

**Summary of the Meeting of the President’s Council of Advisors on Science and Technology (PCAST)
February 3-4, 2020**

- Council Members:** Present: Kelvin K. Droegemeier, Chair; Catherine Bessant; Shannon D. Blunt; Dorota A. Grejner-Brzezinska; Dario Gil; Sharon Hrynkow; H. Fisk Johnson; A.N. Sreeram; Shane Wall; K. Birgitta Whaley
- Date and Time:** February 3, 2020, 8:30 AM – 5:00 PM
- Location:** Eisenhower Executive Office Building, Indian Treaty Room, Washington, DC
- PCAST Staff:** Edward G. McGinnis, PCAST Executive Director, DFO
- Invited Speakers:** Chris Liddell, White House Deputy Chief of Staff for Policy Coordination; Kamie Roberts, Director, Networking and Information Technology Research and Development (NITRD) Program; Michael Kratsios, Chief Technology Officer of the United States; Suresh V. Garimella, Member, National Science Board; Daniel A. Reed, Member, National Science Board; Arthur Bienenstock, Member, National Science Board; Julia M. Phillips, Member, National Science Board; Anneila I. Sargent, Member, National Science Board

Public Meeting -- The session began at 8:30 AM.

Welcome and Opening Remarks

Droegemeier welcomed all present to the second PCAST meeting. Liddell expressed excitement regarding the projects underway and his hopes for their successful outcomes. Droegemeier thanked the group for making good progress and gave special recognition to Kratsios, PCAST subcommittees, McGinnis, Science and Technology Policy Institute colleagues, the National Science Board (NSB) liaisons, and newly nominated but yet to be sworn in PCAST members Hussein Tawbi and Theresa Mayer. Droegemeier reviewed the agenda, noting that the February 4th joint meeting of NSB and PCAST would be the first in history. Other brief remarks were given by Kratsios and McGinnis.

Subcommittee on American Action Plan for Global Leadership in Industries of the Future

Subcommittee Chair: Dario Gil; NSB Liaisons: Suresh Garimella, Daniel Reed

Gil described the mission of the subcommittee to create a 5-year multisector plan for the industries of the future (IoT), each of which is at a different level of maturity. The subcommittee is developing two reports. Report 1 will cover what actions non-Federal sectors could contribute in support of IoT, particularly in the areas of artificial intelligence (AI) and quantum information science (QIS). Report 2 will focus on implications for convergence across the IoT, recognizing that AI and QIS will accelerate the rate of scientific discovery, which will in turn impact biotechnology and advanced manufacturing. Report 2 will identify opportunities for mutual acceleration of discovery in these fields. The session included presentations and discussions of progress on Report 1.

Remarks: Federal Activities in the Area of Quantum Information Science

Michael Kratsios

Kratsios noted the priority given to QIS as part of the Administration's broader technology agenda. Since the National Quantum Initiative Act was passed, the National Quantum Coordination Office at the White House has begun coordinating national efforts. Deliverables discussed included development of a National Strategy for QIS, scheduled to be released in Summer 2020; ongoing collaboration among agencies regarding industry engagement; the White House Academic Roundtable on QIS held in May 2019; and review of proposals for quantum centers to be coordinated by the National Science Foundation (NSF) and the Department of Energy.

Remarks: PCAST's Focus on Quantum Information Science

Dario Gil and Birgitta Whaley

Gil and Whaley discussed ongoing activities and opportunities for industry and academia in QIS, especially quantum computing. Key points included future U.S. scientific and commercial leadership in quantum computing; U.S. industry is expected to invest billions of dollars in quantum computing over the next 5 years; the potential for creating a national network of quantum computing user facilities; and the importance of educating the next generation of quantum scientists and technologists.

Discussion

Participants discussed the innovation potential of a network of computation centers linked together with a "quantum internet"; streamlining the process of forming partnerships; using high performance computing user facilities as a model for QIS user facilities; recommendations for attracting the next generation of scientists to QIS; ways of encouraging collaboration between Federal labs, industry, and academia; the range of scales of investments; increasing the speed of establishing user facilities; the need for quantum standards, security, and intellectual property (IP); and national and international workforce trends and challenges.

Remarks: Federal Activities in the Area of Artificial Intelligence (AI) and PCAST's Role

Michael Kratsios; Dario Gil

Kratsios shared five pillars of the American AI Initiative: 1) Prioritizing AI in research and development budgets and providing higher level strategic guidance to Federal agencies; 2) Improving AI governance by establishing technical standards and providing regulatory guidance; 3) Releasing data to the R&D community to improve research while addressing privacy concerns; 4) Developing an AI-ready workforce by training the next generation of AI technologists and retraining American workers to take advantage of AI as a tool; and 5) Supporting international engagement by building partnerships in the global AI community. Kratsios also described launching the AI Center of Excellence at the General Services Administration in order to increase use of AI in government.

Gil stated that the subcommittee will consider how creative industry partnerships over the next 5 years could both advance the Nation's core AI R&D infrastructure and improve the AI skills of the U.S. workforce. Ideas for recommendations supporting this objective included: scaling up programs that offer credits for cloud-based resources and hardware grants to universities and non-profits; supporting open-access publications and open-source software; need for industry and policy standards in AI with the goal of creating trust in AI.

Discussion

Gil led the group in discussion of topics such as fostering convergence across classical computing, AI, and QIS to accelerate discovery; prioritizing safety, security, and privacy of AI technology to ensure public acceptance; and the importance of a U.S.-based 5G network as part of the basis for IoT.

Subcommittee on New Models of Engagement for Federal and National Laboratories in the Multi-Sector R&D Enterprise

Subcommittee Chair: Shannon Blunt; NSB Liaisons: Arthur Bienenstock, Julia Phillips

Droegemeier invited Theresa Mayer and Hussein Tawbi (both nominated to join PCAST) to introduce themselves before opening the next session. Blunt gave an overview of the subcommittee's charge to: 1) gain a clear understanding of how labs are structured and operate, 2) conceptualize a model of how the National Labs could increase the global competitiveness of the U.S. while continuing their S&T missions, and 3) carry out a gap analysis to identify possible improvements. The framework for the subcommittee's work spans: a) personnel and developing early career scientists; b) facilities and missions of the labs; c) ideas and IP–discoveries and innovations that drive knowledge and technology; d) the role of labs reducing research risk for industry and academia; and e) funding and oversight.

Discussion

Key points raised included: lack of public appreciation for the talent in the labs; need for a better funding model than pay-as-you-go; ongoing need for cross-agency interaction and integration; and advantages and disadvantages of various models that would allow collaboration and funding across agencies; and atomization of funded research at labs.

Remarks: Subcommittee's Big, Bold Ideas

Shannon Blunt; A.N. Sreeram; Shane Wall

Blunt presented four bold ideas for discussion: 1) Creating a "National Energy Act" to help establish a commercial sector (e.g., around fusion) analogous to the space industry commercial sector; 2) Establishing a national advanced manufacturing laboratory that can address scales beyond current pilot projects; 3) Creating a national biotechnology laboratory, which is an S&T field underrepresented in the current network of National Laboratories; and 4) Digital healthcare making full use of AI, Big Data, deep learning, and other emerging tools and industries while addressing the conflict between data use and the privacy requirements of the Health Insurance Portability and Accountability Act (HIPAA).

Networking and Information Technology Research and Development (NITRD) Program Presentation and Discussion

Kamie Roberts, Director, NITRD

Droegemeier reiterated that PCAST is required to perform a NITRD evaluation every 3 years. The last evaluation was in 2015, and PCAST will be overseeing and managing the next evaluation this year.

Roberts provided a brief overview of the NITRD program, including recent accomplishments and impacts, strategic priorities for 2020 and beyond, and 2015 PCAST recommendations and responses. The program is working hard to create collaborations with other parts of the National Science and Technology Council, in particular the Resilience S&T Subcommittee. NITRD is focusing on addressing R&D priorities for American leadership in wireless communications, and developing a public inventory of wireless spectrum R&D tools, datasets, and models. Roberts reviewed issues that PCAST identified in its previous evaluation and how NITRD has addressed them.

Subcommittee on Meeting National Needs for STEM Education and a Diverse Multi-Sector Workforce Subcommittee

Subcommittee Chair: Cathy Bessant; NSB Liaison: Anneila Sargent

Bessant stated that the subcommittee has been considering the connection between H1B visas and growing STEM talent domestically; best practices and exemplar models to increase diversity and inclusion in STEM; re-skilling the U.S. workforce; the transition from 2 to 4-year institutions; and developing multi-sector partnerships. The subcommittee has considered a number of ideas: 1)

Developing a grant program for U.S. universities to create curricula that can support workforce preparation in the fields of QIS and AI; 2) Leveraging retraining commitments that the private sector has already made (e.g., Microsoft TEALS, Cisco Networking Academy) to scale up programs in schools and communities; and 3) Modernizing talent recruitment and establishing job specifications and hiring frameworks that will make the pipeline for talent both broader and more consistent, including non-STEM-educated talent moving into STEM.

Discussion

Participants engaged in discussion about the challenges associated with leveraging funds for university-based programs, non-traditional paths to completing advanced degrees, the need to destigmatize community college and ensure that the measure of success is not just transferring to a 4-year college, the growing interest among young people in joining the skilled technical workforce, the importance of increasing diversity in STEM, particularly starting at an early age and engaging parents as well as children.

Unstructured Discussion

Droegemeier began the discussion with an overview of plans for the February 4th session with NSB. He identified STEM education and the skilled technical workforce as a possible topic for discussion as well as the Vision 2030 for NSF. Sreeram recommended a conversation around the education/ethics aspect of progress driven by S&T. Others proposed discussion of the following questions: How do we collaborate on lotF? How do we ensure that the public understands the value of early stage research? What do we think are the long-term roles of the National Labs and NSF? Is there value in coordination between NSF and Federal labs to fund particular areas of research? Is there a role for a foundation supporting NSF to funnel private funds? It is critical PCAST define goals that are explainable and relatable to the general public both to move its aims forward and for the health of the wider scientific community.

Public Comment Period:

There were no requests for public comment.

Meeting Wrap-up and Adjournment

Droegemeier provided logistical information for the February 4th session.

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NSB Members: Present: Diane Souvaine, Chair; John Anderson; Arthur Beinenstock; Vicki Chandler; Maureen Condic; France Córdova; Kent W. Fuchs; Suresh Garimella; Robert Groves; James Jackson; Steven Leath; Carl W. Lineberger; Victor McCrary; Emilio Moran; Ellen Ochoa; Sethuraman Panchanathan; Bud G.P. Peterson; Julia Phillips, Daniel Reed; Geraldine Richmond; Anneila Sargent; Alan S. Stern; Stephen Willard; John Veysey; Maria Zuber

Date and Time: February 4, 2020, 8:30 AM – 12:35 PM

Location: Eisenhower Executive Office Building, Indian Treaty Room, Washington, DC

PCAST Staff: Edward G. McGinnis, PCAST Executive Director, DFO

Public Meeting – The session began at 8:30am.

Welcome and Opening Remarks

Kelvin Droegemeier, Diane Souvaine

Droegemeier welcomed everyone to the historic joint meeting of NSB and PCAST. Although PCAST and NSB have different structures and missions, both organizations are passionate about their work. After introductions, Souvaine described the role of NSB, and suggested that PCAST and NSB together have the opportunity for more timely and impactful improvements for accelerating the pace of discovery and U.S competitiveness internationally. She noted that NSB sets priorities by identifying trends that, unaddressed, would undermine our global preeminence in science and engineering. Droegemeier reviewed the day’s agenda and introduced the next session.

Presentations and Discussion on NSB Science and Engineering Indicators Report & Vision 2030 Project

Diane Souvaine

Souvaine provided the history of NSB, and then described its roles and function. She briefed the participants on how the 2020 Indicators Report is used by policymakers, researchers, media, and NSB. Products are developed by NSB to make the information more accessible, and products can be policy-neutral or use indicators to make a policy statement. The report is the basis for recent NSB products on career pathways of STEM PhDs and the need to diversify the STEM-capable workforce and the skilled technical workforce.

Remarks: The NSB Science and Engineering Indicators Report

Julia Phillips

Phillips described the changes in the global landscape of science and engineering. NSB identified three macro trends to address in order to maintain U.S. leadership in science and engineering: 1) The science and engineering enterprise is increasingly globalized and complex; 2) The U.S. domestic economy reflects a global trend toward knowledge and technology intensification; and 3) The U.S. has a complacent approach to cultivating our own talent. The primary competitor of the United States in S&T

spending and R&D output is China. Phillips emphasized the competitive options abroad that may attract the foreign talent that formerly came to the U.S. Other topics covered included: The forecast of population growth in historically underrepresented groups in STEM; the growing need for STEM talent in jobs across our economy; and the United States' continued heavy reliance on foreign STEM talent. These issues pose a challenge to the health of the U.S. science and engineering enterprise and the U.S. economic growth.

Remarks: NSB Vision 2030

Roger Beachy

Beachy presented the findings and recommendations of the NSB Vision 2030 ("Task Force"), which focused on four crucial areas: the practice of science, talent, partnerships, and infrastructure. The Task Force identified three infrastructure-related opportunities: 1) Ensure that U.S. S&E infrastructure enables research that spans the breadth of science and engineering; 2) Strategically build S&E infrastructure and capacity across the Nation to catalyze regional scientific and innovation networks; and 3) For costly facilities, work with international partners so that U.S. researchers can fully participate, help set the agenda, and share equally in the discovery. Beachy noted that the Vision 2030 Task Force sees an urgent need to develop domestic talent while continuing to welcome foreign talent, to speed up the transition from government-funded research to innovation by fostering partnerships and collaborations to help make the scientific enterprise more efficient. Lastly, building the STEM-capable workforce is a long-term commitment, but the U.S. has a firm foundation on which to build.

PCAST Subcommittee Discussions

Kelvin Droegemeier

Remarks: Subcommittee on American Action Plan for the Industries of the Future

Birgitta Whaley

Whaley provided an overview of the subcommittee's discussions and work. In the subcommittee's view, industry has a particular role to play in the arena of QIS, both in the creation of quantum computing systems, sensors, and services, but also educating the quantum workforce. For the academic sector, the subcommittee sees the importance of strengthening partnerships with industry and government as well as the role of universities in educating the next generation of scientists and citizens. In addition to QIS, the subcommittee sees an important role for industry in advancing AI through the access to AI infrastructure to academics, backing open-source software and open-access publications, and sponsoring educational programs in AI.

Remarks: Subcommittee on New Models of Engagement for Federal and National Laboratories in the Multisector R&D Enterprise

Shannon Blunt

Blunt described how the subcommittee is conceptualizing a high-level model for how the National Labs could best operate in the lotF context based on three site visit discussions with lab directors. Proposed short-term initiatives touched on five key issues: 1) personnel; 2) facilities and missions of the labs; 3) ideas and IP; 4) risk; and 5) funding and oversight. Short-term initiatives included addressing budget atomization, expanding the pipeline of early career opportunities, and evaluating models for addressing IP issues. The mid-term initiative is to stand up a National Laboratory sandbox with an lotF focus, and the long-term goal is to focus on scaling-up advanced manufacturing capabilities.

Remarks: Subcommittee on Meeting National Needs for STEM Education and Diverse Multisector Workforce

Cathy Bessant

Bessant explained the purpose of the subcommittee and listed the three themes it has developed: 1) Proposing approaches for creating and maintaining a diverse and inclusive workforce for STEM; 2) Addressing how to make changes at national scale beyond small, individual programs; and 3) Developing multigenerational talent. The subcommittee's recommendations require leveraging the private sector and engaging in public-private partnerships, augmenting the work of schools and universities, concentrating on skills-based certifications, making use of non-U.S. talent, and addressing the lack of diversity in STEM disciplines. Recommendations under consideration also include making STEM education mandatory, collaboration between PCAST and NSB to address skilled technical workforce needs and recruitment of nontraditional students, and growing the domestic capacity in science.

Open Discussion between PCAST and NSB Members

Droegemeier outlined the major goals for the session. He initiated discussion with three questions: 1) What do PCAST and NSB want to work on together? 2) How do PCAST and NSB go about doing so? and 3) What are the next steps?

Souvaine described the role and structure of NSB. Ochoa outlined where PCAST can complement NSB in areas of shared interest. PCAST provides a perspective from the industry sector, whereas NSB's experience is primarily derived from academia and Federal agencies. PCAST, through the White House Office of Science and Technology Policy, can convene across Federal agencies, and can particularly reach out to non-R&D agencies like the Departments of Education and Labor (which can provide information on workforce). Key common interests shared between NSB and PCAST include: 1) fostering multi-sector partnerships, 2) developing and maintaining the skilled technical workforce, 3) ensuring that STEM talent is developed, and 4) ensuring STEM diversity, both in terms of underrepresented groups but also with respect to geographic diversity (particularly rural areas, where lack of connectivity can limit access to educational and research opportunities).

Sreeram outlined PCAST's focal areas, including 1) the need for roadmaps for AI and QIS establishing technical benchmarks but also considering their social and ethical impact, 2) amplifying the importance of basic science and R&D to maintain U.S. global leadership, and 3) supporting STEM education—including its wider cultural context—as a means of improving the quality of life for Americans.

The open discussion touched on many subjects, including increasing the participation of young people in STEM; achieving greater geographic dispersion of the fruits of S&T; need for life-long learning and upskilling and reskilling as technology advances; importance of partnerships across sectors (particularly in the face of competition from other nations); including the agricultural and related sectors within the scope of STEM; role of STEM in defense and vice-versa; importance of diversity in experience and background (e.g., technical schools, HBCUs and MSIs) at all levels of the STEM workforce; need to expand support for educational institutions (particularly State institutions, whose funding is on a long downward trajectory) who do the training of the STEM workforce; importance of keeping issues beyond AI and QIS, particularly dealing with the challenge of climate change, at the forefront; competition for STEM talent, both internationally and from other sectors like advocacy and entrepreneurship, is fierce.

Droegemeier summarized the session by identifying two consistently emergent themes from the discussion: 1) talent development, and 2) partnerships.

Public Comment Period:

There were no requests for public comment.

Meeting Wrap-up and Adjournment

Droegemeier opened the remaining time for final thoughts or comments from the participants. McCrary made two points: 1) when State school boards allocate resources to high schools, they are primarily based on college-bound students, which has implications for technical workforce, and 2) industry today is less concerned about keeping proprietary technology secret, but rather competing based on talent and speed, amplifying the points made in the open discussion. Tawbi was struck by the convergence by PCAST and NSB around STEM education and investment in fundamental research. However, China is outstripping the U.S. in experimental development, which is critical for the use of discoveries in driving economies and improving quality of life.

Droegemeier expressed final thoughts reiterating the major themes of the discussions and highlighting the benefits and challenges of leveraging the differences between PCAST and NSB. He then asked each participant to share any final thoughts. These included the following comments: small actions and changes will not be enough to face the big challenges facing U.S. global leadership in STEM; life sciences—agriculture, food, food safety, forestry—have not been part of the discussion, but are as important as other topics covered; this is a Sputnik moment—the challenge the U.S. faces requires urgent action; and the U.S. still leaves too many people behind in STEM. Participants expressed appreciation for the joint meeting.

The meeting adjourned at 12:35 PM.

Respectfully Submitted:

Edward G. McGinnis
Designated Federal Officer