



**Statement By**

**The Institute of Electrical and Electronics  
Engineers – United States of America (IEEE-USA)**

**To the**

**House Committee on Science**

**on**

**U.S. Competitiveness:  
The Innovation Challenge**

**15 August 2005**

IEEE-USA appreciates the opportunity to submit comments for inclusion in the record of House Science Committee hearings on the innovation challenges facing the United States. These comments address the question posed by the committee on what the Federal government should be doing to strengthen the nation's innovation system, with special emphasis on Federal programs of support for research and technical workforce development.

IEEE-USA was established in 1973 to advance the public good and promote the professional careers and public policy interests of the more than 220,000 electrical, electronics and computer engineers who are U.S. members of the Institute of Electrical and Electronics Engineers (IEEE), one of the world's largest technical-professional societies. Our members have been present at the creation of electro-technological innovations that have fueled more than a century of remarkable growth in American industry sectors, ranging from aerospace and defense, computers and telecommunications, electrical power generation and robotics to new and emerging fields including biomedical devices and nanotechnology.

**The Institute of Electrical and Electronics Engineers – United States of America  
1828 L Street, N.W, Suite 1202, Washington, DC 20036  
(O) 202.785.007 (F) 202.785.0835 (EM) [ieeusa@ieee.org](mailto:ieeusa@ieee.org)**

At the dawn of the 21<sup>st</sup> Century, America desperately needs a new national competitiveness strategy. After a decade of economic prosperity in the 1990's, the nation was buffeted by recession in 2001 and by a prolonged jobless recovery marked by unprecedented levels of unemployment in high technology fields. Today we face a new, more rough and tumble form of global economic competition, especially in science, engineering and technology-based sectors that have fueled U.S. prosperity since World War II.

China's emergence as a manufacturing superpower, India's strength as a leading provider of business process outsourcing services and the collapse of the former Soviet Union have added at least 2.5 billion people to world labor markets already awash in talented, highly motivated people. Continuing advances in digital technologies and the inexorable spread of the Internet have added a whole new dimension to America's competitiveness challenge. Any task that can be digitized – from chip design to financial analysis to sophisticated pharmaceutical research – can now be performed in many less developed countries at prices developed countries just can't match.

### **Key Elements of a National Competitiveness Strategy**

Twenty years ago, US policy makers faced a different competitiveness challenge driven by the aggressive expansion of the Japanese and European economies. In response to pressure from business, educational, labor and professional leaders, Congress enacted and Federal agencies implemented fiscal and monetary initiatives that helped to stimulate public and private investments. To an existing commitment to basic research, they added a new emphasis on applied research and technology transfer to accelerate commercialization of new ideas and inventions. Public sector investments in education and training were expanded to include a new focus on lifelong learning to help incumbent workers acquire knowledge and skills needed to master newly emerging and rapidly changing technologies. And trade policy initiatives were expanded to include a greater emphasis on export promotion and open access to overseas markets. As a result, the United States was able to maintain its global economic, military and technological pre-eminence and continue to provide its residents with individual opportunities and living standards unmatched anywhere else in the world.

To help maintain America's economic, military and homeland security in increasingly inter-dependent, technology-driven global markets, public and private policy makers must work together to forge a new National Competitiveness Strategy for the 21<sup>st</sup> Century. Key policy objectives ought to be:

- To improve the nation's education system from pre-school to graduate school and beyond, with special emphasis on improving math, science and communications skills in grades K-12;
- To increase systemic incentives for individuals to pursue education and careers in Science, Math, Engineering and Technical fields and promote more effective utilization of SMET personnel by public and private sector employers; and

- To strengthen the Federal government’s commitment to basic research and enhance its ability to encourage public and private sector investments leading to the development and application of innovative processes, products and services.

### **Implications for the SMET Workforce - Labor Market Supply and Demand Considerations**

Innovation is ultimately about people, their knowledge and their creativity. The S&T workforce challenge, therefore, is to create and sustain an environment that will attract the best and brightest minds and enable them to innovate. A workplace in which creative people at all levels share in the rewards – as well as the risks – associated with innovative behavior is essential to meet changing labor market needs.

Much of the advice directed at Congress on S&T workforce issues is predicated upon looming shortages of scientists and engineers. Such speculative claims were used in the 1980’s and 90’s to justify immigration policy interventions that worsened rather than eased prevailing labor market imbalances. This year, proponents of “Increase the Supply” policies are using the coming retirement of the baby-boom generation, the nation’s growing dependence on foreign-born graduate students and researchers and statistics comparing science and engineering degree production in China, India and the United States to justify similar policy interventions. Business groups are calling on Congress to fill America’s S&T educational pipeline with a younger, more diverse - and less expensive - crop of future S&T workers.

The Business Roundtable’s recent call for a doubling of US science and engineering degree awards by 2015 is an example of just such an appeal.

IEEE-USA believes that policy makers should distinguish between the important societal need to increase the technological literacy of all Americans from narrowly focused calls to increase the supply (and reduce the cost) of science and engineering graduates. Effective solutions to the broader societal problem will help to ensure the ready availability of people with the knowledge and skills needed to meet constantly changing labor market demands.

A policy of pushing or pulling more Americans into science and engineering educational pipelines – in the absence of reasonable assurances of rewarding job and career prospects - is unlikely to succeed. Students don’t major in difficult fields just to get scholarships or help employers meet hiring targets. They major in difficult fields to get jobs – preferably professionally challenging and financially rewarding jobs.

As history has shown, Congressional decisions to address anticipated labor market imbalances by raising temporary H-1B work visa ceilings created serious oversupplies of scientists and engineers in the 1990’s, led to prolonged periods of unemployment for substantial numbers of U.S. and foreign workers and probably helped to dissuade many of the best and brightest U.S. students from pursuing technical careers.

## **Improving SMET Labor Market Incentives and Rewards**

As Harvard labor economist Richard Freeman has observed, the marketplace reality is that US scientists and engineers rank low in terms of wages compared with income earned by other highly skilled professionals and lag significantly behind doctors, lawyers and business executives in terms of income earned over the course of their careers. When coupled with the length of time it takes to earn post-graduate degrees - 2 to 4 years in engineering and up to 8 additional years in some scientific fields – and the challenge of maintaining technical proficiency over a 30 to 40 year career, it should come as no surprise that many Americans perceive science and engineering as an unattractive career choice. The growing reliance of U.S. employers on temporary foreign workers and their ability to transfer high tech jobs to lower cost overseas locations are making such choices even more difficult for many of America’s best and brightest young students.

The challenge for policy makers, then, is to find policies that improve opportunities for America’s best and brightest students to pursue educations and careers in science and engineering fields. Trying to attract more students into the education pipeline without improving attendant incentives and rewards won’t solve America’s high tech workforce challenge. Such an approach will only increase hardships and disappointment when newly minted scientists and engineers find limited job opportunities, lagging financial rewards, job insecurity and uncertain career prospects when they receive their degrees.

## **Workforce Policy Objectives**

As part of a comprehensive national innovation strategy, IEEE-USA believes that workforce-related policies and investments should be directed at the following objectives:

- Strengthen the nation’s education system from pre-school to graduate school and beyond, with special emphasis on improving math, science and communications capabilities in grades K-12 and promoting greater flexibility in undergraduate and graduate degree programs in science and engineering.
- Improve incentives for individuals to pursue education and careers in science, math, engineering and technical fields and promote more effective utilization of graduates by public and private sector employers. This objective can best be accomplished by establishing Federal scholarships for service incentive programs in technology intensive agencies; enacting additional tax incentives for continuing education and training (lifelong learning); and expanding eligibility for Trade Adjustment Assistance to dislocated service sector workers.
- Promote balanced reforms in America’s permanent, employment-based immigration system and reduce the nation’s growing dependence on temporary visa programs.

## **Critical Importance of Federal Investments in Research and Development**

Substantial and sustained public and private investments in research over the past 50 years have spawned an abundance of technological breakthroughs, transformed American society and helped the United States to become the world's pre-eminent economy. Some economists estimate that as much as half of all recorded growth in Gross Domestic Product (GDP) over this period is attributable to technological advances.

While the US continues to lead the world in its capacity to innovate – to convert ideas and inventions to useful and affordable products, services and processes – overall Federal spending on research and development as a percentage of GDP has declined significantly since 1965. The focus of Federally- funded R&D has also changed. It has shifted away from long term investments in basic research - the kind of research that has done the most to spur innovation and economic growth – into much shorter-term investments in applied research and development

Increases in spending on weapons-related research and development at the Department of Defense have accounted for 70% of all federally funded R&D increases in recent years. Of the remainder, 75% has gone to the National Institutes of Health (NIH) and the Department of Homeland Security (DHS). At \$71 billion and \$29 billion respectively, the R&D budgets at DOD and NIH now account for over 75% of all Federal spending on research and development. Federal funding for R&D in the physical sciences and engineering, on the other hand, has been flat or declining for over 30 years. To be optimally successful, the nation's investments in research must be balanced across science and engineering disciplines and between short term needs for practical applications of state of the art technologies and the longer term search for promising technologies of the future.

The federal government has long played a critical role in helping to strengthen the nation's innovation system by sponsoring basic and applied research at universities, government laboratories, and not-for-profit research laboratories. The federal government invests \$132.3 billion in R&D, about 1/3 of the nation's total investment. It funds long-term basic research, whereas industry-sponsored R&D investments are much more narrowly focused on near-term product and process improvements. Thus, Federal support continues to be crucial to the discovery and early stage development of basic knowledge that the US needs to maintain its position of pre-eminence in technological innovation.

Sustained national investment in research and development will be necessary, but is not going to be sufficient to ensure continuing economic and technological pre-eminence. *We must also be able to capture and commercialize the outcomes of such research in ways that will allow us to continue to produce goods and services that meet the test of international markets while simultaneously improving the living standards of our citizens.* While the federal government's funding priority should be basic research - where industry under-invests - there needs to be a renewed focus on bridging the "valley of death" between basic research and the commercialization of technology, as well as funding the applied research that leads to generic and enabling technologies that can be commercialized by private industry.

Policy makers must also understand that research and development is only one component of the “commercialization” challenge. An even bigger obstacle to technology innovation than limited federal R&D dollars may be the Wall Street business imperative to return short term profits each quarter, which discourages long-term, high-risk investments in innovation and technology commercialization. Other key components of a new National Competitiveness Strategy – impacting tax, trade, intellectual property and immigration policy - are beyond the scope of this particular statement.

### **R&D Policy Objectives.**

IEEE-USA believes that Federal research and development policies and investments should be redirected as recommended by the Council on Competitiveness in its Innovate America report in order to:

- Stimulate high-risk research through “Innovation Acceleration” grants that re-allocate 3% of agency R&D budgets,
- Restore DoD’s historic commitment to basic research by redirecting 20% of the S&T budget to long-term research,
- Intensify support for research in the physical sciences and engineering to achieve a more robust national R&D portfolio, and
- Enact a permanent, restructured research and experimentation tax credit and extend the credit to research conducted in university-industry research consortia.

In addition, we endorse related Council on Competitiveness recommendations, including:

- Stimulate greater workforce skills enhancement through the creation of tax-favored, life-long learning accounts,
- Enhance workforce flexibility and facilitate mobility by increasing the portability of healthcare and pension benefits.
- Expand programs of assistance to service sector and other workers who are dislocated by technology and trade,
- Build 10 Innovation Hot Spots over the next five years to capitalize on regional assets and leverage public and private sector investments.

In closing, we would also recommend the timely enactment of legislation to:

- Increase National Science Foundation funding in line with the previous Congressional authorization in Public Law 107-368 that its budget be doubled,
- Fully fund the FY 2002 commitment to expand incentives for NSF’s science and engineering education initiatives,
- Maintain the long-term basic research focus in other science and technology programs, including those administered by the Defense Advanced Research Projects Administration (DARPA) and the Department of Homeland Security (DHS), and

- Increase high performance supercomputing research and development funding, revitalize manufacturing technology in the United States by enacting the Manufacturing Technology Competitiveness Act (HR 250) and support funding for the National Nanotechnology Initiative at levels recommended in the 21<sup>st</sup> Century Nanotechnology Act (Public Law 108-153).

## **Conclusion**

This statement focuses on two important components of a national innovation strategy, and therefore presents only a partial picture of what needs to be done to ensure the ability of the United States to maintain its technological competitiveness in the global economy.

IEEE-USA appreciates the enormity of the many interrelated tasks facing Congress and the Administration and remains committed to working with all interested parties to help identify and implement policy options that will help sustain the prosperity, security and quality of life that we associate with a strong and competitive America.

#####