Testimony Hearings on the President's Information Technology Advisory Committee, Interim Report to the President

Details

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Science, Subcommittee on Basic Research

Joseph Bordogna
Acting Deputy Director National Science Foundation.

Introduction

Mr. Chairman, members of the subcommittee, thank you for allowing me the opportunity to testify on the National Science Foundation's role in fostering the development of the next stages generation of the information age science, engineering and technology.

I am pleased to be here today. This is a topic of utmost importance for the future of our nation's economy and the well-being of our fellow citizens. A healthy, long-term federal investment in the information science, and engineering underlying high performance computing and communications and information and technology is critical if the United States is to remain a world leader - not only in science and engineering - but in our economics, national security, health care, education and overall quality of life.

Let me say at the outset that I will be using the term IT as shorthand for the broad range of topics encompassed by computer, computing, communications, and information science, engineering and technology.

According to the Computing Research Association, the United States now holds a commanding lead in IT, and this lead is "the result of an extraordinary 50-year partnership among government, industry and academia." That partnership was integral to the creation of the Internet and will be integral to the creation of the next generation of computer-communication technologies.

The Science Committee and the Basic Research Subcommittee have long been concerned with the federal investment in IT R&D. In the early 1980's, this subcommittee strongly

encouraged NSF to invest in high-performance computing resources for the nation's academic scientists and engineers.

With this support from the Congress, NSF has supported some of the most successful and innovative computer-communications concepts and technologies at their earliest, most experimental stages. Building on fundamental investment in networking design and theory funded by DARPA, NSF funded university-based supercomputer centers in the mid-1980's to allow academic scientists and engineers access to state-of-the-art computing power. To facilitate access to the centers, NSF began a parallel effort in networking. It built on fundamental investment by DARPA in a more restricted environment, and that resulted in the formation of the national NSFNET backbone network and regional networks connecting university students and faculty to the supercomputing centers. In a very brief period of time, NSFNET and the regional networks began performing important communication and informationaccess functions in addition to supercomputer center access. Through this development and its subsequent privatization, the Internet industry was born.

Mr. Chairman, this story of the Internet's birth is now well known but it is only one example of how fundamental IT investments by NSF and other agencies in information science, engineering and technology have paid huge dividends for the nation. Support of fundamental research in IT advanced computation has been less publicized but equally important to the future of information science and technology. For example, NSF and DARPA's long-standing support of fundamental computation research was instrumental in the development of Computer-Aided Design (CAD), now a multi-billion dollar segment of the computer industry, and of both specialized and generic computing languages that enable efficient, effective use of IT for so many purposes.

These innovations only occurred through sustained, long-term federal investments in information science and engineering by many agencies, including DoD and NSF. One might think that these past successes assure us of an equally bright future. Unfortunately, in a fast paced, technologically-rooted information age world, the worst thing we could do is rest on our laurels.

The key point is that the IT R&D conducted by private industry - be it performed by large or small firms - is now primarily near-term and product-focused. There are many reasons for this trend. With increased global competition, increasingly rapid product cycling and high expectations from shareholders, IT industry managers tend to focus on activities that maximize short-term payoffs. Market pressures are too great and technology changes too rapid to allow major long-term investments and perspective.

The Interim PITAC Report - A Good Beginning

Last spring, President Clinton called for a renewed federal commitment to research in information science and technology. The President's Information Technology Advisory Committee (PITAC) has answered this call by issuing an interim report that sets out a

plan for a coordinated federal effort to support leading-edge IT research in information science and technology.

The PITAC interim report recommends that the National Science Foundation should be the lead agency in coordinating any future administration IT initiative in information science and technology. This has caught the attention of many in the IT computer science community, both outside and inside government. Let me therefore address this point up front.

NSF believes that the concept of the lead agency implies creating a strong, cohesive and lasting federal partnership in information science, engineering and technology for IT R&D. NSF can and should have a strong role in any such multi-agency IT partnership for three important reasons:

- The first is based on NSF's broad mission to promote the progress of science and engineering through support research and education across all the disciplines in service to society. IT is a key enabling technology -- permeating and transforming all types of research -- regardless of discipline. As part of any overall IT initiative NSF will play a leading role in supporting new and innovative ways to use IT in the conduct of all research. Open, competitive access to the most powerful IT capabilities is a critical component of this NSF role.

- The second has to do with the long-term, high risk focus of any government-wide IT initiative. Any major IT initiative must be focused on long-term research challenges. Supporting this research - especially fundamental research and the infrastructure it requires --in advanced computation should form the core of any IT R&D initiative. This is a generic NSF responsibility.

- Third is the NSF mission to support science and engineering education and human resources at all levels. This is especially important for IT information science, engineering and technology since it is a knowledge intensive enterprise.

Regardless, any IT partnership in information science, engineering and technology can succeed only through consensus, trust and close cooperation among all interested parties. Mission agencies like DoD, DoE, NIH, NOAA, and NASA have a large stake in the health of our IT information science and technology enterprise. They should be co-equal partners in any federal initiative. Any other arrangement would be counterproductive and unwise. No single agency can manage an IT initiative effectively.

The interim report expertly describes how IT science and engineering research has transformed our society over the past few decades. Despite such great progress, the

report expresses alarm at the current state of public-sector IT R&D investment. The report concludes that without a significant investment by the federal government in long-term, fundamental research and education, U.S. leadership in IT information science, engineering and technology will quickly evaporate.

NSF considers investments in IT information science, engineering and technology R&D to be among the highest priority R&D investments the federal government can make and we will continue to strengthen our IT investment in the future.

NSF's IT Strategy - Guiding Principles

With this determination in mind, let me discuss briefly NSF's strategy for supporting information science, engineering and technology.

In recent years we at NSF have boosted investments in this area through our Knowledge and Distributed Intelligence activity and other activities such as our investment in the multi-agency Digital Libraries initiative and with our participation in the administration's Next Generation Internet Initiative.

Our Next Generation Internet activities are supported by $62 million available from the Intellectual Infrastructure Fund collected from fees for domain name registration. The Senate is potentially considering repealing the fund, and we ask for your support in protecting NSF's use of the fund for NGI investments.

Guiding all NSF investments in IT information science, engineering and technology will be three overarching principles:

1. A commitment to investing in long-term, high risk and high payoff research and education and the infrastructure that supports such investments;
2. Continued promotion of interdisciplinary approaches to complex IT issues problems in information science, engineering and technology; and
3. A recognition that future programs in IT must continually evolve -- often rapidly within a year or two -- to take advantage of important and promising new opportunities.

These principles can be seen clearly in the 40 new NSF grants -- worth more than $51.5 million -- that were recently awarded through our Knowledge and Distributed Intelligence competition. These awards illustrate how NSF can redefine how scientists and engineers collaborate and examine the natural and human-built world -- as they open new frontiers for discovery and innovation.

A University of Hawaii-led project, for example, will improve understanding of how collaborative learning is facilitated by computer software. This will not only help governments and schools create better collaborative learning and distance learning projects, it will also aid the design of networking tools outside education as well.

Another project by Cornell researchers will use supercomputer simulations, advanced software techniques and visualizations to model the complex structures and dynamics of defective metals and other solids. This has applications to many industries including transportation, where engineers need to understand the complicated changes that occur in metal airplane wings that are buffeted by turbulence.

These are just two examples, but they demonstrate how NSF can spur rapid and radical interdisciplinary advances in areas like advanced computation, intelligent software and systems and scaleable networking human cognition and learning.

NSF Support of IT: New Directions

Through our KDI theme, NSF has sought to allow all areas of science and engineering to make optimal use of IT capabilities. This has been an important step forward and is leading now -- as planned -- to a new, focused effort to attack major IT scientific challenges and to bring IT approaches to bear on major science and engineering challenges in information science, engineering and technology.

These challenges prompt us to enrich the significant progress the United States has made in IT. The PITAC report highlights key IT research areas that now deserve special emphasis because of our improved intellectual infrastructure capacity. These areas include software research, scaleable information infrastructure, high-end computing, and socioeconomic and workforce impacts.

Given these recommendations, where do we see our support for IT heading?

Let me outline three important priorities for NSF in the area of IT for the future. Since our Fiscal Year 2000 Budget is several months from being finalized - these should not be characterized as new budget items or themes. Rather, they are natural evolutions of strategically planned and executed investments made over the past few years. They differ slightly in terms of organization from the priorities presented in the PITAC report, but do robustly capture the heart of the report's recommendations.

The first area is Fundamental and High-Risk IT Research Advanced Computation Research.

The interim PITAC report sounds alarm over the current state of fundamental research in the area of software, scaleable information infrastructure, and high-end computing. These are important broad-based strategic issues, and we do believe that research support for the fundamental, long-term computational science and engineering underlying them must be an NSF priority. Making a quantum leap in these areas will require contributions from across the disciplines.

The second priority area for NSF is competitive access and use of high-end computing and networking.

Any advanced computation research effort can succeed only if researchers - regardless of location - can have access to the most powerful, most advanced computational resources. As I mentioned previously, NSF has a proven track record in this area. Significant opportunities for interagency cooperation in IT infrastructure already exist, and NSF would have a natural role to play in any coordinated, interagency partnership in the area of high-end computing and networking.

The third priority is investing in IT education at all levels.

Advances in IT information technology are dependent solely on individual intellectual creativity and the resulting creation of new knowledge. This makes investments in IT education essential. Employers are seeking a workforce that has not just specific IT skills, but that is seeking individuals who are well-versed in science, engineering and technology concepts overall.

This makes NSF's investments in improving achievement in systemic reform of K-12 science and math education even more significant. Regarding education activities specifically tailored to information science and engineering, NSF also is focusing investing more vigorously in new and innovative approaches to IT education at two-year schools and community colleges through our Advanced Technologically Education (ATE) program. A good example of this approach can be seen in our recent ATE award to Bellevue Community College in the State of Washington to establish a center in Emerging Technologies, focused on IT education and training.

Another important point about education concerns the use of technologies in the classroom. This issue has generated a great deal of discussion among local school boards, policymakers, and the media. Local schools and governments are investing large sums in technology, but often without adequate attention to teacher training, curricula and systemic reform. NSF intends to continue our investments in research on educational technology to broaden understanding of how children learn and what approaches work and which ones do not. This is consistent with the recommendations of the PCAST Report on K-12 Educational Technology that specifically recommended increasing federal investment in educational research. This recommendation was also echoed in the National Science Policy Study, released less than two weeks ago by the Speaker, Mr. Ehlers and the Committee.

Conclusion

To conclude Mr. Chairman, let me again thank you for holding this hearing so that we may exchange views on the future direction of this important area. Let me also restate NSF's willingness to work with you, the subcommittee and the full committee to ensure

a robust federal IT investment in information science, engineering and technology. The PITAC report has raised important concerns over our lack of federal investment in fundamental IT research and we at NSF are eager to respond to this challenge. We stand ready to contribute as a co-equal partner to any potential new federal IT partnership to help ensure U.S. world leadership in IT information science, engineering and technology for the next century and beyond.

Thank you.