

**APPROVED MINUTES
PLENARY OPEN SESSION
457TH MEETING
NATIONAL SCIENCE BOARD**

National Science Foundation (NSF)
Alexandria, Virginia
July 17-18, 2018

Members Present:

Diane L. Souvaine, *NSB Chair*
Ellen Ochoa, *NSB Vice Chair*
John L. Anderson
Deborah L. Ball*
Roger N. Beachy
Arthur Bienenstock
Vinton G. Cerf*
Vicki L. Chandler
W. Kent Fuchs
Robert M. Groves
James Jackson
G. Peter Lepage*
W. Carl Lineberger
Victor R. McCrary
Sethuraman Panchanathan
G.P. Bud Peterson
Julia M. Phillips
Geraldine L. Richmond*

France A. Córdova, *ex officio*

*Consultant

Members Absent:

Inez Fung*
Stephen L. Mayo*
Emilio F. Moran
Anneila I. Sargent
Maria T. Zuber*

There being a quorum, the National Science -Board (NSB, Board) convened in Open Plenary Session at 8:00 a.m. on Tuesday, July 17, 2018, with NSB Chair Dr. Souvaine presiding.

NSB Chair's Opening Remarks

Dr. Souvaine welcomed everyone to the NSB's 457th meeting.

Dr. Souvaine began the meeting by offering her thoughts on the Board's next two years as she began her tenure as NSB Chair. Her complete statement read:

"It's my great honor to be serving you as Board Chair. The scientists, engineers, and educators assembled here on this Board represent some of the best this country has to offer to champion the value of basic research and education to this country's social, economic, and national security prosperity and well-being.

I'm proud to serve with you all and look forward to advancing our mission and goals over the next two years. I am also delighted to have the opportunity to work with the new Vice Chair, Dr. Ellen Ochoa. Ellen brings to this Board and her new role a unique perspective of organizational leadership, scientific management and practice, and senior government service.

I've now served on this Board for a decade. During that entire time, I've had the pleasure to serve with France Córdova, first during her time on the Board, and, for these last four years, during her tenure as NSF Director. Together we have seen and worked to develop a number of best practices in the relationship between the Board and the Foundation.

One of my goals in the next two years is to build on the best practices of communication, cooperation, and collaboration and find ways to institutionalize what works. While there will also always be an element of the Board-Foundation relationship that is influenced by the personalities of the incumbent leaders on both sides, I would like to seek out ways to help bequeath the current effective inter-relationship as a legacy of France's and my time here.

As I think about the Board and its role, both statutorily and historically, it has been at its best when it wears its two hats equally well. On the one hand, we are tasked with governing the Foundation. Our job is to complement the work that France and her team of exceptionally talented and passionate professionals so effectively perform, while fulfilling the Congressional expectation that we bring our collective wisdom, fresh eyes, and diverse perspectives to bear on the strategic matters of the Foundation. As Board members, we need to come to meetings fully prepared to engage in the issues at hand, learn, ask elevating questions that those closest to the topic may have been too close to ask themselves, and offer constructive feedback.

In our governance role, we seek to help NSF be its best. Everyone in this room, from Board members to NSF staff to senior Foundation leadership, all have a mutual commitment to do what is best for this agency.

Our second hat is to be a tireless steward for science and engineering in this country. This role, necessarily, will expand our engagement beyond the strict confines of NSF's portfolio. In looking to what is best for the national needs of science and engineering research and education, we may find ourselves responding to Congressional or Administration requests for advice or perspective on a wide range of issues.

In my conversations with a variety of stakeholders during my term as Vice Chair on the Board, and since becoming Chair, it has been repeatedly stated to me that the depth and breadth of the Board's expertise is viewed as a valuable resource.

Our country has achieved great things in research and education due to the national commitment and support for our basic science and engineering enterprise. Our task is to continue that support and commitment in fair skies and tumultuous seas. We need look no further than the outstanding work of my predecessor, Maria Zuber, to see the impact of consistent engagement across Washington and the country.

To succeed, we need to bring our best selves to this Board. We need to leverage our diverse professional and personal experience to influence, explain, and educate all of NSF's diverse stakeholders with whom we engage. In our stewardship role, we seek to help the country be the best it can be in its support of scientific and engineering discovery and innovation.

These are not lofty, pie-in-the-sky ambitions. We've already seen the power of our voice. We have witnessed Members of Congress quoting statistics and passages from our *Science and Engineering Indicators* report and from the companion briefs to provide evidence for the need to continue strong funding for the federal research agencies. We have listened to community college leaders and students to tell us how our advocacy for skilled technical worker education programs helps mitigate the stigma against these jobs.

Later today, we will hear a panel discussion on the expanding power and influence of AI. France's leadership in this space through her work on the Select Committee on AI, created by the White House under the National Science and Technology Council, is a testament to the importance of this topic to the country and NSF.

France's efforts in the AI space are an excellent example of the marriage between NSF's mission and the greater national imperative. The similar marriage of our two hats serves the same purpose. Our ultimate goal is to further the success of the Foundation. In doing so, we also further the cause of basic science and engineering research and education.

Whether championing diverse pathways to STEM education, particularly for underrepresented populations, or highlighting the societal, economic, and national security risks of federal underfunding of science and education research, we have an opportunity to bring what is best about this body to serve the betterment of the Foundation and the country.

Again, it's my honor to serve as your Chair. Together, we can continue to build on the successes of the past, leave a legacy for continued excellence for the future, and wear our governance and stewardship hats with distinction.

As I conclude my comments, I would like to announce the new committee Chairs and thank them for their willingness to serve in these leadership capacities.

Dr. James Jackson continues as the Chair of the Committee on External Engagements.

Dr. Anneila Sargent Chairs the Committee on Oversight.

Dr. Roger Beachy Chairs the Committee on Strategy.

Dr. Carl Lineberger Chairs the Committee on Awards and Facilities.

Dr. Julia Phillips Chairs the Committee on National Science and Engineering Policy.

In addition, Dr. Kent Fuchs will serve as the Chair for the Subcommittee on Honorary Awards; and Dr. Victor McCrary continues to Chair the Task Force on the Skilled Technical Workforce. I thank you all for your eagerness to do, in many ways, the real work of the Board."

Following her statement, Dr. Souvaine previewed the upcoming meeting agenda. She then turned the meeting over to the Director for her opening remarks.

NSF Director's Remarks

Dr. Córdova began by introducing a 3-minute video created by the Office of Legislative and Public Affairs (OLPA) highlighting the breaking news of NSF-funded IceCube's detection, in September 2017, of high-energy neutrinos from sources beyond our solar system. The confirmation of the detection by other space and ground-based facilities demonstrates the capability of multi-messenger astrophysics. She then acknowledged the press conference held at NSF to present the findings and highlight the significance of the detection. Panelists for the press conference included Francis Halzen, a University of Wisconsin-Madison professor of physics and the lead scientist for the IceCube Neutrino Observatory; Regina Caputo of NASA's Goddard Space Flight Center in Greenbelt, Maryland and the analysis coordinator for the Fermi Large Area Telescope Collaboration; Razmik Mirzoyan, a Max Planck Institute for Physics scientist and the spokesperson for the MAGIC Collaboration; and Olga Botner, a professor of physics at Uppsala University in Sweden and former spokesperson for IceCube.

Dr. Córdova continued by speaking about her participation in the White House Office of Science and Technology Policy (OSTP) State-Federal STEM Education Summit on June 25-26, 2018. She noted that over 175 STEM leaders from all 50 states attended the Summit, which began the process of developing a new five-year STEM education strategic plan. During the week of the Summit, OSTP and NSF recognized more than 140 individuals and organizations honored with Presidential Awards for their excellence in teaching and mentoring in the STEM fields.

Reporting on her outreach domestically, Dr. Córdova stated that she had spoken at the AAAS Forum on Science and Technology Policy panel on U.S. Agency Initiatives Advancing the Frontiers of Science & Policy Innovation. Her topic was *NSF's 10 Big Ideas and New Models for Accelerating Research and Innovation*. In honor of the designation of the LIGO laboratories as American Physical Society Historic Sites, Dr. Córdova, MPS AD Anne McKinney, and other members of the NSF LIGO team were present for the ceremonial plaque laying by American Physical Society President Roger Falcone at LIGO Livingston. On May 10, Dr. Córdova attended the keynote address by OSTP's Michael Kratsios at the White House AI Summit for American Industry. The Summit included the White House's announcement of the creation of a Select Committee on AI. Dr. Córdova stated that she will represent NSF on the Committee. Lastly, Dr. Córdova reported that she had visited David Page, Director of the Whitehead Institute the week prior to the Board meeting. The Institute is studying the genetic differences between males and females and how these play out in disease, development and evolution.

Moving on to her engagements abroad, Dr. Córdova stated that she had traveled to three different events in May. She went to Ireland as a guest of Mark Ferguson, Director General, Science Foundation Ireland (SFI) to participate in a meeting organized between SFI and senior leadership of American companies through the American Chamber of Commerce in Ireland to initiate a "think in" on Challenge Based Research Funding. She reported that she provided remarks on the NSF role in supporting ideas from transformative research to Grand Challenges (such as the Ten Big Ideas), the importance of converging technologies, and partnerships on innovation among

enterprise, public sector, and academia. Dr. Córdova also reported on her participation in the Global Research Council meetings in Moscow, Russia. The focus of the meetings was on the role of science diplomacy and revisiting the topic of peer review. In late May, Dr. Córdova traveled to Israel for a ministerial-level conference entitled “Thinking Out of the Box.”

Dr. Córdova continued by sharing with the Board information about the 4th Annual Community College Innovation Challenge, jointly sponsored by NSF and the American Association of Community Colleges. The Challenge is an opportunity for teams from community colleges to use science, technology, engineering and mathematics to innovate solutions to real-world problems, compete for cash awards, and earn full travel support for students and faculty to attend an Innovation Boot Camp in Washington, D.C. The winner of this year’s event was the team from Western Dakota Tech, which presented a new method that simultaneously cultivates plants and fish.

Dr. Córdova concluded her report with an update on NSF’s branding initiative. She stated that NSF rolled out updated Logo and Visual Identity Guidelines and showed pictures of the new branding on the Livingston LIGO facility and the G5 aircraft attached to NCAR. There was also a photo of the NSF logo on the storage tank at McMurdo Station, Antarctica.

The Chair thanked Dr. Córdova for her report.

Summary of DC Meetings

Dr. Souvaine then summarized her activities since the last Board meeting. She began by relating her meetings with OMB and OSTP, accompanied by Dr. Lepage, to discuss the status of the Board’s Report on NSF Operations and Maintenance (O&M). She added that Dr. Zuber joined them later in the afternoon for meetings with the House Appropriations Committee staff that had requested the report. Dr. Souvaine reported all meetings went well with strong support for the tentative recommendations that the Board presented. She added that the report has since been published and is available on the Board’s website.

Dr. Souvaine continued by speaking about the meetings with Senate and House appropriators and authorizers following the publication of the O&M report. Dr. Souvaine was joined by Dr. Lepage and Dr. Ochoa. She stated that the report was well-received and that the audiences were positively inclined to give serious consideration to any legislative “fixes” that may be required to implement recommendations involving the use of the MREFC account for activities other than construction of major facilities. She noted that the Congressional committee staffs preferred to address the legislative issues after the Board completed its ongoing report on mid-scale research infrastructure. This would enable the committees to address potential legislative issues from both reports at one time.

Dr. Souvaine and Dr. Ochoa also met with Senator Lamar Alexander (R-TN) who expressed interest in the Board’s role and his support for strong funding of research agencies. In a pre-meeting with Sen. Alexander’s staff, there was a good discussion on the value of the Science and Engineering Indicators Report and the Board’s Skilled Technical Workforce initiative.

Dr. Souvaine also reported on the often-postponed briefing to the House Armed Service Committee on the *Science and Engineering Indicators 2018*. She said that the staffers had definitely read the report and their familiarity with it led to a great conversation about the value

of *Indicators* to stakeholders across the U.S. Government. The group also expressed strong support for the Board's Skilled Technical Workforce initiative.

Dr. Souvaine continued her report with some brief comments about her presentation to the Council on Scientific Society Presidents. Her remarks to the group focused on the *Indicators* report, its impact, and the Board's communication efforts. Dr. Souvaine stated that she had emphasized the impact the reports data on China's rise in R&D investing was having on policymakers in Washington. She also pointed the group to the Companion Policy statements as other venues through which to gain a deeper understanding of the issues raised in the report. She added that the audience told her that the rising cost of education debt was creating barriers for many students to enter STEM programs and that there was a need to focus on K-12, not just higher education.

Dr. Souvaine concluded her report by lauding Dr. Bienenstock for his co-Chairing of a project of the American Academy of Arts and Sciences on examining the challenges of International Scientific Partnerships. She had participated in a roundtable in Boston on the topic and stated she was looking forward to hearing more about it in the coming months.

With no questions or remarks forthcoming, Dr. Souvaine adjourned the Plenary Session at 8:40 a.m. with the reminder that the Plenary Open session would reconvene at 10:15 a.m. for a panel discussion on AI.

Session 2

Dr. Souvaine reconvened the Open Plenary session of the 457th Board meeting at 10:15 a.m. on July 17, 2018, to introduce a panel discussion on the subject of AI. She began the session by explaining the genesis of this session. As she described: "AI is becoming increasingly ubiquitous in our society, in laboratories in almost every industry. From Siri to self-driving cars to predicting heart disease, AI is poised to transform society. What will this mean for NSF and for federally-funded research, both in AI and across disciplines? How will AI technologies be used to empower researchers in the physical, chemical, life and social sciences? The challenge to our panelists is to begin a conversation that could shed light on those questions and, most likely, raise many more."

Before turning the floor over to the panel moderator, Dr. Andrew Moore, Dr. Souvaine introduced the panel, noting that their full biographies were in the Board Members' electronic Board books. Dr. Andrew Moore is the Dean of the School of Computer Science at Carnegie Mellon University. Dr. Charles Isbell is the Professor and Executive Associate Dean at Georgia Institute of Technology. Dr. Michael Jordan is the Pehong Chen Distinguished Professor in the Department of Electrical Engineering and Computer Science and the Department of Statistics at the University of California, Berkeley. Dr. James Kurose is the Assistant Director for the Directorate of Computer and Information Sciences and Engineering at NSF and Assistant Director for AI, White House Office of Science and Technology Policy. Dr. Daniela Rus is the Andrew and Erna Viterbi Professor of Electrical Engineering and Computer Science and Director of the Computer Science and AI Laboratory, or CSAIL, at MIT.

Dr. Souvaine then turned the floor to Dr. Moore. After laying out the order of the presentations, Dr. Moore proceeded to provide some historical context to the field of AI. He noted that the Dartmouth Conference of 1956 establish AI as a field of inquiry for the scientific community. [The date was settled after a number of interventions from the audience.] Dr. Moore explained

that the earliest efforts were focused on trying to automate perception; the decision process when someone perceives something and then the action process once a decision has been made. He stated that the breakthrough in this work was when a computer defeated the chess champion Kasparov in the late 1990s. The majority of this success was on the decision side of the equation after programming into the computer the rules of the game. Dr. Moore continued to explain that the next step was to add “learning” to the mix. In some cases, the advent of self-driving cars is an example of this.

Dr. Moore then made a strong case for the need for collaboration between statisticians and machine learning engineers. He argued that statistics are fundamental to the calculation of probabilities of certain actions following from previous actions or decisions. Fine tuning this predictability and how that leads to rational decision making is essential to the development of sophisticated machine learning. Dr. Moore also introduced the idea of Inverse Reinforcement Learning that is being used by self-regulating car companies and security applications to map out what people are doing and what they are likely to do based on their movements and environment. This is getting back to the perception element of AI. He pointed out that the challenge is to improve the hardware and software to allow for thousands of sensors to collect gigabytes of information rather than petabytes for use in improving machine learning. The final step is the verification and validation of the decision loops to better understand how we will live with AI systems and use them to make decisions.

Dr. Moore then handed the floor to Dr. Jordan. Dr. Jordan’s message was focused on his belief that what is today called AI is really just programming machines to programmable tasks, not anything related to “intelligence.” He cautioned against becoming overawed by the “AI” buzzword. He argued that machine learning is not AI. He also suggested another acronym “II” for Intelligent Infrastructure. He described this as the collection of the computer intelligence we find on the internet that maximizes search engines and allows us to speak one language into a computer and another language is spoken by the machine. But, he argued, that is not intelligence because there is no inherent understanding being done by the machine. It is human imitation. Dr. Jordan referred the Board members and audience to a blog post he had published to Medium[®], entitled “AI—The Revolution Hasn’t Happened Yet.”¹

Dr. Jordan’s main message was his belief that the goal should not be the building of a computer stack to support human-imitating AI. He believes the focus should be on systemic engineering advances in which every component of the system does not have to be intelligent for the overall system to be intelligent. Rather than focusing on plastically-envisioned, human imitating AI, the work should seek systems that do the right thing at scale. It is about collecting data and then applying data in intelligent ways.

Dr. Moore then turned the floor to Dr. Rus. Dr. Rus argued for the collaborative potential of robots and computers with their human colleagues rather than one replacing the other. Her observations were on the aspects of robotics that optimize all aspects of our lives to ensure that we live well and effectively. She provided examples from medicine and transportation. In the medicine field, Dr. Rus highlighted how modern technology has allowed doctors in remote areas or doctors who are geographically separated from their patients to receive and analyze diagnostics tests, imaging scans, and other information to provide healthcare to individuals they

¹ Found at: <https://medium.com/@mijordan3/artificial-intelligence-the-revolution-hasnt-happened-yet-5e1d5812e1e7>

may have limited opportunities to see in person. She also provided an example of diagnostic scans for cancer that are machine readable, thus improving accuracy from human only readings of 3.5% error to combined readings of 0.5% error. In the transportation arena, Dr. Rus reported on an algorithm her team is working on that optimizes taxi rides in New York City. By matching demands to supply and allowing for shared rides in cases where riders are going in the same direction, the algorithm predicts that the current population of 14,000 taxis in New York could be reduced to 3000 with 98% demand met and a 3-minute average wait. As Dr. Jordan had stated in his presentation, Dr. Rus noted that AI technology is not at a point where computers are replacing humans in anything more than the most rote physical tasks, such as spot welding two pieces of metal together. She argued that much of what is termed AI is simply computers using data that is manually labeled to sort through and assign caches of data into sorted groupings. She used an example of a photo of a beach. The computer can compare the pixels in the photo with other photos that are labeled “beach” and properly classify the photo as one of a beach. But, she explained, the computer doesn’t know what a beach is, why this photo is a beach, what a beach smells like, feels like, etc.

The next presenter was Dr. Isbell. He began by stating up front that his interest lies in the human-AI interaction, or as he stated it, interactive AI. Dr. Isbell stated that the question is not, “Can we build smarter things?”, but rather “Can we build smarter things that live with us?” Returning to Dr. Rus’ presentation and her example of the reduction in error between human-only interpretations of medical scans and those read by both humans and machines, Dr. Isbell summed it up by stating, “Humans make errors. AI makes errors. But, when you put them together, they make fewer errors.” Dr. Isbell added that the value of collaborative effort between humans and computers comes down to their mutual strengths. Computers can process a lot of data very quickly. But that doesn’t help you make decisions if you are crunching the wrong data. Humans can make the distinction between useful data and noise. When you combine the processing ability of computers and the ability of humans to differentiate useful from not useful data, you have improved results. He admitted that even these skills are not flawless. Crowdsourcing can often lead to erroneous conclusions because the data that was provided by the crowd was not accurate. He advocated for the focus of AI research being on advancing decision support. To date, much of the work has been task-oriented.

The final panelist was Dr. Kurose. He began by thanking the Board for making the panel happen and acknowledging the importance of the topic to the nation’s economic competitiveness, national security, health and welfare, and global leadership. Dr. Kurose’s main message was to outline what was being done at NSF and in the Administration regarding AI. At NSF, he stated that there is a lot of basic research being conducted in the Directorate for Computer and Information Science and Engineering (CISE) the areas of machine learning, computer vision, reason and representation, robotics, speech and language, computational neuroscience. Dr. Kurose also pointed out that NSF investments in this area have been augmented by funds from Google, Microsoft, Amazon, and IBM. He also linked the work of NSF in AI to its Big Ideas, particularly the Big Ideas on Harnessing the Data Revolution and Working at the Human Technology Frontier, where he added that AI is a core technology for both of these initiatives. Transitioning to the Administration, Dr. Kurose highlighted the FY 2019 Research and Development Budget Priorities memo that calls out machine learning, autonomous systems, farm computing, inter-agency initiatives, and computer science education as being priorities for all of the agencies and the Administration. He also referred people to the National Security Strategy 2017 that prioritized emerging technologies in the areas of data science, encryption and AI. He

summarized the Administration work into six pots: 1) AI research and development, 2) AI-ready future American workforce, 3) robust research and development workforce, 4) removing regulatory barriers to AI innovation, 5) DoD and military strategic advantages through use of AI, and 6) leveraging AI for government services. Dr. Kurose concluded by providing some information about the National Science and Technology Council Select Committee on AI, of which Dr. Córdova is a co-Chair with Mr. Michael Kratsios from OSTP and Dr. Steven Walker from DARPA.

Dr. Moore began the question and answer session by musing about the role of AI in the areas of the natural and life sciences. Dr. Jordan responded that he felt the social sciences, especially economics, had been neglected in much of the AI conversation. The other speakers all noted that there is a need to bring cross-disciplinary research into the AI conversation.

Dr. Moore then noted the trend in seeing top researchers leaving national labs and academia for jobs at big internet companies. He asked the panelists what should be done to ensure a healthy university environment to keep good people in academia and partnerships with corporate entities vibrant. Dr. Jordan responded by directly advocating for continuing to support immigration opportunities for bright young students and researchers. Dr. Rus proposed the creation of a consortium of academic and government entities for the AI field that would support the research needed in the area. Dr. Isbell noted that the first step is to admit there is a problem. He cited the statistic that there is a 30% reduction in computer science Ph.D.s in academia. The bulk of recent Ph.D. graduates are moving to industry. Dr. Kurose argued for a focus on sustaining a robust funding environment for young faculty and faculty fellowships. He posited that folks are going to industry for the challenges, not just the money [salary].

Dr. Moore continued the discussion with a question about the societal impact of AI and the responsibility scientists and engineers have to think beyond just the technical applications and to include how the technology is used and its impacts. The consensus response of the panelists was that there is a need to expand the conversation beyond the science departments and disciplines developing the “hows” of AI to include those that can start to answer the “so what” of AI.

At this point Dr. Moore had to leave the meeting and the discussion was opened to Board members.

Dr. Chandler began by asking how to best address the need for computational thinking in grades K-12 when there is such a disparity in access and funding of technology across the public and private school systems. Dr. Rus responded by stating that there needs to be a national decision about the role of computational literacy in the primary school curriculum. If computational literacy is seen as a critical element of the curriculum, resources need to put towards it. She highlighted countries such as China, Japan, South Korea, and Italy, as well as the Baltic countries, as examples of countries that have made computer literacy a national priority. Dr. Isbell noted that in the State of Georgia there are 15,000 certified Spanish language teachers and there are 95 certified computer science teachers. Part of the problem is in the sheer number of teachers to take the solution to scale across a state and the country. Dr. Kurose added that there is work being done on this and pointed to the expansion of Advanced Placement (A.P.) exams in computer science. He stated that a second computer science exam was added to the A.P. list of exams and the numbers of students taking the two exams has increased over the past few years. He stated that 50,000 students took the second exam its first year offered and that between 2016

and 2017 the numbers of female, Africa-American, and Latino and Hispanic students taking the computer science exams had doubled in each of those demographic categories.

Dr. Souvaine adjourned the second session at 12:15 p.m. for the lunch break. She announced that the Plenary would reconvene at 11:50 p.m. on Wednesday, July 18.

Session 3

Dr. Souvaine reconvened the Plenary session at 11:50 p.m. on July 18, 2018. She welcomed everyone back to the meeting and turned the floor to NSF Director, Dr. Córdova, to introduce the session's speakers.

Dr. Córdova stated that the session was focused on the agency's relationship with the National Academies of Science, Engineering, and Medicine (NASEM). She explained that NSF has been examining all aspects of its relationship with NASEM over the previous three years. While NSF values NASEM as a most essential part of its work, NSF wants to maximize the investments it makes in NASEM through the reports NASEM produces that guide NSF's work and the advice NASEM provides toward NSF's strategic direction. She added that there was also a need to reduce duplication of report requests and duplication of report subject matter. This was addressed by assigning the management of the NASEM relationship to one central point of contact.

Dr. Córdova stated that Dr. Suzanne Iacono, head of the Office of Integrative Activities (OIA), would address these issues in her briefing. She added that Dr. Rebecca Keiser, the head of the Office of International Science and Engineering (OISE), would address the Committee of Visitors feedback on its examination of NSF's funding relationship with NASEM for multiple international organizations.

Dr. Iacono proceeded to brief the Board on recent revisions made to how NSF interacts with NASEM. The center of that system is a team focused on the National Academies and led by a representative from OIA, and a reports tracker that serves as a coordination tool and status tracker for all reports NSF has funded NASEM to produce. Dr. Iacono continued by providing a summary of the impacts of recent reports. One example she gave was the decision to descope the Ocean Observatories Initiative based largely on the NASEM Ocean Science decadal survey published in 2015. Dr. Iacono concluded by setting out five recommendations for modifying the scope and management of National Academies projects to improve impact. First, the NASEM should explore new models for projects so that they can produce high-impact results more quickly. Second, NASEM's consensus studies proposals should describe the intended impact. Third, NASEM and NSF need to work together jointly to ensure that study committees receive a clear and focused charge. Fourth, NASEM's report recommendations should be novel, insightful, specific, and actionable. Fifth, NASEM and NSF program staff should remain cognizant of the timelines for potential opportunities and work to ensure that projects are scoped and managed appropriately.

During the brief question and answer period that followed Dr. Iacono's briefing, Dr. McCrary asked how much NSF spent on NASEM work each year. Dr. Iacono responded that over the past

decade, NSF has averaged \$15-17 million annually for reports, workshops, and other deliverables. Dr. Cerf asked about where the requests for reports came from; from NSF staff, the scientists that NSF supports, or other sources. Dr. Iacono responded that the reports have a variety of origins. Dr. Córdova added that the reports can be originated from NSF interests, Congress, NASEM ideas, or from another agency. Dr. Marcia McNutt, the President of the National Academy of Sciences, who was in the audience for this session, added that there are also occasions when Congress will request a NASEM report and mandate the funding come from NSF, due to the subject matter. Dr. Chandler asked about the longevity of reports and their durability on the NSF radar. She referenced a recently released report from the NASEM Committee on Women in Science, Engineering, and Medicine noting that the report's publication just happened to coincide with the tide of attention paid to sexual harassment in the workplace, despite the request for the report having been made two years before its publication. Dr. Iacono responded that NSF pays attention to the reports its requests or funds indefinitely. In terms of specific evaluation of report impact, Dr. McNutt indicated that NASEM follows up on each report at the six-month and one-year point, post-publication, in an effort to assess impact.

Dr. Keiser then briefed the Board on the Committee of Visitors report. Dr. Keiser began by explaining NSF's funding arrangement with NASEM in support of international science organizations. She reported that NASEM's Board on International Scientific Organizations (BISO) is in charge of the U.S. participation in the International Council on Science (also known as the ICSU after its former name: International Council of Scientific Unions), which recently merged with the Social Science Council. Dr. Keiser explained that the role of the scientific unions is to foster early career scientists; enable scientific interactions; define standards and nomenclature; conduct science diplomacy; facilitate capacity building with developing countries; and confer international awards. She added that there are 16 scientific unions that NSF funds through BISO. NSF's contributions range from \$4-12 million per year. The big change as a result of the Committee of Visitors analysis will be that the former BISO practice of submitting 16 different proposals to fund each of the unions will be consolidated to one award from NSF to BISO for all its activities. OISE will be the recipient of the proposal.

Dr. Keiser then took questions. In response to questions about the type and size of the past proposals, Dr. Keiser stated that the proposals are unsolicited, and their size varies with the size of the union, and the work being proposed for that grant period, to include expected travel. She also said that the proposals are externally reviewed, even though the dollar amounts would allow for internal NSF review. Dr. Córdova added one final comment to the discussion. She stated that one of the first questions the Committee of Visitors asked was "Why are you doing this, NSF? It is quite far removed from your normal business." Dr. Córdova said that the response was that this is an important part of intentional collaboration and there is no one else to step up and fund it. NSF has made a financial and philosophical commitment to NASEM that NSF sees this as important and will continue to fund it.

With that, Dr. Souvaine concluded the session at 12:30 for lunch and asked that everyone return by 1:20 for the final open plenary session.

Session 4

Chair's Remarks

Dr. Souvaine welcomed the NSF staff, guests, and members of the public listening via webcast. She began her remarks by welcoming Dr. Fleming Crim back to NSF in his new role as the Chief Operating Officer.

Director's Remarks

Dr. Córdova began by referring the Board to the written update from Amanda Greenwell on Legislative and Public Affairs (OLPA) that was in the Board Book. She then highlighted one topic in the OLPA update concerning the appointment of members to the newly Congressionally-mandated STEM Education Advisory Panel. Dr. Córdova stated that NSF had announced the appointment of 18 members, in consultation with the Department of Education, NASA and the National Oceanic and Atmospheric Administration. The Panel will be Chaired by Gabriela Gonzalez from the Intel Corporation and Vice Chaired by David Evans, Executive Director of the National Science Teachers Association.

Dr. Córdova then announced new senior staff moves and additions across the Foundation. In addition to Dr. Crim's return to NSF as Chief Operating Officer, she announced the arrival of Dr. Arthur "Skip" Lupia to be the new Assistant Director for the Directorate for Social, Behavioral, and Economic Sciences (SBE). Dr. John Veysey assumed his full-time role as Executive Officer to the National Science Board. Dr. Stephanie Hampton will be the new Division Director for Division of Environmental Biology in the Directorate for Biological Sciences (BIO). Dr. Henry Kautz is the new Division Director for the Division of Information and Intelligent Systems in the Directorate for Computer and Information Science and Engineering. Mr. Daniel Hofherr is the new Division Director for the Division of Information Sciences in the Office of Information and Resource Management. Dr. Basil Nikolau joined NSF as the new Division Director for the Division of Molecular and Cell Biosciences in BIO. Dr. Donal Manahan assumed his new position as Division Director for the Division of Integrative Organismal Systems in BIO in early July. Ms. Emilda Rivers became the new Division Director for the National Center for Science and Engineering Statistics in June. Dr. Córdova concluded her remarks by acknowledging the departure of two former Assistant Directors, Dr. Fay Cook from SBE and Dr. William Lewis from the Directorate for Education and Human Resources.

Approval of Prior Minutes

Dr. Souvaine presented the minutes of the [May Open Plenary](#) for approval. Those minutes were approved as presented.

Open Committee Reports

Dr. Souvaine then turned to the open committee reports, noting that the full record of committee activities would be detailed in the respective committee minutes.

Dr. Phillips reported for the Committee on National Science and Engineering Policy (SEP). She stated that the Committee had received an update on the ongoing effort to modify the *Science and Engineering Indicators* Report beginning with the 2020 edition. She said the discussion focused on the new thematic reports. She added that decisions about the subject matter of the individual reports and the timing of their rollout are forthcoming following some addition discussions between the Committee and NCSES.

Dr. Beachy reported for the Committee on Strategy (CS). He stated that the CS heard a status update on the FY 2018 appropriations and the FY 2019 budget request.

Dr. Lineberger reported that the Committee on Awards and Facilities (A&F) received an update on the construction of the Regional Class Research Vessels. The Committee also considered changes to the information/action item sequence, with a new policy document expected to be presented for approval at the November 2018 meeting.

Dr. Jackson represented the Committee on External Engagement (EE) and reported that the Committee heard a summary of the listening session that was held in conjunction with the Community College Innovation Challenge. The Committee also reviewed a draft of the Congressional engagement plan.

Dr. Ochoa reported for the Committee on Oversight (CO) in place of Dr. Anderson who Chaired the meeting in Dr. Sargent's absence. She reported that Dr. Anderson provided a summary of the Merit Review Report retreat that was held on July 16. The retreat examined how NSF and NSB could enhance the report's relevance and transparency to its stakeholders. Dr. Ochoa also started that the Committee received an update from the Chief Financial Officer on NSF's enterprise risk management efforts. The Committee also heard the regular OIG and CFO updates.

Dr. Victor McCrary reported on the work of the Skilled Technical Workforce Task Force. He reported that the task force provided an update on the June stakeholder meetings held in Washington with the Departments of Labor and Education, among others. The Task Force also discussed its strategy working paper.

Vote: NSB Calendar for CY 2019

Next, Dr. Souvaine presented the proposed list of dates for NSB meetings and the annual retreat for calendar year 2019. Dr. Souvaine asked for a motion to approve. The motion was so made and seconded. The calendar was approved as presented.

NSF Learning Agenda Presentation

Dr. Souvaine moved to the final agenda item of the meeting, a presentation by NSF on its learning agenda initiative. She turned the floor over to Dr. Córdova who introduced the

presentation and the speakers, Dr. Rebecca Kruse from the Office of Integrative Activities and Dr. Jolene Jesse from the Directorate for Education and Human Resources. The learning agenda approach was first used in NSF's INCLUDES program (focused on broadening participation in STEM) and that program served as the basis for the presentation.

Dr. Kruse began by providing the context behind learning agendas. She stated that NSF strives to lead the evaluation and assessment of investments in science and engineering research and education. She added that organizational learning can support the implementation of complex initiatives and that NSF considers learning agendas as a tool for supporting strategic learning and performance improvement. Using the OMB definition, Dr. Kruse said that a learning agenda is a set of broad questions directly related to the work of the agency that when answered enables the agency to work more effectively and efficiently. Once those questions are identified, a learning agenda also prioritizes and establishes the plan for answering both short- and long-term priority questions. To implement a learning agenda, Dr. Kruse added that implementation includes identifying and understanding stakeholders, identifying and prioritizing the right questions to improve performance, developing a plan for answering those questions, implementing the plan studies and analyses, and acting on the findings through the diffusion and dissemination of evidence. She summarized that a learning agenda emphasizes engaging the stakeholders throughout the process.

Dr. Jesse continued by using the INCLUDES program and its theory of change as a case study. She defined a theory of change as the relationship between a vision for an initiative and the strategy for achieving the initiative. She added that by using the elements of the OMB definition of a learning agenda, NSF is examining and seeking to improve the INCLUDES program as the agency embarks on the program's second phase.

Dr. Souvaine thanked the presenters. She then reminded everyone that the nominations period was open for the Annual Honorary Awards nominations. There being no further business, Dr. Souvaine adjourned the meeting at 2:30 p.m.

X 

Dr. Brad Gutierrez
Executive Secretary, NSB
Signed by: BRAD A GUTIERREZ