**Statement of Dr. Steven C. Beering**
**Chairman, National Science Board**
**to the**
**Committee on Science and Technology**
**Subcommittee on Research and Science Education**
**United States House of Representatives**
**on**
**The National Science Foundation's FY 2011 Budget Request**
**March 10, 2010**
**10 a.m.**

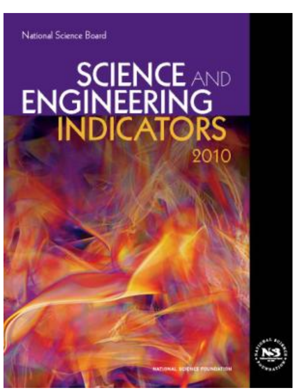
Chairman Lipinski, Ranking Member Ehlers, and Members of the Subcommittee, I appreciate the opportunity to testify before you today. I am Steven Beering, Chairman of the National Science Board and President *Emeritus* of Purdue University.

## National Science Board

I am honored to represent the members of the National Science Board before you today. Congress established the National Science Board in 1950 and gave it dual responsibilities:

- Oversee the activities of, and establish the policies for, the National Science Foundation (NSF)
- Serve as an advisory body to the President and Congress on national policy issues related to science and engineering (S&E) research and education.

The National Science Foundation is the primary source of funding for academic basic research across non-biomedical science and engineering disciplines. NSF funds cutting-edge research at the frontiers of knowledge, and also supports scientific facilities and activities in science, technology, engineering, mathematics (STEM) education. We applaud your continuing support for NSF and your commitment to sustaining U.S. leadership in science and technology.




## Concerns for American Science Leadership from Science and Engineering Indicators 2010

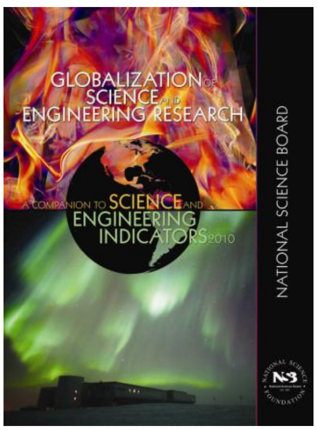
The United States has long been a leading center of science, technology, and innovation, but we now face challenges as a result of growing capacity in science and technology (S&T) across the globe. Economists increasingly emphasize the central role of knowledge, particularly R&D and other activities to promote science and technology, in a country's economic success[1]. But as recent indicators show us, in our biennial statistical report, *Science and Engineering Indicators 2010* (SEI 2010), many countries and economies have taken steps to open their markets to trade and foreign

[1] National Science Board (NSB). 2010. *Science and Engineering Indicators 2010* (NSB-10-01), p. 6-7.

investment, develop or recast their S&T infrastructures, stimulate industrial research and development (R&D), expand their higher education systems, and build indigenous R&D capabilities. In short, they are developing strategic plans and policy frameworks for increasing S&T capacity, and investing in the requisite infrastructure and workforce to achieve their objectives. And while the EU and Japan continue to be major players in S&T, China and other developing nations are rapidly building S&T capacity.

While the United States continues to be by far the largest R&D-performing country in terms of absolute dollar investment, China and other Asian nations are rapidly increasing their R&D investments. Between 1996 and 2007, China increased its R&D expenditures at a 20 percent annual growth rate from a substantially lower base, while the United States and other mature S&T countries averaged about a 5 to 6 percent annual growth rate from a higher base. As a result, relative regional investments in R&D changed markedly: the North American region's (United States, Canada, and Mexico) share of estimated world R&D activity decreased from 40 to 35 percent; the European Union's share decreased from 31 to 28 percent. These declines in global R&D share reflect the Asia/Pacific region's increase from 24 to 31 percent, with most of that increase contributed by countries other than Japan.

China and other Asian countries also pose a challenge to U.S. preeminence in terms of students and researchers involved in S&T activities. On both indicators, China's absolute numbers have increased in




recent years. As SEI 2010 points out, the number of S&E doctorates awarded in China rose from about 1,900 in 1993 to almost 23,000 in 2006, more than a 12-fold increase. While the number of degrees granted does not provide information on the quality of the students, in 2006 China awarded nearly as many doctoral degrees as the United States, and may have since surpassed the United States[2].

Between 1995 and 2007, the number of researchers in China more than doubled from about 0.5 million to more than 1.4 million, an increase in world percentage from 13 to 25 percent. In comparison, the number of researchers in the United States and the EU grew by an annual rate of about 3 percent over the same time period. China's publication volume increased by about 14 percent annually over the period 1995 to 2008, moving it into 2nd place behind the United States, up from 14th place in 1995[3].

Increased global R&D activity should by no means be viewed as negative. It leads to a dynamic global system of exchange of scientific knowledge and collaboration among diverse researchers, and provides opportunities to build shared international facilities. However, the United States must view increased global capacity in S&T as a call to sustained action to continue robust investments in science and technology.

**FY 2011 Budget Request**

This year's budget request for science and technology agencies 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 of special importance in tight economic times, when private firms are hesitant to invest in R&D projects whose economic benefits may not be immediate. Funding the National Science Foundation at the FY 2011 budget request level is essential to our nation's continued prowess in S&T-based innovation, economic prosperity, and high quality of life.

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[2] NSB. p. 2-35.
[3] NSB, p. 5-5.

The President's NSF budget request of $7.4 billion reflects the clear understanding that investments in science and technology are not luxuries but rather critical investments to fund the research and innovation that will build America's future. If approved, this 6.9 percent increase in real terms, 8.0 percent in current dollars, above the 2010 funding level, would put NSF on track to double its budget in 10 years, as part of the President's Plan for Science and Innovation and roughly consistent with the America COMPETES Act.

The request for the National Science Board is $4.84 million, an increase of $300,000, or 6.6 percent, over the FY 2010 budget of $4.54 million. This increase will allow the Board to continue to strengthen its role in policy for NSF and in advising the President and Congress on significant national policy issues in science and engineering and education in science and engineering.

Funding for NSF's Agency Operations and Award Management (AOAM) account continues to be a top priority for the Board. This account represents the majority of the funding devoted to agency operations. In FY 2010, the President's budget request for NSF for an AOAM increase of 8.3% was reduced to only 2%. For NSF to continue to serve our nation, we must have adequate human and physical infrastructure and management. The quality of the merit review process greatly depends upon NSF having staff with the necessary expertise, within and across disciplines, to select and recruit superior reviewers and panelists. To sustain excellence in merit review, the Board urges full support of the request for the AOAM account.

Now, I wish to address several topics raised by Chairman Lipinski.

**National Science Board Priorities**

The Board has recently identified priority areas to explore over the next 12 to 24 months: grantee data policies at NSF, multi-investigator and multi-scale research efforts supported by NSF, and revisiting the NSF merit review criteria. Each of these studies will examine issues of high importance to NSF, and the Board intends to provide substantive guidance to the agency at the conclusion of each study. Below are brief summaries of the topics.

*1. Data Policies*

Increasing ease of gathering massive amounts of data and of use of large-scale collaborative projects has made it a priority to consider NSF data policies. The Board will examine how NSF data policies govern how data collected in NSF-supported projects should be managed and shared, to ensure broad, timely, and long-term data availability and accessibility. The Board's study will build upon its 2005 report, *Long-Lived Digital Data Collections: Enabling Research and Education in the 21st Century* (NSB-05-40). Although the initial focus of the study will be NSF's data policies, the Board hopes to use this study to engender a discussion of the topic in a broader federal context.

Several policy questions will be considered, including:

- How can NSF most effectively develop cyberinfrastructure that supports the data acquisition, accessibility, manipulation, and storage needs of the broad scientific community, particularly at NSF-funded large facilities and distributed networks that generate extremely large amounts of raw data?
- Is there a way to capitalize on cyberinfrastructure investments made and lessons learned among multiple NSF facilities facing similar data issues?
- What role, if any, should NSF play in managing and ensuring the long-term availability and accessibility of data – particularly digital data?

- How should data collected with NSF funding be managed and shared to ensure openness?

*2. Multi-Investigator and Mid-Scale Research*

NSF utilizes a variety of mechanisms to facilitate research at the frontiers of knowledge (e.g. cooperative agreements, centers, programs linking industry and academia, and MREFC projects). In light of the ever-increasing size and complexity of research projects, the Board plans to examine the adequacy of its support frameworks for mid-scale, multi-investigator research. Research projects that cost approximately $10 to $100 million (larger than average awards, but smaller than MREFC projects), and are conducted by multiple investigators and sometimes encompass multiple disciplines, are the subject of this study.

In broad terms, the Board plans to examine NSF's current efforts in supporting mid-scale research activities, and explore the best means for doing so in the future.

*3. Merit Review Criteria*

All NSF proposals are evaluated with respect to two equally important merit review criteria – intellectual merit and broader impacts. These merit review criteria were established in 1997 to replace a four-criteria system, in which reviewers evaluated researcher performance competence, intrinsic merit of the research, utility or relevance of the research, and effect on the infrastructure of science and engineering.
The Board last reviewed the NSF merit review in the mid-2000s, at the request of Congress. The Board issued a report in September 2005, concluding that the NSF merit review process is fair and effective, and "remains an international 'gold standard' for review of science and engineering research proposals."

The Board intends to reevaluate the two current merit review criteria and decide whether to retain the current criteria or to consider some degree of enhancement. As part of this reevaluation, the Board intends to examine, among other issues, whether enhancements could be made to clarify the meaning and appropriate responses concerning "transformative research" for the first criterion, and "broadening participation" for the second criterion.

**NSF Investment in Research Infrastructure**

In addition to its examination of NSF multi-investigator and mid-scale research, the Board has created a new subcommittee to focus on facilities. Recognizing the need to address the issue of strategic facility planning across NSF, the Board last year established the Subcommittee on Facilities (SCF) under its Committee on Strategy and Budget (CSB), with responsibility for providing guidance on strategic planning for the entire NSF research equipment and facilities portfolio. SCF activities include undertaking an annual review of the portfolio of all NSF-funded research facilities (including facilities funded under Research and Related Activities account). This annual review will allow SCF to provide to CSB and the Board a clear assessment of the impact that specific projects and the overall facilities portfolio will have on long-term budget planning at NSF, and recommend to CSB and the Board guidance to be provided to NSF management on the prioritization of all projects that have completed a Conceptual Design Review (CDR) and are being considered for further funding to develop Preliminary Designs. This committee is established under the auspices of CSB to allow for full discussion of NSF's research infrastructure investments relative to the agency's other types of research investments. Its intent is to maintain Board focus on all phases of facilities – design, development, construction, operations, and decommissioning.

The MREFC account supports the acquisition, construction, and commissioning of major research facilities to provide unique capabilities at the forefront of science and engineering research. There are several distinct phases in the NSF process for conceptualizing, planning, and constructing MREFCs: conceptual design stage, preliminary design (Readiness) stage, and final design stage. The Board is involved in the process at two key critical design points - following preliminary design review (PDR) and final design review. The Board is exploring with NSF how the Board may best be involved in selecting projects that advance towards the Readiness stage.

During the Readiness stage, a Preliminary Design is developed and vetted through a formal PDR by the MREFC panel (composed of all NSF Assistant Directors, Office Heads, and the Deputy Director) and outside experts. The Preliminary Design is generally used as the baseline project definition when requesting Congressional appropriation of construction funds. If the PDR judges the preliminary design to be of high scientific merit and construction readiness, the MREFC panel recommends to the Director that the Board consider advancing the project to the Proposed New Starts category of facilities for inclusion in a future President's budget request. The Board votes up-down to advance the project to the Final Design Stage.

During the Final Design Stage, the project continues its pre-construction planning, and NSF conducts annual cost review updates, with results reported to the Board. A Final Design Review (FDR) is conducted to ensure that the project is aligned with the appropriated budget, if such budget is successfully attained through the Congressional appropriation process. The FDR also considers whether the underlying assumptions about the project continue to be valid, and whether the project is fully ready to undertake construction activity. Following the FDR, the Board is asked to approve the obligation of MREFC funds (if Congress has appropriated funding for the project) to begin construction.

Facility operating costs are considered in the context of deciding whether to undertake construction of a new facility under the MREFC account. Projects are repeatedly assessed throughout the planning and construction period to ensure accurate awareness of projected operating costs. Beginning with the NSF FY 2009 budget request, the NSF Director instituted a no cost overrun policy requiring that the project cost estimate at PDR include adequate contingency to cover all foreseeable risks, and that any cost increases not covered by contingency be accommodated by scope reduction. Since implementing the policy for new facilities, NSF has been successful at staying within cost and schedule plans.

**Reauthorization of America COMPETES Act**

The Board has several operational issues related to staffing, ensuring timely information for S&E Indicators, and in defining a quorum for gatherings outside of plenary sessions. Ongoing discussions with Subcommittee staff should help resolve these important issues.

**Closing Remarks**

The Board urges that Congress fund in full the President's budget request for the National Science Foundation. As our nation recovers from economic recession, investments in science and engineering research and education are ever more critical to laying the long-term foundation for S&T-based innovation that drives the creation of new jobs and industries. The economic growth and the quality of life that we enjoyed in the 20th century were made possible in large part by scientific discoveries and technological innovations. Continued economic prosperity and improvements in the American quality of life will require a continued, and indeed enhanced, Federal commitment to investing in science and engineering research and education.

Mr. Chairman, after seven years on the Board and serving for the last four years as Chairman, my term is about to end in May. On behalf of the National Science Board and the S&E research and education communities, I would like to thank the Members of the Subcommittee for your long-term recognition of and commitment to support for the National Science Foundation.