



Computing Research Funding: Circling the Wagons or Expanding the Frontiers?



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June 2006

<http://lazowska.cs.washington.edu/snowbird/>

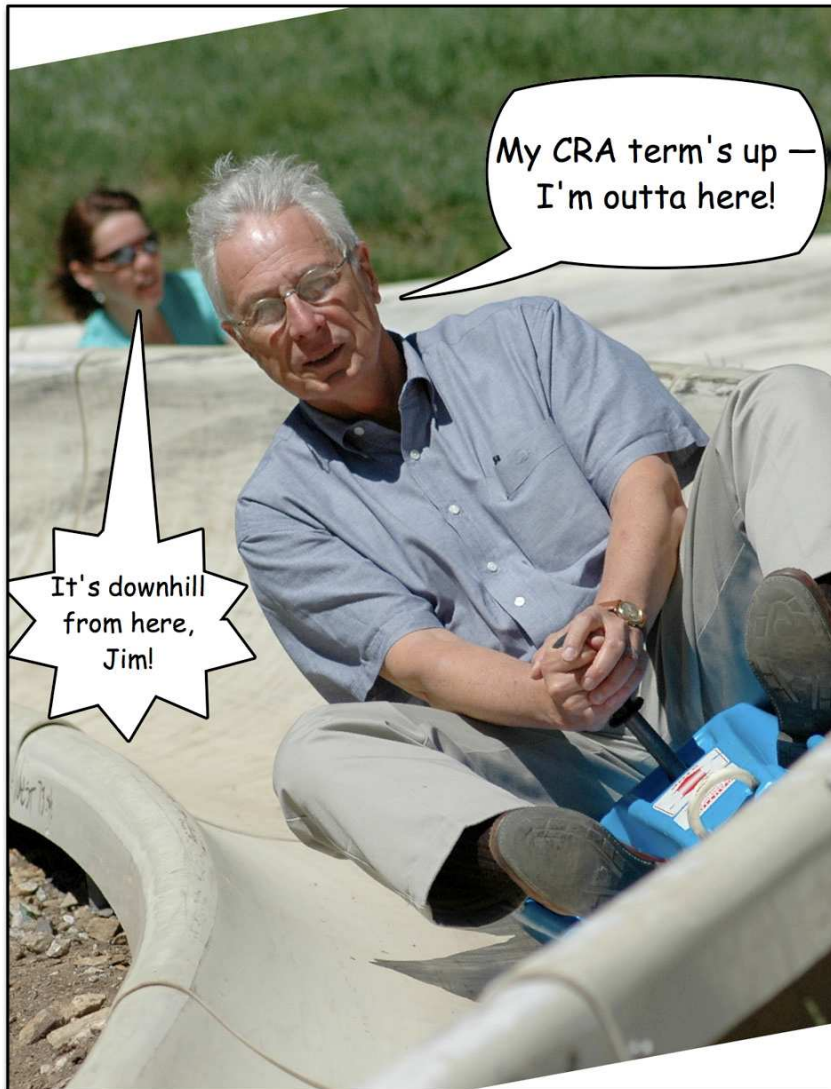
Snowbird 1998



Snowbird 1998



Snowbird 1998



Snowbird 1998

Computing Research Association

Opportunities

- **IT workforce issues are big news**
 - Information Technology Association of America
 - There's an existing labor shortage of 346,000 IT jobs in companies of 100 employees or more
 - One in ten IT jobs currently is vacant

Snowbird 1998

Computing Research Association

- Applications of what we have created are proliferating
 - From educational technology to astronomy
- Bandwidth is going through the roof
 - Prices are still in the attic, but that'll change
- The go-go companies are becoming politically active
 - TechNet

Snowbird 1998

Computing Research Association

- The opportunities for innovation have never been greater
 - We can achieve the prediction of Moore's Law for another few decades -- and the doublings actually matter now!

Snowbird 1998

Computing Research Association

- **Research funding may actually increase significantly**
 - Presidential Advisory Committee on High Performance Computing and Communications, Information Technology, and the Next Generation Internet (www.ccic.gov/ac/it-letter.html#letter)
 - President Clinton's commencement address at MIT (web.mit.edu/newsoffice/nr/1998/clintonspeech.html)

Snowbird 1998

Computing Research Association

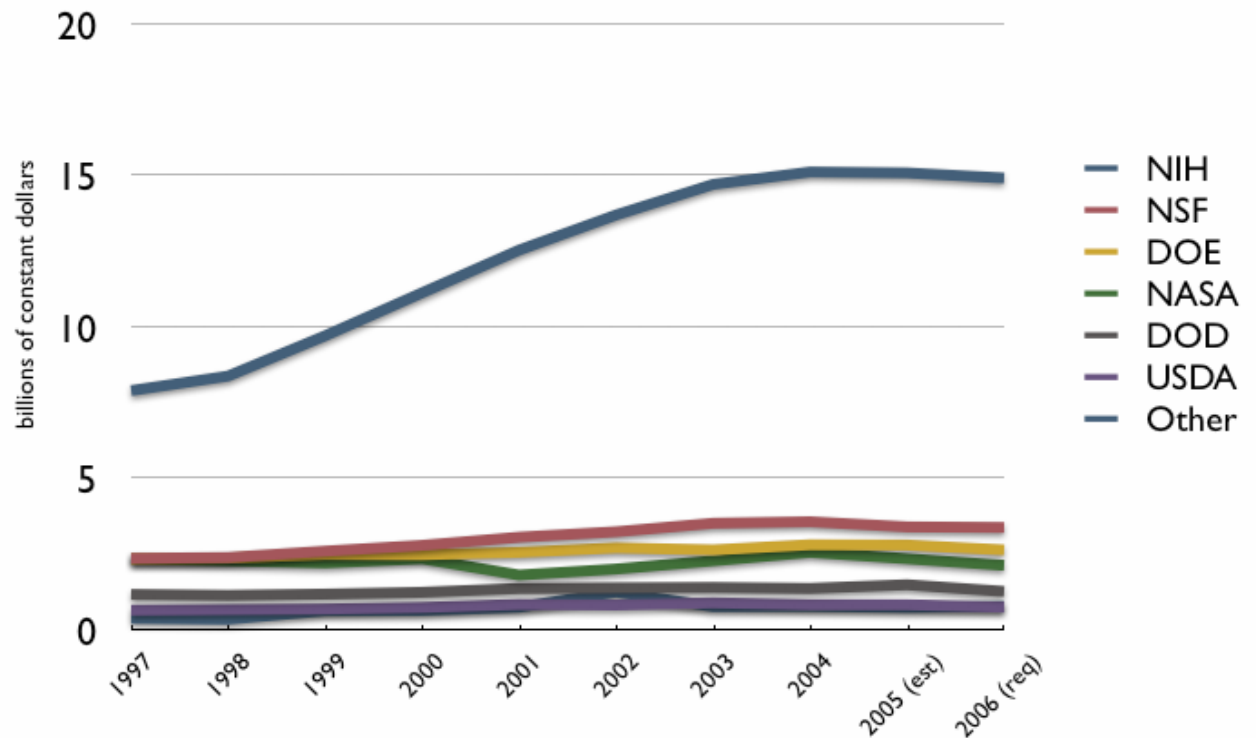
The Challenge

- Do we have the creativity to respond?
Or has it been squeezed out of us over
the past decade?
 - We must articulate a set of compelling
long-term research visions for our field
 - We must avoid our well-ingrained tendency
to circle the wagons and shoot inwards

This time last year ...

⌘ Austere research budgets as far as the eye could see

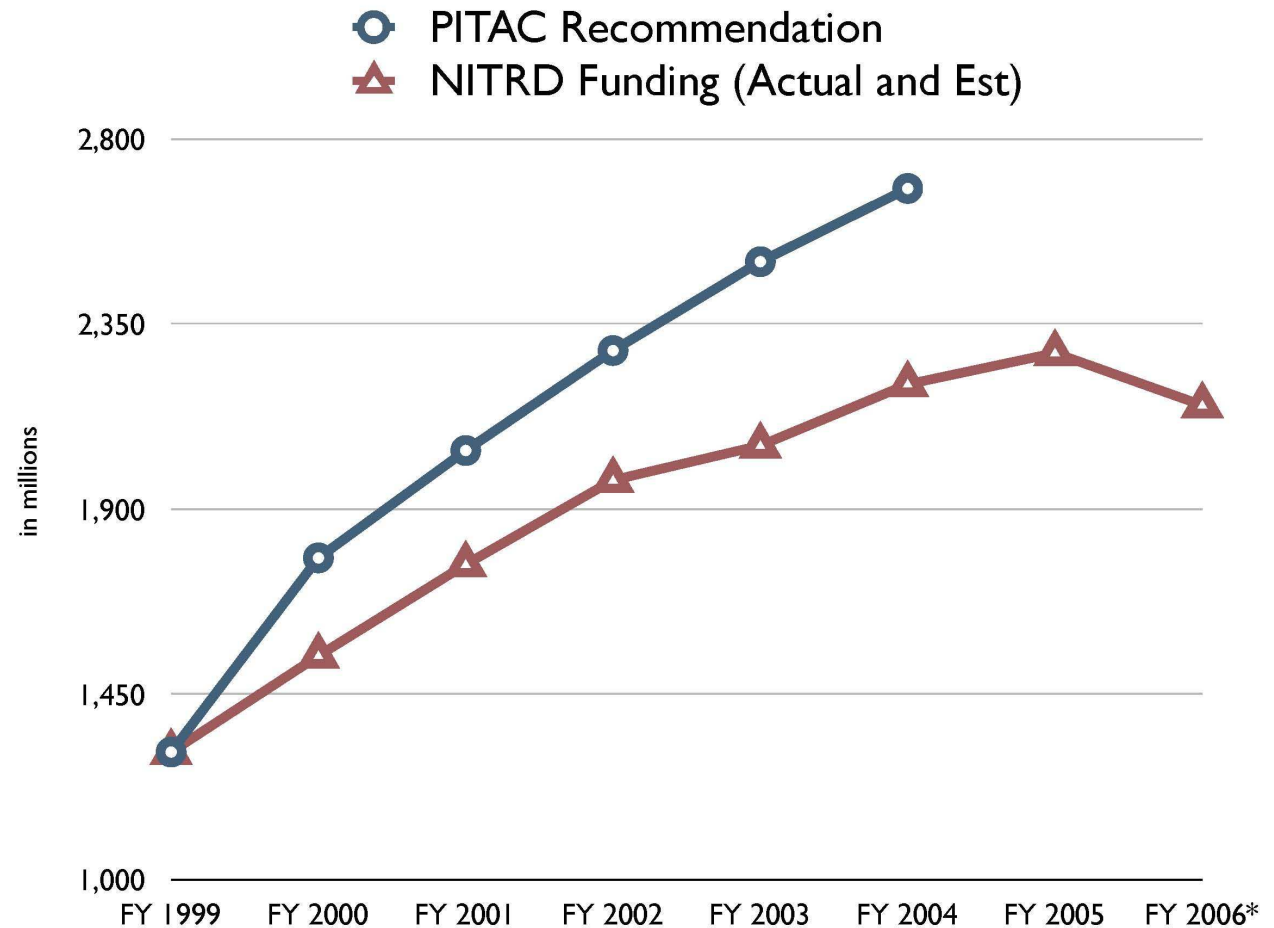
Trends in Basic Research, by Agency
FY 1997 - 2006



Source: AAAS Reports I through XXX, based on OMB and agency R&D budget data.
Includes conduct of R&D and R&D facilities.
Constant dollar conversions based on OMB's GDP deflators from the FY 2006 budget.

This time last year ...

⌘ NITRD flat-lined and headed downward



This time last year ...

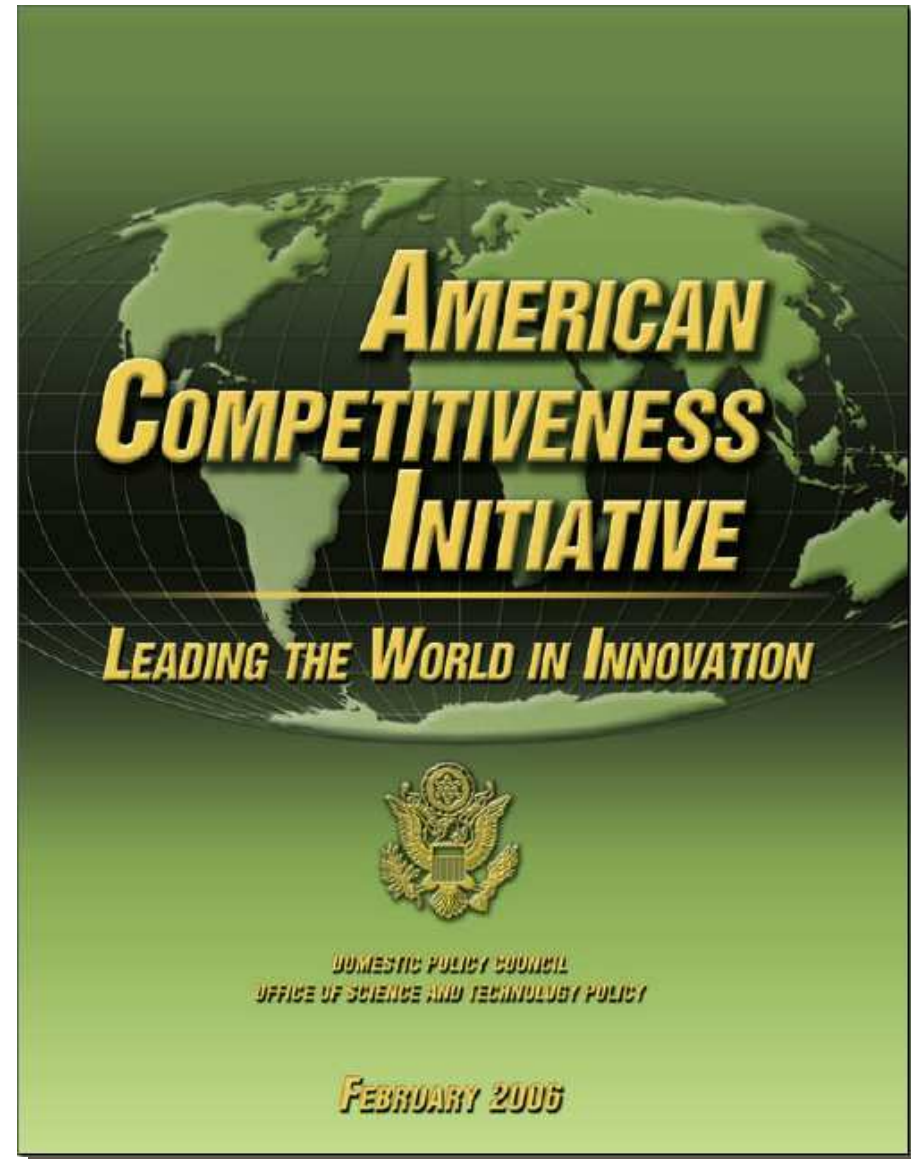
- ⌘ PITAC and PCAST marginalized; Administration apparently oblivious to many things, including that our national competitiveness was at risk

FoOT in MoUTH

by Ross P. Kettle



Then, on January 31 2006 ...



Elements of the ACI



⌘ Research

- ⌘ Commitment to double NSF, DoE SC, NIST over 10 years
- ⌘ Make permanent the R&D tax credit

⌘ Education

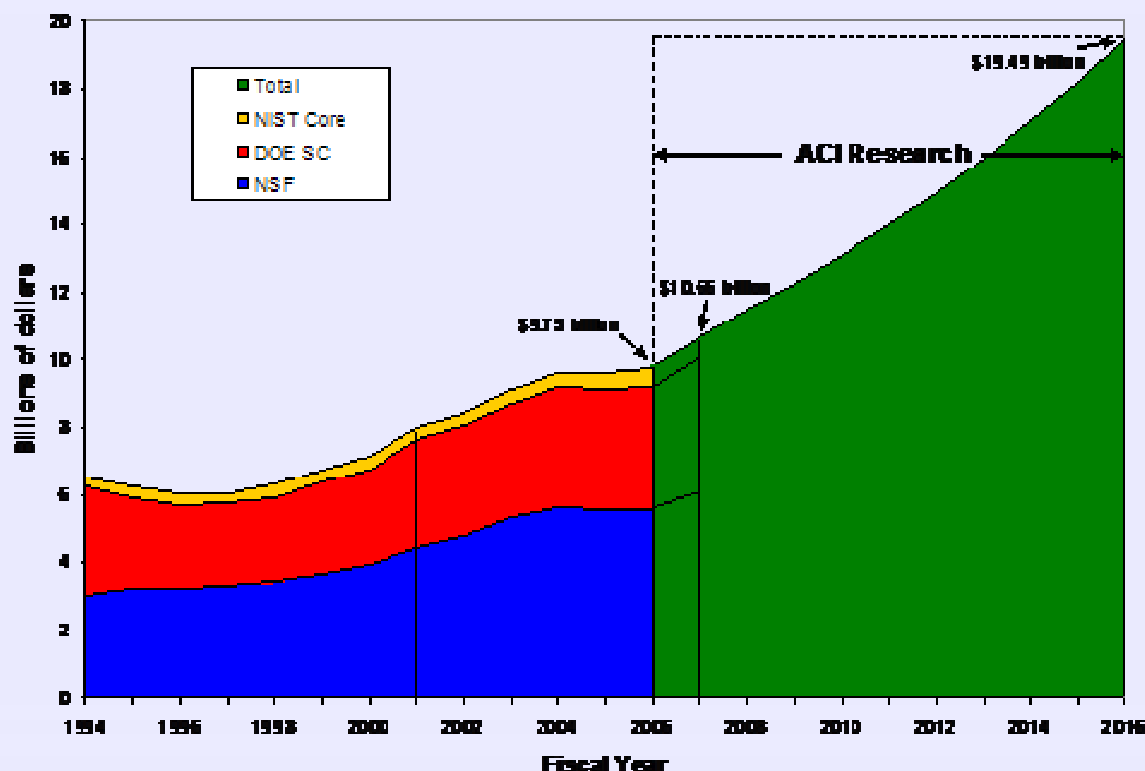
- ⌘ 70,000 new teachers, alternative teacher certification, bolster AP, improve participation in math and science

⌘ Workforce/Immigration

- ⌘ Expand worker training programs
- ⌘ Flexible H-1B caps, reform visa issues

Figure 1: ACI Research Funding, 2007-2016.

American Competitiveness Initiative Research: FY 2007- FY 2016



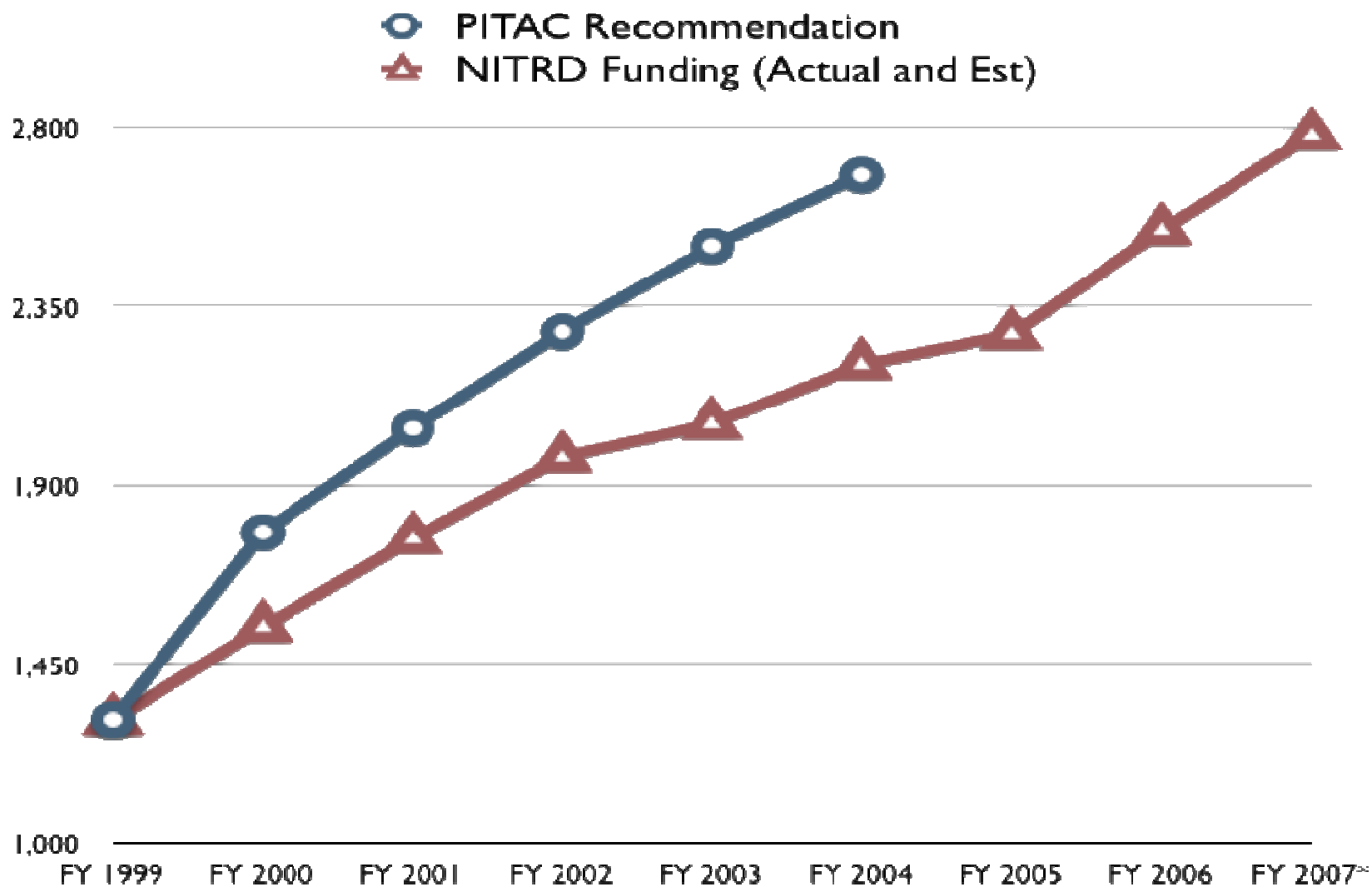
	FY 2006 Funding	ACI Research FY 2007		ACI Research FY 2016	
	(billions of dollars)	(billions of dollars)	% increase	(billions of dollars)	% increase over FY06
NSF	\$5.58	\$6.02	7.8	\$11.16 ¹	100.0
DoE SC	\$3.60	\$4.10	14.0	\$7.19 ¹	100.0
NIST Core ²	\$0.57 ³	\$0.54	-5.8 ⁴	\$1.14 ¹	100.0
TOTAL	\$9.75	\$10.66	9.3	\$19.49	100.0

¹ ACI doubles total research fund; individual agency allocations remain to be determined.

² NIST core consists of NIST lab research and construction accounts.

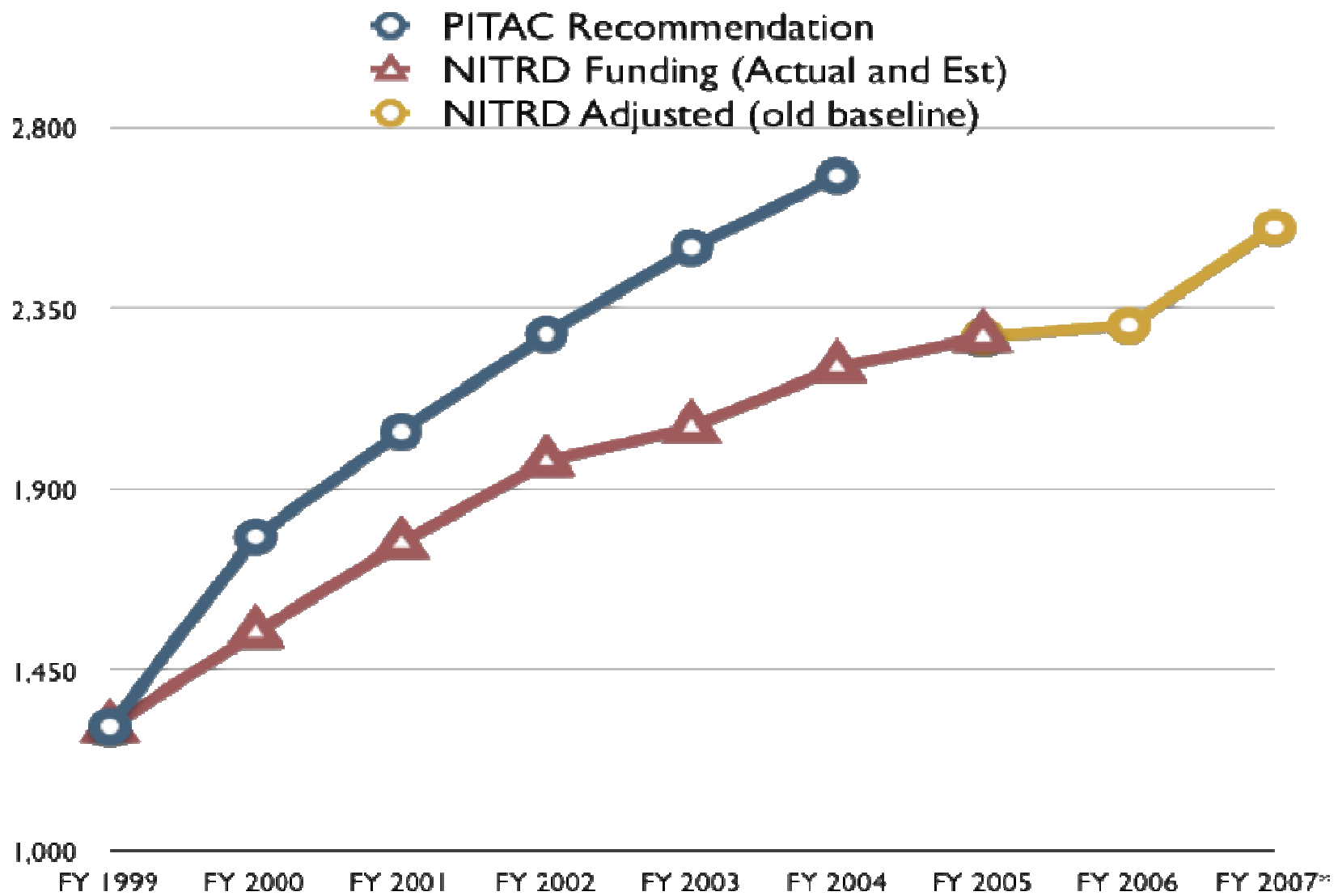
³ The 2006 enacted level for NIST core includes \$137 million in earmarks.

⁴ Represents a 24 percent increase after accounting for earmarks.



Sources: *Investing in Our Future*, PITAC, 1999; NCO/IT R&D, 2004

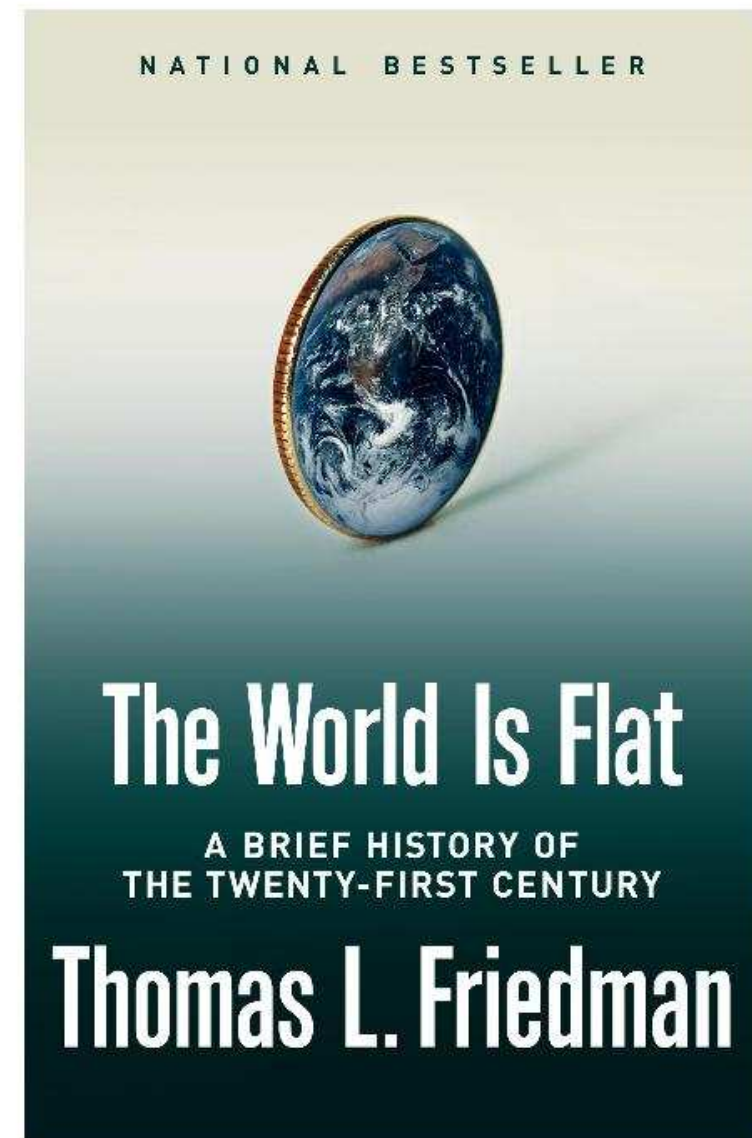
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Sources: *Investing in Our Future*, PITAC, 1999; NCO/IT R&D, 2006

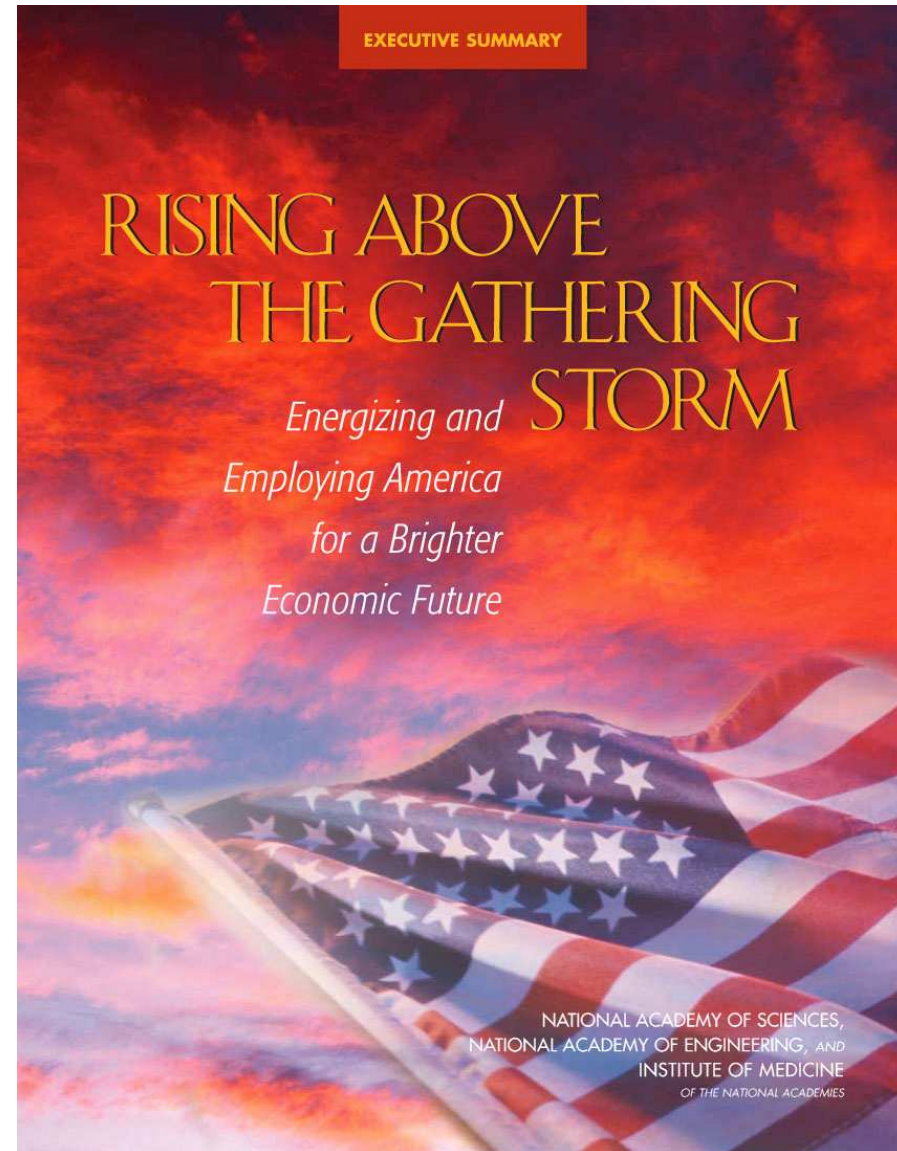
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How did we get there?



Among the key
influencers/marketers:

Norm Augustine
Chuck Vest
Lamar Alexander
John Chambers
Craig Barrett
Gordon Moore
Bill Brody
CoC/InnovateAmerica





WHERE IN THE WORLD WILL THE NEXT BIG IDEA COME FROM?

The United States has long been the acknowledged world leader in innovation, a strength that is the foundation of America's national security and future job growth. But today, other countries are building world class research and educational institutions and are graduating increasingly qualified science and engineering students at a faster pace than ever before.

Make no mistake: The search for scientific breakthroughs and new technologies will go forward whether we lead or follow. To remain at the forefront, America must increase investments in basic research, improve math and science education, provide incentives for research and development and attract and retain the brightest minds from all around the globe.

We call on our leaders to help keep America the driving force in innovation.

www.InnovateAmerica.org

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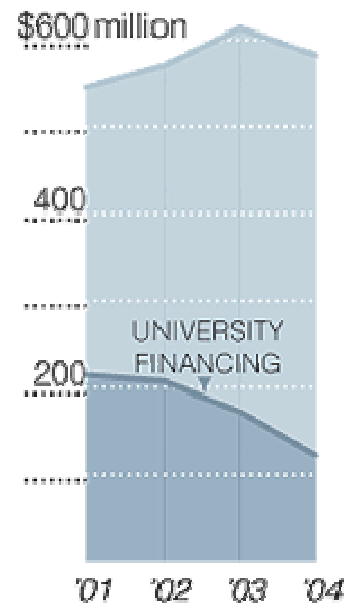
The New York Times

Pentagon redirects its research dollars

by John Markoff

April 2, 2005

Darpa total computer science financing



Source: Darpa

The Washington Post

Our Incredible Shrinking Curiosity

by Rick Weiss

April 10, 2005

The New York Times

Research worth fighting for

OpEd by John M. Deutch and
William H. Perry

April 13, 2005

The New York Times

Bush disarms, unilaterally

OpEd by Tom Friedman

April 15, 2005

The Mercury News

Quiet Change in Priorities Poses Dire Threat

Editorial

April 17, 2005



**Bad Policy Choices are Worrisome for
U.S. Economy's Future**

by Norman J. Ornstein

April 20, 2005



Congress Must Increase Bush's Science Budget

by Morton M. Kondracke

April 25, 2005



An Endless Frontier Postponed

OpEd by Ed Lazowska and
Dave Patterson

May 6, 2005





The Imagination Drain

Editorial

May 6, 2005



Scientists Complain About Pentagon Cuts

by Matthew Fordhal

May 11, 2005

The New York Times

Virtually Unprotected

Editorial

June 2, 2005

THE WALL STREET JOURNAL.

**America Gasps For Breath
in the R&D Marathon**

OpEd by Harris Miller and
Vint Cerf

July 27, 2005

The New York Times

**A Techie, Absolutely,
And More**

by Steve Lohr

August 23, 2005



Investing in Tomorrow

by Mort Zuckerman

September 8, 2005

The Washington Post

Ready for High-Tech Progress

by Sebastian Mallaby

October 17, 2005



WINNING THE INNOVATION RACE

Americans weary of partisan bickering in Washington might be surprised to learn that elected officials from both parties—along with leaders in business, labor and education—are joining forces to address one of the nation's key long-term challenges: winning the innovation race.

Across the political spectrum, there is growing consensus that America's future economic competitiveness largely depends on scientific and technological innovation—and that steps must be taken to ensure our economy remains among the most innovative in the world. Other countries are building cutting-edge research and educational institutions, and graduating increasingly qualified science and engineering students in greater numbers than ever. That puts the U.S. at a growing competitive disadvantage.

In his State of the Union address, the president announced the American Competitiveness Initiative, to encourage innovation throughout our economy. In Congress, several bills that are also aimed at boosting competitiveness through innovation have attracted wide, bipartisan support.

Action in Washington has been stimulated in part by reports from the National Academy of Sciences, the Council on Competitiveness, the Task Force on the Future of American Innovation and other groups representing an array of industry, education and workforce leaders. Each recommends policies to strengthen U.S.

leadership in science and technology in response to rising global competition.

Innovation requires a well-educated, highly skilled workforce. America needs to expand and improve education, particularly in math, science and engineering. Meanwhile, we need immigration policies that enable U.S. technology industries to hire talented foreign workers whose specialized skills are in short supply domestically.

Innovation also requires long-term investment in research and development. We need to sustain the federal government's historic commitment to support basic research, particularly in universities, and we should consider policies that would encourage additional private investment in R&D.

Amid growing global competition, the United States must reinforce the foundation of its prosperity.

Finally, innovation in science and technology requires a strong regulatory and physical infrastructure. We need to update and improve access to advanced information services, transportation, healthcare and energy. And we must encourage innovation by strengthening and modernizing how we protect intellectual property.

These and other recommendations form an innovation agenda that is winning wide support. What is most needed, however, is a sense of urgency. Worldwide, competition is intensifying and innovation is accelerating. For America to stay competitive, Congress must move on legislation with deliberate speed.

Learn more at microsoft.com/issues.

Microsoft

TIME

FURY OVER MUHAMMAD

IS AMERICA FLUNKING SCIENCE?

Our superiority was once the envy of the world. But we are slacking off just as other countries are getting stronger. What's the formula for a comeback?

BY MICHAEL D. LEMONICK



TIME

FROM THE MAGAZINE

Sunday, Feb. 05, 2006

Are We Losing Our Edge?

The U.S. still leads the world in scientific innovation. But years of declining investment and fresh competition from abroad threaten to end our supremacy

By MICHAEL D. LEMONICK


Gabriel Aeppli was born in Switzerland, but when he was 1 year old, his father came to the U.S. to pursue a career as a mathematician. Back then, America was a scientific "city on the hill," a place where enormous resources, academic freedom, a tradition of skepticism and a history of excellence lured everyone from astronomers to zoologists from all over the world, and like Aeppli's father, many of them never had any interest in leaving.

Aeppli, now 48, attended M.I.T., where he got a Ph.D. in electrical engineering, and went on to work at Bell Labs, the legendary research arm of AT&T. Then he moved on to the NEC research laboratory, outside Princeton, N.J., as a senior research scientist. But while industrial labs used to be well-funded havens for freewheeling scientific inquiry, says Aeppli, "my career was limited because opportunities to lead were very few." So he left for an academic job in Britain. He now holds a chair in physics at University College London and also directs the London Center for Nanotechnology. "I've been able to start with a clean sheet of paper and create something unique in a world-class city," he says. "We doubt that could be done anywhere else."

Edison Liu is a Hong Kong native who studied in the U.S. and eventually rose to become director of the division of clinical sciences at the National Cancer Institute. But in 2001 the government of Singapore made him an offer he couldn't refuse: the directorship of the brand new Genome Institute along with a \$25 million starting budget--part of a \$288 million integrated network of life-science research centers and biotech start-ups called Biopolis. Says Liu: "I came because I saw that the entire leadership of the country, the fabric of the country was thirsting for biology."

If those were just isolated cases, they would be easy to dismiss. Such stories, though, have become disturbingly common. After more than a half-century of unchallenged superiority

The point is not to be self-congratulatory or to over-state the role that we played



⌘ But we *did* have a strategy and it *was* effective!

⊞ Get the facts straight about DARPA and computer science

⊞ This really got the ball rolling!

⊞ Hitch ourselves to the Duderstadt and Augustine National Academies reports, rather than going it alone

⊞ We became the poster children for their message

The road ahead ...

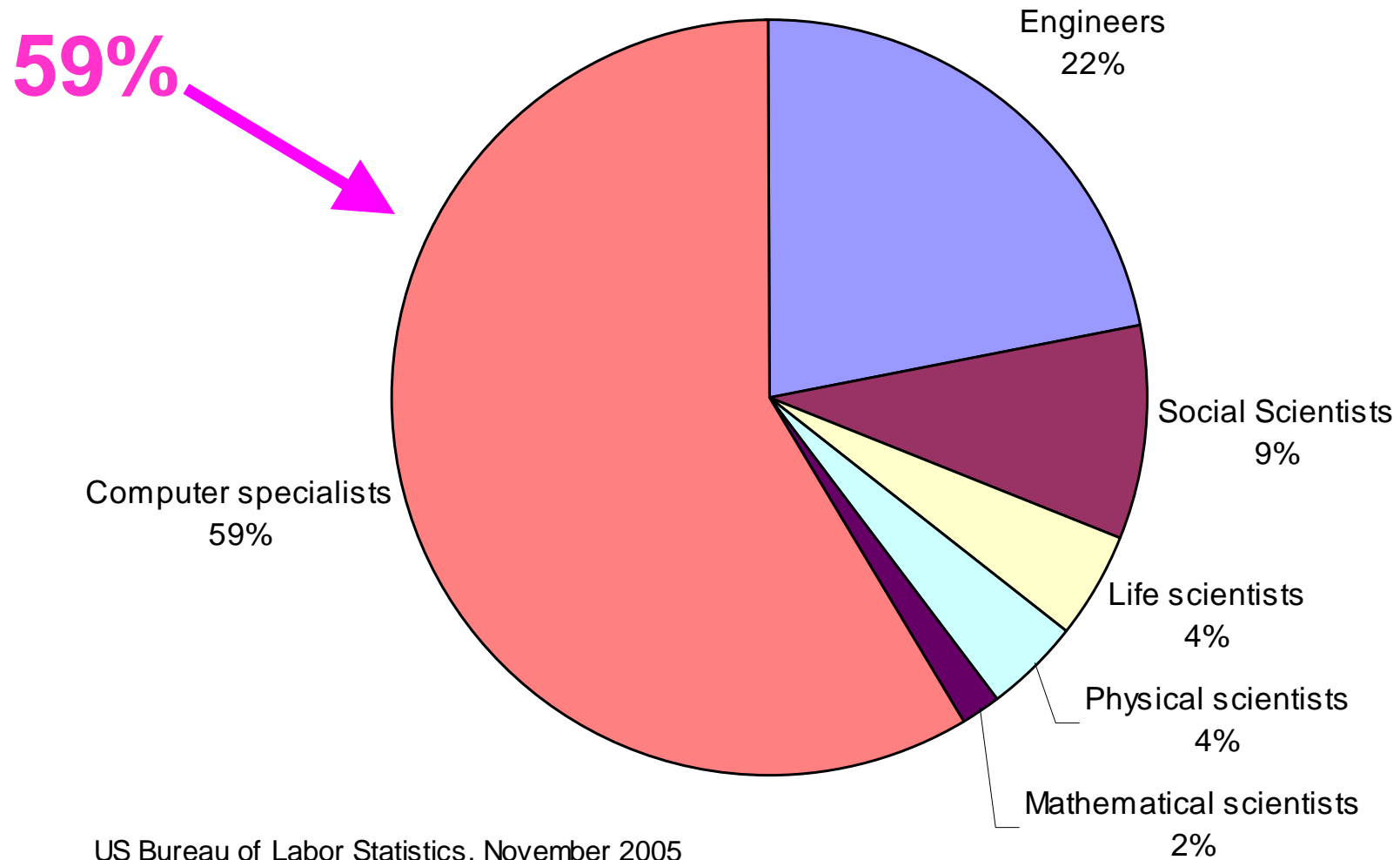


- ⌘ Gotta get the money for science and engineering overall
 - ☒ The ACI is not a done deal - there are many competing priorities
- ⌘ Gotta be sure that IT is not viewed as yesterday's news
 - ☒ Must articulate multiple compelling research visions!
- ⌘ Gotta improve the perception of the field -- and the reality, as well
 - ☒ A great field for *all* people to study in and work in
 - ☒ A great foundation for *any* career

Why us? (Why computing?)

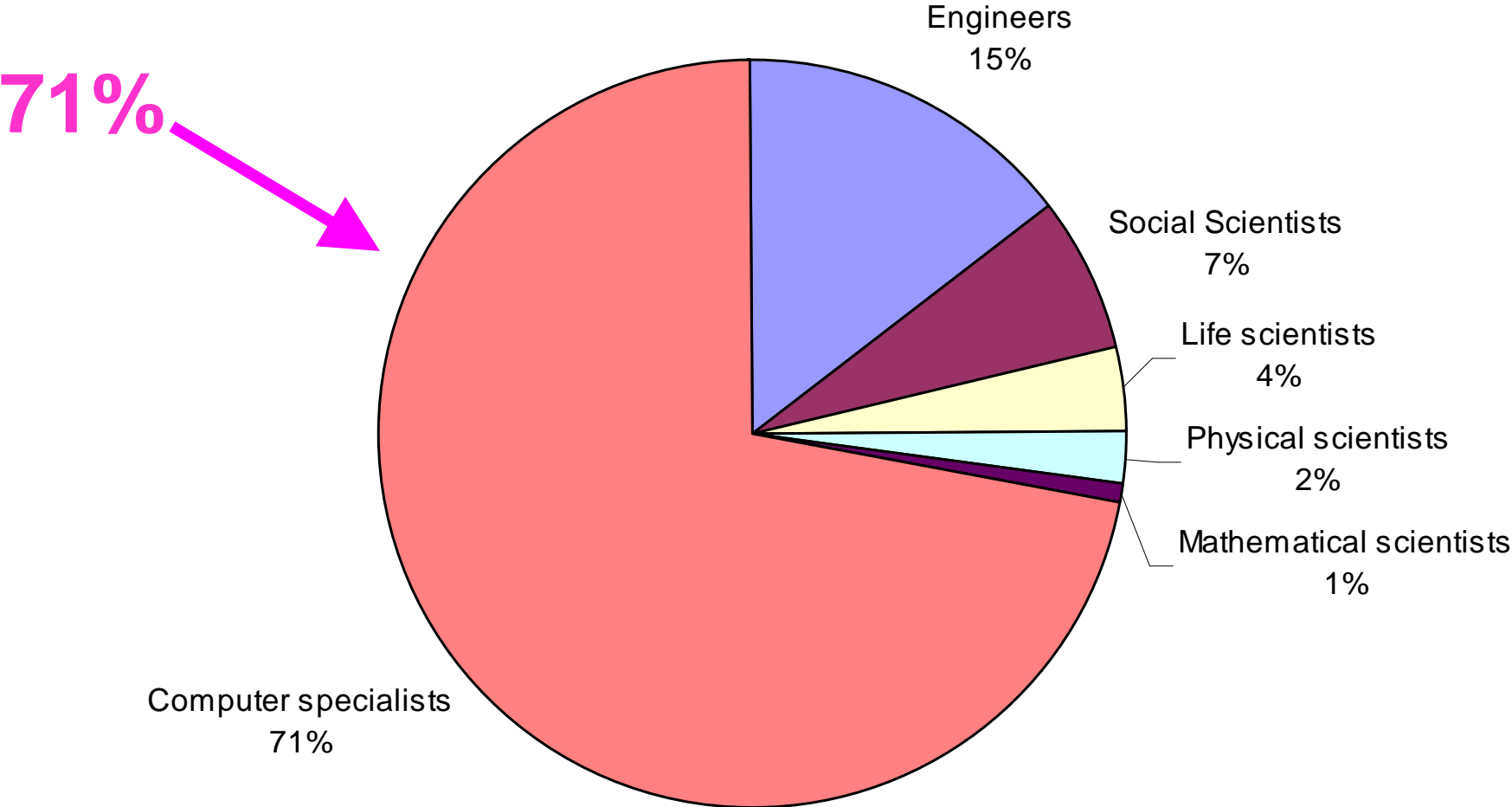
- ⌘ Advances in computing change the way we live, work, learn, and communicate
- ⌘ Advances in computing drive advances in nearly all other fields
- ⌘ Advances in computing power our economy
 - ⌘ Not just through the growth of the IT industry - through **Multi Factor Productivity Growth** throughout the economy
- ⌘ Advances in computing are the cornerstone of our national security
- ⌘ Computing is a field of huge intellectual opportunity
- ⌘ Computing is where the jobs are

Projected Science & Engineering Job Openings (new jobs plus net replacements, 2004-2014)



US Bureau of Labor Statistics, November 2005
<http://www.bls.gov/pub/mlr/2005/11/art5full.pdf>

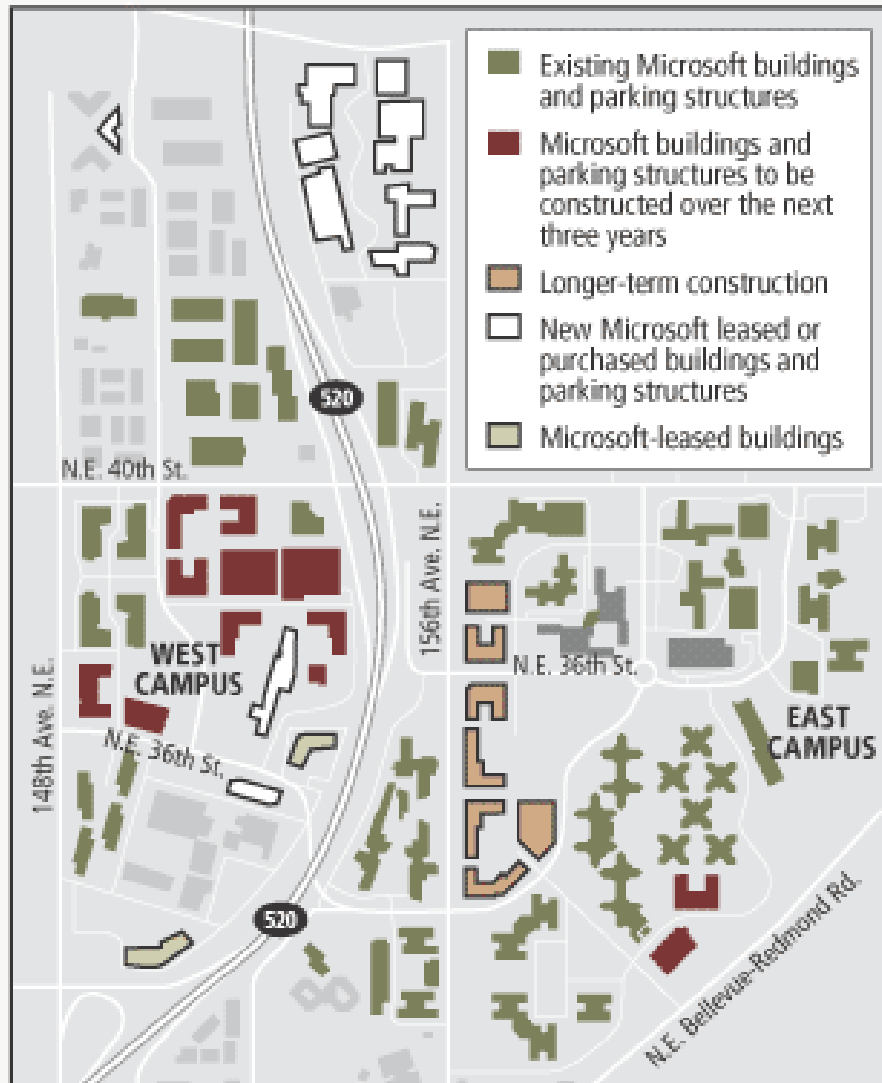
Projected Science & Engineering Job Creation (new jobs, 2004-2014)





EXPANSION IN REDMOND

Accelerating its expansion plans, Microsoft expects to add 14 buildings to its Redmond headquarters campus between now and mid-2009, through construction and real estate acquisitions.



Source: Microsoft Corp.

SEATTLE POST-INTELLIGENCER

Huge Microsoft expansion to ripple through region

STATE PRAISES SPEEDUP OF \$1 BILLION PLAN

Impact on jobs, economy, transportation projects

BY BRIER DUDLEY
Seattle Times technology reporter

Microsoft is adding the equivalent of two Googles to its Redmond

campus over the next three years, spending \$1 billion to build or buy 14 buildings with space for up to 12,000 employees. The plans, de-

tailed Thursday, would result in one of the world's largest corporate campuses, spread out on the woody plateau near Lake Sammamish.

Government officials said the project would boost the state economy and could add momentum to regional transportation

projects, including plans to replace the Evergreen Point Floating Bridge.

Gov. Christine Gregoire said the project also challenges the state to improve its education system, so that state residents have a better chance of filling the new jobs.

Please see > **MICROSOFT, A16**

Expansion by the numbers

3.1 million: Square footage being added.

10 million: Campus's total square footage after expansion.

Up to 12,000: Employees to be accommodated by the expansion.

30,255: Number of Microsoft employees in Puget Sound area. There are 63,564 worldwide.

Source: Microsoft

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Saturday, June 24, 2006 - Page updated at 12:00 AM

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Big Google ideas generated here

By **Kristi Heim**

Seattle Times business reporter

Google hasn't talked much about it until now, but its Seattle-area office has been quietly cranking out influential ideas and products in the less than two years since it opened.

In fact, roughly 60 percent of the products shown by Google co-founder Larry Page at the Consumer Electronics Show in January had their start in Kirkland.

The office Google calls its Seattle Engineering Center is on two floors of a nondescript office building in Kirkland. It has all the standard Google trappings, such as a massage room, Ikea furniture in bright primary colors, soft beanbag chairs and a cafeteria serving gourmet organic fare. There are wine-and-cheese receptions every Friday afternoon with Page and co-founder Sergei Brin on videoconference.

"This office wasn't started that long ago "

◀ PREV 2 of 3 NEXT ▶

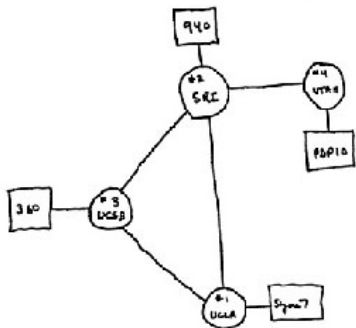


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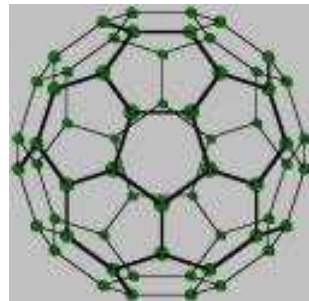
Alan Eustace, Google's senior vice president of engineering, visited the Kirkland office Friday.

Intellectual opportunity

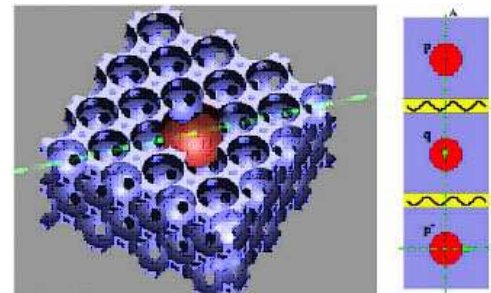
⌘ "... the software industry is going to make more breakthroughs in these next 10 years than it's made in the last 30 ... software is really going to transform not just what we think about as the computer industry, but the way that everything is done ..."



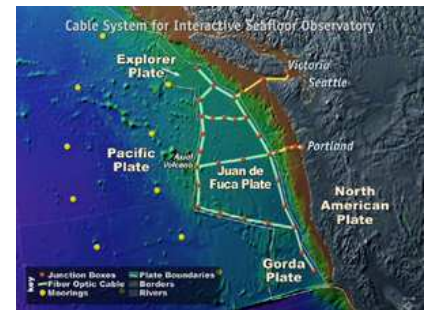
Re-architecting the Internet



Harnessing parallelism



Quantum computing



Transforming all fields of science and engineering

2020 SCIENCE

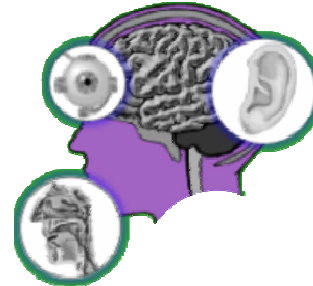




Wreckless driving



A teacher for every learner



Prosthetics / augmentation / access



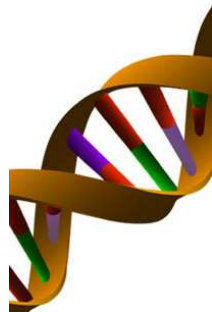
Personalized Health care



Flattening the world



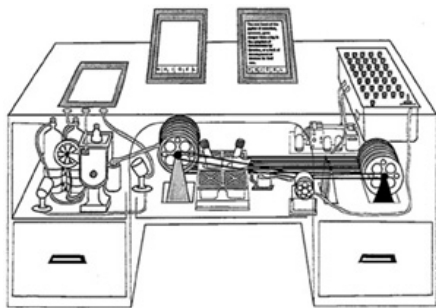
Computing, innovation, and creativity



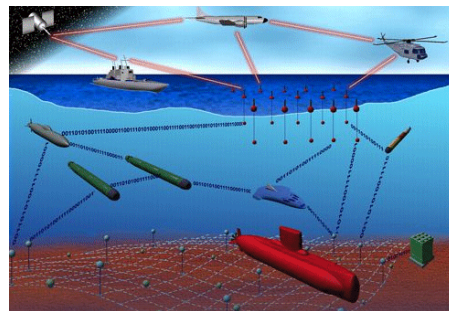
Computational biology and medicine



The end of business travel



The personal Memex



Transforming the nation's defense



Synthetic biology



60TH anniversary
IEEE Φ computer society



USENIX **CASC**

Computing Research Funding Task Force



Publications



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Computing Community Consortium (CCC)

⌘ Response prepared on behalf of CRA by

Andy Bernat

Ed Lazowska

Randy Bryant

Peter Lee

Susan Graham

Dan Reed

Anita Jones

Wim Sweldens

Dick Karp

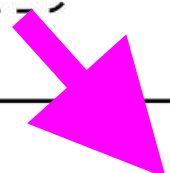
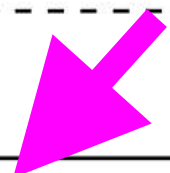
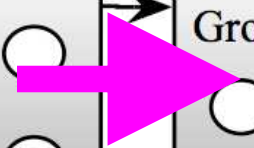
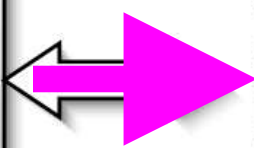
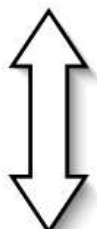
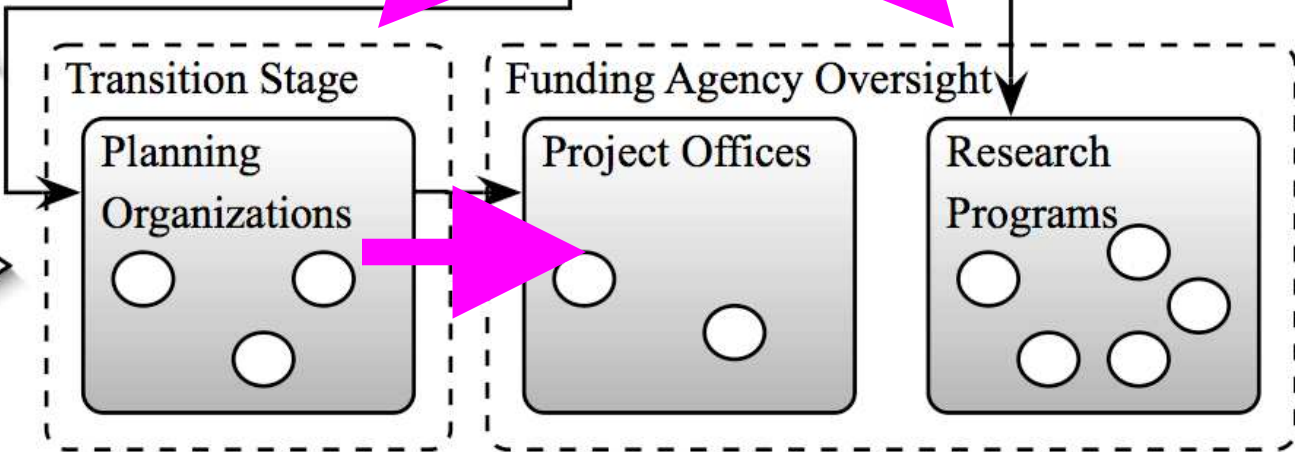
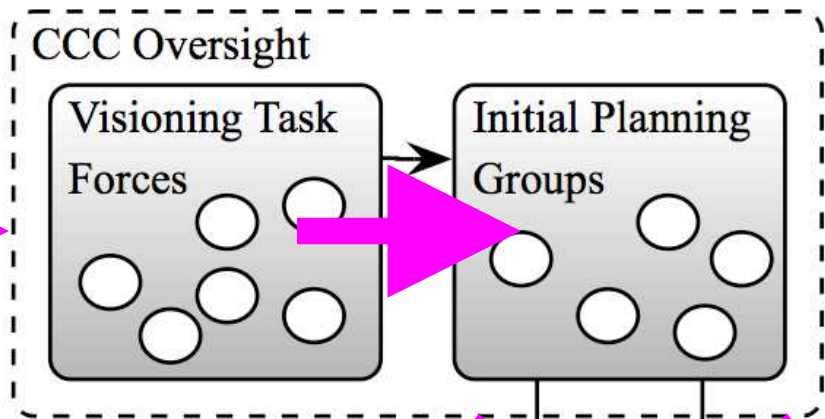
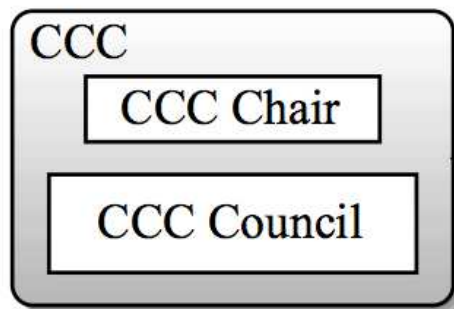
Jeff Vitter

Ken Kennedy

⌘ Support letters from 132 academic institutions, 16 companies, 7 centers/labs, 5 professional societies

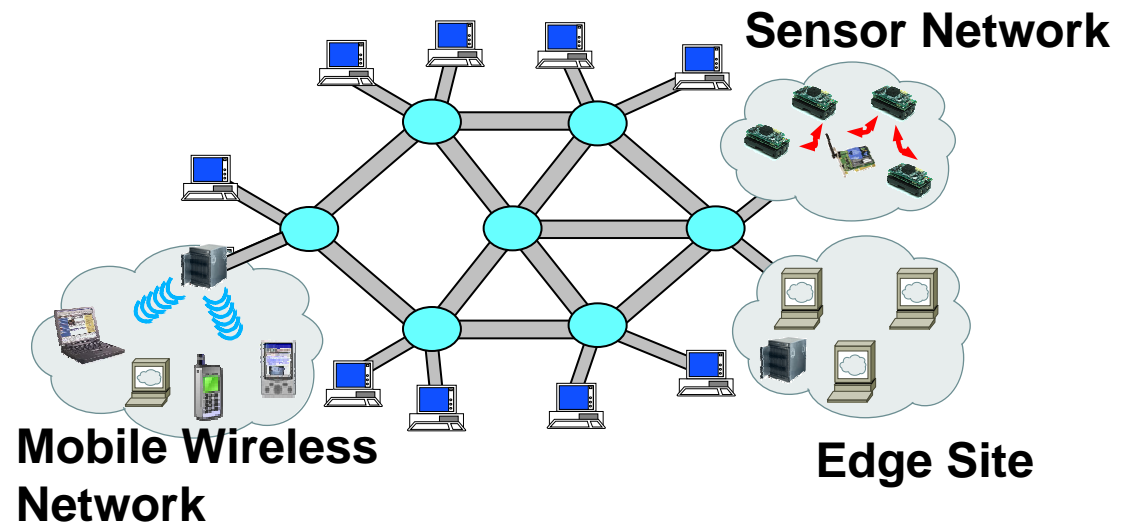


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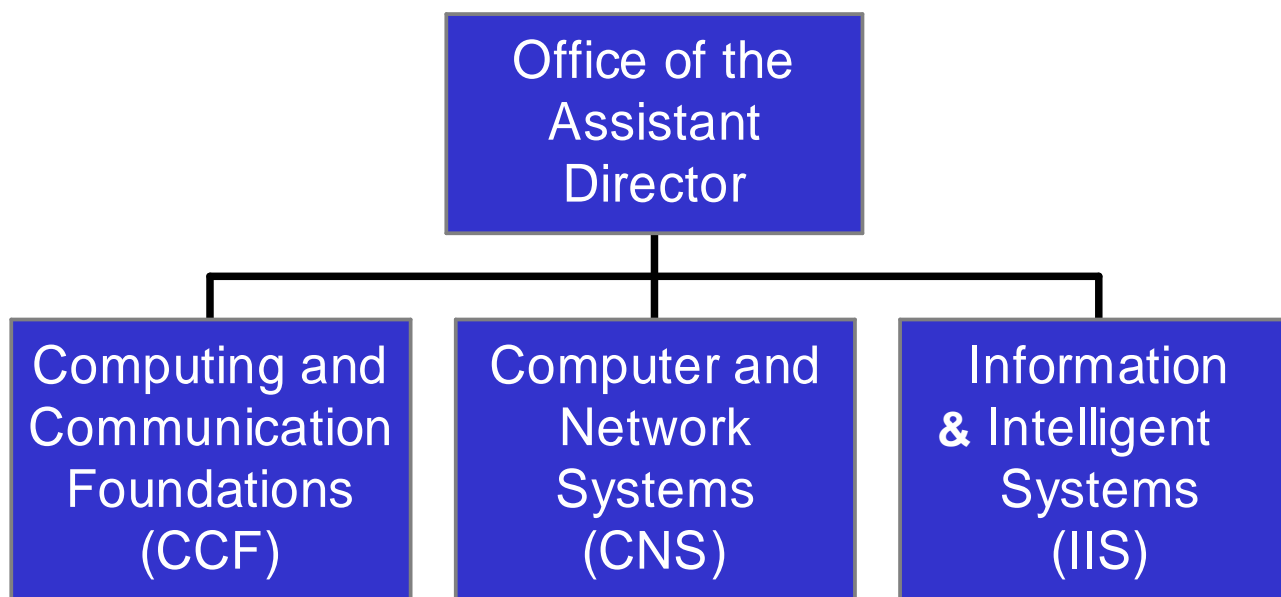




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Last Updated: December 1, 2005



Computer Science Study Group (CS2G)

- DARPA program (in conjunction with IDA) to fund research up to \$750,000 in broad computer science and information management/processing to provide revolutionary advances in problems of significance to DoD
- Eligibility – U.S. citizen, tenure-track junior faculty in any department, eligible for classified security clearance

Computer Science Study Group Program

- First year – get Secret clearance, orientation on DoD organization and processes, visit operational, training and research activities and services to see first-hand and understand environment and challenges, attend research workshops, prepare research proposals
- Second year – receive grant up to \$500K, perform research at university, continue visits
- Third year – optional additional research up to \$250K with matching funds

Details at www.DARPA.mil

Contact Pete Kind, PKind@ida.org



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CIBC:Workshops:WorkshopCRC06

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 - 1.1 [Agenda](#)
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 - 1.4 [Workshop Presentations](#)
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CRA-NIH Computing Research Challenges in Biomedicine Workshop - June 15-16, 2006 [edit]

Bethesda Marriott Hotel, 5151 Pooks Hill Rd., Bethesda, MD
Register: <http://www.blsmmeetings.net/H1009> [↗](#) (by invitation only)

This meeting focuses on computational needs that are central to the mission of NIH. As noted in the 2004 NIH Roadmap vision, computing is essential to progress in biomedicine: The success of computational biology is shown by the fact that computation has become integral and critical to modern biomedical research. However, the report also noted the substantial and substantive challenges biomedical researchers face in embracing cutting-edge computing research, as well as those faced by computing researchers in understanding current and future biomedical computing needs: Because computation is integral to biomedical research, its deficiencies have become significant limiters on the rate of progress of biomedical research.

This workshop will address these and other associated challenges for realizing the synergies between these two fields that can drive both forward through cooperative effort.

The workshop participants will consist of a small number of invited leaders in computing and selected NIH Program Directors. The objective of the Workshop is not to create a report, but to develop a list of focused action items that will have impact within the NIH and computing communities.

Agenda [edit]

- [Workshop Agenda - CRA-NIH-Agenda06.pdf](#)

Participant List [edit]

- [Participant List - CRA-NIH_2006_Participant_List.pdf](#)

Workshop Overview and Goals Slides [edit]

- [Overview and Goals - CRA-NIH_2006_Workshop-Goals.ppt](#)

Workshop Presentations [edit]

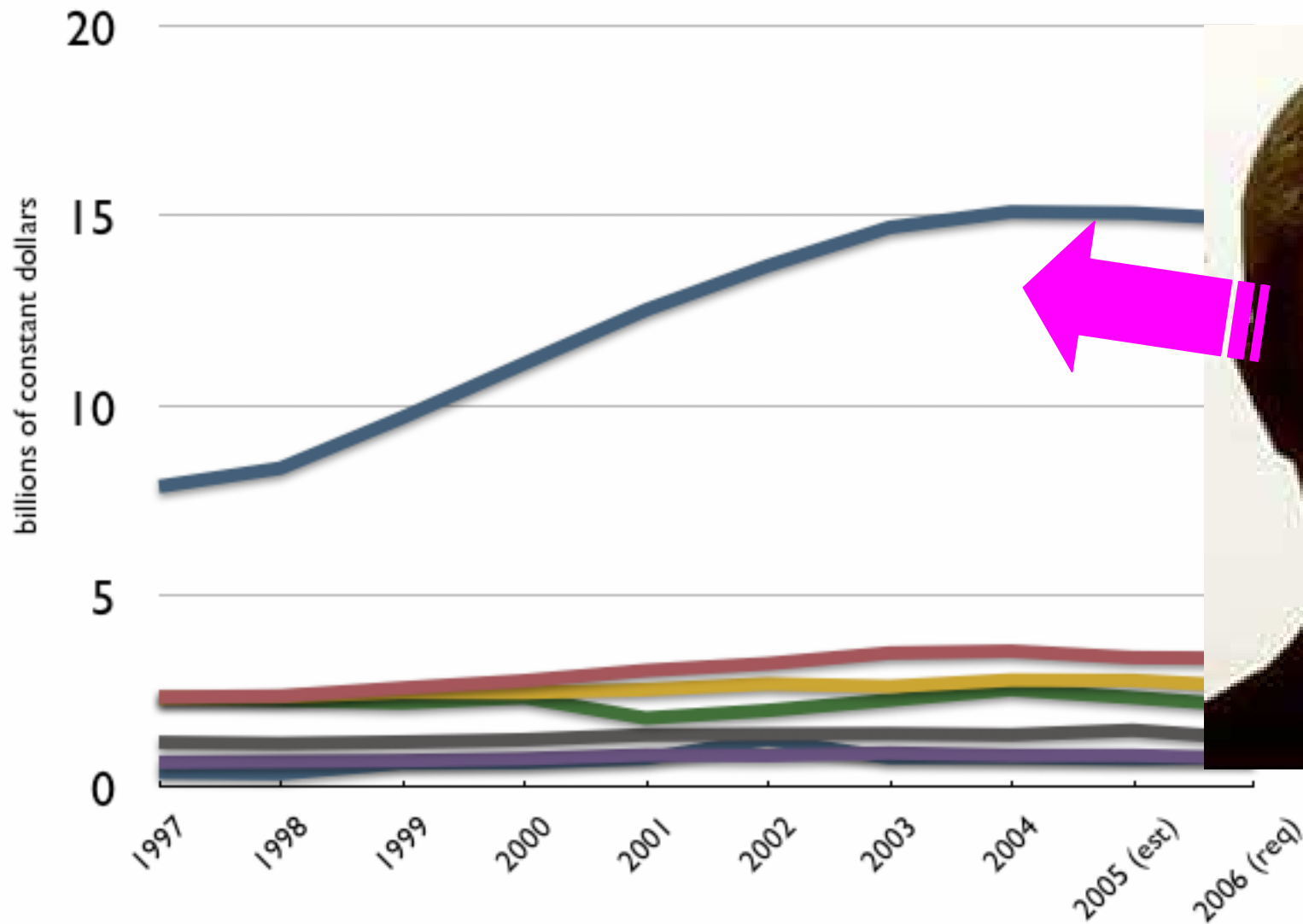
- [Chris Johnson's Presentation \(Large 61MB\) - CRA-NIH-Workshop06-Johnson.pdf](#)
- [Lee Hood's Presentation](#)
- [Jill Mesirov's Presentation](#)
- [Dan Reed's Presentation \(Large 15MB\) - CRA-NIH-Reed06.pdf](#)

Working Group Slides [edit]

- [Red Team Slides - CRA-NIH_2006_RedTeam.ppt](#)
- [Blue Team Slides - CRA-NIH_2006_BlueTeam.ppt](#)
- [Green Team Slides - CRA-NIH_2006_GreenTeam.ppt](#)

NIH

Trends in Basic Research, by Agency FY 1997 - 2006



**Willy
Sutton**

Source: AAAS Reports I through XXX, based on OMB and agency R&D budget data.
Includes conduct of R&D and R&D facilities.
Constant dollar conversions based on OMB's GDP deflators from the FY 2006 budget.

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National Asset

Rich Heritage

Preparing for the Future

Responsible Citizen

New!
Kids Page



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⌘ Contact Fred Chang, in attendance at Snowbird



⌘ Lab R&D is vibrant!

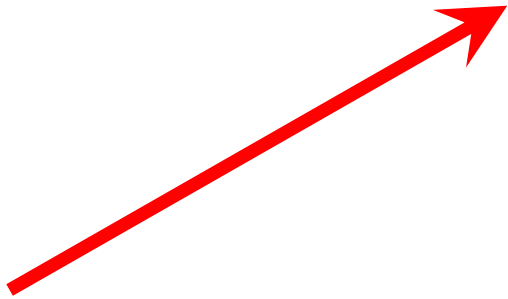
Accenture Technology Labs
Argonne National Laboratory
Avaya
CA Labs
Computer Science Research Institute
at Sandia National Labs
Fraunhofer Center for Experimental
Software Engineering
Fujitsu Laboratories of America
Google
Hewlett-Packard Company
IBM Research
IDA Center for Computing Sciences
Intel Corporation
Lawrence Berkeley National Laboratory
Los Alamos National Laboratory
Lucent Technologies, Bell Labs

McAfee Research
Microsoft Corporation
Mitsubishi Electric Research Labs
National Center for Atmospheric
Research
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NTT DoCoMo USA Labs
Pacific Northwest National Laboratory
Panasonic Information & Networking
Technologies Lab
Ricoh Innovations
San Diego Supercomputer Center
SAP Labs
SRI International
Sun Microsystems
Telcordia Technologies

The road ahead ...



- ⌘ Gotta get the money for science and engineering overall
 - ☒ The ACI is not a done deal - there are many competing priorities
- ⌘ Gotta be sure that IT is not viewed as yesterday's news
 - ☒ Must articulate multiple compelling research visions!
- ⌘ Gotta improve the perception of the field -- and the reality, as well
 - ☒ A great field for *all* people to study in and work in
 - ☒ A great foundation for *any* career



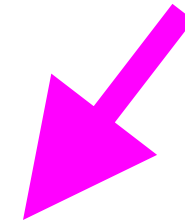
Posted on Tue, Jun. 20, 2006

 [email this](#)  [print this](#)

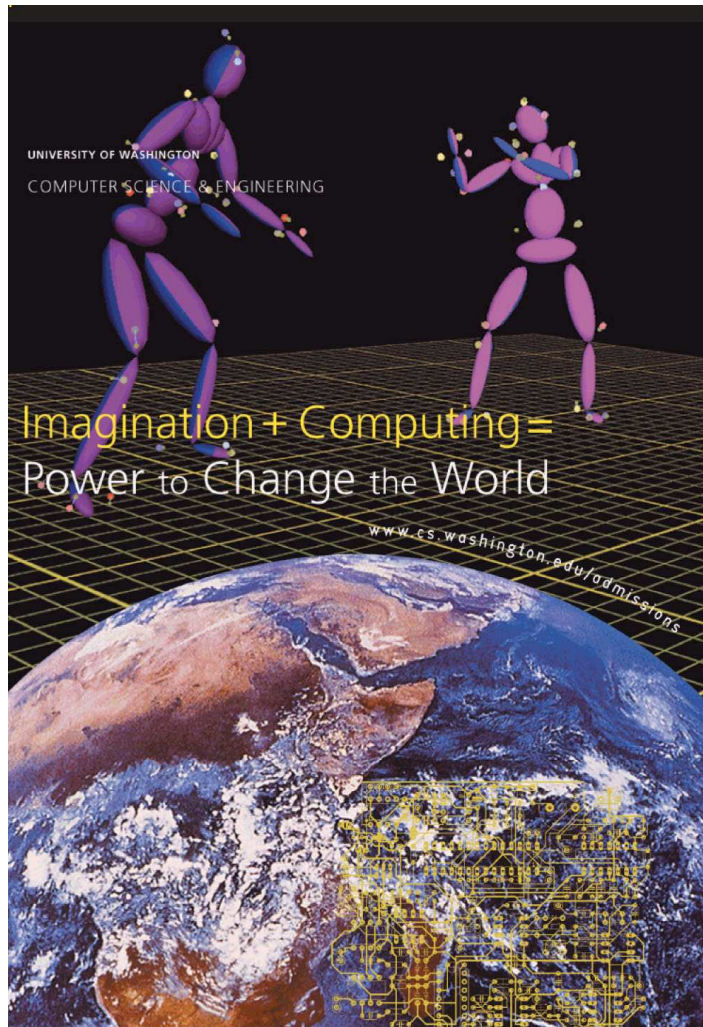
Supercomputers are about to get a lot more super

By Robert S. Boyd
Knight Ridder Newspapers

On a more familiar level, a petascale computer will be at least 75 times faster than the most powerful game machine, and 100 times faster than a top-of-the-line desktop personal computer



“It’s the software, stupid!”



<http://www.cs.washington.edu/WhyCSE/>

It doesn't get much better than this!

- ⌘ Advances in computing change the way we live, work, learn, and communicate
- ⌘ Advances in computing drive advances in nearly all other fields
- ⌘ Advances in computing power our economy
 - ⌘ Not just through the growth of the IT industry - through **Multi Factor Productivity Growth** throughout the economy
- ⌘ Advances in computing are the cornerstone of our national security
- ⌘ Computing is a field of huge intellectual opportunity
- ⌘ Computing is where the jobs are

For further information ...

⌘ The Promise of Computing

⌘ <http://lazowska.cs.washington.edu/promise/>

⌘ Jim Gray's Turing Award talk

⌘ http://research.microsoft.com/~gray/talks/Gray_Turing_FCRC.ppt

⌘ Microsoft 2020 Science

⌘ <http://research.microsoft.com/towards2020science>

⌘ NRC *Rising Above the Gathering Storm*

⌘ <http://www.nap.edu/catalog/11463.html>

⌘ Tom Friedman's *The World Is Flat*

⌘ <http://www.amazon.com/gp/product/0374292795/>

⌘ UW CSE recruiting videos

⌘ <http://www.cs.washington.edu/WhyCSE/>

⌘ This talk

⌘ <http://lazowska.cs.washington.edu/snowbird/>

⌘ PowerPoint source

⌘ <http://lazowska.cs.washington.edu/snowbird/snowbird.ppt>