

## Directorate for Engineering Advisory Committee Meeting

National Science Foundation  
Arlington, Virginia  
October 20–21, 2010  
Room 1235

### SUMMARY

#### **AdCom Members Present:**

Dr. Steven Castillo (Chair)  
Dr. Linda Abriola  
Dr. Ilesanmi Adesida  
Dr. Patrick Farrell  
Dr. Alison Flatau  
Dr. Pramod Khargonekar  
Mr. Tom Knight  
Dr. Bruce Logan  
Dr. Margaret Murnane  
Dr. Eugenia Paulus  
Dr. Tresa Pollock  
Dr. Michael Silevitch  
Dr. Mehmet Toner

#### **AdCom Members Absent:**

Dr. Matthew Tirrell

#### **ENG Senior Staff Present:**

Dr. Thomas Peterson (AD)  
Ms. Joanne Culbertson  
Mr. Darren Dutterer  
Dr. Omnia El-Hakim  
Ms. Cecile Gonzalez  
Ms. Susan Kemnitzer

Dr. John McGrath  
Dr. Steven McKnight  
Dr. Kesh Narayanan  
Dr. Sohi Rastegar  
Dr. Michael Reischman  
Dr. Mihail Roco  
Dr. Robert Trew

#### **ENG Senior Staff Absent:**

Dr. Allen Soyster

*Wednesday, October 20, 2010*

#### **CALL TO ORDER AND APPROVAL OF MINUTES**

Dr. Steven Castillo welcomed participants to the fall meeting of the Directorate for Engineering (ENG) Advisory Committee (AdCom) and called the meeting to order. He asked for suggested changes to the minutes from the spring meeting, and a spelling error was noted.

A motion was made to accept the minutes with the one change noted. The motion was approved and seconded. The minutes were accepted.

## **ENGINEERING DIRECTORATE UPDATE**

Dr. Thomas Peterson, the Assistant Director for Engineering, stressed the importance of discussion and feedback from participants at the AdCom meeting. He gave an update on Directorate activities and introduced the new ENG staff. He noted that the new NSF Director, Dr. Subra Suresh, had taken the oath of office.

Dr. Peterson summarized ENG strategic planning activities and sought AdCom input on prioritizing goals and recommendations and on key outcomes.

### **Discussion**

*What percentage of the NSF budget would be devoted to the Science, Engineering and Education for Sustainability (SEES) activity?* Dr. Peterson stated that the FY 2011 Request includes approximately \$700 million and the FY 2012 budget request will also include funding.

## **OVERVIEW OF ENG STRATEGIC THINKING REPORTS AND OVERARCHING GOALS**

### **Overview and Goal One: Lead in Frontier Engineering Research**

Dr. John McGrath, division director for CBET, introduced the ENG strategic thinking activity, the four strategic goals, and the key recommendations of the working groups.

The Strategic Thinking Working Group (STWG) chose to retain the core of the 2005 plan. The group is committed to assessment and outcome evaluation, which will influence planning and decision-making.

The Group's key recommendations were to:

- Focus on core programs for fundamental engineering research. When setting up new programs, reflect on how they will affect the core.
- Increase funding for Emerging Frontiers in Research and Innovation (EFRI) and support potentially transformative research through core programs, Rapid Response Grants, and Early-Concept Grants for Exploratory Research (EAGER). Challenge the community to think about changing the paradigm with high risk/high reward potentially transformative research.
- Form a working group to give visibility and continuity to activities to promote international collaboration.
- Focus on core programs for fundamental engineering research. When setting up new programs, reflect on how they will affect the core.

## **Discussion**

*The term “innovation ecosystem” needs additional clarification. What is an ecosystem? What metrics can we use to assess the creation of such ecosystems?* Dr. McGrath noted that Dr. Narayanan would be discussing the innovation ecosystem.

## **Goal Two: Cultivate an Innovation Ecosystem**

Dr. Kesh Narayanan, division director for IIP, gave an overview of the innovation goal. He discussed NSF’s role in education, research, and innovation, including entrepreneurship. ENG is using the definition of innovation from *A Strategy for American Innovation*—“the development of novel products, services, and processes for the benefit of society.” NSF supports activities in the innovation spectrum that range from discovery to translational research.

ENG will enable NSF to be the premier Federal agency for innovation by supporting the cultivation of an innovation ecosystem and spawning innovation opportunities through partnerships. Key recommendations include:

- Catalyze interactions between academe and industry and promote strategic global partnerships.
- Support translational research to move fundamental research towards commercialization.
- Establish platforms that enable a continuum of discovery from proof of concept to prototypes and beyond.

## **Discussion**

*How will ENG deal with intellectual property (IP)? This can be a major problem with individual states and countries treating IP differently.* NSF is involved with the University Industry Demonstration Project (UIDP), which has developed common tools and guiding principles. Work is still underway on issues concerning background intellectual property.

*What are examples of international collaborations?* The STWG has reviewed the European innovation strategies; they need to take stock of current investments and strategic decisions that affect international collaboration.

Dr. Peterson noted that NSF needs to be realistic about IP; the Foundation is not the major driver on this issue. NSF’s Office of International Science and Engineering (OISE) coordinates international activities. ENG pursues partnerships with OISE and the other directorates and balances the huge number of opportunities against funding constraints. Some programs, such as the Engineering Research Centers (ERCs), have an explicit international component.

*A common definition of innovation is needed.*

## **Goal Three: Develop the Next-Generation Engineer**

Ms. Susan Kemnitzer, deputy division director for EEC, discussed the third goal, which focuses on developing the next generation of engineers. She presented several key recommendations.

- Collaborate with engineering schools to produce innovative, entrepreneurial, and globally aware graduates.

- Document and assess alternative and non-traditional pathways for diversifying engineering education.
- Assess the value of an engineering education.
- Evaluate ENG's investments in students and align them with strategic goals.
- Strengthen ENG broadening participation activities.
- Continue to support the Research Experiences for Undergraduates (REU) and Research Experiences for Teachers (RET) programs.
- Expand and strengthen public information and outreach activities.

### **Discussion**

*How can we quantify the nation's need for engineers? There appears to be conflicting information on this important issue. Do high school students need better preparation to perform effectively in college engineering programs? Can engineering schools accommodate the number of engineering students that the nation needs? EEC hopes to work with NSF's Division of Science Resource Studies on these issues and on the value of engineering education. In addition to total capacity, it's important to consider the geographic distribution of available spaces.*

*How is NSF promoting connections between community colleges and four year undergraduate programs? NSF's Advanced Technology Education program has emphasized technician training but is now shifting to include four year schools. Colleges and universities have a responsibility to help students to make this transition. Some states, such as California, have introduced initiatives to encourage universities to accept more community college students.*

*Information about the demographics of students supported by NSF grants is included in the annual reports.*

### **Goal Four: Strive for Excellence in ENG Organization**

Dr. Steven McKnight, division director for CMMI, provided an overview of the fourth goal which focuses on internal operations and staff development and training. Key recommendations include:

- Organically incorporate evaluation and assessment into ENG processes.
- Optimize the structure and management of the disciplinary divisions within ENG in relation to other NSF directorates.
- Develop and implement a clear strategy to increase diversity, particularly in the directorate's senior leadership positions.
- Manage funding rates by managing proposal-generating documents and proposal submissions.
- Enhance communications and coordination.
- Enhance internal and external training.

Dr. McKnight indicated that ENG would hire an individual to oversee ENG's assessment and evaluation activities who would report to the deputy assistant director.

*What qualities does ENG seek in the evaluation coordinator?* This is a senior-level position for someone with a background in business intelligence, informatics, and operations research. This individual would bring an understanding of how to do things from a quantitative perspective and could receive training in traditional evaluation and assessment techniques.

### **Discussion**

*What is the rationale for restrictions on proposal submissions?* An analysis of ENG proposal submissions over the past five years showed resubmissions to be a significant factor. ENG hopes to eliminate 20 percent of the proposals with these restrictions.

*What are the details of the restrictions on the number of proposals that can be submitted to ENG?* Individuals would be limited to two proposals per year Directorate-wide.

*Many co-principal investigators receive little funding under center proposals; would the limit apply to center proposals?* Proposals submitted in response to solicitations would not be covered by the restrictions.

*This goal encompasses a broad range of recommendations. What resources would be needed to implement them? What trade-offs can ENG make to provide resources for these efforts?* Dr. Peterson reiterated ENG's commitment to assessment; he would appreciate AdCom input on prioritization.

*Some research topics are fragmented between programs in different divisions/directorates. Can we address this issue through collaborative projects?* ENG is engaged in collaborations with other directorates and divisions, particularly the Directorate for Computer Information Science and Engineering (CISE) and the Division of Materials Research (DMR). Collaboration is sometimes hampered by uneven funding levels.

*What is the level of funding for potentially transformative research (PTR) through EAGER and RAPID?* In the last few years, EFRI, EAGER, and RAPID together have been approximately 5 percent of the ENG budget. This represents an increase in targeted funding from approximately 3 percent in 2005. The core programs also support PTR.

*How will ENG use the AdCom input? Will the recommendations be relabeled as strategies? Will there be specific time lines and funding levels?* Dr. Peterson responded that he would like to focus on implementation. ENG will prioritize the recommendations and set time frames for implementation based on available resources.

### **CHARGE TO BREAK-OUT GROUPS**

Dr. Peterson charged the break-out groups to consider ENG's goals and recommendations and identify any potential issues that had been overlooked.

*[After a short break, AdCom separated into break-out groups.]*

## REPORTS FROM BREAK-OUT GROUPS

Each break-out group provided a brief summary of their discussion and key recommendations.

### **Break-out Group on Goal One: Lead in Frontier Engineering Research**

Dr. Margaret Murnane reported for the break-out group on goal one. The group identified no gaps.

The issue is how to challenge the community to reinvent itself. Assessment is needed to ensure that this is happening and that the community is not too narrow.

The panel review process may not support PTR. ENG should hold back 5 to 10 percent of the funds for high-risk/PTR proposals. In addition, ENG should provide sustained funding for principal investigators (PIs) who do PTR. There should also be a Foundation-wide initiative for mid-career awards on the order of 5 years and approximately \$800K.

Promoting interdisciplinary team research is critical to advancing PTR. The research frontiers involve interdisciplinary research. Targeted support is needed for cross-disciplinary teams; additional support is needed for mid-scale research.

International travel benefits faculty and students. It is effective to support international workshops and partnerships; researchers need to be aware of frontier research around the globe. International activities also play a key role in workforce development.

### **Discussion**

*More effort is needed to promote science and engineering collaborations to enhance scientists' understanding of engineering.*

### **Break-out Group on Goal 2: Cultivate an Innovation Ecosystem**

Mr. Tom Knight reported for the break-out group on goal two. The group identified two gaps. More education is needed to develop skills for innovation. In addition, the AdCom should include a broader group of stakeholders.

The group supports ENG's goals and priorities. They focused on outcomes and questions in three areas.

*Should NSF influence the university tenure evaluation process—placing more weight on translational research and innovation? If so, how would NSF do this?* The group recommends that NSF fund more translational proposals and that the review criteria be modified to include translational research.

They also made recommendations to improve technology transfer.

- NSF should provide supplements to encourage faculty to find partners to translate ideas into products and services that benefit society.
- NSF should encourage deans to promote innovation by, for example, sponsoring an "Innovation Dean of the Year."

- NSF could provide the framework to transfer intellectual property from PFI and the ERCs.

The group offered several suggestions for educating students. NSF could support a program of Innovative Experiences for Undergraduates, a national prize for entrepreneurial ideas, and could encourage universities to include innovation in capstone course. NSF could also support the development of curriculum on entrepreneurship. *U.S. News & World Report* could include a section on the top universities in engineering innovation.

### **Discussion**

*The master's thesis could be modified to include not only advances in fundamental knowledge but also innovation or a strategic initiative in a company. The recent report from the National Science Board (NSB), [Preparing the Next Generation of Stem Innovators](#), may be relevant.*

### **Break-out Group on Goal Three: Develop the Next-Generation Engineer**

Dr. Eugenia Paulus reported for the break-out group on goal three.

*Colleges of engineering invest more than \$8 billion per year compared to ENG's \$25 million. How does NSF have an impact?*

*The emphasis on engineers as innovators and continued support for research on learning is important. How can we ensure that good work is put to use?*

Overall they agreed with the goals. They suggested that RET and REU could be included under broadening participation.

The focus on alternative pathways should be expanded, particularly for community colleges, reentry, and mid career. In addition, a definition of broader impacts should be developed that specifically addresses innovation.

### **Discussion**

*ASEE and other professional societies have made significant efforts to raise public awareness of engineering. ENG should support these activities but not strive to be a leader.*

*There is a lot of misunderstanding of engineering; this is a problem inside NSF as well as the broader society.*

*Engineers as innovators can help universities to get additional funding. Innovation can capture the imagination and change the public personae of engineers.*

### **Break-out Group on Goal Four: Strive for Excellence in ENG Organization**

Dr. Alison Flatau reported for the break-out group on goal four. This goal focuses on excellence in ENG encompassing both organization and operations. The goal should incorporate continuous improvement, with ENG reaching out to the community and stakeholders for feedback. Key comments and recommendations include:

- They support assessment and evaluation; outputs and outcomes should be assessed.

- There is room for improvement in ENG structure and management, particularly in the areas of interdisciplinary and cross-directorate funding. Strategies are needed to ensure that there is a balanced pool of candidates for senior leadership and program manager positions. These individuals are the face of the directorate.
- The Directorate needs to clearly articulate its goals and motivation for limiting proposal submissions. The group suggests that the proposed policy be reconsidered; it would not promote agile, multidisciplinary research. The real problem appears to be the process for managing proposals; ENG should explore approaches used by other directorates.
- They support the recommendations for communication and coordination, which could be merged with the structure and management recommendation. They support the proposed internal and external training, which may enhance proposal quality—especially for organizations that have not received any NSF awards.

## **Discussion**

*Conflicting reviews are a special problem for young researchers. At NIH, proposals and resubmittals are reviewed by the same team. This builds a knowledge base and promotes consistency that is lacking in the NSF review process. However, problematic reviewers may pose a greater risk with this approach.*

*There are ways to improve the current NSF review process. For example, if resubmittals clearly identified changes, this would reduce the workload on reviewers and focus attention on what is new.*

*There is no consistency in the review process, and this has a big impact on young researchers. The current system also increases reviewers' workload because each panel reviews the whole proposal.*

*What percentage of the proposals are a nuisance? What percentage of the proposals would be eliminated if the ENG proposal were implemented? Approximately 25 percent of the proposals are resubmissions. ENG does not fund about 80 percent of the proposals; generally about 10 to 15 percent are rated fair or poor.*

*The plan contains many new initiatives but doesn't identify reductions to offset the new activities. It would be helpful to develop a prioritized list of activities that are not currently funded. Dr. Peterson noted that the discussion was an opportunity for AdCom to provide input on the strategic plan and whether ENG is moving in the right direction. He welcomes their suggestions and comments on strategic planning and directorate activities.*

*ENG should emphasize the role of engineering in translating research into jobs and enhancing the nation's global competitiveness. A systematic effort should be made to develop a leadership role for NSF on these issues. ENG should highlight key impacts from NSF activities and articulate how NSF-supported efforts help the nation to regain economic ground and to develop the next-generation workforce.*

*How have program officers been involved in the planning process? Dr. Peterson responded that Directorate staff members have been actively involved in developing the plan.*

Dr. Castillo proposed that AdCom endorse the ENG plan and the goals in the discussion with the NSF Director; the committee agreed. There has been a lot of progress.

*Setting priorities would strengthen the plan. In addition, developing a clear definition of potentially transformative research and more cohesive and accessible information would enhance assessment. Use of data mining tools and possible changes to the annual reports may also facilitate more effective assessment.*

*The plan should address the balance between single investigator awards and large awards, such as ERCs. Dr. Peterson noted that a NSB subcommittee is exploring the issue of support for midscale research.*

*What is the status of NSF's strategic plan?* Dr. Peterson noted that a third draft of the NSF plan is available. The NSF document remains relevant to the discussion of the ENG plan.

*Have there been studies on the number of engineers needed in the U.S?* Dr. Peterson noted that various studies have been conducted but with conflicting results. *The area of security services appears to require many engineers.*

*[The meeting adjourned for the day.]*

Thursday, October 21, 2010

## **INDUSTRIAL INNOVATION AND PARTNERSHIP (IIP) OVERVIEW**

Dr. Narayanan provided an overview of the IIP Division.

### **Discussion**

*What is the source of Phase II matching funds for Small Business Innovation Research (SBIR) awards? Funds come from equity, angels, large corporations, licensing, and product sales. There are no restrictions on countries that can invest, and ENG has seen investments from Korea, Europe, and Japan.*

*What is the average lifetime of an Industry/University Cooperative Research Center (I/UCRC)? Awards are made for five years at a time, with a maximum of 10 years. IIP recently introduced an extension of up to 15 years with limited funding; the continuation of support from NSF attracts industry and other agencies.*

*How much is the peak funding? NSF awards start at \$50K to \$80K per year. In addition, each industrial member could be paying from \$30K to \$50K per year.*

*Centers whose I/UCRC award has expired would like a continuing affiliation with NSF. However, they should compete for additional funding through supplements. Dr. Narayanan agreed. NSF recently provided an opportunity for the centers to apply for funding for fundamental research that is inspired by industrial needs.*

*How are the ERCs and I/UCRCs linked? There isn't a formal connection; some I/UCRCs have competed and become ERCs. This isn't easy, however, because the two programs have different mandates. ERCs are driven by long-range impact and transformational research, while the I/UCRCs are focused on industrial research.*

*How important is education in the I/UCRCs? Each project has a graduate student who reports to the industrial board.*

*What is the optimal organization of NSF programs? There appear to be a lot of programs that support innovation. Address potential duplication before developing new programs. Dr. Peterson acknowledged that it would be worth looking at a blank slate to define the optimal program mix.*

*It's important to capture efforts under regular NSF grants that foster innovation. Companies hear about NSF-supported research and invest money. NSF may not be aware of these activities, which often happen naturally. Similarly, efforts to foster innovation offer a major educational opportunity. ENG should involve undergraduates in programs to boost innovation.*

## **IIP COMMITTEE OF VISITORS REPORT**

Mr. Tom Knight and Dr. Louis Martin-Vega briefed the AdCom on the IIP Committee of Visitors (COV) report.

### **Discussion**

*Innovation presents challenges. How does one avoid conflicts of interest (COI) and promote an effective hand-off to industry? How can one innovate within academe without creating conflicts? It would be helpful to develop best practices on COI issues.*

*Faculty may not understand industry's needs and may not be good at innovation. Dr. Martin-Vega noted that GOALI (Grant Opportunities for Academic Liaison with Industry) offers a way to gain domain knowledge that is fundamentally different from SBIR—where the awards are made to companies. Working in an industrial environment should be considered fieldwork; it often provides the basis for significant research.*

*What is the collective vision across IIP and other ENG programs of how to turn research into something useful to society? How can what we learn from IIP help core programs to promote innovation? Can we develop general principles? It's important to capture these insights in the highlights and to share them with a wider audience. These insights could also help to sharpen the definition of broader impacts.*

*IIP's data collection is commendable. A quantitative approach is needed to define the issues and potential solutions to the Valley of Death. Dr. Narayanan said that this would be pursued.*

*Are there quantitative metrics for tenure promotion that reflect contributions to innovation? How would we articulate this? Deans are considering this issue, and NSF could give these efforts greater legitimacy and credibility.*

Dr. Martin-Vega and Mr. Knight noted that IIP has extensive commercialization experience that they can share with other federal agencies.

## **DISCUSSION OF OUTCOMES FOR ENG STRATEGIC PLAN**

Dr. Peterson asked whether the emphasis on innovation has overshadowed NSF's role in supporting fundamental research. He believes that the ENG budget reflects an appropriate balance between these activities but seeks AdCom input on this issue.

*What exactly does NSF bring to the table? It's important to be clear about the ENG and NSF roles in the entire innovation space. NSF has limited resources but it can play a special role. How can we leverage NSF's efforts more effectively and teach the community to promote innovation more effectively?*

*NSF is known for transformation and innovation, which covers a broad spectrum of activities. It's important to develop and communicate an appropriate definition of innovation.*

*Commercialization is one piece of innovation; NSF has a bigger role.*

*What metrics would be appropriate to assess IIP's contributions to innovation? How do we consider NSF's role in the context of NIST and DARPA? Has DARPA become the focus for high-risk research?*

Dr. Rastegar noted that ENG used the IIP definition of innovation and focused on the engagement of the academic community in the innovation process.

*With the proposed definition, innovation could be a unique niche for ENG within the agency. To get broader participation within NSF, we need to educate scientists on the reasonable possibility of failure in innovation. For them, discovery is everything.*

Dr. Peterson acknowledged the challenges in developing a definition for innovation. The current definition helps to articulate ENG's role. However, to engage the entire agency it's important to recognize the different pieces of the innovation process. Fundamental research is essential.

*Entrepreneurship is key to innovation. How can we train the engineers of tomorrow in entrepreneurial skills? Entrepreneurship can also help to inspire kids and attract them to engineering.*

*Innovation is complex; it's misleading to describe fundamental research and innovation as two separate activities. Much success has come from transformational research; it's important to retain a feedback loop between fundamental research and innovation. Engineers bring together science, mathematics, and technology to develop new things that benefit society. Collaborations between scientists and engineers can be highly productive in tackling important societal problems.*

An ENG staff member noted that in outreach activities NSF describes itself as "where discovery begins." NSF should consider increasing the scope of its brand to encompass innovation.

*Similar to the changes that NSF catalyzed on diversity, NSF can encourage universities to be more innovative. ENG can educate NSF, and then the agency can educate the community.*

## **PREPARATION FOR DISCUSSION WITH NSF DEPUTY DIRECTOR**

The AdCom members reviewed the issues to be discussed with the Deputy Director.

## **ADDITIONAL DISCUSSION**

Members revisited prior discussions that were cut short.

*There should be a national meeting of students who receive NSF fellowships. In addition, it would be helpful to track these students longitudinally through a listserv or formal tracking system.*

*Should broader impacts be tied more closely to the ENG plan?* Dr. Peterson noted that there are a wide variety of interpretations of broader impacts.

*More consistent guidance may be needed on how reviewers should interpret broader impacts.*

*ENG should revisit their recommendations and develop a more strategic approach. AdCom agreed that it was important to reduce staff burden but that there may be unintended consequences from limitations on the number of proposals that can be submitted.*

*Focusing resubmissions on weaknesses in the original proposal may be one way to reduce workload. This approach may involve problems as well; focused proposals may not be reviewed as favorably. There can also be “gaming” in the resubmission process.*

*Can program managers do more triage—not send for review duplicative proposals or those that are very likely to be rated poorly?*

## **DISCUSSION WITH NSF DEPUTY DIRECTOR**

Dr. Castillo thanked NSF Deputy Director Dr. Cora Marrett for joining them. It had been a very good day and a half of reports and discussion with the Directorate for Engineering. He thanked Dr. Peterson and his staff for their organizational work.

Dr. Marrett noted that they were impressed with the adoption of the term “innovation ecosystem” as a major Directorate theme. This is important to the nation’s future.

Dr. Castillo noted that the innovation ecosystem spans a large space from engineering sciences through to commercialization and partnerships with the corporate world. The AdCom supports this vision and NSF’s role as the national leader in innovation.

Since fall 2009, significant progress had been made with the ENG plan; AdCom was impressed with the effort. The framework is relevant to the community’s needs and it aligns with NSF’s mission. It’s important for the Directorate to continue to develop the plan including timelines, goals, benchmarks and implementation. Four members of the Adcom chaired sub-groups to review the plan; Dr. Castillo invited them to share their insights with the Deputy Director.

Dr. Murnane’s team looked at Goal 1—leading frontier engineering research. Their group believes that the 21<sup>st</sup> century will be the century of engineering; engineering is critical to advancing the frontiers. We need engineering ideas, tools, systems, and mindsets for other directorates to advance. The role of ENG will be increasingly central to NSF’s mission.

Mr. Knight discussed Goal 2—cultivating an innovation ecosystem. They identified two needs—to teach students innovation science and to include other constituencies, such as industry, state and local governments, and investor communities, in the innovation ecosystem. They suggested that the plan identify outcomes in the areas of incorporating innovation contributions into the tenure evaluation process, recognizing success in technology transfer and innovation (such as supplements or prizes) and educating students to become innovators.

Dr. Paulus’ team reviewed Goal 3—developing the next-generation engineer. Educating engineers to be innovators is a top priority. There was a discussion of projections of future demand for engineers. The group proposed activities to catalyze innovation, such as including innovation activities in NSF’s broader impacts criteria and incorporating innovation into ABET criteria.

Dr. Flatau led the team that examined Goal 4—striving for organizational excellence. The Directorate can provide multidisciplinary leadership in engineering research, education, and

innovation. She outlined a number of suggestions to further enhance ENG's impact. Directorate assessment and evaluation activities should consider the impact on stakeholders and the economy. The group shares ENG's concern about workload, but they believe that limiting the number of proposals per investigator may have unintended consequences. The appropriate algorithm should be tested against historical data before the policy is implemented. They proposed that ENG iterate with AdCom on the best approach to addressing this problem.

Dr. Marrett expressed her appreciation to AdCom for their input. The innovation ecosystem concerns the entire foundation. She asked what NSF needs to do to support the whole process from creative ideas all the way through to innovation and the creation of products, processes, and services that benefit society. ENG leads activities on the innovation ecosystem; it's important to also involve the rest of the Foundation. She commends ENG for reaching out broadly to stakeholders and forming partnerships with more than the university community. This is an effective model.

The NSF strategic plan reflects Dr. Suresh's new directions. It's commendable that ENG has taken the agency's strategic plan and translated it to the Directorate level.

The Director has asked, "What do we mean by success? What metrics should we use?" In addition, funding rates are a concern. Universities and researchers can help NSF to manage the cost of resubmissions. The agency needs to maintain excellence in times of fiscal pressure.

*It may take a decade or more to see the results of NSF-supported research. What data are needed to assess impact? Could the NSF annual reports be modified to provide more useful data for evaluation?*

Dr. Marrett noted that the STAR METRICS project addresses the long-term impacts of NSF awards. NSF hopes to minimize the burden on PIs by linking different data systems to assess results. The agency doesn't have a good way now to identify impacts; this requires long-term evaluation. AdCom can help others to understand that the impacts of transformational research take time. It's important that we communicate this message to a variety of audiences.

*We'd like young adults to enter the workforce with a passion for innovation. Engineering could play a larger role in engaging kids in science and technology careers. For example, at some of the I/UCRCs industry has supported innovative projects for teachers.*

*How can ENG engage more with the Office of the Director and the Directorate for Education and Human Resources (EHR) on this issue, which is a national priority? Perhaps engineering faculty could get joint appointments between engineering and schools of education. Engineering's "can do" attitude can be an asset in dealing with the challenges of K-12 education. How can we encourage retired scientists and engineers to participate in K-14 education?*

Dr. Marrett noted that there is a cross-Foundation group that is focusing on NSF's role in education. NSF supports a data-driven approach to education activities, where programs build upon strategies with demonstrated success.

*Education Secretary Duncan has a lot of passion for education. Does NSF work with the Department of Energy (DOE) on education issues?*

Dr. Marrett responded that the two agencies will be engaged; they are currently defining the areas where partnership would be most fruitful.

*Assessment was a major topic of discussion at the AdCom meeting. AdCom is supportive of this focus; assessment is essential to effective educational programs.*

*What is NSF's role in K–12 education?*

Dr. Marrett responded that people expect a lot from NSF but that the agency is constrained in what it can do with K–12 education. For example, one should not expect NSF to produce the teacher workforce. NSF develops the knowledge base and helps to define what materials and experiences are effective. In addition, NSF does not play a lead role in scaling up programs.

*Implementing educational programs is complex—with thousands of local school boards, teachers unions, and state boards of education.*

Dr. Marrett reiterated the importance of understanding the innovation ecosystem and generating new knowledge about this important topic. Discussions are underway about national goals and shared science standards. NSF can offer proposals for what should happen at the national level. Standards have been developed for math and reading; the next effort will focus on science, and it's important to incorporate design in this effort.

Dr. Marrett thanked the AdCom for their input. Dr. Castillo thanked Dr. Marrett for meeting with the committee.

Dr. Peterson expressed his appreciation for AdCom's support during the period where Dr. Marrett was the Acting Director.

*[The meeting adjourned.]*