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

Details

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Introduction

Mr. Chairman and Members of the Subcommittee, I welcome this opportunity to testify before you today about an issue I feel is one of the most important research challenges facing the nation today. Computers, the Internet and related communication networks, and powerful new software products are among the major forces driving the America economy. It is hard to find a business, define a job, or find a product or service that does not benefit in some way from the advances made in information technology over the past few years. Our nation's security, the quality of health care, education, and the environment all depend on our ability to master the power of these new tools.

Information technology is an industry whose future depends on continuous innovation. During the past 25 years the capacity of computer chips has increased a staggering 100 thousand times—and there is no sign that the trend is slowing. This rate of change depends completely on the ability of enterprising businesses to invent new products, but these inventions are tightly linked to research that began years—even decades—earlier in universities or industrial laboratories.

Over the years, federal research investment has been essential for ensuring a continuing flow of the ideas needed to maintain this astonishing rate of innovation. Federal research played a crucial role in developments leading to advanced computer and communication equipment. Last year the Computing Research Association published a report showing how federal research provided the key underpinning for advances ranging from modern data-base management, computer graphics and the wonderfully simple visual tools we take for granted in operating desktop computers or navigating the World Wide Web, basic computer architectures, and of course the Internet itself.

A few years ago the Congress directed the Administration to assemble an independent advisory group to review federal research spending and provide advice. The President established the President's Information Technology Advisory Committee (PITAC) in February 1997. The group includes many of the nation's foremost experts in the development and use of information technology in business and universities around the country.

Their recently released interim report concluded that there is reason to be concerned about the state of federal information technology research both because of inadequate overall levels of support and because we are not moving quickly enough to adjust the management of federal research to take advantage of a new set of opportunities. The business members of this group were clear that they have always relied heavily on federal support of fundamental research in information technology as a foundation for their inventions and that America's continued leadership in information technology is intimately tied to a robust, innovative federal research program. We in the Administration are taking these concerns seriously and are working actively to address them. The President has asked me to lead this effort. I will outline our overall strategy later in my remarks.

A Crucial Role

Advances in information technology will provide the basis for much of America's economic growth as we head into the next century. Over the past five years production in computers, semiconductors, and communications equipment quadrupled at a time when total industrial production grew by 28 percent. The U.S. information technology industry now employs over 4.3 million Americans and added nearly 250 thousand new jobs between 1995 and 1996. Employment growth in the area has outstripped the supply of Americans able to qualify for them—this in spite of the fact that the jobs paid 73 percent more than the average private sector wage.

The Internet is rapidly becoming a major marketplace. As expected, the first major users were information industries themselves. In 1997, Cisco Systems was doing more than $3 billion in annual sales and Dell computers reached sales rates over $6 million per week. More traditional businesses are entering this marketplace rapidly. The on-line bookstore Amazon.com sold $148 million worth of books in 1997 and the retail bookstore Barns and Noble is launching its own on-line business. Auto-by-Tel, a Web-based automotive marketplace, is doing $500 million a month in auto sales ($6 billion annualized).

The indirect effects of information technology on the economy are much larger. Information technologies allow productive management systems to tie nation-wide and worldwide teams together on short notice to design, test, market, and finance products and services. Information systems allow more efficient design of products and more efficient operation of equipment resulting in lower costs, lower waste, and lower pollution. CAT scanners and many other tools of modern medicine rely on powerful, reliable computational systems. Airline operations, banking services, shipping services, automobile repair shops, and many other businesses are able to deliver better, safer, higher quality services at lower costs because of these technologies.

The technologies also improve the quality of our lives in ways that do not show up in economic statistics. Advanced technologies may be able to provide educational opportunities throughout a person's life using methods that approach the fun and challenge of learning from an individual tutor. The quality of life for many elderly people and persons with disabilities can be greatly improved. Improved control systems can provide greater safety in air and highway travel. We can use the technology to make the processes of government more open, more accessible, and easier to use. And the technology opens unprecedented new entertainment experiences and opportunities for keeping in touch with parents, children, and friends who may now live across the planet.

Information technologies also play an essential role increasing the productivity of the research and innovation process itself. Powerful simulation tools are essential for advances in biology, chemistry, physics, environmental science and many other areas. Our ability to understand how genes actually operate to affect the processes of life depend on our ability to understand the operation of complex molecules. Advances in metallurgy depend on sophisticated simulations of crystal structures. Weather prediction depends on simulations based on vast data resources. Engineering advances in the design of complex structures, crash-resistant automobiles, efficient aircraft engines, and many other areas depend on powerful simulations. Economic simulations provide powerful new tools for helping us understand the performance of free economies.

The PITAC Review

The 26 members of the PITAC include corporate leaders from the computing and communications industry, two recipients of the National Medal of Technology, and experts from the research, education, and library communities. The Committee is co-chaired by Dr. Ken Kennedy, Director of the center for Research on Parallel Computation and the Ann and John Doerr Professor of Computational Engineering at Rice University, and Dr. Bill Joy, co-founder and Vice President for Research at Sun Microsystems.

Dr. Kennedy outlines the advice of his Committee in testimony presented here today. I have assembled an interagency team to review our options for responding to their advice. Fortunately we are able to build on a foundation of interagency coordination in this area which began with the High Performance Computing and Communication program chartered by the Congress over six years ago. The Departments of Defense and Energy, NASA, NSF, NIST, NIH and other agencies have been active participants. A small National Coordinating Office, reporting to OSTP, has operated as an executive agent of this interagency group throughout this process. We are pleased that the House has passed legislation refreshing the challenge to this interagency group in the past month and thank this Committee for its leadership in doing this. I am optimistic that the Senate will concur with your decision in the next few weeks so that this new charter can become law. On a related topic, the Senate is considering repealing a provision that allows the NSF to use $62 million from an Intellectual Infrastructure Fund to contribute to the Next Generation Internet Initiative. I ask for your support in protecting NSF use of the Fund.

PITAC was clearly concerned that the nation is under-investing in information technology research; our job is to identify a responsible response within the discipline of a balanced budget. The Committee also is concerned that the changes being made in the management of information technology research as a result of the end of the Cold War could lead to declining support in critical research areas which should instead be increasing. It also emphasized the need to ensure strong programs in both defense in civilian research agencies and the need to define new roles for agencies like the National Science Foundation, which may need to pick up new responsibilities. We are carefully reviewing opportunities in all federal agencies with significant programs in information technology research.

Our Response

The PITAC review stresses both the need to sustain federal investment in information technology research and the need to rethink priorities and management in ways that reflect new opportunities. Flexibility is essential in this rapidly changing field. If the past decade is a guide, the most important advances will come from utterly unexpected directions.

Several features of an information-rich future do seem apparent. If there is a single theme, it is that as the power of information devices increase, they become both easier to use and less visible. We've moved from a world where computers were run by what seemed like high priests in glass-enclosed rooms to a world where powerful information devices are operated by our kids at home and others are hidden in the control systems of cars, tools, and a host of other devices we use at home and at work. Our goal in a research program should be to balance investments needed to continue technical progress in the extremely powerful machines needed to tackle major scientific and engineering problems, with the investments needed to ensure faster and more powerful communication networks, and to undertake the basic work needed to design and operate reliable systems that can serve the practical needs of all

Americans. The new tools should let people think about the issues they care about—whether its editing a musical score or designing a bridge or reviewing treatment opportunities with a patient—and not be forced to translate their interests into an obscure language spoken only by computers. A few features of such systems are becoming clear:

Computing power will be located in many different sites and linked in ways that provide different levels of power as required. Applications can choose to exploit processing located in many different parts of a wide network or use the processing power of large central nodes. These selections will be as transparent to the users as the location of information servers are to users of web browsers.

Each of us will be supported by hundreds if not thousands of individual processors, most providing anonymous services as components of manufacturing equipment, automobiles, medical sensors, and many others.

Most of these information processors will be linked with each other with powerful, flexible communication networks. Access to these networks will not require physical connection; high-speed links will be available through secure wireless connections.

These systems will provide people with the information they want when they want it, where they want it, and in a form best suited to the occasion. A simple question can trigger a worldwide search through medical publications—in all languages—yielding a clear, useful answer in the form of text, images, or other forms. Enormous, complex bodies of information about economic data, weather simulations, gene functions and other areas will be presented using visual and other tools designed to present them in a form best matched to human capacity for understanding. Teams physically far apart can work closely in shared information spaces.

Powerful computer simulations will provide essential tools for design and testing of products and equipment (including design of products tailored for individual needs and tastes), new tools for research in fields ranging from climate change to pharmaceutical design to analysis of the formation of stars and galaxies.

The complex software supporting these extraordinary capabilities will be designed, tested, repaired and maintained with the same confidence that we now design complex equipment like aircraft and bridges. Faults will be predicted and undetected errors will not lead to catastrophic failures but to a minor degradation of performance while the problems are repaired.

Outlines of a Research Plan

PITAC was clear that they wanted strong continued support for fundamental research in topics like software development, the ability of humans to make practical use of emerging information systems, and the ethical, social, and other impacts of changes in our society being caused by the information revolution. Their core argument is that research in information science must itself become an essential part of our research base and should be treated as an independent discipline instead of an adjunct to other research. We are carefully considering options for addressing this important issue. Clearly it is essential to strengthen the bonds linking research in information sciences with investigators who need these tools to advance missions in defense, space research, weather modeling, and scientific research. But it is also important that we give information sciences adequate priority in its own right as we make tough budget decisions about R&D priorities. We are reviewing research options aimed at:

- developing new methods for designing and testing software and software maintenance that can ensure reliability and security as well as methods to increase the productivity of software creation;
- finding better ways to master the avalanche of information flowing through our lives which requires better ways to analyze and abstract information available in text, images, and other formats;
- inventing flexible, reliable information networks that will link machines and millions if not billions of separate processors—some operated directly by humans but most integrated into products or even autonomous systems;
- ensuring continued advances in the power of high speed computers and that US firms retain world leadership in this critical area; and
- understanding the ethical, economic, social, and other issues we are confronting as information technology transforms the nature of work in America and reshapes virtually every business and public service.

If we are to achieve these goals it is essential that we find new ways to link research teams that require powerful computation and communication services with the tools and the expertise they need. Research in protein chemistry, astrophysics, climate modeling, engineering simulations, economic modeling and many others depends on access to world-class machines.

Next Steps

During the coming months, I will be working closely with federal agencies, members of the PITAC, and other experts to forge a plan which the President can present to you next spring. I hope that we will be able to work with members of this Committee in developing these plans. There can be little doubt that fundamental research in information technology is critical for America's welfare, security, and prosperity in the 21st century. It's influence will clearly be as great as the agricultural technologies that ended up moving most Americans off the farm early in this century, and the technologies of electricity, the telephone and the internal combustion engine. Research in information technology clearly deserves a major place in our national research portfolio. The PITAC argued strongly that simple expansion of what we are already doing is unlikely to be the right answer and we are reviewing a range of proposals. The research problems faced in information technology are unique and deserve fresh ideas about how to address them. We have learned a lot about what does and doesn't work in the management of research over the past decades and its essential that we draw on what we have learned in designing new approaches for information technology research. It is important that our research:

- ensure support for basic, high risk areas and encourage a search for the unexpected;
- encourage partnerships linking many academic disciplines and research teams drawing on the best minds in industry and universities;
- the process for selecting priorities and projects should be open, competitive, and reviewed by peers;
- attract participation from all parts of the country; and
- integrate research goals with the goal of providing education and training.

Americans expect the federal government to take a leadership role in supporting fundamental research in areas critical to our future. The PITAC has presented us with a range of important challenges. I look forward to working with members of this Committee in the coming months in shaping an effective response.

Neal F. Lane

Assistant to the President for Science and Technology
and
Director, Office of Science and Technology Policy

On August 4, 1998, Neal F. Lane was sworn in as Director of the Office of Science and Technology Policy. Dr. Lane also serves as Assistant to the President for Science and Technology, often referred to simply as the President's 'Science Advisor.'

Immediately prior to his move to the White House, Dr. Lane served as Director of the National Science Foundation from October of 1993, during which time he also served as a member of the National Science Board.

Prior to becoming NSF Director, Dr. Lane was Provost and Professor of Physics at Rice University in Houston, Texas, a position he had held since 1986. His tenure at Rice began in 1966, when he joined the Department of Physics as an assistant professor. In 1972, he became Professor of Physics and Space Physics and Astronomy. He left Rice from mid-1984 to 1986 to serve as Chancellor of the University of Colorado at Colorado Springs. In addition, while on leave from Rice from 1979 to 1980, he worked for the National Science Foundation as the Director of the Division of Physics.

Widely recognized as a scientist and educator, Dr. Lane has published widely on research topics in atomic and molecular physics and has made numerous presentations on science and science policy. Early in his career he received an NSF Post-doctoral Fellowship and an Alfred P. Sloan Foundation Fellowship. He earned Phi Beta Kappa honors in 1960 and was inducted into Sigma Xi National Research Society in 1964, serving as its president in 1993. While a professor at Rice, he was a two-time recipient of the University's George R. Brown Prize for Superior Teaching. Dr. Lane has also received honorary degrees from several institutions of higher education.

Through his work with scientific and professional organizations and his participation on review and advisory committees for various Federal and state agencies. Dr. Lane has contributed to public service throughout his career. He is a fellow of the American Physical Society, the American Academy of Arts and Sciences, the American Association for Advancement of Science and a member of the American Association of Physics Teachers.

Born in Oklahoma City in 1938, Dr. Lane earned his B.S., M.S., and Ph.D. degrees in physics from the University of Oklahoma. He is married to Jone Sue (Williams) Lane, has two children Christy Saydjari and John and two grandchildren Alex and Allia Saydjari.