives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



In summary

- DII 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.
- The DII proposal is designed to illustrate the bold character and significant funding level we believe are necessary to secure the nation's leadership in technological innovation.

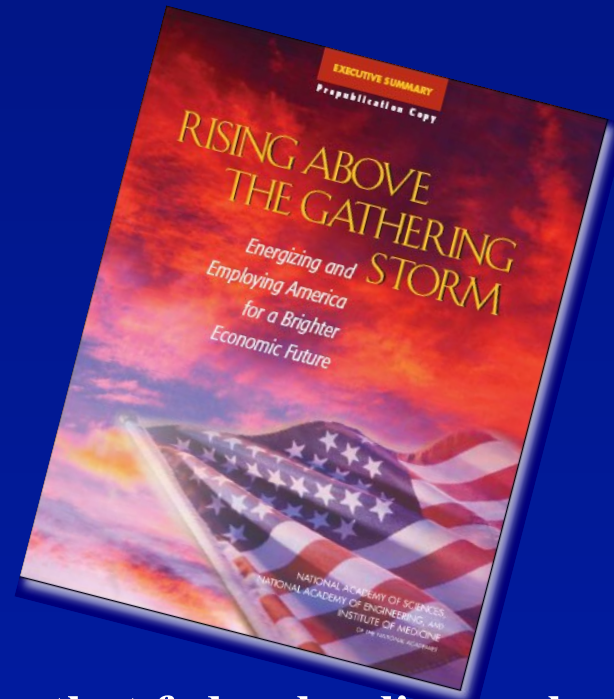






Allied National Academies Report

- **Rising Above The Gathering Storm:
Energizing and Employing America for
a Brighter Economic Future**
 - **Committee on Science Engineering and Public
Policy (CoSEPuP)**



Charge:

What are the top 10 actions, in priority order, that federal policy-makers could take to enhance the science and technology enterprise so that the United States can successfully compete, prosper, and be secure in the global community of the 21st Century? What strategy, with several concrete steps, could be used to implement each of those actions?



Rising Above the Gathering Storm

- **Strong agreement with research needs described in *Engineering Research and America's Future***
 - **Double federal support of long-term basic research over next 7 years**
 - **Create a program to support 200 of the nation's promising young researchers with grants of \$500,000 (over 5 years) at a cost of \$100 million per year when fully implemented**
 - **Institute a National Coordination Office for Research Infrastructure to manage a centralized research-infrastructure fund of \$500 million per year over the next 5 years**
 - **Provide federal research agencies with the discretion and resources to catalyze high-risk, high-payoff research**
 - **Create in the Department of Energy (DOE) an organization like the Defense Advanced Research Projects Agency (DARPA) called the Advanced Research Projects Agency-Energy (ARPA-E)**
 - **Institute a Presidential Innovation Award to stimulate scientific and engineering advances in the national interest.**



Rising Above the Gathering Storm

- Goes beyond the research-related recommendations in addressing other national challenges, including:
 - **Preparation of K12 Math and Science teachers: 10,000 Teachers, 10 Million Minds**
 - **Higher Education Policies: Developing the Best and the Brightest**
 - **Economic Policy: Incentives for Innovation**

Gathering Storm Report: Available at <http://books.nap.edu/catalog/11463.html>



How can Congress help?

- Resist efforts to cut federal R&D in physical science and engineering still further (e.g., FY2006 cuts planned for DOD 6.1-6.3, DOE Science, NASA Science, etc.)
- Provide appropriations to achieve authorization target of doubling the NSF budget.
- Enact a 21st Century National Education Defense Act for graduate student support (e.g., DOD).
- Provide tax incentives and regulatory relief to encourage basic research in industry.
- Launch a major interagency initiative to fund Discovery-Innovation Institutes.



Next steps

- Draft was first reviewed and then circulated in early 2005 to engineering community, stimulating almost 200 responses.
- Redraft was completed in April, cleared with Committee, and now out for final review (hopefully completed this week).
- Final report published in late May.



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- Redraft was completed in April, cleared with Committee, and now out for final review (hopefully completed this week).
- Final report published in late May.
- **And then the REAL work begins...**