Summary

As a part of its ongoing mission, the Presidential Information Technology Advisory Committee (PITAC) has completed an initial review of the Information Technology for the 21st Century (IT^2) initiative and its Implementation Plan put forward by the participating federal agencies. This letter is intended to convey the initial conclusions of that review. The review included discussions with the leadership for this initiative in the various agencies involved. In the course of this review, consideration has also been given to related measures before the Congress.

This review centers on the following six points of imperative, on which the letter elaborates.

- Multi-year federal investment in long term IT research for the Nation's infrastructure, security, and economic future.
- Effective cross-agency coordination to leverage research needs and results across mission requirements.
- Agency emphasis on advanced applications and enabling middleware.
- Adequate funding for NSF to provide access to high-end computing facilities for the general university research community across all areas of research.
- Support for multidisciplinary teams and centers addressing long term, high-risk IT research.
- Research funding for socioeconomic impact and workforce issues of IT.

The Nation's future depends strongly on the federal investment made now in long term IT research. Additionally, there is a pressing need for research to address the scalability, security, and reliability of the IT infrastructure that is now vital to the national security, economic competitiveness, and day-to-day events of our lives.

Introduction

Both the Administration and the Congress have responded to the PITAC's warning concerning the critical importance of increased federal funding for fundamental research in information technology (IT) to the Nation's security and economic prosperity in the coming decades. The Information Technology for the 21st Century (IT^2) initiative included in the President's budget request to Congress and The Network and Information Technology Research and Development Act (NITRD) introduced by Chairman Sensenbrenner in the House both directly address the recommendations in the PITAC report of February 1999.

It is essential that the bipartisan recognition of this critical investment be carried into realization this year in order to refill the pipeline with ideas and human capital that will lead to expertise and innovation in succeeding decades. The state of the Nation's economy and security in the early decades of the next century will be in a very real sense driven by the federal investment made now in this long term research in IT, and by how the federal agencies, the university community, and industry coordinate and collaborate in this vital effort.

Developments and applications in information technology have accounted for a third of the growth in the U.S. economy in this decade, and have been the driver of what may be the longest sustained period of economic expansion and prosperity that the Nation has known. This technology, coming to fruition to so impact the Nation's economy in the 90s, is the direct result of federal research investment during the two previous decades.

This federally-funded research in IT twenty years ago - little noticed in the economy then - not only produced the foundational technology for today's IT industry, but also the human capital that is its engine. The Internet, and all of the economic expansion and commerce that is now driving the Nation's economy through IT in the 90s, could not be happening now had this federal investment in research not been made twenty years ago.

If innovations and new expertise are to be available when needed, we must act now to reinvigorate the long term IT research endeavor. This will revitalize the computing infrastructure at university campuses and other civilian research facilities, which are rapidly behind the state of the art at a time when global connectivity and competition enables rapid change in the relative capabilities of nations.

Proposed funding initiatives

The IT^2 initiative, in the President's FY2000 budget, proposes $366 million in increased investments in computing, information, and communications research and development (R&D). This expands the knowledge base in fundamental information science, advances the Nation's capabilities in cutting edge research, and trains the next generation of researchers who will sustain the Information Revolution well into the 21st Century. This initiative responds directly to the findings and recommendations of the PITAC as stated in its report released in February 1999, and consequently the PITAC strongly supports the IT^2 initiative.

A related bill - HR 2086, The Network and Information Technology Research and Development Act - has been introduced in Congress, also closely tracking the PITAC recommendations. The PITAC has expressed its enthusiastic support for this legislation as well.

The PITAC report cited specifically the need for strong attention to four areas of IT:

- Software Research
- Scalable Information Infrastructure

- High-End Computing
- Socioeconomic Research

The IT^2 Implementation Plan is composed of three elements:

- Fundamental Information Technology Research and Development
- Advanced Computing for Science, Engineering, and the Nation
- Social, Economic, and Workforce Implications of Information Technology

The first of these elements maps generally to the first two of the PITAC areas, while the last two elements map, respectively, to the last two PITAC areas.

The concept of the IT^2 initiative, as put forth in the Overview of the Implementation Plan, clearly reflects the concern expressed by the PITAC report, as well as the general course of action recommended in the report. The agency leadership involved in developing the IT^2 Implementation Plan is to be commended for considerable and effective effort in addressing this important initiative. All of the agencies included in this initiative have a vital contribution to the critical IT research called for in the PITAC report.

Management and cross-agency coordination

Although the Agency Specifics as stated in the Plan are specific to agency missions, conversations with agency leadership indicate intentions to coordinate the effort across agencies, subject to mission requirements. Agency leadership cites time constraints and differing funding mechanisms, in addition to mission requirements, as impediments to coordination. This cross-agency coordination is essential in order to effectively direct effort at the most critical areas, as well as to transfer developments across agency applications. The CISE Director at NSF is the designated leader of the cross-agency coordination in the Plan, and has a strong commitment to this important effort.

The expressed constraint of mission requirements clearly reinforces the PITAC recommendation of a significant leadership role for NSF in this initiative, and that role is incorporated in the Implementation Plan. Further, the need for programmatic changes in NSF for this initiative - larger longer-term grants, higher-risk projects, multidisciplinary teams and centers, somewhat more directed efforts -has been incorporated in the Plan and has clearly been endorsed by the NSF leadership. The IT^2 effort in NSF is directed through CISE, in concert with the PITAC recommendations, but the incorporation of multidisciplinary cross-directorate research efforts is indicated in the Plan, has been noted in recent Congressional testimony, and is confirmed by the NSF leadership.

Research

Both software research and progress in scalable information infrastructure are well represented in the agencies' IT^2 fundamental IT R&D plans, as are some aspects of high-end computing.

The mission agencies have focused on specific aspects of those broad areas. DoD emphasizes embedded and autonomous networked systems, and information exploitation; DOE emphasizes technologies for scientific simulation; NASA's brief summary includes system synthesis and automated reasoning; NIH highlights biomedical applications software and algorithms; and NOAA plans high performance computing technologies in coupling of models, use of caching, and standardized adaptable data formats. That leaves everything else to NSF.

Some of the agency programs are overly narrow and near-term as described; others are appropriately visionary and ambitious. It will be important that the agencies (including NSF) engage in coordinated and multi-year planning of their research agendas, to insure broad coverage and to encourage long term agendas.

In general, we encourage the agencies to pay more attention to long term research in support of advanced applications and the middleware necessary to build them, to complement the important focus on technologies and infrastructure. Also, since a major portion of these new advanced applications are more "general purpose," as opposed to scientific and technical, we encourage the agencies to expand their application focus to include these new general purpose applications as appropriate. Furthermore, since these general purpose applications should be of great interest and benefit to federal civilian agencies not currently part of the IT^2 program, it will be important to engage such agencies in the discussions in order to better understand their requirements.

The inclusion of the new Advanced Research and Development Activity (ARDA) in the DoD component of the IT^2 initiative is very positive since this activity directly addresses some of the PITAC concerns with security and reliability of the Nation's IT infrastructure.

Access to high-end facilities

The PITAC report noted the pressing need of the civilian research community for access to high-end computing facilities tracking those available to the security communities. Today the NSF capability has fallen from its former parity to being more than an order of magnitude behind. Only NSF among the federal agencies has a primary mission to provide access to high-end facilities for the general university research community thereby enabling research on any topic facilitated by high-end computing. It is essential that funding to NSF for this purpose be more in line with the PITAC recommendations in order to enable NSF to carry out this role effectively.

The IT^2 plan calls for both NSF and DOE to acquire 5-terascale systems. Each system is to be competitively sited by the respective agency, with advice from a joint review committee. Both will provide access to the general research community, but the DOE system will give priority to efforts addressing areas of science and engineering of current priority interest to the mission of DOE. While the IT^2 NSF plan does not go beyond FY2000, DOE also states that it plans to acquire a 40-terascale system in later years. The NITRD bill, in contrast, authorizes funding for NSF acquisition, but not for DOE. The

NITRD authorizes a five year funding path at NSF, starting at $70 million (twice that called for in the IT^2 NSF plan) and ramps up to $85 million in the fifth year. The NITRD funding profile is close to that envisioned for NSF as necessary to achieve this goal by the PITAC.

The Plan does not address the problem of providing high bandwidth access to universities regardless of geographical location. Although progress is being made on this front in the NGI initiative, continued attention to this access problem is necessary in regard to inclusion of needed universities for both research expertise and graduate education.

Multidisciplinary teams and centers

The PITAC report called for a variety of modes of funding, including some multidisciplinary Enabling Technology Centers (ETCs) and some large-scale Expedition Centers, both centered at universities. The IT^2 Implementation Plan includes ETCs, though not explicitly named as such, in the NSF effort but at lower annual funding levels than recommended by PITAC. NITRD authorizes Information Technology Research Centers at up to $5M annual funding. The larger Expedition Centers recommended by PITAC are not included explicitly in the IT^2 Implementation Plan, but were the subject of a DARPA Broad Area Announcement (BAA) issued earlier this fiscal year. DARPA indicates a strong response to the BAA and hopes to establish some as yet unfunded Expedition Centers. DOE and NASA also indicate intentions for multidisciplinary teams or centers, but without the specifics given by NSF. The IT^2 plan does not address the issue of multi-agency funding of centers, another aspect of the PITAC recommendations. Hopefully, larger visionary centers can be included in the continuation of this IT initiative beyond the initial year.

Socioeconomic and workforce issues

The Implementation Plan includes various efforts - even some centers in the socioeconomic impact area, but the funding for this area is relatively small and is not likely to be sufficient to address all of the components included in the Plan. The Administration and Congress have initiated funding programs to address a number of socioeconomic and workforce (SEW) issues including equity of access, funding to support K-12 educational initiatives, community technology centers and various other interventions. However, as emphasized in the PITAC report it is vital that investments be made to support university and federal research into understanding the fundamental nature of the IT revolution, its underlying opportunities and problems and developing carefully controlled evaluative studies of potential interventions.

These research findings will ensure maximal benefit is realized from the many interventional investments that are currently being made by the federal and corporate sectors. PITAC members observe that the industrial revolution was much more carefully researched from the beginning than the current IT revolution. We applaud the NSF plan to create centers for SEW research and urge additional cross-agency investments in research in vital SEW areas. It is also important that workforce training and distance

learning utilizing IT and the network be given attention. Both NSF and NASA indicate intentions for efforts in this area, possibly through teams or centers.

Conclusion

It is essential that a federal investment be made in IT research that is adequate to provide the supply of ideas and human capital necessary to sustain and advance this current driver of our economy into coming decades and to ensure the security and reliability of this new foundation of our infrastructure. This is an investment with clear and serious consequences for the Nation. The IT^2 initiative of $366 million for FY 2000 is less than the PITAC recommendation of $472 million, but is a promising start. But it is just a start. The federal investment must necessarily be long term. We are pleased that although the NITRD bill covers only those Agencies under the jurisdiction of the House Science committee, it provides for five years of investment.

Funding for the IT^2 initiative and related measures in Congress is very uncertain at the time of this report, with several drastic cuts having been made by some committees. The PITAC intends to continue this review of the IT^2 initiative and related bills in Congress as the budget is developed.

We conclude by calling again for all branches of the Government to work together to make this essential investment in IT. The IT^2 initiative and related bills in Congress are a positive response to the PITAC's serious concern about the long term consequences of under-investment in IT research and human capital. Our security and economy in the coming decades will reflect the investments we make now and in the next few years.