

**APPROVED MINUTES¹
OPEN SESSION
429TH MEETING
NATIONAL SCIENCE BOARD**

National Science Foundation
Arlington, Virginia
December 4-5, 2012

Members Present

Dan E. Arvizu, Chairman
Kelvin K. Droegemeier, Vice Chairman
Bonnie Bassler
Arthur Bienenstock#
Ray M. Bowen
France A. Córdoba
Esin Gulari
G. Peter Lepage
Alan I. Leshner
W. Carl Lineberger
G.P. “Bud” Peterson
Douglas D. Randall
Geraldine Richmond
Anneila I. Sargent
Diane L. Souvaine
Arnold F. Stancell
Claude M. Steele
Robert J. Zimmer

Subra Suresh, *ex officio*

Consultants Present

Mark R. Abbott
Arthur K. Reilly

Members Absent

(None)

¹ The minutes of the 429th meeting were approved by the Board at the February 2013 meeting.
#Participated by telephone

The National Science Board (Board, NSB) convened in Open Session at 9:30 a.m. on Wednesday, December 5, 2012, with Dr. Dan Arvizu, Chairman, presiding. (Agenda NSB-12-57, Board Book page 338). In accordance with the Government in the Sunshine Act, this portion of the meeting was open to the public.

Prior to the meeting, Dr. Arvizu made the following announcement relating to Board Member appointments:

- Dr. Arthur Bienenstock was officially appointed by the President in November 2012, replacing Dr. Louis Lanzerotti for the Class of 2016. Dr. Bienenstock is Professor Emeritus of Photon Science, Special Assistant to the President for Federal Research Policy, and Director of the Wallenberg Research Link at Stanford University.

He also announced that on December 3, 2012, the President appointed the following Board Members for the Class of 2018:

- Dr. Deborah L. Ball, Dean of the School of Education, University of Michigan (replacing Dr. Camilla Benbow);
- Dr. Inez Fung, Professor of Atmospheric Science, University of California, Berkeley (replacing Dr. Patricia Galloway);
- Dr. G. Peter Lepage, Dean of the College of Arts and Sciences, Cornell University (replacing Dr. Richard Thompson); and
- Dr. Geraldine Richmond, Professor of Chemistry and Materials Science, University of Oregon (replacing Dr. José-Marie Griffiths).

Dr. Arvizu gave the Oath of Office to Drs. Bienenstock, Lepage, and Richmond who were present at the meeting.

AGENDA ITEM 8: Approval of Open Session Minutes, July 17-18, 2012

The Board unanimously APPROVED the Open Session minutes of the July 17-18, 2012 Board meeting (NSB-12-43, Board Book page 371).

AGENDA ITEM 9: Chairman's Report

In the Chairman's Introduction on Tuesday, December 4, 2012 and during the Chairman's Report in the Plenary Open Session on Wednesday, December 5, 2012, Dr. Arvizu announced and reported on several items.

a. Administrative Burdens

On the topic of administrative burdens - the burdens imposed on federally-supported researchers at U.S. universities, colleges, and non-profit institutions - the Chairman stated that Drs. Arthur Bienenstock, Kelvin Droegemeier, and Alan Leshner initiated informal discussions on this topic. Two articles on this subject were provided to Board Members, one by Dr. Bienenstock, "Administrative Burdens Stifle Faculty and Erode University Resources," American Physical

Society, 1995, and one by Dr. Leshner, "Reduce Administrative Burden," *Science*, December 12, 2008 (Board Book pages 392, 396).

Dr. Arvizu called upon Dr. Bienenstock to report. Dr. Bienenstock stated that the administrative burdens on the Nation's faculty researchers has grown significantly over the last few decades, creating what the National Research Council (NRC) termed, "a drag on the efficiency of all university research." As might be expected in this time of severe budgetary strain, the issue of increasing regulation, which has substantially increased across the university and reduced research time and productivity among faculty, has caught the attention of Congress and the Administration.

With the collective expertise and leadership of NSF and members of the research community, Dr. Bienenstock thought the Board has an opportunity to contribute uniquely to the ongoing Federal dialogue. He stated that the Board can help make changes to Federal research policy and draw attention to the needs of the individual investigators whose work underpins the entire R&D enterprise. For this reason, Dr. Bienenstock proposed that the Board establish a Task Force on Administrative Burdens to consider the problem and possible solutions.

Dr. Bienenstock referenced the articles written by him and Dr. Leshner. He reminded the Board of a few key points that highlight the importance of this topic. The NRC report on *Research Universities and the Future of America* states that excessive regulatory burdens could potentially cost billions of dollars over the next decade. In the 2012 survey by Federal Demonstration Partnership members, faculty reported spending an average of 42 percent of their time allocated to a federally-funded research project on associated pre- and post-award administrative tasks. He stated that regulatory requirements are necessary to ensure safety and proper use of sponsored research funding; however, ineffective and duplicative requirements could be eliminated, reformed, or harmonized. The Federal Government has begun taking the necessary steps to reform regulations and standardize reporting requirements, yet there is more to be done.

Dr. Bienenstock addressed a draft charge that was distributed to Board Members at the meeting. He stated that he and Drs. Droegemeier and Leshner, with assistance from the Board Office staff, put together a draft charge to help the Board consider the proposal for a new task force. As envisioned in this charge, the task force would complement existing Federal efforts by focusing on the administrative burdens imposed on the individual researcher. It would seek to characterize the problem and its origin and evolution, identify opportunities to reduce burden, and develop policy recommendations accordingly.

Dr. Leshner emphasized the importance of focusing on the researcher and the burden on the researcher. The task at hand is to reduce that burden without decreasing accountability or responsibility and without increasing the administrative burdens on the university. He noted that there is tremendous redundancy across Government agencies. He stated that there is an opportunity to reduce administrative burdens that requires commitment by all the parties involved. Dr. Leshner also commented that the Commissioner for Research and Innovation of the European Union (EU) and the Chairman of the European Parliament Committee on Science declared that they are going to reduce the bureaucracy attached with EU granting.

Dr. Droegemeier commented that the word "burden" underscores the fact that the research community values transparency and understands the importance of meeting compliance obligations. He also stated that the Board is focused on the importance and progress of science.

Dr. Subra Suresh, NSF Director, thanked Drs. Bienenstock, Droegemeier and Leshner for initiating this activity. He commented that the implications go beyond the university community or the principal investigator (PI) community and that there are also huge implications for NSF staff. Dr. Suresh stated that he hopes the Board engages with the science community and outside entities. Dr. Carl Lineberger commented that the Board does not often have the opportunity to engage in activities that cut across every corner of the constituency.

Based on this discussion:

The Chairman established the Task Force on Administrative Burdens with Dr. Arthur Bienenstock as chairman.

The Board unanimously APPROVED a draft Charge to the Task Force on Administrative Burdens, subject to minor edits approved by the task force chairman and the Board Chairman (NSB-12-67, Appendix A).

Dr. Droegemeier suggested compiling a timeline for the task force's activities for the Board's consideration. Dr. Arvizu stated that it was expected that the task force will report on its progress at the next Board meeting.

b. Letter to OSTP on Science Communication and Travel Restrictions

On May 18, 2012, the Office of Management and Budget (OMB) issued a Memo to the Heads of Executive Departments and Agencies, "Use of Evidence and Evaluation in the 2014 Budget" (Board Book page 385), which requires agencies to cut their 2013 travel spending to at least 30 percent below the 2010 levels, and to keep travel spending at that reduced level through 2016. The memo also limits the number of employees an agency can send to any particular meeting in a given year.

Dr. Arvizu introduced a draft letter from him to Dr. John Holdren, Assistant to the President for Science and Technology Policy and Director, Office of Science and Technology Policy (OSTP) (Board Book page 383). The letter explains how NSF's effectiveness is threatened by these new conditions. NSF had already been working to keep expenses as low as possible by reducing staff travel and substituting teleconferences with webinars for panels.

Dr. Arvizu's letter on behalf of the Board indicates that additional cuts and restrictions threaten to isolate the NSF scientific staff from the scientists they are meant to lead; make recruiting of NSF staff, who provide crucial new thinking and links to NSF's community, difficult; and endanger NSF's ability to do effective oversight of its investments. He added that a number of other scientific associations and organizations have also expressed concern about the topic of the OMB memo.

A letter to Congressional leadership, prepared by the American Association for the Advancement of Science (AAAS), was signed by 53 scientific societies (Board Book page 390). It warns that travel restrictions for scientists will impede the flow of scientific information and professional development, which then threatens innovation, competitiveness, health, and national security.

Dr. Arvizu opened the floor for comments, and Dr. Suresh noted that the day after the first OMB circular was issued, several of the science funding agencies in Washington, NSF included, requested, as quickly as possible, a meeting with OMB leadership and the White House to discuss the potentially devastating implications given that travel is mission-critical to their work. Dr. Suresh participated in that meeting, and he and other agency representatives continued to articulate the importance of travel for scientists. He stated that the memo from the Board to Dr. Holdren and any subsequent conversations with the broader community in Washington would add concerns voiced by other members of the community.

Dr. France Córdova commented that there should be more travel, not less, for NSF scientific staff in order to manage what they have been charged to do on behalf of the entire U.S. Government. She added that it would be foolish to invite audits and inspector general investigations if scientists faltered in their responsibility to have effective oversight. She suggested adding specific examples to the letter to give it more definition. Dr. Geraldine Richmond built on Dr. Córdova's comments and suggested sending additional letters to include additional examples and views.

The Board unanimously APPROVED the draft letter to the Office of Science and Technology Policy (OSTP) regarding scientific communication and travel restrictions, subject to minor edits approved by the Chairman. (Appendix B)

c. Follow-up on Merit Review Implementation

On the topic of merit review, the Chairman reminded the Board that in December 2011, NSB published a report, *National Science Foundation's Merit Review Criteria, Review and Revisions* (NSB-11-86).² The Chairman indicated that the Board is interested in hearing about NSF's implementation of the Board's recommendations for a set of Principles and revised Merit Review Criteria, including the collection and analysis of data that contributed to the Board-approved enhancements. He requested that NSF provide or present information about the Merit Review implementation at one of the upcoming meetings.

d. Follow-up Research on Digital Research Data

Finally, the Chairman reported that the Board Office asked the Science Technology Policy Institute (STPI) to conduct follow-up research on the December 2011 NSB report, *Digital Research Data Sharing and Management* (NSB-11-79).³ In that report, the Board identified the importance of managing large sets of digital data. The Board specifically noted that "new jobs in areas of expertise are emerging in response to the evolving role of data in science and engineering;

² Report available at: <http://www.nsf.gov/nsb/publications/2011/meritreviewcriteria.pdf>

³ Report available at: <http://www.nsf.gov/nsb/publications/2011/nsb1124.pdf>

yet, opportunities for workforce development are not fully recognized.” STPI produced a White Paper on the issues surrounding the data management workforce and offered recommendations on how to better support these professionals. (Board Book Addendum)

e. Board Member Recognition

Dr. Subra Suresh was selected as the recipient of the 2013 Benjamin Franklin Medal awarded by the Franklin Institute in Philadelphia, whose award laureates include science and technology’s most important and influential names over the last 2 centuries.

Additionally, Dr. Suresh received the Timoshenko Medal, an annual award by the American Society of Mechanical Engineers (ASME) “in recognition of distinguished contributions to the field of applied mechanics.” It is widely regarded as the highest international award in that field.

Dr. France Córdova was inducted as a Board Member of the Center for the Advancement of Science in Space (CASIS), a non-profit organization promoting and managing research on board the International Space Station U.S. National Laboratory.

Dr. Diane Souvaine was appointed Vice Provost for Research at Tufts University.

f. Webcast of Board Meeting / Concurrent Sessions

The Board meeting was Webcast and simultaneously available to viewers through the Internet. The Webcast included the Plenary Open Session of the full Board as well as Open Sessions of its committees. The Webcast is available from the NSB and NSF Web sites, <http://www.tvworldwide.com/events/nsf/121204/>. Also, for the first time in several years, committee meetings were held in concurrent sessions.

AGENDA ITEM 9: Director’s Report

Dr. Subra Suresh, NSF Director, reported on the following items:

a. NSF Staff Introductions

Dr. F. Fleming Crim will join NSF in January 2013 as Assistant Director (AD), Directorate for Mathematical and Physical Sciences (MPS). Dr. Crim will come to NSF from the University of Wisconsin where he serves as John E. Willard and Hilldale Professor in the Department of Chemistry. Dr. Crim has a distinguished record of accomplishments in research and education, including leadership roles in the National Academies of Science. He received his Ph.D. from Cornell University.

Dr. Kesh Narayanan agreed to serve as Acting AD, Directorate for Engineering (ENG) effective December 3, 2013. Dr. Narayanan served as the ENG Deputy Assistant Director. Previously, Dr. Narayanan served as Director, ENG Division of Industrial Innovation and Partnerships (IIP), which supports partnerships for the transformation of discovery into societal benefits. Before joining NSF in 1994, Dr. Narayanan held the position of Chief Scientist for the building materials

division of CertainTeed Corporation. Dr. Narayanan received his Ph.D. in Materials Science and Engineering from Carnegie Mellon University.

Ms. Dorothy Aronson was appointed Division Director, Information Systems, Office of Information and Resource Management (OIRM) on October 7, 2012. Ms. Aronson had served as Acting Division Director since October 9, 2011. Before joining NSF, she held a number of positions at the Defense Advanced Research Projects Agency, including Director, Office of Management Operations. Ms. Aronson holds a B.A. from Duke University.

Dr. Richard Duschl joined NSF as Division Director, Research on Learning in Formal and Informal Settings, Directorate for Education and Human Resources (EHR) on November 4, 2012. Dr. Duschl came to NSF from Pennsylvania State University where he holds the Waterbury Chair for Secondary Education. Prior to joining Penn State, he was Professor of Science Education in the Graduate School of Education at Rutgers University and was an executive member of the Rutgers Center for Cognitive Science. Dr. Duschl received his Ph.D. in Science Education from the University of Maryland, College Park.

Dr. Jeryl Mumpower joined NSF as Division Director, Division of Social and Economic Sciences, Directorate for Social, Behavioral and Economic Sciences (SBE) on September 4, 2012. Dr. Mumpower came to NSF from Texas A&M University where he is Professor and Director of the Masters in Public Service and Administration Program and Lozano Long Chair in Business and Government. Prior to joining the faculty at Texas A&M, he was at the University of Albany for more than 20 years. He received his Ph.D. in Social and Quantitative Psychology from the University of Colorado, Boulder.

b. Congressional Update

Dr. Suresh reported that the Federal Government is currently operating under a continuing resolution (CR) until March 27, 2013. For NSF specifically, the funding rate for operations aligns with the level provided for FY 2012 (\$7 billion), prorated for this period of time. The CR legislation also requires that NSF update the appropriations committees on plans for operations for the period covered by the CR, and NSF provided this information at the end of October 2012.

Currently, the major issue before the House and Senate is to come to agreement on more permanent deficit reduction measures in order to avoid the so-called “fiscal cliff” stipulated in the Budget Control Act of 2011. A central element of this is the process for automatic spending cuts known as sequestration, which would reduce Federal spending by \$1.2 trillion over the next 10 years. Under this scenario, each NSF appropriation would be looking at approximately an 8 percent decrease in funding for FY 2013 starting October 1, 2013. These levels were specified in the “OMB Report Pursuant to the Sequestration Transparency Act of 2012 (P. L. 112–155),” which was issued by OMB on September 14, 2012.⁴ If that were to happen, it would result in 1,000 fewer new research grants that NSF would fund next year.

⁴ OMB report available at: http://www.whitehouse.gov/sites/default/files/omb/assets/legislative_reports/stareport.pdf

On November 15, 2012, Dr. Suresh testified before the House Science, Space, and Technology Committee on “The U.S. Antarctic Program: Achieving Fiscal and Logistical Efficiency While Supporting Sound Science.” Other witnesses included Mr. Norman Augustine, Chairman for the U.S. Antarctic Program Blue Ribbon Panel; General Duncan McNabb, USAF (Ret.), member of the Blue Ribbon Panel; and Dr. Warren Zapol, Chairman of the NRC Committee on Future Science Opportunities in Antarctica and the Southern Ocean.

Representative Lamar Smith (R-TX) was selected and confirmed to succeed Representative Ralph Hall, who is term-limited, as Chairman of the House Science, Space, and Technology Committee.

c. 60th Anniversary of the NSF Graduate Research Fellowship Program

Following the Board meeting on December 5, 2012, the Board was invited to attend a commemoration in honor of the 60th Anniversary of NSF Graduate Research Fellowship Program (GRFP). GRFP is the country’s oldest fellowship program that directly supports graduate students in science, technology, engineering, and mathematics (STEM) fields. Dr. Arvizu gave the introductory remarks. Speakers included Dr. Suresh; Dr. Cora Marrett, NSF Deputy Director; Dr. Steven Chu, former GRF Nobel Laureate in Physics and current Secretary of the Department of Energy; and Dr. Robert Zimmer, former GRF, current President of the University of Chicago, and NSB member. Dr. Joan Ferrine-Mundy, EHR Assistant Director, gave the closing remarks.

NSF will also be launching a new initiative on graduate research fellows called Graduate Research Opportunities Worldwide (GROW).

AGENDA ITEM 10: Open Committee Reports

[Note: The Committee on Education and Human Resources (CEH) did not meet in December 2012.]

a. Executive Committee (EC)

Dr. Subra Suresh, EC chairman, reported that the primary purpose of the meeting was to describe the process for developing future meeting agendas. The committee emphasized the desire to keep topics focused on significant, big, and important issues deserving the Board’s attention to ensure the health and well-being of the science and engineering enterprise. Each of the five standing committee chairmen was asked to provide brief insights on proposed future agenda topics.

Dr. Claude Steele, CEH chairman, described several potential topics for the CEH committee, including workforce development and alternate career paths for Ph.D.’s, improvement to STEM teaching in the first 2 years of college, and increased inclusivity in STEM education. EC encouraged the group to review the topics outlined at the meeting and distill recent education reports into a set of policy items that could form the basis of a set of goals for CEH in the coming year.

Dr. Diane Souvaine, chairman of the Committee on Programs and Plans (CPP), provided several potential agenda items for this committee, including working on the required joint meeting of the Committee on Programs and Plans / Committee on Strategy and Budget (Joint CPP-CSB), and several upcoming information items.

EC also heard from other committee chairmen. Dr. France Córdova, CSB chairman, indicated that CSB anticipated discussions on FY 2013 and FY 2014 budgets in the next meeting in addition to an update on the strategic planning activities at NSF for the next 5-year plan. Dr. Bud Peterson, chairman of the Committee on Audit and Oversight (A&O), said that he would get a set of committee-proposed agenda topics to the executive committee in the near future. Dr. Ray Bowen, chairman of the Committee on Science and Engineering Indicators (SEI), commented on the structured process for the development of *Science and Engineering Indicators*. He also indicated a potential discussion of progress on development of a mobile application for SEI in the future.

The EC chairman stated that he will look to CEH in a future meeting to provide a more distilled version of some of the topics that were discussed, and looked forward to hearing the proposed agenda topics from A&O. EC will establish the agenda items for the February 2013 meeting and future meetings.

b. Committee on Audit and Oversight (A&O)

Dr. Bud Peterson, A&O chairman, reported that Ms. Allison Lerner, NSF Inspector General (IG), reported on two recently concluded Office of Inspector General (OIG) investigations. She noted that the Attorney General approved statutory law enforcement authority for the OIG, broadening its investigative powers. The OIG will sponsor a webinar or workshop in early 2013 for the awardee community in an effort to discuss and answer questions about the data analytics methods and capabilities that are employed by OIG in their grant audits.

Mr. Sal Ercolano, Clifton Larson Allen Partner-in-Charge of the NSF financial statement audit, gave a summary of the FY 2012 audit related reports. The auditors gave NSF an unqualified “clean” opinion on the financial audit and found no material weaknesses. Mr. Ercolano noted that the agency, the OIG, and the Defense Contract Audit Agency (DCAA) have not yet been able to resolve most of the issues involved on the one significant deficiency noted, but they are expecting to do so in the coming year. The Federal Information Security Management Act (FISMA) report on the NSF information technology (IT) security program also had no significant deficiencies. Additional lesser findings were included in the FISMA report and will be included in the upcoming management letter.

Dr. Brett Baker, Assistant Inspector General for Audit, presented the OIG FY 2013 Audit Plan. (Presentation Book) He discussed the process for providing oversight for grants and how data analytics can strengthen it. The Board discussed the complementary roles OIG and NSF management in the undertaking of audits and the analysis and application of audit results.

Ms. Martha Rubenstein, NSF Chief Financial Officer (CFO), gave an update on material she had provided to the Board in advance. She noted that the American Recovery and Reinvestment Act (ARRA) acceleration waiver request was submitted early to OMB. The Board extended congratulations to Ms. Rubenstein on NSF’s 15th consecutive “clean” audit opinion.

Dr. Arvizu noted that both the OIG and CFO deserve recognition for their efforts to work through complex issues in a collaborative manner. Both Drs. Peterson and Arvizu agreed that it is important to look at challenging issues in the broader context of NSF's responsibilities, such as the internal review planned for management of large facilities.

Mr. Gene Hubbard, NSF Chief Human Capital Officer, gave an update on the results from the Office of Personnel Management's (OPM) 2012 Federal Employee Viewpoint Survey. Although the NSF results show that employees are dedicated and believe the work they and NSF do is important, the survey also indicates a continued downward trend in employee satisfaction scores. A&O encouraged NSF to continue taking aggressive, concrete actions to address challenge areas as indicated by the survey results, in particular addressing employee engagement, employee workload, and overall employee satisfaction.

c. Committee on Science and Engineering Indicators (SEI)

Dr. Ray Bowen, SEI chairman, reported that SEI approved the narrative chapter outlines for *Science and Engineering Indicators (Indicators) 2014*. A working group of the committee convened to review and make potential changes to the state chapter, and is expected to meet again before the February 2013 meeting. Chapter reviewer and lead reviewer assignments will also be made by the February 2013 meeting.

Ms. Cheryl Roesel, Publications Manager, NSF National Center for Science and Engineering Statistics (NCSES), provided a demonstration of the new *Indicators 2012* mobile application. (Presentation Book) The application will deliver all of the SEI content (the main report, the Digest, the state data tool, and the companion reports) on both Apple and Android mobile devices. It is expected to be available for public use in early 2013.

The mobile application is one step toward providing the user community with better access to the data in *Indicators*. Dr. Myron Gutmann, AD for SBE, reported that NCSES began another new project to take fuller advantage of digital media. This project hopes to move *Indicators* from being a print document that is converted into digital format to make it a document that is "born digital." The project will be based on broad-based consultation with the Board and the user community, with proposed improvements to be implemented for *Indicators 2016*.

Dr. Gutmann promised that further detail will be available at the Board's February 2013 meeting.

The second Companion Piece to *Indicators 2012* entitled, *Diminishing Funding and Rising Expectations: Trends and Challenges for Public Research Universities (NSB-12-45)*⁵ was released on September 25, 2012. Dr. Matthew Wilson, Science and Engineering Policy Analyst, Board Office, described the rollout for the report. The strategy to engage in a sustained outreach to national and local media and other stakeholders was successful. It resulted in more than 270 media placements in various types of publications and over a dozen interviews with Drs. Arvizu, Bowen, Droegemeier, and Griffiths.

⁵ Report available at: <http://www.nsf.gov/nsb/sei/companion2/files/nsb1245.pdf>

The successful release for all of the SEI 2012 components, which included the main report followed by the two policy companion reports over the span of 9 months, led to a broader discussion of *Indicators* communication and outreach. The committee discussed the planned outreach opportunities for 2013, and then reviewed potential new activities for upcoming years.

The staff has proposed a communication strategy following the 2012 model that could generate sustained interest between now and the release of the next edition of *Indicators* in January 2014. Committee members were supportive of the strategy, but expressed concern about the level of effort that may be required by staff, contractors, and Board members. Staff will seek to identify outreach opportunities that promise high impact with a relatively low investment of time and energy, and bring those ideas to the Board for consideration. Dr. Bowen asked the committee members to follow-up with him on additional thoughts they have on this proposal as the committee plans activities for 2013.

Finally, SEI discussed potential topics for the 2014 Companion Piece. Members emphasized choosing topics that are timely, that fit with the overall Board priorities, and that could foster partnerships with other suitable organizations. The committee plans to continue this discussion at the February 2013 meeting.

d. Committee on Programs and Plans (CPP)

Dr. Diane Souvaine, CPP chairman, reported that the committee addressed the updated Calendar Year 2013 Schedule of Action and Information Items for NSB Review (NSB-/CPP-12-43, Board Book, page 20). She noted that the committee has a variety of items on the schedule for the February 2013 meeting, including an action item for the National Ecological Observatory Network (NEON) operations and maintenance, a Joint CPP-CSB session where NSF will present their annual facilities plan, and a Program Portfolio Planning session with a topic yet to be determined.

NSB Discussion Item: Structure and Charge for CPP and CPP Subcommittee (Board book pages, 29, 30)

The committee discussed the structure and charge for CPP. During the past few years, CPP has had several subcommittees and task forces, but currently has only the Subcommittee on Polar Issues (SOPI). The committee reviewed the charge for SOPI. Given the importance of Polar Programs, the overlap in scope of the CPP and SOPI charges, and the recent realignment of the Office of Polar Programs into the Directorate for Geosciences (GEO), CPP agreed to recommend to the Board Chairman that SOPI be dissolved as a subcommittee and that the charge for SOPI be folded into the charge for the CPP committee. This action would not diminish the importance of Polar Programs, and Polar Programs will appear regularly as an agenda item for the full committee. The committee also discussed recent changes in the operation of CPP; in particular, the threshold at which a proposed award must be reviewed by CPP in order to provide more time for CPP to engage in policy discussions related to program planning. Committee members will work on revisions to the CPP charge to reflect these recent changes in an upcoming teleconference.

Dr. Arvizu asked for comments from the Board. Dr. Córdova stated that she was interested in what NSF leadership and staff thought of the structure change. Dr. Suresh responded he felt that whether a subcommittee or not, what comes out of the discussions is what is important. He mentioned that Polar Programs is important for NSF, and the best way to express this was not to have Polar Programs as a separate office, but to have it part of a research enterprise. In that vein, he supported the recommendation of CPP.

Mr. Arthur Reilly commented that from his perspective, not only the importance of the Board is presented with regard to the Antarctic Program, but the Blue Ribbon Panel. It is a testimony to the importance of Polar Programs to have them integrated into the broad range of disciplines under CPP.

Dr. Bowen concurred, and stated that the integration should be interpreted as representing a greater interest of Polar Programs on the part of the full Board. Also, because the Board is scheduling simultaneous committee meetings, having Polar Programs as part of CPP ensures that all CPP members will be fully engaged in the Polar Programs items.

Based on the above recommendation and consensus:

The Board Chairman DISCHARGED the Committee on Programs and Plans, Subcommittee on Polar Issues (SOPI).

Dr. Arvizu thanked Dr. Thomas Taylor, who served as SOPI chairman, and members of the subcommittee - Drs. Camilla Benbow, France Córdova, Patricia Galloway, Alan Leshner, Carl Lineberger, Douglas Randall, and Robert Zimmer - as well as Ms. Adrienne Deitemeyer, who served as Executive Secretary.

NSB Information Item: Advanced Technology Solar Telescope (ATST): Construction Update (Presentation Book)

Dr. Craig Foltz, MPS Program Director, presented this information item. Dr. Foltz described the science associated with the ATST project and updated the committee on recent legal proceedings, which led to ground breaking for construction on November 30, 2012. Due to delays associated with the legal proceedings over the past 30 months, a new baseline will need to be developed. Dr. Foltz expects this item to be brought before the Board in May 2013.

CPP members raised questions regarding ongoing efforts to work with the local communities concerned with the project, and were assured these collaborative efforts would continue. They also asked about the descope of the project due to the delays, and Dr. Foltz replied that the science would not be impacted significantly and that CPP will hear more about the descope when NSF provides an update next year. The Board reiterated its concern that the contingency issue between the Large Facility Office and the OIG needs to be resolved.

NSB Discussion Item: Implementation of Board Policy on Recompensation
(Board Book pages 31, 32)

The committee discussed the implementation of the Board policy on recompetition, “NSB Statement on Competition, Recompensation, and Renewal of NSF Awards” (NSB-08-16).⁶ The recommendations of the NSF Business and Operations Advisory Committee (BOAC) subcommittee were the last step in the process for NSF to finalize the implementation of recompetition.

Dr. Marrett reaffirmed the agency’s agreement with the recompetition policy, noting that new proposals for large facility awards must include plans for recompetition at the inception. She also noted that exceptions to the recompetition policy will be rare, and the decision will be made by NSF’s Director. She assured CPP that the NSF Director would keep them informed of potential issues as they arise regarding a project’s recompetition.

Discussion on the Board’s role in the decision to recompute a project ensued. Some members expressed concern about allowing the recompute decision to fall solely to NSF’s Director; however, others felt it was the Board’s role to set policy and not become involved in the details of projects. CPP decided to further discuss the issue during a teleconference to be scheduled in a few weeks.

NSB Information Item: Renewal of the Cornell High Energy Synchrotron Source (CHESS) and the Assessment of the MPS Division of Materials Research (DMR): Future Role in Synchrotron Science (Presentation Book)

Dr. Ian Robertson, DMR Division Director, presented a timeline for the receipt of the CHESS renewal proposal and its review. He also informed the committee that DMR was undergoing an assessment process regarding its future role in synchrotron science. He stated that DMR will come before the Board with an information item in August 2013, and report on the progress of both the assessment committee and the review of CHESS renewal approval. He anticipates an action item will follow in November 2013, and a full report of the assessment will be made in December 2014.

NSB Discussion Item: CPP Program Portfolio Planning
(Board Book pages, 96, 266, and 270)

Space Weather: The committee followed-up on a discussion from the July 2012 meeting on the Space Weather Program Portfolio (NSB/PPP-12-45, Board Book page 35). Dr. Stephan Nelson, Section Head, Center for Atmospheric Research (NCAR) and Facilities from GEO was on hand to answer questions.

Drs. Kelvin Droegemeier and Anneila Sargent served as lead discussants for this item. Dr. Droegemeier noted that the intent of the document was to capture what was discussed at the Board meeting along with background material needed for a fuller understanding of the issue.

⁶ Statement on recompetition available at: http://www.nsf.gov/nsb/publications/2008/nsb0816_statement.pdf

The committee discussed the purpose of the document, and determined that it provided solid background information and should serve as an internal document for NSF planning purposes. CPP members agreed that the Space Weather document would be accepted as part of its meeting record.

Big Data: (Board Book Addendum) The committee then turned to the December 2012 topic, the NSF Framework for Investments in Data Intensive Science and Engineering. The following provided an overview of the issues NSF faces regarding Big Data and/or data intensive science and engineering: Dr. Farnam Jahanian, AD for the Directorate for Computer and Information Science and Engineering (CISE); Mr. Alan Blatecky, Office Director, Office of Cyberinfrastructure (OCI); Dr. Joan Ferrini-Mundy, AD for EHR; Dr. Celeste Rohlfing, Acting AD for MPS; Dr. Joann Roskoski, Deputy Director, Directorate for Biological Sciences (BIO); Dr. Myron Gutmann, AD for SBE; and Dr. Kesh Narayanan, Acting AD for ENG.

Dr. Kelvin Droegemeier, Dr. Mark Abbott, and Mr. Arthur Reilly served as lead discussants. The committee engaged in a productive discussion with NSF senior management on this topic. The resulting summary document was distributed to Board Members (NSB/PPP-12-46, Appendix C), which was submitted for the record of the Plenary Open Session. CPP will likely request a follow-up information item in the future to gauge the progress of the Big Data efforts and to further evaluate the portfolio planning process and determine how to make it more effective. CPP members were pleased with the outcome of the discussion, and thanked NSF management for their efforts to bring the Big Data topic before the committee.

CPP also discussed potential future topics for four planning sessions in 2013 – one for each Board meeting. The committee considered the topic of Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) for either May or August 2013. Another recommended topic is water, particularly global water issues, as an important emerging area for discussion.

NSB Information Item: U.S. Antarctic Program
(Board Book pages 40,68, 72, 74, 89) (Presentation Book)

Lastly, the committee heard a discussion on the U.S. Antarctic Program (USAP). In July 2012, a report of the USAP Blue Ribbon Panel, *More and Better Science in Antarctica through Increased Logistical Effectiveness*⁷ was released. Since that time, Dr. Suresh convened an internal NSF Tiger Team to review the recommendations and provide implementation guidance. In November 2012, Dr. Suresh also testified before Congress on the report and next steps in responding to the Blue Ribbon Panel's recommendations.

Dr. Kelly Falkner, Acting Head, Office of Polar Programs, and chairman of the NSF Tiger Team, presented a summary of the team's report and recommendations. She also informed the Board that the Murmansk Shipping Company icebreaker, *Ignatyuk*, would be used for the 2012 to 2013 season, and that they expected the refurbished the *Polar Star* to be used next year and for 7-10 years thereafter.

⁷ Report available at: http://www.nsf.gov/od/opp/usap_special_review/usap_brp/rpt/antarctica_07232012.pdf

Drs. Lineberger, Bowen and Sargent served as lead discussants. Dr. Lineberger led the discussion, beginning with his impressions of his recent trip to Antarctica with contributions from Drs. France Córdova and Arnold Stancell, who also summarized their experiences on the ice. All expressed thanks to the NSF staff that supported the Board Members on the trip.

Dr. Bowen described the Blue Ribbon Report as an important document for the future of the USAP. He noted that, as outlined in the report, the absence of a capital budget plan is a problem. Dr. Suresh commented that a multi-year budget was part of a recent President's Council of Advisors on Science and Technology (PCAST) report, and invited Board help in making the case for long-term budgets to Congress. Dr. Sargent added that the single point failure possibility is a concern that should be addressed. She also asked whether scenarios that reduced dependence on McMurdo Station had been considered, and was promised an existing report on the topic. Dr. Córdova noted that even with tight travel funds, NSF should ensure its staff are able to spend time on the ground for their oversight responsibilities. CPP concluded that there are ongoing questions that should be discussed, and plans to schedule an upcoming teleconference, as well as an agenda item at the February 2013 meeting.

e. Committee on Strategy and Budget (CSB)

Dr. France Córdova, CSB chairman, reported that she updated the committee on NSF's activities related to NSF's Strategic Plan. She stated that NSF recently launched a strategic planning process, which will result in a new NSF Strategic Plan for the 2014 - 2018 time period.

Dr. Joseph Dehmer, Senior Advisor for Strategic Planning, will head the writing efforts for this plan. It is expected that this will be a February 2013 CSB agenda item.

Dr. Suresh updated the committee on the status of the FY 2013 appropriation and noted that NSF continues to operate under a long-term CR.

The committee discussed a study related to trends in science budgets, which will aim to identify the kinds of information the Board should receive in order to help NSF with strategic planning and budgeting. For this purpose, the Board needs information that is appropriate to strategic level assessment and guidance for NSF. Such information is necessarily based on the research and development budgets of the Federal Government as a whole and of NSF in particular to provide a high-level understanding of the U.S. scientific enterprise.

At fiscal year's end, the Board Office started working with the Science Technology Policy Institute (STPI) to develop ideas on how to better provide information for the Board in this realm. The committee sought volunteers to serve as reviewers and report as products are developed in the course of this study, and to potentially work with STPI and the Board Office to guide the inquiry and design of the information products. Several members volunteered to serve with this group: Drs. Lepage, Souvaine, Stancell, Zimmer in addition to Dr. Córdova, and others as needed. The end product will be a written report primarily for internal use that would identify the important themes and findings and will outline options for improved Board oversight.

Dr. Arvizu adjourned the Open Session at 10:40 a.m.

[signed]

Ann A. Ferrante
Executive Secretary
National Science Board

Attachments:

Appendix A: Charge to the Task Force on Administrative Burdens (NSB-12-67)

Appendix B: Draft Letter OSTP from NSB Chairman re Scientific Communication and Travel
Restrictions

Appendix C: CPP Investments in Data Intensive Science and Engineering (NSB/CPP-12-46)

Charge to the Task Force on Administrative Burdens

Statutory Basis

"The Board shall render to the President and the Congress reports on specific, individual policy matters within the authority of the Foundation (or otherwise as requested by the Congress or the President) related to science and engineering and education in science and engineering, as the Board, the President, or the Congress determines the need for such reports."

-- 42 U.S.C. § 1863(j)(2)

Action Recommended

The National Science Board (Board) will examine the administrative burden imposed on federally supported researchers at U.S. colleges, universities, and non-profit institutions and offer recommendations where appropriate on relieving the administrative workload.

Background

Over the past decade, there has been a variety of reports suggesting that Federal requirements are an increasing burden on academic researchers. A 2012 report by the National Research Council's (NRC) Committee on Research Universities, *Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security*, found that "the problem of excessive regulatory burdens ... puts a drag on the efficiency of all university research" --- potentially costing "billions of dollars over the next decade." That report recommended that Federal agencies "reduce or eliminate regulations that increase administrative costs, impede research productivity, and deflect creative energy without substantially improving the research environment," and that they harmonize regulations and reporting requirements across agencies. In a 2006 survey of its members and a subsequent report, the Federal Demonstration Partnership, a cooperative initiative among Federal agencies and institutional recipients of Federal funds, found that faculty spent an average of 42 percent of their time for federally sponsored research projects on associated administrative tasks.

Congress, in response to the NRC report, has held multiple hearings on this topic and in October 2012 requested that the Government Accountability Office (GAO) conduct a review of current regulations and reporting requirements imposed on research universities. In the past two years, the Obama Administration issued two Executive Orders (EO) on this topic: *Improving Regulation and Regulatory Review* (EO 13563) and *Identifying and Reducing Regulatory Burdens* (EO 13610). These seek to reduce the "significant burdens and costs" associated with Federal regulations while recognizing their "indispensable role in protecting public health, welfare, safety, and our environment." As a consequence of these and other EOs, the Office of Management and Budget (OMB) has developed a number of proposed changes and reforms that relate to research grants. These were captured in the February 2012 document *Reform of Federal Policies Relating to Grants and Cooperative Agreements; Cost Principles and Administrative Requirements (Including Single Audit Act)*, which continues to be revised following a period of public comment.

The Board shares the concern that some administrative tasks may be unnecessarily consuming valuable time that our Nation's scientists, engineers, and educators could otherwise devote to the federally sponsored research that underpins our national security, prosperity, health, and welfare. Given the budget constraints at many of our Nation's research institutions⁸, and broad Federal interest in reform, the Board feels that a rigorous assessment of Federal Government mandates, and the related university requirements, that lead to administrative burdens for researchers is necessary and timely.

Policy Objectives

In an effort to improve the efficiency and productivity of the R&D enterprise, the Task Force on Administrative Burdens will carry out the following initiatives and then bring policy recommendations to the full Board:

- Understand the evolution and extent of current regulatory and reporting requirements for federally funded research, in particular for the Nation's six largest funding agencies⁹;
- Identify and examine data on faculty administrative burden resulting from these requirements, including the pattern of changes in reported burden over time;
- Identify opportunities to reduce faculty administrative burden stemming from federally supported research requirements while maintaining regulatory policies that ensure accountability and that federally sponsored research continues to be conducted in an ethical and safe manner;
- Examine the contribution of university policies to research faculty administrative burden;
- Explore current efforts on the part of Federal agencies to harmonize reporting, streamline duplicative requirements and eliminate or modify ineffective regulation; and,
- Develop policy recommendations for National Science Foundation (NSF) engagement and recommend additional such efforts.

Logistics

The task force will develop an inventory and assessment of recent and ongoing activities related to the scope of the study and an inventory of Federal agency requirements that contribute to faculty administrative burdens. Based on examination of existing data, a survey or request for information

may be developed by the task force, within appropriate Federal regulations, and distributed to grantees. It is anticipated that the task force will produce a final report that summarizes its findings and presents recommendations for reducing faculty administrative burden within 12 months from the date of the formation of the task force. Printed copies of a final Board report will be distributed widely and available on the Board Web site for the general public, universities, Congress, various special interest groups, and the broader scientific community. In addition, the task force may issue a statement or comments indicating the Board's position on proposed reform of Federal research grants by the OMB. The task force expects to conclude its activities within 18 months from the date that formation of the task force is approved. The Board Office will serve as the focal point for coordination and implementation of all task force activities.

⁸ See, for instance, the 2012 NSB report *Diminishing Funding and Rising Expectations: Trends and Challenges for Public Research Universities*

⁹ These agencies – the National Institutes of Health, National Science Foundation, Department of Defense, National Space and Aeronautics Administration, Department of Energy, and U.S. Department of Agriculture -- provided 97 percent of all Federal academic R&D support in 2009.

DRAFT LETTER TO OSTP FROM NSB CHAIRMAN
Topic: Scientific Communication and Travel Restrictions

John Holdren, Ph.D.
Director, Office of Science and Technology Policy
Executive Office of the President Eisenhower
Executive Office Building Washington, DC 20504

Dear Dr. Holdren,

I am writing on behalf of the National Science Board (NSB, Board), the independent governing body responsible for oversight of the National Science Foundation (NSF). The Board is concerned with portions of the Office of Management and Budget's (OMB's) May 11, 2012, M-12-12 Memorandum that may endanger the NSF's ability to accomplish its mission. Specifically, the OMB Memorandum mandates that agencies cut their 2013 spending on travel to at least 30% below 2010 levels and to maintain this reduced level of spending through FY 2016. The Board is concerned that such substantial cuts to NSF's already lean travel budget would impede the agency's capacity to lead the scientific community and perform as a wise decision maker and steward of basic science research.

The Board concurs with the need to avoid wasteful government spending. NSF has been highly responsible in this regard. It has held its administrative expenses, including salaries and travel, to approximately 5% of its budget for over a decade. In that time period, its proposal loads – which are an indicator of its overall workloads -- have grown by 40%. NSF has maintained this impressive efficiency in the face of substantial workload increases by limiting staff; cutting administrative costs, including travel; and deploying technology strategically. Significantly decreasing travel funding threatens NSF's ability to achieve its mission by reducing travel to scientific meetings, by impairing the agency's ability to recruit key scientific talent, and by reducing travel for purposes of providing advice to and oversight of major scientific infrastructure and centers.

Scientists, including NSF program officers, attend scientific meetings to share information, to facilitate interactions among scientists with common interests and complementary capabilities, and to garner information about recent advances and fruitful new areas for investment. If interactions cannot occur efficiently through attendance at a number of these types of gatherings, NSF staff may not be able to gather and convey the relevant information equitably, efficiently, and effectively. In addition, the leading edge of findings and ideas in science is not found in journals but rather in discussions at conferences and workshops prior to publication. When NSF cannot convene such meetings for leading-edge scientific exchange and advice to the agency, and when its staff cannot attend such meetings convened by others, the staff and the organization as a whole are in danger of becoming out of date.

Conferences and workshops are also where NSF program officers inform large sets of scientists about grant opportunities, agency priorities, review and funding processes, policy changes, and other topics that help scientists develop better proposals. The opportunity to meet, listen to and ask questions of program officers can be especially important to early-career scientists. Conversely, having the opportunity to hear and respond to many scientists' questions and concerns at a single venue enables our program officers to understand the range of needs and priorities of the nations' scientists. Further curtailing these interactions threatens the quality of every aspect of the NSF's work.

An important, and somewhat unusual, aspect of NSF's workforce is that many of the scientific staff serve only temporarily (for 1-4 years) with NSF. These visiting scientists bring up-to-date knowledge and fresh thinking to the agency and keep the Foundation in close touch with the relevant communities. Unlike other agencies, NSF has no branch locations in the US. Instead, our temporary personnel serve as our regional ambassadors when they return to their home institutions. These key personnel often make personal and professional sacrifices in order to serve as stewards for science: being away from home and having less time for their own research programs. They are disadvantaged if they must dramatically reduce their travel to conferences or to their home institutions in order to serve the Foundation. To the extent that the agency cannot promise them the ability to do necessary travel, NSF's ability to recruit them is hampered.

With regard to oversight, the Foundation needs to continue its careful, effective oversight and guidance of its investments. NSF is committed to the kind of proactive oversight that enables awardees to avoid problems, not just holding them accountable after a problem is found. The Foundation engages in this sort of oversight and capacity building both in terms of the science being conducted, which involves program officers for Centers and large infrastructure being deeply aware and involved, and also in terms of institutional grants management and financial adequacy, which involves the agency's business process and grants experts engaging in oversight and capacity building. Telecommunications are used with regularity to do some of this work, but remote communications are imperfect substitutes for on-site scrutiny and discussion. Smaller institutions are probably most disadvantaged when program officers and grants administration staff cannot visit to examine, advise, and assist.

In sum, restricting attendance at scientific meetings will impede crucial scientific communication and advances. Further these travel cuts will impede NSF's ability to achieve its mission to promote the progress of science for the public good by significantly constraining its communications with science and innovation communities, reducing its ability to employ outside scientists as expert and efficient participants in the agency's work, and limiting its ability to oversee its investments.

Thank you for taking time to consider the concerns of the National Science Board.

Respectfully,

Dan E. Arvizu
Chairman, National Science Board

Committee on Programs and Plans
Program Portfolio Planning

Investments in Data Intensive Science and Engineering

December 2012 NSB Meeting

Authors: Dr. Kelvin Droegemeier (NSB), Dr. Mark Abbott (NSB), Mr. Art Reilly (NSB),
Dr. Farnam Jahanian (NSF/CISE), Mr. Alan Blatecky (NSF/CISE)

The National Science Board (NSB) has charged its Committee on Programs and Plans (CPP) with long-range policy oversight of the National Science Foundation's (NSF) Research and Related Activities (R&RA) portfolio. To inform this oversight and provide an interactive forum for informal recommendations and advice, CPP conducts program portfolio planning discussions at each meeting. These discussions seek to address issues that have the potential to impact the portfolio as a whole or which have strategic significance. Because they are inherently forward-looking, these discussions often focus on plans that are under development. This document summarizes CPP's December 2012 portfolio planning discussion, which addressed NSF's framework for responding to the challenges arising from the exponential growth in the size, complexity and rate of acquisition of scientific data sets.

The "Big Data" discussion featured Dr. Farnam Jahanian (CISE) and Mr. Alan Blatecky (OCI) as the NSF lead discussants. They were assisted by Drs. Myron Gutmann (SBE), Joann Roskoski (BIO), Kesh Narayanan (ENG), Joan Ferrini-Mundy (EHR), and Celeste Rohlfing (MPS), whose participation reflects the broad disciplinary importance of the topic. The discussion centered on broad reaching strategic questions rather than current programs or plans, and it is CPP's intent that this summary document aid NSF in planning and development rather than be prescriptive.

Background and Presentation

Data are everywhere. They are produced in rapidly increasing volume, variety, and velocity by virtually all scientific, educational, governmental, societal and commercial enterprises.^[i] Unprecedented volumes and types of data, coupled with advances in methods to combine and analyze them, are enabling new approaches to learning and discovery, information sharing, and assessment to enable ever more timely and better informed decisions and actions in many domains. The hope is that the big data explosion is poised to contribute to addressing national priorities such as environment and sustainability, health and well-being, advanced manufacturing, disaster resiliency, transportation, energy, security, and education and workforce development. The expectation is that solutions to these issues will be interdisciplinary, crossing over all research and education disciplines.

NSF's basic missions are deeply relevant to the frontiers of data collection and use. Ubiquitous deployment of sensors is resulting extremely large data set primed to lead into new science and engineering capabilities. The data explosion is transforming the culture and conduct of science, engineering, and STEM education. Relatedly, demand will continue to grow for a new generation of STEM workers who are expert in data-intensive technologies and methodologies.

On March 29, 2012, the White House Office of Science and Technology Policy launched the **Federal Big Data R&D Initiative**. As part of that initiative, all NSF Directorates as well as 8 NIH Institutes announced the *Core Techniques and Technologies for Advancing Big Data Science & Engineering (BIG DATA)*

Solicitation which aims to advance the core scientific and technological means of managing, analyzing, visualizing, and extracting useful information from large, diverse, distributed and heterogeneous data sets.

NSF's framework for investment in data involves:

- Foundational research into new techniques and technologies for deriving knowledge from data;
- Development of new cyberinfrastructure for managing, curating and serving data to research communities;
- Education and workforce development initiatives for predicted demands in data science experts and practitioners; and
- New types of interdisciplinary collaborations and communities.

Interests in data include:

- Providing cyberinfrastructure to manage, curate and serve data to science and engineering research and education communities, potentially leading to a federated system that builds upon existing models;
- Providing leading-edge research in data analytics, big data storage and management, and e-science collaboration;
- Playing a role in enabling the education of a new generation of STEM scientists who are expert in data-related technologies and sciences; and
- Enabling new approaches for big data research and development communities.
- Fundamental research in dynamic interactions of real time large data collection, monitoring and resilient control and response.

NSF's future role: Key Challenges and Questions

1. What is the role of NSF to store and support scientific data generated by its awards and projects?
2. What types of data policies does NSF need to develop to ensure open access and support wide reuse of data?
3. With fixed research budgets for the foreseeable future, what is the appropriate funding balance for data storage and curation, support and services, and basic research?
4. What should NSF be doing to develop the next generation of data and data-intensive scientists?
5. How should NSF address issues such as international standards for research data interoperability, inter-agency cooperation, and massive integration of data?

Discussion and Recommendations

“Data is where networking was in the early 80’s. We know it’s important, we know it’s going to transform what we do, but we’re not sure how yet.” – Alan Blatecky

Board members enthusiastically received NSF's approach to “Big Data” challenges, and applauded efforts to develop a framework that will organize the many associated problems and opportunities. They did caution that terming it an “investment” framework may be too limiting, noted that many of the problems need to be thought about more abstractly first, and spoke in support of enabling decisions about data to be made by the scientists who are closest to the problems and most intimately appreciate the value of the data they collect.

While discussants shared the overall sense of opportunity and an expectation that the emergence of new forms of massive, integrated data sets will enable new innovation and discoveries, some Board members observed that these questions, especially those related to interoperability, are timeless. Not only have they been asked repeatedly since the advent of computers, but issues of what to do with research data are as old as science itself.

Need for a Strategic Approach

While Board discussants acknowledged that the key challenges and questions posed by NSF are essential and important, they suggested that a higher level of abstraction would be useful in developing a data strategy. In particular, they suggested looking at the deeper issues in how we value, review, and publish scientific results in order to clarify NSF's objectives with respect to data policies. Discussants suggested that without knowing what we are trying to achieve, we cannot identify what is important or worth preserving. They also cautioned that although it is often easy to invest in specific technological solutions before answering these questions, the Foundation would be better served by developing functional requirements first.

NSB discussants advocated consciously weighing the risks of inaction against the cost of a policy and the scientific value accrued via an investment. Board members also suggested that the Foundation consider initial principles and requirements rather than architecture to enable continued evolution and innovation. Board members praised the current data management plan requirements as an example of the right approach, and thanked NSF discussants for providing a preliminary analysis. They also suggested that systematic efforts to identify common challenges and issues could help develop these principles.

While Board members embraced the NSF's willingness to address challenging issues like privacy and access to data, they also cautioned that the details of these issues were not an appropriate role for the Board. Rather, they argued that there was an opportunity for the Board to help NSF identify future opportunities and to push the forefronts of data science outward. In this context, NSF discussants observed that many of the Foundation's past investments in basic computing and information science underpinned much of the current explosion in "Big Data."

In response to descriptions of how facilities have helped create and advance the frontiers, Board members cautioned that although facilities can teach lessons, that there is a very long-tail of idiosyncratic data sets. This observation is readily supported by an analysis of 6,000 data management plans in proposals to the Directorate for Biological Sciences. Moreover, the IT capabilities that are now available to individual scientists were once the domain solely of universities and national labs. Thus the "long tail" has now shifted the balance of institutional power from centers to individual scientists and small groups.

The Role of NSF

While all discussants recognized that there is a unique and essential role for NSF in meeting the "Big Data" challenge, the problem landscape is sufficiently broad that no simple, clear solutions emerged from the discussion. But --- in addition to the need for higher level strategic planning that is detailed above --- several dominant themes emerged: the need for a data workforce; the importance of academic institutions and culture; limited resources; and the international nature of some challenges. In addition discussants suggested that the NSF could benefit from examining existing models such as the Internet.

Board members suggested that the most appropriate role for the NSF is as a catalyst or facilitator, as the establishment of a true national data infrastructure is far beyond its resources (or, indeed, the resources of any agency). In fact, discussants were apprehensive that any unfunded mandates, whether from NSF policy or external sources, could have far reaching implications. Implicit in the discussion was the idea that setting forth high-level principles and processes could promote innovation and be more responsive to the many diverse scientific communities.

Discussants suggested that NSF could help build the communities necessary to collect, maintain, and use big data sets. When Board members suggested that pilot programs could leverage existing resources to develop innovative and community-driven responses to data challenges, NSF responded that a number of

pilots were ongoing. The Foundation highlighted two categories of activity: pilots aimed at community building and those aimed at encouraging interoperability across and between disciplines. Members also encouraged NSF to continue funding individual grants that address specific data infrastructure challenges.

Finally, the Director cautioned that injudiciously branding data sets as “NSF approved” could imply validity to data that has not undergone peer review, undermining the Foundation’s “brand.”

A Data Workforce

Discussants noted that to develop and implement the new management and analytical strategies needed for the increasing number of extremely large and complex digital data sets, new skills would be needed in the scientific workforce. As the 2011 NSB Task Force on Data Policies reported in *Digital Research Data Sharing and Management*, “New jobs and areas of expertise are emerging in response to the evolving role of data in science and engineering, yet opportunities for education, training, and workforce development are not fully recognized and supported.”

Discussants observed that the NSF, with its dual focus on research and education, is uniquely suited to meet this challenge. Board members also embraced Dr. Ferrini-Mundy’s observation that “Big Data” is also part of the solution, offering exciting new options for understanding STEM teaching and learning. By making data continually available to instructors and linking with other data sets, there is the potential to help teachers better understand the impacts of their activities and interventions.

Research Administration, Culture, and Institutions

Board members suggested that NSF could play a leadership role in understanding how academic institutions and processes could change in response to the profound shifts in the IT landscape and big data. For example, they noted that little value is often ascribed to the creation and stewardship of data, or even in building effective, enduring collaborations around data sets. While NSF clearly cannot dictate university policy, it is free to include data considerations in, for example, the evaluation of a project’s broader impacts. This kind of leadership could influence university decision-making. NSF noted that applicants will soon be able to list data sets among their 10 supporting publications, and Board members agreed that was a positive step.

While not in NSF’s purview, Board members also noted that “Big Data” challenges are having a deeper impact on university institutions. Massive online open courses are one example of data-driven disruption in education. The evolving nature of libraries, which increasingly exist at the confluence of intellectual property, information technology, and research domains is another. Board members suggested that the library community should be engaged by NSF. On the other hand, as faculty can begin to conduct research and teach outside the confines of the traditional university, there are potentially new types of institutions that may emerge. NSF is positioned to both study and nurture these new institutions, which in turn may require new ways of thinking about grants that go outside the traditional university.

Resource Constraints

Board members noted the dramatic cost implications associated with data preservation, access, standards, and curation. They encouraged NSF to remain aware of the costs and benefits associated with any policy proposal as well as of who would bear those costs. The Director encapsulated this issue by observing that the United Kingdom’s effort to advance “gold” open access policies imposed a 2% increase in funding agency overhead – a cost of roughly \$320 million per year. Currently, the NSF budget includes approximately 6 percent per year for administration and operations. Discussants concurred that, especially in a time of budget constraints, that the NSF could not afford a 30% increase in administrative overhead.

An International Problem

The international nature of interoperability problems was a persistent theme of the discussion. Board members were reminded that NSF has a history, particularly through facilities built on international partnerships of being an agent of positive change in “Big Data” problems. Some Board members expressed the view that ownership of data is increasingly the new intellectual currency, especially with respect to international partners, and suggested that this was an opportunity for the Global Research Council. The Director told Board members that this issue is expected to be on the agenda of the Council for the next several years.

Learning from Models

Recognizing that data preservation, access, standards, and management are potentially boundless challenges, Board members suggested that we could look to other, similar problems as a model for effective Foundation action. The development of the Internet, in particular, was proposed as a good model for leveraging NSF investments in generalized core capabilities but partnering with other agencies. The “Internet” model suggests that by promoting voluntary standards and a democratized, multi-stakeholder governance model, NSF can build beyond its own resources, supporting continued growth and innovation.

Board members stressed that these standards should be identified in cooperation with scientific communities, suggesting that this approach would work best if it was integrated in existing processes rather than as an ancillary set of requirements. They argued that this approach would help keep decisions about data as close to the science as possible.

Conclusion

CPP appreciated NSF’s willingness to bring forth a complex, evolving problem with implications for the entire scientific enterprise. The Committee encourages NSF to clearly identify the objectives of its data policies, using that process to clarify what is important or worth preserving. It hopes that the discussion captured in this summary will be useful to the Foundation as it continues to develop its “Big Data” strategy.

^[i] “Dealing with Data,” Science Magazine, Volume 331, February 11, 2011