



**Testimony of
Dr. Ray M. Bowen, Chairman
National Science Board**

**Before the Subcommittee on Research and Science Education
House Committee on Science, Space, and Technology
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Chairman Brooks, Ranking Member Lipinski, and members of the Subcommittee, I appreciate the opportunity to speak with you today in support of the National Science Foundation's budget request for Fiscal Year 2013. I am Ray Bowen, Chairman of the National Science Board and President *Emeritus* of Texas A&M University, and I am also a Distinguished Visiting Professor at Rice University.

Before I begin my testimony, I would like to say a few words about the Board's working relationship with NSF senior management. Over the past year and a half, the Board has had the pleasure of working with NSF's Director, Subra Suresh. Dr. Suresh has brought fresh ideas to the Foundation, many of which are incorporated in the Budget Request before you. All of the Board members have appreciated the close relationship we've developed with Dr. Suresh and his senior management team. We've had immediate access to the Director and all of his staff, and this working relationship has developed into quite a strong bond. With the Board members representing the science, engineering, and education community writ large, this collaborative relationship has served the Nation well.

Introduction

On behalf of the National Science Board, I would like to thank members of the Subcommittee for your enduring support of the National Science Foundation and its investment in an extensive portfolio of research and education enterprises spanning broad and cross-cutting areas of science, technology, engineering, and mathematics. In keeping with its vision to facilitate *a nation that capitalizes on new concepts in science and engineering and provides global leadership in advancing research and education*, the Foundation has taken great care in the development of its Fiscal Year 2013 Budget Request. Specifically, the Request sets out to reiterate the Foundation's primary role in supporting basic research and education.

The National Science Foundation Act of 1950 created the Foundation and the National Science Board and established that NSF's primary mission is to support basic research. Specifically, the purpose of the National Science Foundation as stated in its enabling legislation is "to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels in the...sciences... to support scientific and educational activities and to appraise the impact of research upon industrial development and upon the general welfare..."

For more than 60 years, the National Science Foundation has played a central role in innovation by catalyzing the development of fundamental ideas across the frontiers of science and engineering knowledge and supporting the people who generate them. As the only federal agency dedicated to the support of basic research and education in all fields of science and engineering, NSF is positioned to strategically stimulate innovative research that connects the science and engineering enterprise with potential economic, societal, and educational benefits. NSF's high-risk, potentially transformative investments will continue to lead the way for the important discoveries, the education of the future science and engineering innovators, and development of cutting-edge technologies that will help keep our Nation globally competitive, prosperous, and secure.

Fiscal Year 2013 Budget Request

The National Science Foundation's FY 2013 Budget Request reflects careful and wise decision-making of the commitment of federal funding toward innovative, targeted investments that closely align with both agency and Administration priorities. The Request totals \$7.373 billion, an increase of \$340 million or 4.8 percent over the FY 2012 Estimate, consistent with the Administration's commitment to doubling funding for NSF and other key basic research agencies. Specifically, the NSF 2013 Budget Request reflects a clear understanding that investments in science and technology are investments that will build America's future. This request acknowledges the critical nature of science and technology to America's long-term economic growth. Federal support for research and education across science and engineering fields is critical, particularly now, in our current economic environment. This is especially true given that private firms have decreased their investments in long-term research and development projects.

The Board is especially supportive of those programs that reach across disciplines to bring fresh approaches from differing perspectives to tackle some of the greatest challenges of our time. Many of those programs are part of the agency's OneNSF initiative. Throughout its history of developing successful collaborations with researchers in many disciplines, NSF is in the best position to bring together the science community to address seemingly intractable problems at the frontiers of knowledge. The details of these efforts are best left to Dr. Suresh and the agency's senior management to describe.

For the budget request before you today, one specific area I would like to highlight is the Foundation's Agency Operations and Award Management account, also known as the AOAM account.

The AOAM account provides the fundamental framework through which the Foundation's science and engineering research and education programs are administered. AOAM funding covers NSF's scientific, professional, and administrative workforce; the physical and technological infrastructure necessary for a productive, safe and secure work environment; and the essential business operations critical to managing NSF's administrative processes and providing high-quality customer service to the public. To sustain its excellent management, the Board urges full funding for NSF's AOAM account.

For the National Science Board Office, the Board requests \$4.44 million, level with our budget for FY 2012. This will allow the Board to continue its national policy role and its oversight role for NSF.

Many breakthroughs in research and development could not have been realized without the Nation's investment in science and engineering. Imagine our world without some of the National Science Foundation supported discoveries and inventions that we now take for granted, such as Magnetic Resonance Imaging, more commonly known by its acronym MRI, a critical tool in helping physicians diagnose a wide array of illnesses, and the internet on our iPhones or BlackBerrys. These kinds of innovations and inventions are critical to the economic well being of our Nation. In some instances just one discovery can spawn the development of entirely new and prosperous market sectors. Our Nation needs this investment, now more than ever.

U.S. Leadership in Science and Technology

In the recently released *Science and Engineering Indicators Digest 2012* publication, the Board elected to emphasize Research & Development (R&D) capacity and outputs of the United States and how global trends affect them. These trends demonstrate that increasingly economies worldwide rely on innovation to progress, thus driving the increased global dependence and thirst for knowledge. The data indicates that the United States remains the global leader in supporting science and technology (S&T) research and development, but other countries are catching up, in recognition of the potential return on investments in science and engineering.

As reported in *Indicators 2012*, the United States lost 28 percent of its high-technology manufacturing jobs over the last decade; this represents 687,000 jobs since 2000. While economic recessions in 2001 and 2008 and more efficient manufacturing processes have contributed to this decline, other contributing factors include the growth of foreign investment in R&D and the resulting increase in foreign R&D capacity. Further, the globalization of supply chains enables lower skilled work to be performed in more remote locations at reduced labor costs. While the U.S. remains the overall world leader in high-technology manufacturing, its lead is shrinking, and China has emerged as a world leader in high-technology trade. At this juncture, the United States is falling alarmingly close to being overtaken by rapidly increasing Asian investments in knowledge- and technology-intensive industries to bolster their economies.

Public Research Universities and Colleges

Universities and colleges are the key performers of the Nation's basic research, performing more than half of U.S. basic research (53 percent) in 2009. Support from the federal government makes up about 60 percent of academic research and development funding.

In the 2012 edition of *Indicators*, the Board also sought to highlight trends in state funding of research universities. The Board is concerned with the overall decline in funding for these institutions. *Indicators* show that between 2009 and 2011, 35 out of the 50 states reported reductions in state appropriations for higher education. This reduction, coupled with the decline that followed the 2001 recession, resulted in a 10 percent decline for the decade after accounting for inflation. The reduction also coincided with an increase in enrollment. As a result, per-student funding, after inflation, declined by 20 percent from 2002 to 2010.

The academic basic research enterprise provides the mentoring and experience essential to the training of new scientists and engineers. Significantly, the Nation's public research universities graduate a major share of undergraduate and graduate students majoring in key areas of science, technology, engineering, and mathematics. These graduates are essential participants in the Nation's science and engineering workforce and have a crucial role in fostering the Nation's economic development.

NSF's National Center for Science and Engineering Statistics conducted a public opinion poll surveying Public Attitudes Toward and Understanding of Science and Technology. Since 1985, NSF surveys have asked Americans whether, "even if it brings no immediate benefits, scientific research that advances the frontiers of knowledge is necessary and should be supported by the federal government." In 2010, 82% agreed or strongly agreed with this statement. Agreement with this statement has ranged from a low of 76% in 1992 to a high of 87% in 2006. These data indicate that a significant portion of the American public understands the link between supporting basic research and our Nation's economic well-being.

The Globalization of Higher Education

The developed world's lead in higher education has declined dramatically as the number of students in developing countries earning science and engineering degrees has risen. In 2008, the U.S. produced only four percent of the world's engineering degrees, while 56 percent were awarded in Asia, including a third in China. About 30 percent of all university undergraduate degrees earned in China were in engineering.

The number of natural science and engineering degrees rose in China from 280,000 to one million between 2000 and 2008, compared to 248,000 in the United States. In addition, the number of natural sciences and engineering doctorates awarded by Chinese universities has more than tripled since 2000. With 26,000 awarded in 2008, the number of Chinese doctorates now exceeds the number earned in the United States. It should also be noted that a large share of U.S. doctorate degrees is awarded to foreign students. In 2009, 44 percent of the 24,700 U.S. natural sciences and engineering doctorates were awarded to temporary visa holders. For engineering doctorates, 57 percent were awarded to foreign students.

With the world leadership role of the United States in science and engineering increasingly challenged, the National Science Foundation continues to do its part in maintaining the preeminence of the United States in science and engineering. The National Science Foundation's basic research mission continues to be the highest priority for the Foundation today.

National Science Board Activities

As part of NSF's policy-setting process and its role as advisor to Congress and the President on national science and engineering issues, the Board identifies areas for review and further examination through the establishment of task forces dedicated to an identified issue or topic. I'd like to briefly mention three of our most recent studies.

Merit Review Criteria

In May of 2010, the National Science Board initiated a review of the Foundation's Merit Review Criteria, thereby establishing the Task Force on Merit Review. It had been more than a decade

since the two criteria were implemented and the Board felt, as representatives of the research community, that review of the criteria was critical to ensuring the continued integrity of the peer review process. This is particularly timely given the projected increase in the number proposals submitted annually.

Every proposal submitted to NSF is evaluated as part of the Merit Review process and with respect to two important Merit Review Criteria—Intellectual Merit of the project and the Broader Impacts of the work to the public.

The importance of considering potential broader impacts in the process of deciding which projects to fund was re-emphasized in the America COMPETES Reauthorization Act of 2010. This legislation identifies a number of socially relevant outcomes, to which NSF-funded research contributes. Similarly, the NSF Strategic Plan emphasizes the value of broader impacts of scientific research, beyond the intrinsic importance of advancing scientific knowledge.

Based on the Task Force’s analyses, the NSB concluded that the two current Merit Review Criteria of Intellectual Merit and Broader Impacts remain appropriate for evaluating NSF proposals. However, the Board concluded that revisions were needed, both to draw a clearer connection of the Criteria to core principles and to better articulate the essential elements of each criterion. The Foundation is currently working to implement this guidance.

The Board’s review of the criteria was a necessary undertaking to ensure that the investments in research and education initiatives are in keeping with the National Science Foundation’s strategic goals for support of science and engineering research and education.

Data Policies

The progress of science and engineering has always been dependent on the collection of data. A core expectation of the scientific method is the documentation and sharing of results, underlying data, and methodologies. The increasing ease with which digital research data are gathered, processed, analyzed, and disseminated has expanded the scale, scope, and complexity of science and engineering data collections and highlights the need for improved research data policies. A mandated responsibility of the National Science Foundation is “to provide a central clearinghouse for the collection, interpretation, and analysis of data on scientific and engineering resources” (“National Science Foundation: Functions,” Title 42 *U.S. Code*, Chapter. 16. Sec. 1862). Therefore, NSF is dedicated to improving and implementing policies that provide a strong and sustainable foundation for sharing and managing digital research data for the benefit of the science and engineering research community.

In February 2010, the Board chose data policies as another priority and established the Task Force on Data Policies under the Committee on Strategy and Budget. The task force was charged with the further refinement of NSF data policies to address key challenges and outline possible options to more effectively use digital research data to meet the mission of NSF. The work of the task force culminated in a final report from the National Science Board that presents key challenges and recommendations related to the sharing and management of digital research data generated by NSF-funded activities.

The Board's view on data policies is reflected in the report, which stresses that timely attention to digital research data sharing and management is fundamental to supporting U.S. science and engineering in the twenty-first century. The Board recognizes the evolving role of data in science and society and strong and sustainable data sharing and management policies as a critical national need.

Instrumentation Report

Another priority for the Board over this past year has been mid-scale instrumentation. The America COMPETES Reauthorization Act of 2010 (ACRA 2010) Section 507 directed the National Science Board (Board) to "...evaluate the needs, across all disciplines supported by the Foundation, for mid-scale research instrumentation..." and to report its findings and recommendations to the Congress. In identifying mid-scale instrumentation activities, the Board was guided by the language of the ACRA 2010 as those mid-scale instrumentation investments falling between the MRI and MREFC programs.

During calendar year 2011, the Board's Committee on Strategy and Budget directed its Subcommittee on Facilities to investigate the means and extent to which the needs of the scientific community are being met by on-going and planned investments in mid-scale instrumentation. The Board's examination comprised an evaluation of mid-scale research instrumentation activities and funding approaches in each of NSF's Science and Engineering directorates and offices, and an analysis of anticipated mid-scale instrumentation needs across NSF-supported disciplines. The Board solicited input from these organizations regarding current mid-scale instrumentation activities, including projects, funding mechanisms, partnering, life cycles and anticipated demands for future mid-scale instrumentation within the science communities served by NSF.

Overall, the Board found that the current research infrastructure investments across the Foundation are in alignment with the Board's earlier recommendations on funding and prioritization, including for mid-scale research instrumentation. In particular, the Board found that NSF's current balance of small, medium and large instrumentation is sound, and that the variety of mechanisms by which NSF prioritizes, solicits, evaluates, and supports mid-scale instrumentation – both directly and indirectly through large centers and facilities – provides flexibility and vigor to NSF's efforts. Consequently, although the Board's evaluation points to the importance of continuing to strongly support mid-scale instrumentation, the Board does not recommend that NSF expand existing Foundation-wide programs or create a new Foundation-wide program for mid-scale instrumentation at this time. The Board will continue to work with NSF management and staff to capture, assess, prioritize and support anticipated needs for mid-scale instrumentation as part of NSF's research infrastructure investments.

Board Involvement in Budget Planning

The Board is intimately engaged in the development of the agency's Budget Request and related initiatives, which are featured in its annual Budget Request. The Board's involvement in the budget formulation process occurs primarily through its Committee on Strategy and Budget, which works with NSF senior leadership. The Board is involved with and kept apprised of the development of the budget every step of the way— from the initial planning stage for the next budget through informal discussions, numerous teleconferences, and final approval of the

submission to the Office of Management and Budget. In working with the Foundation to determine priorities, the Board takes into account the priorities of the Administration and Congress. We also bring our experience with the needs and readiness of the Nation's science and engineering community as a whole.

Conclusion

In closing, I'd like to reiterate that the outcomes of prior years of support have had positive effects on our Nation and its growth and prosperity, contributing directly to the economy and the creation of jobs in the United States. This 2013 Budget Request seeks to increase the efforts and results of this trend. Accordingly, the Board emphatically supports the National Science Foundation's focus on science, engineering, and educational investments as proposed in NSF's fiscal year 2013 Budget Request. The Board views this as a crucial and timely investment in our Nation's future.

The Board maintains support for the National Science Foundation's comprehensive and flexible portfolio of meritorious projects that have far reaching societal impacts. Flexibility in supporting a diverse portfolio enables the Foundation to identify and foster both fundamental and transformative discoveries within and among fields of inquiry. Preservation of the National Science Foundation's eminence as the Nation's premier agency supporting basic research and education in mathematics, science, engineering and technology is critical. Therefore, the Board strongly supports the President's Fiscal Year 2013 Budget Request for the National Science Foundation.