JOINT STATEMENT OF THE COMPUTING RESEARCH COMMUNITY

FOR THE
HOUSE SCIENCE COMMITTEE
HEARING ON

"*The Future of Computer Science Research in the U.S.*"

May 12, 2005

Thank you, Chairman Boehlert and Ranking Member Gordon, for convening this hearing and for your committee's continued support of information technology research and development. The American Society for Information Science and Technology (ASIS&T), Coalition for Academic Scientific Computation (CASC), Computing Research Association (CRA), Electrical and Computer Engineering Department Heads Association (ECEDHA), Society for Industrial and Applied Mathematics (SIAM), and U.S. Public Policy Committee of the Association for Computing Machinery (USACM) join in endorsing this testimony because we believe the health of the computing research enterprise to be crucial to the nation's future economic competitiveness, our national defense and homeland security, the health of our citizens, and further discovery in the sciences.

The United States, in both the public and private sectors, has done a remarkable job in forging a leadership role in information technology, due in large part to a healthy fundamental computing research enterprise. That leadership role has paid great dividends to the country and the world. However, we are concerned that the U.S. is in danger of ceding leadership if current trends continue. Fortunately, the U.S. remains in good position to reverse those trends if we act soon.

Our testimony examines how the U.S. came to assume its dominant position in IT and the benefits that role conveys to the nation. We also examine why the changing landscape for federal support of computing research imperils U.S. leadership in IT, and in turn, U.S. economic performance in the coming decades. Finally, we outline what we believe should be done to shore up that leadership.

We commend the committee for its interest in this topic and hope this "view from the community" provides you a valuable perspective on the critical importance of IT on national prosperity, and how changes to the federal research portfolio impact the IT sector.

The Impact of New Technologies

The importance of computing research and computational science in enabling the new economy is well documented. The resulting advances in information technology have led to significant improvements in product design, development and distribution for American industry, provided instant communications for people worldwide, and enabled new scientific disciplines such as bioinformatics and nanotechnology that show great promise in improving a whole range of health, security, and communications technologies. Federal Reserve Board Chairman Alan Greenspan has said that the growing use of information technology has been the distinguishing feature of this "pivotal period in American economic history." Recent analysis suggests that the remarkable growth the U.S. experienced between 1995 and 2000 was spurred by an increase in productivity enabled almost completely by factors related to IT. "IT drove the U.S. productivity revival [from 1995-2000]," according to Harvard economist Dale Jorgenson.

Information technology has also changed the conduct of research. Innovations in computing technologies are enabling scientific discovery across every scientific discipline – from mapping the human brain to modeling climatic change. Researchers, faced with research problems that are ever more complex and interdisciplinary in nature, are using IT to collaborate across the globe, simulate experiments, visualize large and complex datasets, and collect and manage massive amounts of data.

The Information Technology Ecosystem that Gives Birth to New Technologies

A significant reason for this dramatic advance in IT and the subsequent increase in innovation and productivity is the "extraordinarily productive interplay of federally funded university research, federally and privately funded industrial research, and entrepreneurial companies founded and staffed by people who moved back and forth between universities and industry," according to a 1995 report by the National Research Council. That report, and a subsequent 1999 report by the President's Information Technology Advisory Committee (PITAC), emphasized the "spectacular" return on the federal investment in long-term IT research and development.

The 1995 NRC report, *Evolving the High Performance Computing and Communications Initiative to Support the Nation's Information Infrastructure*, included a compelling graphic illustrating this spectacular return. The graphic was updated in 2002 and is included with this testimony. (See figure 1.)

It is worth a moment to consider the graphic. The graphic charts the development of technologies from their origins in industrial and federally-supported university R&D, to the introduction of the first commercial products, through the creation of billion-dollar industries and markets. The original 1995 report identified 9 of these multibillion-dollar IT industries (the categories on the left side of the graphic). Seven years later, the number of examples had grown to 19 – multibillion-dollar industries that are transforming our lives and driving our economy.

The graphic also illustrates the dynamic interplay between federally-supported university-based research and industrial R&D efforts. In some cases, such as reduced instruction set computing (RISC) processors (a chip architecture that forms the basis for processors used by Sun, IBM, HP, and Apple, and has significantly influenced all microprocessor design) and RAID disk servers ("redundant arrays of inexpensive disks"), the initial ideas came from industry, but government-supported university research was necessary to advance the technology. In other cases, such as timesharing, graphical user interfaces, and the internet, the ideas originated in the universities long before they matured to a point where subsequent research by industry helped move the technologies towards commercialization. In each example, the industry/university research relationship has been complementary. University research, focused as it is on fundamental questions and long-term problems, does not supplant industry research and development. And industry, which contributed $190 billion in 2002 (down from $198 billion in 2001) in overall R&D geared primarily towards short-term development, does not supplant university research.

This is an important point that bears some development. The great majority of industry-based research and development is of a fundamentally different character than university-based research. Industry-based research and development is, by necessity, much shorter term than the fundamental research performed in universities. It tends to be focused on product and process development, areas which will have more immediate impact on business profitability. Industry generally avoids long-term research because it entails risk in a couple of unappealing ways. First, it is hard to predict the outcome of fundamental research. The value of the research may surface in unanticipated areas. Second, fundamental research, because it is published openly, provides broad value to all players in the marketplace. It is difficult for any one company to "protect" the fundamental knowledge gleaned from long-term research and capitalize on it without all players in the marketplace having a chance to incorporate the new knowledge into their thinking.

Those companies that do make significant fundamental research investments tend to be the largest companies in the sector. Their dominant position in the market ensures that they benefit from any market-wide improvement in technology basic research might bring. But, even with that advantage, the investment of companies like Microsoft and Intel in fundamental research remains a small percentage of their overall IT R&D investment (in Microsoft's case, it's estimated at around 5 percent of the company's R&D budget), and many companies of equivalent size (Oracle, Dell, Cisco) don't invest in long-term R&D at all.

The chart also illustrates one other important characteristic of the IT R&D ecosystem – it is very interdependent. Note that the arrows that show the flow of people and ideas move not only between industry, university and commercial sectors, but between subfields as well, sometimes in unanticipated ways. Developments in internetworking technologies led to the development of the Internet and World Wide Web (and the rise of Yahoo and Google), but also to developments in Local Area Networking and Workstations. Work on timesharing and client and server computing in the 1960s led to the development of e-mail and instant messaging. In addition, this interdependence increasingly includes subfields beyond traditional IT, helping enable whole new disciplines like bioinformatics, optoelectronics, and nanotechnology.

Perhaps the most noteworthy aspect of the graphic is its illustration of the long incubation period for these technologies between the time they were conceived and first researched to the time they arrived in the market as commercial products. In nearly every case, that lag time is measured in decades. This is the clearest illustration of the results of a sustained, robust commitment to long-term, fundamental research. The innovation that creates the technologies that drive the new economy today is the fruit of investments the federal government made in basic research 10, 15, 30 years ago. Essentially every aspect of information technology upon which we rely today – the Internet, web browsers, public key cryptography for secure credit card transactions, parallel database systems, high-performance computer graphics, portable communications such as cellphones, broadband last mile…essentially every billion-dollar sub-market – is a product of this commitment, and bears the stamp of federally-supported research.

One important aspect of federally-supported university research that is only hinted at in the flow of arrows on this complex graphic is that it produces people – researchers and practitioners – as well as ideas. This is especially important given the current outlook for IT jobs in the coming decade. Despite current concerns about offshoring and the end of the IT boom times, the U.S. Bureau of Labor Statistics this year released projections that continue to show a huge projected shortfall in IT workers over the next 10 years. As figure 2 illustrates, the vast majority of the entire projected workforce shortfall in all of science and engineering is in information technology. These are jobs that require a Bachelors-level education or greater. In addition to people, university research also produces tangible products, such as free software and programming tools, which are heavily relied upon in the commercial and defense sectors. Continued support of university research is therefore crucially important in keeping the fires of innovation lit here in the U.S.

But the impact of IT research on enabling of innovation resonates far beyond just the IT sector. IT has played an essential – many argue *the* essential – role in the economic growth of the U.S. in the past 20 years. Most of the actual economic value of IT does not come directly from fundamental discoveries in electronics, computers, software, communications, or algorithms – these are inputs to larger processes of product and service innovation, most of which happens in the private sector and in competitive markets. Nevertheless, the seeds of this economic growth are in the fundamental discoveries, most of which are pre-competitive and occur in the nation's universities and research laboratories. The economic growth would not happen without these discoveries. Our concern is on the precarious state of research that primes the pump of economic growth, and that puts the U.S. in jeopardy.

The Changing Landscape for Computing

The landscape for computing research funding has changed significantly since PITAC began its review of the federal IT R&D effort in 1997. Since the early 1960s, the federal agencies arguably most responsible for supporting computing research, the development of the field and much of the innovation that has resulted are the National Science Foundation, the Defense Advanced Research Projects Agency, and the Department of Energy. At the time PITAC began its review, NSF and DARPA bore a leading and nearly equal share of the overall federal investment in IT R&D. In FY 1998, DARPA funding constituted 30 percent of federal IT R&D spending, compared to NSF's 27 percent share.

However, as the overall investment has increased, DARPA's share of the research – both as a percentage of the overall effort and in absolute dollars – has declined. While NSF's $795 million investment in IT R&D in FY 2005 represents 35 percent of overall federal IT R&D (an increase in its total share since FY 1998), DARPA's $143 million in FY 2005 represents just 6 percent of the overall IT R&D budget, a significant decrease in its share since FY 1998.

We are concerned about DARPA's diminished role in supporting computing research and the impact that it will have on the field, DARPA's mission, and the nation as a whole. Central to these concerns is the idea that the field – and hence, the nation -- benefited greatly by having different approaches to funding computing research represented by the NSF model and the DARPA model. While NSF has primarily focused on support for individual investigators at a wide range of institutions – and support for computing infrastructure at America's universities – DARPA's approach has varied over the years. Historically, DARPA program managers could fund individual researchers, or even "centers of excellence" – typically university research centers – with useful and critically important flexibility. DARPA program managers had great discretion in funding projects they believed to be promising. In this way, DARPA was able to create and nourish communities of researchers to focus on problems of particular interest to the agency and to the Department of Defense, with great success.

The combination of the different approaches has proven enormously beneficial to the nation, we argue, and to DARPA's overall mission of assuring that the U.S. maintains "a lead in applying state-of-the-art technology for military capabilities and [preventing] technological surprise from her adversaries." DARPA-supported research in computing over a period of over four decades, beginning in the 1960s, has laid down the foundations for the modern microprocessor, the internet, the graphical user interface, single-user workstations, and a whole host of other innovations that have not only made the U.S. military the lethal and effective fighting force it is today, but have driven the new economy and enabled a whole range of new scientific disciplines.

However, through a series of policy changes, including the use of "go/no-go" decisions applied to critical research at 12 to 18 month intervals and the increasing classification of research sponsored by the agency[1], DARPA has shifted much of its focus in IT R&D from pushing the leading edge of computing research to "bridging the gap" between basic research and deployable technologies – in essence relying primarily on other agencies – such as NSF and Department of Energy's Office of Science -- to fund the basic research needed to advance the field.

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[1] There are, of course, important reasons for classifying federal research, especially when it is clear that the research might reveal our defense capabilities or vulnerabilities. However, it should also be understood that there are real costs – including that the research is unavailable for public dissemination and scrutiny, and that many university researchers, arguably some of the best minds in the country, are no longer able to contribute to the work. In the case of DARPA's cyber security research, there is another significant cost to bear as well. The military (and the government overall) has a huge dependence on our nation's commercial infrastructure, but classifying the research in information security means that it is largely unavailable for use in protecting this commercial infrastructure.

These changes at DARPA have discouraged university participation in research, effectively reducing DARPA "mindshare" – the percentage of people working on DARPA problems – at the nation's universities. This is borne out by a review of DARPA's support for IT R&D at universities. While DARPA's overall funding for IT R&D across the agency increased from $543 million in FY 2001 to $586 million in FY 2004 (in unadjusted dollars), DARPA IT research funding for universities dropped by nearly half – from $214 million in FY 2001 to $123 million in FY 2004 – according to numbers the agency provided in response to questions from the Senate Armed Services Committee.

The research community is not alone in noting the potential impact. A DOD Defense Science Board Task Force report on High Performance Microprocessors in February 2005, noted that DOD – primarily DARPA – "is no longer perceived as being seriously involved in -- or even taking steps to ensure that others are conducting -- research to enable the embedded processing proficiency on which its strategic advantage depends. This withdrawal has created a vacuum where no part of the U.S. government is able to exert leadership, especially with respect to the revolutionary component of the research portfolio." The report continues in a remarkable footnote:

> This development is partly explained by historic circumstances. Since World War II, the DOD has been the primary supporter of research in university Electrical Engineering and Computer Science (EECS) departments, with NSF contributing some funds towards basic research. From the early 1960's through the 1980's, one tremendously successful aspect of the DOD's funding in the information technology space came from DARPA's unique approach to the funding of Applied Research (6.2 funding), which hybridized university and industry research through a process that envisioned revolutionary new capabilities, identified barriers to their realization, focused the best minds in the field on new approaches to overcome those barriers and fostered rapid commercialization and DOD adoption. The hybridization of university and industry researchers was a crucial element; it kept the best and the brightest in the university sector well informed of defense issues and the university researchers acted as useful "prods" to the defense contractors, making it impossible for them to dismiss revolutionary concepts whose feasibility was demonstrated by university-based 6.2 efforts that produced convincing "proof of concept" prototypes. As EECS grew in scale and its scope extended beyond DOD applications, a "success disaster" ensued in that EECS essentially "outgrew" the ability of the DOD to be its primary source of directional influence, let alone funding. Furthermore, DOD never developed a strategy to deal with this transition. With pressures to fund developments are unique to the Defense (e.g., military aircraft, tanks, artillery, etc.), the DOD withdrew its EECS research leadership. Recently, DARPA has further limited university participation, especially as prime contractors, in its Computer Science 6.2 programs, which were by far its most significant investments in university research (vastly outstripping 6.1 funding). These limitations have come in a number of ways, including non-fiscal limitations, such as the classification of work in areas that were previously unclassified, precluding university submission as prime contractors on certain solicitations, and reducing the periods of performance to 18-24 months.
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> -*High Performance Microchip Supply*, Defense Science Board, February 2005, Appendix D, p. 87-88

Unfortunately, the other mission agencies have not yet stepped in to fill the gap created by DARPA's withdrawal. As PITAC members Edward Lazowska and Dave Patterson noted in a recent *Science Magazine* editorial, the Department of Homeland Security spends less than 2 percent of its Science and Technology budget on cybersecurity, and only a small fraction of that on research. NASA is downsizing computational science, and IT research budgets at the Department of Energy and the National Institutes of Health are slated for cuts in the president's FY 2006 budget. In effect, the national commitment to fundamental research in IT has waned. Ironically, this began at about the same time the economists began to understand the huge benefit that such research provided for economic growth.

This fact, combined with an overall growth in the number of researchers in the field and an increase in the breadth of the discipline, has placed a significant burden for funding basic IT R&D on NSF. The agency reports that in FY 2004, NSF supported 86 percent of federal obligations for basic research in computer science at academic institutions – and the agency's Computing and Information Science and Engineering directorate (CISE) is beginning to show the strain. In FY 2004, the funding rate for competitive awards in CISE fell to a decadal low of 16 percent, lowest of any directorate at NSF and well below the NSF average. Programs in critical areas like information security and assurance are experiencing even lower success rates – NSF's CyberTrust program reported an 8.2 percent success rate for FY 2004. Other fundamental areas, where long-term advances are critical to broad research advances, are also suffering neglect. In particular, computational science, which was the raison d'etre for the entire Federal High Performance Computing and Communications (HPCC) Program, has become an expanding area for all sciences, however, it has been without any focal point in the overall Federal HPPC Program (now renamed as NITRD). Moreover, even at NSF, support for mathematics and computing sciences – which underlie the health of computing research - has been declining in real terms since FY 2004. Such budget and program management decisions, we argue, are harmful to the field and to the nation as a whole.

To be clear, our concern is not just with the impact of changes at a single agency. Rather, our concern is that the total level of national investment in fundamental IT research rise to the need that our economy requires in an increasingly competitive world.

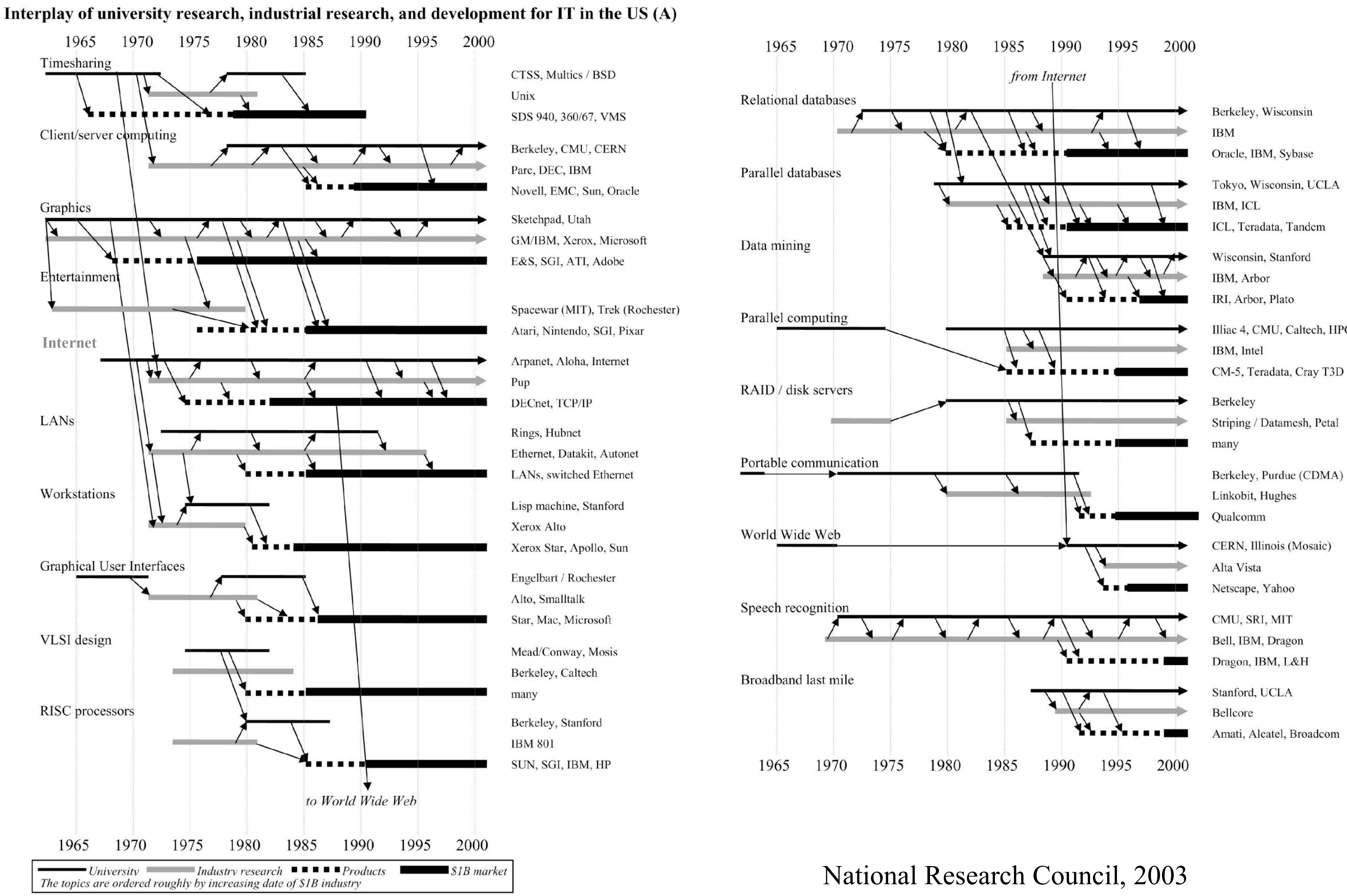
As Lazowska and Patterson note: "At a time when global competitors are gaining the capacity and commitment to challenge U.S. high-tech leadership, this changed landscape threatens to derail the extraordinarily productive interplay of academia, government, and industry in IT. Given the importance of IT in enabling the new economy and in opening new areas of scientific discovery, we simply cannot afford to cede leadership."

Maintaining Leadership

The U.S. still has the world's strongest capability in fundamental research in IT, and the most experience in how to leverage that capability toward economic growth. This is a robust system that can take stresses from decreased funding for a short time as we determine our strategy. But we run a grave risk in letting the uncertainty about funding for fundamental IT research go on too long. The first causalities are the brilliant young people, many of them from other countries, who come to the U.S. to learn from and contribute to our global lead in this area. Already, tightened visa rules and a perception of a more hostile environment in the U.S. encumber our ability to attract many of these brilliant minds. Without support, they will go to Canada, Europe, Australia and other countries that are actively courting them. Those other countries know the value the U.S. has realized from its system of fundamental research – and want it for themselves. Even with their own economic difficulties, those countries are increasing their investments in such research.

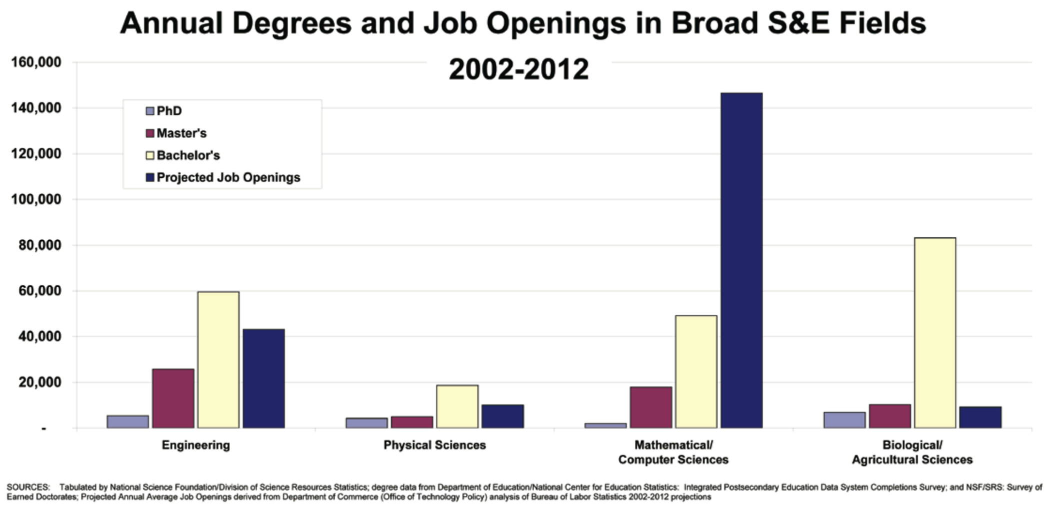
The U.S. took a critical step some years ago in doubling the nation's investment in health research, and, at the urging of your committee, agreeing to double its investment in other areas of research, including IT research. We believe that was the right decision. The current delays in that process of doubling are understandable, but the costs of delaying too long are very high. We taught the rest of the world how to grow from such investment and they learned the lesson well.

That federal investment helps fuel the innovation that insures the U.S. remains the world leader in business, that we have the strongest possible defense, and that we continue to find ways to live longer, healthier lives. To keep the fires of innovation lit, we should continue to boost funding levels for fundamental IT R&D. We should insure that NSF, DARPA, and the Department of Energy have broad, strong, sustained research programs in IT independent of special initiatives. And we should work to maintain the special qualities of federally-supported university research.



National Research Council, 2003

Figure 1



Annual Degrees and Job Openings in Broad S&E Fields
2002-2012
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
-
PhD
Master's
Bachelor's
Projected Job Openings
Engineering
Physical Sciences
Mathematical/
Computer Sciences
Biological/
Agricultural Sciences
SOURCES: Tabulated by National Science Foundation/Division of Science Resources Statistics; degree data from Department of Education/National Center for Education Statistics: Integrated Postsecondary Education Data System Completions Survey; and NSF/SRS: Survey of Earned Doctorates; Projected Annual Average Job Openings derived from Department of Commerce (Office of Technology Policy) analysis of Bureau of Labor Statistics 2002-2012 projections

Figure 2

Appendix A

What others are saying:

Council on Competitiveness, *Innovate America* report on the *National Innovation Initiative,* released December, 2004. Available online at: http://www.compete.org

To Out-Compete Is to Out-Compute
Few areas of technology hold more promise for stimulating innovation and propelling competitiveness than high performance computing. Along with theory and experimentation, modeling and simulation with high performance computers has become the third leg of science and path to competitive advantage. There's now in vivo, in vitro and in silica. A recent survey by the Council on Competitiveness of U.S. chief technology and chief information officers revealed that nearly 100 percent consider high performance computing tools essential to their business survival. And they are realizing a range of strategic competitive benefits from using this technology, such as shortened product development cycles and faster time to market (in some cases more than 50 percent faster), all of which improve a company's bottom line.

But we are only beginning to reap the potential innovation and competitive benefits that use of this technology promises. With dramatically more powerful systems, companies can extract trillions of dollars in excess cost through business enterprise transformation. We can revolutionize manufacturing through advanced modeling and simulation of the entire process from raw resource to finished product. We can dramatically accelerate the drug discovery process, and substantially increase oil recovery rates by modeling entire oil fields. By shrinking "time to insight" and "time to solution" through the use of high performance computing, companies in virtually every sector will be able to accelerate the innovative process in ways simply not seen in the past, resulting in new capabilities and revolutionary products and services that capture and cement global market share. As Robert Bishop, CEO of Silicon Graphics, notes, "In the 21st century, to out-compete is to out-compute."

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Because of the IT revolution - especially in software - a major component of manufacturing is service-based. As the U.S. Congress Office of Technology Assessment noted: "Software is...a marriage of manufacture and service, since it has the character of both a good (it can be stored and shipped) and a service (computer programs are not immutably fixed)." But, we classify software as a service, not a manufacture. Consider how it is being applied:

- Manufacturers like Xerox are installing service capabilities in their machines - diagnostic software that is capable of signaling to the manufacturer when a part is nearing the end of its useful life, before the problem is ever visible to the customer.
- In 1985, when Ford Motor Company wanted safety data on its vehicles, it spent $60,000 to slam a vehicle into a wall. Today, that frontal crash is performed virtually on high performance computers - at a cost of around $10.
- To design the 777, Boeing developed a software program that allowed its engineers to "fly" in a computerized prototype of the aircraft and iterate the design in virtual space.
- Wal-Mart has installed miniature tracking devices on its products, enabling computerized inventory tracking and controls.

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Goal No. 1 Revitalize Frontier and Multidisciplinary Research

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Nowhere is the need for new multidisciplinary approaches clearer than in the area of emerging "services science" - the melding together of the more established fields of computer science, operations research, industrial engineering, mathematics, management sciences, decision sciences, social sciences and legal sciences that may transform entire enterprises and drive innovation at the intersection of business and technology expertise.

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A 21st Century Infrastructure

In the late 19th and 20th centuries, the United States pioneered the world's most advanced infrastructure in transportation (railroads, highways, air travel), telecommunications, energy, water and waste management.

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Even the Internet, the marvel of modern communications, needs an upgrade. In 1985, the Internet connected 2,000 computers. Today, there are more than 233 million Internet hosts and more than 812 million users.105 The Internet of the future must be able to connect billions of information appliances, like computers, portable devices, wireless modems, GPS locators and sensors. The current infrastructure was not designed to support this explosion of users and devices - and much more investment will be needed to transform the technology and support innovation.

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Task Force on the Future of American Innovation, *The Knowledge Economy: Is The United States Losing Its Competitive Edge?*, released February, 2005. Available on-line at http://futureofinnovation.org

Federal support of science and engineering research in universities and national laboratories has been key to America's prosperity for more than half a century. A robust educational system to support and train the best U.S. scientists and engineers and to attract outstanding students from other nations is essential for producing a world-class workforce and enabling the R&D enterprise it underpins. But in recent years federal investments in the physical sciences, math and engineering have not kept pace with the demands of a knowledge economy, declining sharply as a percentage of the gross domestic product. This has placed future innovation and our economic competitiveness at risk.

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It is essential that we act now; otherwise our global leadership will dwindle, and the talent pool required to support our high-tech economy will evaporate.

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U.S. Commission on National Security/21st Century (Hart-Rudman Committee), *Road Map for National Security: Imperative for Change. Phase III*, January 2001. Available online at: http://govinfo.library.unt.edu/nssg/PhaseIIIFR.pdf

...[T]he U.S. government has seriously underfunded basic scientific research in recent years... [T]he inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine. American national leadership must understand these deficiencies as threats to national security. If we do not invest heavily and wisely in rebuilding these two core strengths, America will be incapable of maintaining its global position long into the 21st century.

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About the Endorsing Organizations

American Society for Information Science and Technology (http://www.asist.org) -- Since 1937, the American Society for Information Science and Technology (ASIS&T) has been the society for information professionals leading the search for new and better theories, techniques, and technologies to improve access to information.

ASIS&T brings together diverse streams of knowledge, focusing what might be disparate approaches into novel solutions to common problems. ASIS&T bridges the gaps not only between disciplines but also between the research that drives and the practices that sustain new developments.

ASIS&T counts among its membership some 4,000 information specialists from such fields as computer science, linguistics, management, librarianship, engineering, law, medicine, chemistry, and education; individuals who share a common interest in improving the ways society stores, retrieves, analyzes, manages, archives and disseminates information, coming together for mutual benefit.

Coalition for Academic Scientific Computation (http://www.casc.org) -- CASC is a nonprofit organization of supercomputing centers, research universities and federal laboratories that offer leading edge hardware, software, and expertise in high performance computing resources and "advanced visualization environments." Founded in 1989, CASC has grown into a national association representing 42 centers and programs in 28 states.

Coalition members complement traditional methods of laboratory and theoretical investigation by using high performance computers to simulate natural phenomena and environmental threats, handle and analyze data and create images – all at performance levels not available from smaller computers. By applying advanced technology, CASC members help extend the state of the art to achieve the scientific, technical, and information management breakthroughs that will keep the U.S. in the forefront of the 21st century information technology revolution.

Computing Research Association (http://www.cra.org) -- The Computing Research Association (CRA) is an association of more than 200 North American academic departments of computer science, computer engineering, and related fields; laboratories and centers in industry, government, and academia engaging in basic computing research; and affiliated professional societies.

CRA's mission is to strengthen research and advanced education in the computing fields, expand opportunities for women and minorities, and improve public and policymaker understanding of the importance of computing and computing research in our society.

Electrical and Computer Engineering Department Heads Association (http://www.ecedha.org) -- The Electrical and Computer Engineering Department Heads

Association is composed of heads or chairs of departments offering accredited programs in electrical and/or computer engineering.

The purposes of ECEDHA are threefold: help advance the field, help members exchange ideas, and improve communication with the profession, industry, government, and others.

ECEDHA membership is open to the official leaders (whether called head, chair, or some other title) of U.S. university departments offering ABET-accredited electrical and/or computer engineering (or similarly named) programs. Of about 300 departments offering such programs, almost 90 percent are currently represented in ECEDHA.

Society for Industrial and Applied Mathematics (http://www.siam.org) -- SIAM has grown from a membership of few hundred in the early 1950s to over 10,000 members today. SIAM members are applied and computational mathematicians, computer scientists, numerical analysts, engineers, statisticians, and mathematics educators. They work in industrial and service organizations, universities, colleges, and government agencies and laboratories all over the world. In addition, SIAM has over 400 institutional members—colleges, universities, corporations, and research organizations.

U.S. Public Policy Committee of the Association for Computing Machinery (http://www.acm.org/usacm) – USACM is the U.S. Public Policy Committee of the Association for Computing Machinery, which is widely recognized as the premier organization for computing professionals, delivering resources that advance the computing as a science and a profession, enabling professional development, and promoting policies and research that benefit society. ACM is the world's first educational and scientific computing society with almost 80,000 members worldwide. USACM members include leading computer scientists, engineers, and other professionals from industry, academia, and government.