

Directorate for Engineering Advisory Committee Meeting

National Science Foundation
Stafford II, Room 555
Arlington, Virginia
April 13–14, 2011

SUMMARY

AdCom Members Present:

Dr. Steven Castillo (Chair)
Dr. Ilesanmi Adesida
Dr. Patrick Farrell
Dr. Alison Flatau
Dr. Pramod Khargonekar
Mr. Tom Knight
Dr. Bruce Logan
Dr. Margaret Murname
Dr. Tresa M. Pollock
Dr. Michael Silevitch
Dr. David Spencer
Dr. Matthew Tirell
Dr. Mehmet Toner

ENG Senior Staff Present:

Dr. Thomas Peterson (AD)
Ms. Joanne Culbertson
Mr. Darren Dutterer
Dr. Omnia El-Hakim
Dr. Theresa Maldonado
Dr. John McGrath
Dr. Steven McKnight
Dr. Kesh Narayanan
Dr. Sohi Rastegar
Dr. Mihail Roco
Dr. Robert Trew

AdCom Members Absent:

Dr. Linda Abriola
Dr. Lueny Morell

ENG Senior Staff Absent:

Ms. Cecile Gonzalez

Also Attending:

Dr. Alan Blatecky
Dr. Rita Teutonico
Dr. Cato Laurencin – April 14, 2011

Wednesday, April 13, 2011

CALL TO ORDER

Dr. Thomas Peterson welcomed everyone to the spring meeting of the Directorate for Engineering (ENG) Advisory Committee (AdCom) and reviewed the materials and agenda.

DISCUSSION WITH THE NSF DIRECTOR

Dr. Peterson welcomed the NSF Director Dr. Subra Suresh and the Acting Deputy Director Dr. Cora Marrett. Dr. Suresh thanked the committee members for their participation and welcomed their suggestions.

Discussion

Initially the conversation focused on strategic planning and priority setting. NSF will continue to articulate the need for funding to enable the U.S. to remain a global leader. With growing global competition, it's essential to support fundamental research that is the engine for innovation. However, under current fiscal constraints, NSF may need to end some programs to make way for new ones. NSF is reviewing its priorities but some activities, such as human capital development, will remain a top priority regardless of funding.

The discussion focused on ways that NSF can provide incentives to encourage faculty to promote innovation and innovation ecosystems and to collaborate with industry. Dr. Suresh emphasized NSF's role in promoting long-term support for fundamental research that may lead to innovation and economic growth. However, NSF, in partnership with other agencies, can also do a lot to help promote the development of innovation ecosystems. Programs such as the Small Business Innovation Research (SBIR) program can play a key role. ENG and other NSF directorates are also instrumental in addressing major societal issues, such as the grand challenges identified by the National Academy of Engineering.

Metrics warrant additional emphasis; NSF needs better data to demonstrate the value of its investments. For example, longitudinal data on participants in the Graduate Research Fellowships (GRF) program are needed to assess the program's role in enhancing careers, particularly for women and underrepresented minorities. NSF is exploring different approaches to gathering and monitoring data over the long term and capturing the economic impact of innovation. A new center on data and statistics will help NSF to address issues on data collection and analysis.

NSF's budget reflects a large investment in sustainability, and all directorates and offices are participating in the Science, Engineering, and Education for Sustainability (SEES) initiative. NSF supports research and education across all fields of science and engineering. NSF-funded researchers can address all forms of energy and can consider related social and policy issues.

It's essential that all NSF directorates support education; NSF is unique in integrating research and education. Implementing best practices for educational innovation can help to attract students and ensure that engineering education remains relevant. ENG's initiatives with science museums and for veterans may provide agency-wide models.

APPROVAL OF MINUTES

The minutes of the previous meeting were approved. No changes were requested.

ENGINEERING DIRECTORATE UPDATE

[Including Strategic Planning Efforts, and Budget Planning for Fiscal Years 2011 and 2012]

Dr. Peterson introduced new staff and provided an update on strategic planning, broadening participation, budget and trends and collaborative investments. He outlined the engineering areas of emphasis, the NSF grand challenges in SEES and CIF21 (Cyberinfrastructure Framework for 21st Century Science and Engineering), national priorities in the innovation ecosystem, advanced manufacturing, EARS (Enhancing Access to the Radio Spectrum), NNI (National Nanotechnology Initiative), and the NRI (National Robotics Initiative).

STATUS REPORT ON SEES INITIATIVE AND ENERGY WORKING GROUP INPUT

Dr. Rita Teutonico gave an overview of SEES goals and activities.

Discussion

The initiative is designed to enable new collaborations that encompass all research and education communities and to spur the creation of new knowledge. The networks are also encouraged to engage with students, stakeholders, and the general public. Potential outcome measures include the formation of research laboratories, publications, and workforce development.

SEES research addresses decision-making under uncertainty and decision-making tools. These are areas in which social science research can play a key role, particularly with issues relating to equity. A systems-based approach can make an important contribution and Dr. Teutonico has been pleased by environmental engineers' initial response to SEES. Several NSF solicitations support research on global climate change; NSF's role is to support fundamental research on important scientific questions.

ENERGY WORKING GROUP INPUT

Dr. Ilesanmi Adesida gave a status report on the Energy Working Group (EWG)—a joint effort between ENG and the Directorate for Mathematical and Physical Sciences—to engage the community in developing economically viable approaches to clean energy and educating students about the impact of clean energy on society.

Discussion

The EWG is addressing all facets of the problem—engineering, manufacturing and scale up as well as issues related to energy storage and innovation. Translating the research and effective outreach will be key to their success; researchers need to be trained to communicate effectively and to participate in public forums. Key metrics for success would include enhanced systems-level thinking, collaboration, and workforce development.

Their intent is to bring together key stakeholders from the different research communities. It's important to frame the problem in a way that is realistic and flexible and to highlight complementary and conflicting issues. A systems perspective and a focus on decision making and optimization may help to define what's possible. This will be an important aspect of students' training.

Sustainable energy will involve a mix of energy sources; nuclear energy will be part of the mix although they will have to address the safety issues. Safety engineering will be an important topic for the future.

STATUS REPORT ON CIF21 INITIATIVE

Dr. Alan Blatecky provided an overview of the Cyberinfrastructure for the 21st Century Initiative (CIF21) and described their strategic plan and metrics. CIF21 is designed to enhance interdisciplinary collaboration and enable us to effectively manage a sea of data.

Discussion

The initiative reflects interagency collaboration. The White House is developing an interagency data working group, through the Networking and Information Technology Research and Development program, in which NSF expects to play a leadership role.

The CIF21 Road Map focuses on providing services and considers different hardwares and approaches, including bio, physics, and clouds. Costs are a major consideration. In the future it may cost as much as \$1 billion for a top-ranked machine. NSF is rethinking its role and how to leverage Department of Defense (DoD) resources. NSF may decide to emphasize algorithms, software, and education.

A lot of money has been spent on cybersecurity research but deployment has been underfunded. Moving cybersecurity research and innovation to practice is a major focus; for example, how can we make authentication easier? CIF21 ties applications to specific science requirements.

NSF's role in long-term data storage and management is under review. Some communities are drowning in data; a systematic overall approach is needed. The supercomputer centers have major data capabilities that can be made available to the community. The NSF Office of Cyberinfrastructure (OCI) is also looking at pilots and the experiences of different campuses to understand their role in the data/computer network.

One metric for CIF21 would be for Major Research Instrumentation projects and the two Major Research Equipment and Facilities projects to share data within two years. Initially, OCI hopes to implement a prototype for an individual discipline and to learn from this experience.

ENGINEERING DIRECTORATE UPDATE

Dr. Peterson completed the Engineering Directorate Update.

Discussion

In response to a query about the status of fiscal year (FY) 2011 initiatives, it was noted that NSF cannot announce new activities until it has an approved budget. With tighter budgets, ENG will have to set priorities. NSF may benefit from a new funding model, with greater support from outside sources. ENG currently partners with the Semiconductor Research Corporation and it may explore opportunities with other industry consortia. NSF also collaborates with the DoD, the Department of Energy (DoE), and other agencies to leverage agency funding.

Although the Nanoscale Science and Engineering Centers are being phased out, nanotechnology will be supported through the nano Engineering Research Centers, the Science and Technology Centers, and other activities.

CHARGE TO BREAK-OUT GROUPS

Dr. Peterson charged the two break-out groups on SEES and CIF21.

[The committee took a break.]

REPORTS FROM BREAK-OUT GROUPS

Break-out Group on the CIF21 Initiative

Dr. McKnight reported for the break-out group.

The discussion focused on two themes: 1/how engineers can take advantage of CIF21 assets and how they can be structured to best fit engineering applications, and 2/ how engineers can contribute to the development of cyberinfrastructure (CI) hardware and software. The group suggests that the CI be tailored to address the common elements in complex systems that are being engineered—systems ranging from logistics and supply chains to issues concerning Homeland security or management of the nuclear weapons inventory. Potential CI might include forward-looking models and data from ubiquitous sensors to verify the models. There may be community-specific needs, and the optimal scale may vary for different activities, but it's important to identify common problems among the communities.

There are also considerations of whether engineering research is best suited to high performance computers or to distributed resources. In the past, many of the big impacts in engineering have been associated with lateral proliferation. Furthermore, only a handful of people are equipped to deal with the data deluge associated with supercomputers.

There was discussion of whether it makes sense to have a STC or an ERC focused on CI. This would give CI greater visibility and would challenge the engineering community to determine how best to use cyberinfrastructure. Another possibility would be to support a center focused on cloud computing for engineering research problems. Such a center may have significant potential for enhancing education and public awareness and may offer opportunities for broad-based partnerships

Engineers can help to develop hardware and software and to address challenges in data management and computing issues related to cooling and possibly new physics.

Discussion

The break-out group didn't address the current availability or use of supercomputers.

Fundamental research is needed on the issues associated with the data deluge, and it's important to develop standards for data format and availability. Relying primarily on computer infrastructure to solve the data problem could affect how society evolves.

Break-out Group on the SEES Initiative

Dr. John McGrath reported for the break-out group.

The group discussed the solicitation's context and ENG's targeted and core investments in sustainability. They strongly support the SEES activities and encourage ENG to participate in the postdoctoral fellows activity. They emphasized the importance of supporting both new and ongoing research groups. Furthermore, it's important to recognize that it takes time to form effective research collaborations. They strongly support the ENG-DoE partnership. Potential metrics might address paradigm shifts as well as new curriculum and new ways of thinking for the SEES-trained workforce.

The group highlighted several concerns. They hope to ensure that the solicitation's evaluation criteria reflect systems approaches and that there continues to be strong support for transformative research through the core. Furthermore, it's important that the solicitation reflect the importance of involving stakeholders throughout the process.

Discussion

SEES has significant potential for broader impacts, especially education; this should be emphasized in the solicitation.

[The meeting adjourned for the day.]

Thursday, April 14, 2011

ENGINEERING EDUCATION AND CENTERS (EEC) OVERVIEW

Dr. Theresa Maldonado gave an overview of the EEC Division and its emphasis on improving the rigor of engineering education research and bridging the gap between researchers and practitioners. Dr. Maldonado also discussed the engineer of the future and alternative pathways for engineering education.

Discussion

Contingent on funding, ENG and the Directorate for Education and Human Resources (EHR) plan to support a new center for innovation that will define a national agenda and curriculum for undergraduate education. It may be appropriate to introduce the topic of social entrepreneurship into the discussion of innovation. Although the center is focused on undergraduate education, outreach to pre-college and community college students may be valuable. It will be critical that the center faculty have hands-on experience with innovation and that there be good teaching. Partnering with professional societies may offer a way to enhance the emphasis on teaching.

Another strategy for advancing innovation would be to support the professional master's degree. Master's students can promote the translation of research; they play a key role at many state schools.

It was acknowledged that it's hard to encourage faculty to focus on translational research when funding is focused on hypothesis-driven work. Incentives are needed to spur faculty to focus on innovation.

EMERGING FRONTIERS IN RESEARCH AND INNOVATION

Dr. Sohi Rastegar provided background on the Office of Emerging Frontiers in Research and Innovation (EFRI) programs, the topic selection process, and an assessment by the Science and Technology Policy Institute (STPI). He announced the three topics for FY 2012:

- Flexible Bioelectronics Systems
- Origami Design for Integration of Self-Assembling Systems for Engineering Innovation and
- Photosynthetic Biorefineries.

He also discussed potential EFRI strategies for broadening participation.

Discussion

For some transformative research, it may not be possible to define clear topics or outcomes; it's important to retain flexibility in the topic selection and proposal review process.

EFRI COMMITTEE OF VISITORS REPORT

Dr. Cato Laurencin gave an overview of the Committee of Visitors (COV) report. Under Dr. Rastegar's strong leadership, EFRI has funded potentially transformative research from a broad range of institutions. The proposals reflect paradigm shifts; there is a strong potential to create new research areas. EFRI awards enabled investigators to develop new technologies and helped to fill the gap between single PI awards and ERCs.

The process for soliciting and reviewing proposals and the EFRI portfolio are appropriate, except for the participation of underrepresented groups. The solicitation should emphasize broader impacts and require PIs to describe how their proposals would enhance workforce diversity at all levels. In addition, EFRI may wish to engage directly with minority-serving institutions.

Additional issues for consideration include:

- Assessing the disparity in reviewers' assessments of proposals
- Including non-traditional reviewers, such as venture capitalists
- Exploring ways to enhance community input on potential topics
- Streamlining the program planning and prioritization process and enhancing EFRI staff support
- Developing pathways to ensure continued advancement of EFRI-funded research
- Assessing impacts and outcomes from EFRI awards
- Improving the COV process by obtaining better on reviewer demographics

Discussion

There was discussion about what constitutes transformative and interdisciplinary research and the potential of transformative research to reshape education. ENG has established a group to help coordinate the submission and review of interdisciplinary proposals. NSF's initiative for Integrated NSF Support Promoting Interdisciplinary Research and Education (INSPIRE) is also targeted on promoting the interdisciplinary research that often leads to transformative research.

Dr. Laurencin reiterated that the percentage of individuals from underrepresented groups who served as reviewers or received EFRI awards was too low. ENG should enhance participation of underrepresented minorities and seek to increase students in the pipeline through efforts such

as REU. The COV recommends that EFRI develop an action plan that can serve as a model for other NSF programs. The Keck Futures Initiative may provide a model for bringing together different groups to address this issue. Participation at meetings of the professional societies or the engineering deans may also be useful. NSF is reassessing broader impacts as part of the NSB assessment of the merit review process. To enhance efforts to promote transformative research, it may be useful to think of underrepresented groups in very inclusive terms, including individuals with a different world view from the individuals that NSF normally supports.

MEETING WRAP-UP

Dr. Peterson announced that Dr. Adesida would be the new chair of the ENG AdCom, and he thanked Dr. Castillo for his service.

[The meeting adjourned at 12:00 p.m.]