

Directorate for Engineering (ENG) Advisory Committee

April 19-20, 2007

**National Science Foundation
Room 375
Arlington, VA**

Meeting Summary

The spring meeting of the Directorate for Engineering's Advisory Committee (AdCom) was held at the National Science Foundation in Arlington, Virginia on April 19-20, 2007. Details on the presentations were provided in the ENG AdCom meeting materials.

Members Present:

Dr. Richard K. Miller (Chair), Franklin W. Olin College of Engineering, Needham, MA
Dr. Cato Laurencin, Chemical and Biomedical Engineering, University of Virginia, Charlottesville, VA
Dr. Arun Majumdar, Department of Mechanical Engineering, University of California at Berkeley, Berkeley, CA
Dr. Gary S. May, Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA
Dr. Margaret Murnane, Joint Institute for Laboratory Astrophysics, University of Colorado at Boulder, Boulder, CO
Dr. Alan Needleman, Division of Engineering, Brown University, Providence, RI
Dr. Cherri M. Pancake, Electrical Engineering & Computer Science, Oregon State University, Corvallis, OR
Dr. Winfred Phillips, University of Florida, Gainesville, FL
Dr. Jacquelyn Sullivan, Integrated Teaching & Learning Program/K-12 Program, University of Colorado, Boulder, CO
Dr. E. Jennings Taylor, Faraday Technology, Inc., Troy, OH

Members Absent:

Dr. Francine Berman, San Diego Supercomputer Center, University of California, San Diego, La Jolla, CA
Dr. John C. Crittenden, Civil and Environmental Engineering, Arizona State University, Tempe, AZ
Dr. Lesia Crumpton-Young, Industrial Engineering & Management Systems, University of Central Florida, Orlando, FL
Dr. Marshall Jones, GE Global Research, Niskayuna, NY
Dr. Matthew Tirrell, College of Engineering, University of California Santa Barbara, Santa Barbara, CA

ENG Senior Staff Present:

Richard Buckius, Assistant Director of Engineering
Michael Reischman, Deputy Assistant Director of Engineering
Adnan Akay, Division Director, Division of Civil, Mechanical & Manufacturing Innovation (ENG/CMMI)
Jo Culbertson, Staff Associate for Planning and Evaluation
Darren Dutterer, Staff Associate for Budget
Mary Juhas, Program Director of Diversity and Outreach
Kesh Narayanan, Division Director, Division of Industrial Innovation & Partnerships (ENG/IIP)
Judy Raper, Division Director, Division of Chemical, Bioengineering, Environmental, & Transport Systems (ENG/CBET)
Sohi Rastegar, Division Director, Office of Emerging Frontiers in Research & Innovation (ENG/EFRI)
Mihail Roco, Senior Advisor for Nanotechnology
Al Soyster, Division Director, Division of Engineering Education and Centers (EEC)
Usha Varshney, Division Director, Division of Electrical, Communications & Cyber Systems (ENG/ECCS)

Thursday, April 19, 2007

Welcome and Introductions

Dr. Richard Miller, ENG AdCom Chair, called the meeting to order at 8:35 a.m. (See attached agenda). Introductions were made and Dr. Miller reviewed the agenda. In response to the April 16 massacre on the Virginia Tech campus, the ENG AdCom passed a resolution to send a letter of condolence and support for the faculty, staff, and students in the Virginia Tech engineering community. The minutes from the November 16-17 2006 meeting were approved.

Directorate Update

Dr. Richard Buckius, Assistant Director for Engineering, provided an update on the Directorate and NSF and introduced new staff members. He also highlighted the topics to be addressed during the AdCom meeting and the breakout group sessions on Engineering PhD Education and Engineering Grand Challenges. He requested AdCom's input on these topics.

Discussion:

- An AdCom member noted that the American Competitiveness Initiative is the driver for NSF's budget growth. He queried whether ENG has thought about collaborating with SBE on assessments to help "make the case" for engineering. Dr. Buckius indicated that ENG's support for the NAE Grand Challenges in Engineering project helps to emphasize ENG's role at the frontiers of research. ENG has a strong relationship with SBE and discussions are underway about collaborative activities. There are no common efforts on assessment at this time.
- The ENG AdCom commended Dr. Buckius for the excellent data in his presentation and the Directorate's stewardship in managing difficult trends. Dr. Buckius noted that it was a group effort.
- One member asked whether reviewers of transformative research proposals are special instructions that differ from those given to other reviewers. There was some concern that transformative proposals may not be reviewed as favorably as other proposals since they often have less supporting data. Dr. Buckius responded that Small Grants for Exploratory Research (SGER) proposals are reviewed internally in a two stage- review process.
- A CMMI staff member noted that the Nanoscale Exploratory Research (NER) panelists are given specific guidance for their review (e.g. expect less preliminary data than for other proposals). Another CMMI staff member noted that transformative proposals are also reviewed in the regular panels. For transformative proposals, the panel may note that the proposal is exciting but that it doesn't appear to be ready for a regular grant. Program officers are looking for such proposals.
- An AdCom member noted that it would be helpful to give panelists examples of transformative research.
- In Dr. Buckius' presentation, he shared data that indicated that less than half of the investigators that were surveyed expected NSF to support transformative research. A member asked whether the concern was about success rates for such proposals or the award size. Dr. Buckius noted that ENG funding for transformative proposals was limited by tight resources. He also indicated that the Directorate should fund larger awards.
- A view was expressed that the funding rate for CAREER proposals should be equal to the ENG funding rate. It was important to support a higher percentage of CAREER awards since they are critical to starting people's careers. Dr. Buckius said that ENG has 12-13 percent of the NSF budget but funds about 25 percent of all CAREER proposals. ENG is trying to balance support for CAREER and other awards.
- An ENG Division Director noted an issue associated with funding a higher proportion of the CAREER awards. It is important for young faculty to make the transition from CAREER to receiving support through NSF's core programs. If additional resources were diverted to supporting CAREER awards, this would affect the success rate for unsolicited awards. It might become more difficult for individuals to get regular awards as they near the end of their CAREER funding.
- Recommendations from the AdCom were welcomed.

Emerging Frontiers in Research and Innovation (EFRI) Update

Dr. Sohi Rastegar, Director, Office of Emerging Frontiers in Research and Innovation, provided an update on EFRI activities in FY 07 and planned activities for FY 08. He summarized the process for selecting topics and for soliciting, reviewing and awarding grants under EFRI. He identified the topics for the FY 08 solicitation that will be released in mid to late July 2007 (Cognitive Engineered Systems and Resilient and Sustainable Infrastructures).

Discussion:

- It was suggested that EFRI may achieve its greatest impact by allowing individuals to submit proposals outside the designated topic areas. True research breakthroughs are rare and opening up the competition may increase the chances of a successful outcome. Dr. Rastegar indicated that ENG has looked at this option and that it deserves further consideration.
- The AdCom asked what happens to topic ideas that are not chosen for solicitations. Dr. Rastegar said that topics are often revised and resubmitted. For example, RESIN was not a successful topic in FY 07 but ENG provided seed money for workshops to further develop the topic. RESIN was selected as a solicitation topic for FY 08.
- The group talked about the trade offs inherent in narrow vs broad topic areas. Dr. Rastegar said that they structured the topic areas to reflect the frontiers but also to ensure that the research community would be ready to respond. The AdCom noted that with 100 proposals submitted in response to the solicitation for EFRI, the topic breadth seems appropriate. ENG would like additional input from the AdCom on this topic.

Diversity and Broadening Participation

Dr. Mary Juhas, Program Director for Diversity and Outreach, provided an overview of ENG diversity activities and issues.

- An AdCom member said that there didn't seem to have been a meaningful trend in the lack of minority "declaration of status" data. It was suggested that the age of the minority faculty submitting proposals might provide more meaningful data.
- It was suggested that Dr. Juhas look at Purdue's 2.5 day diversity orientation for faculty. The way in which Purdue implemented this with their leadership team is a potential model. The program has had a lot of success.
- In developing programs and workshops that target K-12, it is important to have programs that don't require a high buy in price (i.e. \$250K) which would put low-income schools at a disadvantage for participating.
- The group asked what FY 07 funding was for the REU and Minority Supplement programs. Dr. Buckius said that REU funding is about \$12M per year and has been flat for FY 05-06. He stated that they are both powerful programs. ENG investment is over 20 percent of the entire NSF amount for REU. Supplement funding has been relatively constant. Would the ENG AdCom recommend that this be increased?
- Dr. Varshney noted that the minority graduate research supplement program was a pilot project in FY 06. In FY 07 it will be expanded to all ENG divisions with \$1.10M available and applications due May 15, 2007. There was a concern expressed that the window for submitting applications is sometime very small.
- The group encouraged ENG to continue with its push for efforts to increase diversity. They also said the REU program is one of the best things NSF does and there should be a site at every research university in the US. NSF was strongly urged to consider how to make that happen.

ENG Division Overviews

Division of Electrical, Communications and Cyber Systems (ECCS)

Dr. Usha Varshney provided an update on the mission, vision, goals, and activities of the ECCS division.

Division of Chemical, Bioengineering, Environmental and Transport Systems (CBET)

Dr. Judy Raper presented the CBET vision, mission, goals and research themes.

Discussion:

- What percentage of proposals that are not currently funded would be supported if resources were available? Dr. Raper said that her goal would be to support about 60 percent of the proposals in CBET. Dr. Buckius said that ENG would need to double its budget if it were to fund all of the proposals with ratings that are equal to or greater than the proposals that are now funded. This would result in a funding rate of about 30 percent.
- There is concern about the funding rate for unsolicited proposals; in some segments of the community the success rate is perceived to be as low as 5-6 percent. A special concern was expressed about the funding rate for Programs to the Research to Aid Persons with Disabilities (RAPD) program, which used to have higher success rates. Dr. Raper indicated that for CBET the funding rate for unsolicited proposals is about 10 percent. She believes that investigator initiated proposals are the most transformative and would like to increase the funding rate for these proposals. Dr. Buckius noted that in 2006 the overall funding rate for competitive proposals was 14 percent, although it was in the single digits for some programs.
- The group echoed ENG's concerns about funding for unsolicited proposals and the desire to increase the amount of discretionary funds.

Division of Civil, Mechanical and Manufacturing Innovation (CMMI)

Dr. Adnan Akay provided an overview of CMMI's research focus in the context of the ACI.

Division of Industrial Innovation and Partnerships (IIP)

Dr. Kesh Narayanan summarized the division's vision and mission and its role in accelerating innovation.

Discussion:

- Are the Discovery to Innovation Networks and the Discovery to Innovation Partnerships an ecosystem to foster these efforts or are they formal programs? Dr. Narayanan said that at this point they are an ecosystem to bring the various stakeholders together.
- Babson College does a lot of research on entrepreneurship and the valley of death—where there is a gap between research funding and industry funding. Can the engineering community gain insights from the business schools about how to manage these issues? Dr. Narayanan agreed that we could learn from the business schools but that the focus should be on engineering.
- The time line implies that invention occurs in academic environments in the absence of interaction with the market. Dr. Narayanan noted that this was an oversimplification; invention is not a linear process. It goes back and forth, and ongoing interaction with the market is important.
- The ENG AdCom Subcommittee on Industrial Partnerships will focus on some of these issues. They will be working closely with the Government-Industry-University Research Roundtable (GUIRR).

Division of Engineering Education and Centers (EEC)

Dr. Allen Soyster presented his objectives for the EEC division in 2020. He also summarized actions that the division has taken in response to the recommendations of the 2004 EEC COV report.

Discussion:

- A concern was expressed about the need to help individuals from disadvantaged backgrounds by, for example, providing fellowships for them.
- A comment was made that graduate fellowship salaries are too low. Higher salaries would be more competitive with industry and increasing the salary levels would have a real impact on American students going into graduate education rather than industry careers. Dr. Soyster said that the percentage of US students studying engineering is dropping by about 1 percent per year. If PhD students weren't subsidized, there might not be any.
- There was a query about how the new ERC-lite centers targeted on EPSCoR states would affect the number of Engineering Research Centers. Dr. Soyster indicated that there is currently no funding for the ERC-lite centers. He estimated that there might be up to five such centers.
- In his presentation, Dr. Soyster presented an argument that universities that provide high quality engineering education would be rewarded with high tuition income. It was noted that state support for university operating budgets varies considerably—ranging from about 9 percent to 22 percent. In many cases, increased tuition does

not come directly to the colleges of engineering. Dr. Soyster agreed and noted that there are key differences in the business models of public and private institutions. An AdCom member also observed that at some institutions a large number of the students are on scholarships and contribute no tuition. For example, at Brown University approximately 40 percent of the students receive scholarships.

National Academy of Engineering (NAE) Project: Grand Challenges for Engineering

Dr. Buckius introduced the NAE Grand Challenges in Engineering project and noted that it is one of two NAE projects that ENG is currently supporting. Both projects were being discussed at the meeting and the AdCom had an opportunity to provide input concerning these efforts.

Randy Atkins, Senior Program Officer for Media and Public Relations at the National Academy of Engineering, discussed the goals and organization of the grand challenges project and the public input that they have received. He engaged the AdCom in a discussion to solicit their ideas.

Discussion:

- One AdCom member indicated that he had not heard of the project before; it had not been communicated to members of the Institute of Medicine (IOM). He indicated that he believed that it was important to make everyone in the engineering community aware of this effort. Mr. Atkins indicated that he had provided information about the project to the IOM but that he would do so again. He mentioned that the project would be discussed at the upcoming NAE Convocation of Engineering Societies.
- An AdCom member noted that Larry Page of Google is a member of the Grand Challenges committee. One way to engage the public at large would be to have Google assist in public outreach activities.

NAE Project: Understanding and Improving K-12 Engineering Education in the United States

Dr. Jacquelyn Sullivan reported on the NAE Committee on K-12 Engineering Education.

Discussion:

- In Dr. Sullivan's presentation, she noted the importance of engineering education for non-engineering majors. A member agreed that this was an area that deserved further attention. He indicated that there is tremendous variation in the representation of women in different fields of engineering. What is the reason for these differences? Are women better represented in some of the fields of engineering in other countries? Dr. Sullivan did not know of good studies on this issue. She noted, however, that in Puerto Rico all students are required to take mathematics and science through the 8th grade; this gives them better preparation for engineering. The AdCom member indicated that he agreed that such preparation is needed in the U.S.
- What is the role of parents and culture in determining which students enter engineering? Dr. Sullivan responded that anecdotal information suggests that family pressure is a factor. One of the members indicated that he had gone through the educational system in India where engineering could be a springboard to better jobs. Dr. Sullivan indicated that she believed that economic drivers were more important in boys' decisions to become engineers than for girls. She suggested that engineering be marketed as a way to make a difference by enhancing U.S. economic and intellectual competitiveness.
- For many individuals, their perception of engineering is colored by the science and mathematics prerequisites. Dr. Sullivan indicated that she believed that people overemphasize the math requirements for entry level engineering courses. She cited a study at Ohio State that indicated that students needed only to be "calculus ready" to be prepared for undergraduate engineering courses; it wasn't essential that they have completed calculus. She believed that in many cases it would be possible to provide courses that integrated both mathematics and engineering content.
- An AdCom member noted that this challenge is not new. In public schools in the U.S., there are no engineering role models and there is a lack of information. Organizations that reach out to high schools are poorly funded. Small, isolated, extracurricular programs are not the answer. Dr. Sullivan said that the goal of the study is to understand the actual pressure points in K-12. How can we redirect students to engineering or redress problems with the K-12 experience? We are prescribing solutions without knowing what the issues and root contributions are at the K-12 level.

- An ENG division director indicated that the engineering community should recruit students who are involved in lots of extracurricular activities—students who are balanced. Dr. Sullivan agreed; the current practice is to go after the “Dilberts”.

Engineering PhD Education

Dr. Allen Soyster and Dr. Adnan Akay highlighted the need for a Renaissance in Engineering PhD education. They described the issues and challenges in Engineering PhD education and the role played by NSF. They highlighted the desired attributes of engineering PhDs in today’s global economy and actions that NSF will take to promote change in graduate education.

Discussion:

- Dr. Akay’s suggested list of attributes for engineering PhDs is similar to that of ABET and also to the characteristics identified by the ERCs’ industrial partners. There was concern, however, that the list is too long; it may make sense to group some of the items. In addition, there are attributes that appear to be missing from the list. For example it is important to be culturally aware and bi-or multi-lingual. It is also important to understand markets, patents, intellectual property and business models.
- One potential barrier to getting a PhD in Engineering is the open-endedness of the degree term. It may take seven or eight years compared to three years for a law degree.
- It was noted that the universities have little incentive to modify their programs. A different business model may be needed to attract the right students and to give universities an incentive to address critical issues in engineering graduate education.
- One promising development is that young engineering faculty appear to be genuinely interested in teaching. This is a real change from ten years ago.

Reports from Breakout Sessions

Breakout on PhD Education in Engineering

Dr. Cheri Pancake reported on the discussions from the group. The current PhD education system is not adequately addressing the needs of students.

What is the problem? National data imply that there isn’t a PhD supply problem but universities need more engineering graduate students. What are the quality issues? More engineering PhDs are being hired by industry; there is anecdotal evidence both of industry’s satisfaction and of dissatisfaction. It would be useful to have statistics on what percentage of the top 10 percent of engineering graduates decide to pursue an engineering PhD.

Ideas for Dealing with the System

- Focus more on the students (rather than our need for their labor).
- If the main need is for engineering graduate students, what’s a better model for coming up with “research worker bees”?
- Reduce the number of years required to get a PhD to five to seven years beyond the BS and four years beyond the MS. This is particularly important for women and minorities.
- Decouple graduate fellowships from particular research grants. Let students take the fellowships to whatever institution they believe will offer them the best preparation. This might allow graduate students to vote with their feet for the programs that they find most useful.
- To reform engineering graduate education, forward-thinking institutions will need to conduct experiments with these initiatives.

Adopt the guiding principle that Engineering degrees open doors

- Outside academe, a BS in engineering offers financial advantage but there is less return on investment from the MS and PhD degrees. Shift the emphasis on graduate quality and reputation from the PhD to the MS degree. (This has already happened in business schools, where the rankings now focus on the MBA).
- Create separate paths for different needs. Have research-oriented MS and PhD degrees for academic or other research careers. Provide practice-oriented degrees focusing on the ability to forecast the effects of new technologies and on new types of leadership.

- Will require new types of faculty, too; most engineering faculty haven't really "engineered" anything. Universities would have to find ways to make their programs more attractive to students.

Current PhD programs focus on the needs of the institution rather than the needs of the students or future employers.

- Today we graduate at least some PhDs whose career expectations are not necessarily being met. Some individuals can't get academic positions and others people re-enter the market when they don't make tenure. For the future, we need to see how the process can be reshaped to focus on students' needs.
- Need to decouple the issue of need for "research workers" from the need to "produce more PhDs". We suggest serious follow-up on this.

Additions to "Adnan's List"

- Ability to recognize problems before they are clearly defined
- Ability to marshal the resources needed to make a difference
- Understanding business models
- Understanding intellectual property and patents

Engineering Grand Challenges

Dr. Arun Majumdar summarized the key grand challenges discussed in the breakout group:

Energy. We need to restructure the debate on energy issues to focus on carbon; the energy crisis now is based on carbon. There will be trading and economics driven by carbon and there will be technology based on carbon as well. We need to do an engineering analysis of potential technologies. Based on the numbers, some appealing technologies will be shown to not contribute to solving the carbon problem.

To reduce carbon output, we need to evaluate all activities based on a "carbon index." All goods and services would have a number that defines its carbon impact. For example, if one buys a banana that was produced in Florida versus South America, it would have a different carbon impact. We need to embed the index into all walks of life and to provide broad public education about the impact of carbon and how it is reflected in the carbon index.

Tissue Regeneration. With the population getting older, tissue regeneration, such as limb regeneration, is becoming a major issue. This can be done at a minimal level now but with additional research, this field could have a profound impact in 20 years.

Water. Sustainability of water resources, water management, and drinking water are critical issues. A key issue on a global scale is the development of simple, affordable, decentralized ways to provide potable water. This would have major health implications. It would be good to develop quantitative metrics for water quality and quantity.

Education. Technology is needed to deliver education for the masses on a global basis. Many countries now have access to communications through cell phones. It is possible to create and deliver education to people that are without access to formal education. This also involves engineering education and brings in issues of equity and justice.

Educating the Public on What Engineers do and How They Bring Value. The public needs to understand how engineering and technology affects everybody's life. And they need to understand that without engineering they won't have adequate drinking water. A marketing campaign is needed. We also need a new term for the engineer of the future who will solve the world's problems (something along the lines of "Rocket Scientist").

Discussion:

- Ubiquitous availability of educational resources is very important. We are getting closer to the \$100 computer. Through efforts such as Curriki—a global education and learning community—free web-based curriculum and education resources are being made widely available to individuals around the world.
- Dr. Majumdar noted that the Berkeley Center for Information Technology Research in Interest to Society (CITRUS) has a similar effort. They are working on a cell phone that will soon be a \$10 computer. Are there education packages that can be delivered through the cell phone that would have much more widespread use?

- Is there any thought given to a version of the cell phone for the aging population that doesn't have the tiny keys/tiny letters? The cell phone is a young person's technology; it will not be as useful to people as they get older.
- There are issues of the management of all natural resources with global climate change, not just water.
- The grand challenges should really be grand -- not incremental. They should encompass issues and challenges that we can barely imagine.

Status Report on Industry-University Partnership Subcommittee

Dr. E. Jennings Taylor provided an update on the charge and the activities of the ENG AdCom subcommittee on Industry-University Partnerships.

Discussion:

- At Olin College, their policy is to give away the IP as much as possible. However, they have run into problems with the Bayh-Dole Act. They can't give away the IP if it was funded by federal funds. Dr. Taylor responded that universities can give away their IP if they haven't filed for a patent.
- IP is becoming such an issue that corporations are taking their research overseas and in a number of instances, foreign companies are co-funding the research.
- With sponsored research, licensing fees are going to only a handful of universities.
- Large companies are successful in working with universities. They don't want IP; they just want the freedom to operate.
- What opportunities are lost to U.S. businesses if no one picks up the IP? There have been decades of federally-funded and industry-funded research that never went anywhere; the loss to the country is enormous. Dr. Taylor responded that small business may be conduits to manage the technology transfer processes. This may also provide a mechanism to get more sponsored research to the universities.
- There are complex issues associated with ownership, giveaway, development, letting it rest, value, and foreign patents. They are all important. Responsibility is a key factor; Bayh-Dole was designed to ensure that someone would take responsibility. The most common misunderstandings in technology transfer concern issues of money and responsibility.

Update on Cyberinfrastructure Activities

Dr. Abhi Deshmukh provided an update on Directorate activities in cyberinfrastructure and the implementation of the recommendations of the ENG AdCom Subcommittee on Cyberinfrastructure.

Discussion:

Dr. Pancake, who served on the AdCom subcommittee, said that she was very pleased with the Directorate's efforts. Dr. Buckius said that the subcommittee report was useful and helped to guide ENG policies and investments.

Preparations for Discussion with the Deputy Director

The ENG AdCom discussed several issues that they wanted to raise with NSF's Deputy Director, Dr. Olsen.

Dr. Buckius acknowledged outgoing ENG AdCom members Winfred Philips, Jacquelyn Sullivan, and Gary May with a token of the Directorate's appreciation. With no further discussion, the meeting was adjourned at 5:55 p.m.

Friday, April 20, 2007

Review of Agenda

The meeting reconvened at 8:30 am. Dr. Miller reviewed the agenda for the day.

Overview of the Industrial Innovation and Partnerships (IIP) Division

Dr. Kesh Narayanan provided an overview of the Industrial Innovation and Partnerships (IIP) Division and actions taken to implement the recommendations of the previous Committee of Visitors (COV) report.

Discussion:

- How long do startup businesses need before they are self-sustaining? Dr. Narayanan said that it varies by field. In the IT field, it may take only a few years but for biotechnology and materials manufacturing it can take 10 years or longer. ENG has a survey that covers 8-10 years.
- A survey should be conducted of survivability versus buyout; buyout is often a goal for start ups.
- Intellectual property is not completely resolved in many businesses. How do you handle non-disclosure with panels that are reviewing proposals if the IP hasn't been done? Dr. Taylor responded that ownership of IP typically belongs to the company and disclosure to a review panel is not considered public disclosure.
- How does NSF select topic areas for the SBIR solicitations and how long are the areas maintained? Dr. Narayanan noted that the NSF topic areas are broader than those of other Federal agencies. The selection of the topics is driven by considerations of who will invest in small companies. The subtopics within these areas cover a full spectrum of science and engineering. Program Directors in each cluster periodically have panels to review the topics; it is an ongoing process. Some solicitations are almost open, like the current solicitation that closes in June.
- Why are the success rates so different for Phase I and Phase II awardees? Dr. Narayanan responded that the difference is partly by design. After Phase I, we work with the awardees; NSF wants to "grow" the investment. There would be enough quality proposals to have more Phase I awards; resources are the constraining factor.

IIP COV Report

E. Jennings Taylor provided an overview of the IIP 2004-2006 COV review and their key findings and recommendations.

Discussion:

- With SBIR awards, one is taking risks so there will be some failures. The IIP survey was a high-level analysis that looked at averages. Is there a more detailed analysis of company performance? It is important to develop metrics that define and assess risk.
- Dr. Narayanan noted that ENG is participating in a joint conference with the Kauffman Foundation that has similar objectives to the SBIR program. ENG also awarded a grant to MIT to explore approaches to mentoring grantees at the local or regional level. NSF can provide grantees a resource and the Kauffman Foundation has economists that can help to analyze data. ENG is also connected with the Angel Capital Association through the Kauffman Foundation.
- Is there any effort to engage students in entrepreneurial activities? Students need more expertise than they can get from faculty. It would be good for students to have access to small businesses.
- Are there any interactions with the Alfred Mann Foundation? Dr. Narayanan responded that there have been some initial conversations.

NAE Project: Developing Effective Messages for Improving Public Understanding of Engineering

Mr. Greg Pearson, NAE Program Officer, provided a mid-project update on Developing Effective Messages for Improving Public Understanding of Engineering. He summarized the project's goals and initial findings.

Discussion:

- The AdCom noted the importance of this effort. However, it may be prudent to wait for the results of the additional surveys of underrepresented groups before drawing any conclusions about target messages. Image is very important for this population; they need to connect with the image to believe the message. For example,

the National Society of Black Engineers will have a special issue of its magazine in June featuring America's sexiest engineers. They want to portray engineers as attractive, well rounded people. This type of approach captures people's interest. Mr. Pearson agreed that creative implementation is critical.

- Historically, the peak numbers of engineering PhDs were realized during the Vietnam War and the space age. One way to galvanize youth into engineering may be to focus on the "next big thing". Has the committee considered this approach? Mr. Pearson said that they thought about 9-11 but did not explicitly address this as part of the project.
- Internet surveys may involve a selection bias since individuals who access and use the Internet are more likely to be informed adults. It is important to reach all segments of society. A completely different type of campaign may be needed to reach the uninformed public (people who don't know what engineers do). An effective campaign might have a significant impact on this population.
- Mr. Pearson said that this is a potential weakness of the project but that most surveys today are being done online. The NAE explored other approaches. There is a company that uses random digit dialing and personal interviews to identify a large panel of people that are not actively involved in the Internet. These individuals are then given computers, if they do not have them, so that they can participate in online surveys. This is, however, very expensive.

Mr. Pearson noted that all of the focus groups had overrepresentation of minorities. It may also be possible to work with the Harris Poll to identify people on panels who have not had access to computers or not for long. Survey work is as much art as it is a science; the data need to be interpreted carefully. Mr. Pearson said that the NAE believes that the project's overall findings are valid.

- It is not likely that one message will work for the entire population. It will be important to target different messages on various segments of the population. It will be particularly important to develop appropriate messages for underrepresented groups since they are the individuals whose participation needs to be increased the most. Mr. Pearson said that the emphasis of the project was on increasing public understanding broadly, not primarily to "fill the pipeline". The NAE hopes to reach out to adults, companies, schools systems, parents, and guidance counselors as well as students.
- Visible television coverage, such as the Johnson and Johnson commercials about nurses, may be effective in reaching underrepresented groups. Such exposure for engineering is currently very limited. One way to get public attention may be to have engineering topics featured on Oprah Winfrey.
- There is a risk that we could "over engineer" this project. The messages have to be the right messages for the public, not for the engineering community.
- What are the metrics for success at the end? The NAE had proposed to NSF another component of the project to measure success but it was not funded. The idea was to do a baseline survey and then random surveys at 1, 2, and 3 years to see if the effectiveness of the messages had changed. It may also be useful to use longitudinal approaches to explore interest in different fields of engineering. Suggestions from the AdCom would be welcome.

Dr. Miller thanked Mr. Pearson for meeting with the ENG AdCom.

Preparation for the NSF Deputy Director

Dr. Miller reviewed the questions and topics to address with Dr. Olsen.

Discussions with the Deputy Director

Dr. Kathie Olsen, NSF Deputy Director, met with the ENG AdCom. Introductions were made.

Dr. Miller thanked Dr. Olsen and NSF for their support for Engineering, reflected in the increase in the ENG budget. Dr. Miller said that the ENG reorganization has been successful and the engineering community is pleased to have Dr. Buckius as the ENG Assistant Director. He also thanked NSF for support of the NAE program in public understanding of engineering. Dr. Olsen said that the funding rate is still too low and that they will continue to work on this.

Dr. Bement and Dr. Olson like what engineering is doing. Before Dr. Olsen went to NASA, she didn't completely understand what engineers did. She would like ENG to get the message to young women about the role of engineering in helping society. This is a good message to get into the grade schools through activities such as Design Squad. It is important to tell kids what engineers do.

Dr. Miller asked Dr. Olsen for her vision of the opportunities and challenges facing NSF in the next 5 years. Dr. Olsen said that it is a positive time for NSF. The country has responded to a number of reports. Industry has played a major role in highlighting the importance of engineering and the physical sciences and investments in basic research. The FY 08 budget request is strong; NSF is hopeful that it will be approved. Investment in fundamental research is key to national competitiveness. Engineering is integral to competitiveness and the nation's well being.

The challenging questions in science and engineering are interdisciplinary; they need to bring everyone to the table to address them. CDI and other cross-directorate activities reflect this. When NSF was identifying cross-directorate initiatives for FY 08, Dr. Bement asked senior management "Where do the ideas come from and what has been the role of your AdCom? Are they supportive?" The advisory committees are critically important in helping NSF to determine its direction and focus.

Discussion:

- Although the Directorate's funding is behind where it should be, the group noted their appreciation for NSF's support for Engineering. The ACI is a great opportunity for engineering and the ENG AdCom offered their support in making the case for funding and in identifying opportunities. Dr. Olsen said that NSF worked very hard to get the full R&RA request for FY 07 during the Continuing Resolution. Very strong letters went to Congress, the White House, and OMB from university chancellors and presidents and they were co-signed by industrial leaders. The letters discussed the role of these investments in advancing national benefits. The arguments for the workforce of the future and economic competitiveness are very compelling. The appropriate level of investment in fundamental research is a policy decision. In his testimony, Dr. Bement often asks "How competitive do you want the nation to be?" Support for fundamental research is critical to the nation's competitiveness. Dr. Bement is out of the office participating in a NSF Day at Oak Ridge National Laboratory. He will meet with the small business community to emphasize the importance of NSF workforce activities and to seek their input on how to improve them. NSF views workforce efforts as key to promoting innovation and economic competitiveness.
- What role can NSF play in terms of national education policy to promote systemic K-12 changes if they are recommended in the NAE study? Dr. Olsen said that it is complicated; education is still very much a local issue. She noted that there is a slide that shows NSF's role compared to that of other federal agencies (noted below and attached). NSF funds about 2 percent of the total federal budget for education in K-12. Most funding for education is at the state and local level. NSF plays a critical role in terms of teacher training and teacher preparation, both pre-certification and afterwards. NSF has summer institutes for teachers that introduce them to state of the art science; many teachers in science and engineering have never taken a course in math or science. NSF supports activities for outstanding teachers such as the Presidential Awards for Excellence in Mathematics and Science Teaching. NSF also supports curriculum development and ensures that educational resources and best practices are made widely available through the web. Furthermore, Dr. Olsen emphasized that all of NSF's educational programs are evaluated for their effectiveness.
- Dr. Olsen noted that there are no federal standards. However, the mathematics societies produce reports defining what concepts are needed for different grade levels. These reports help to guide state standards and serve as a basis for individuals who develop new curriculum with support from NSF. Dr. Olsen said that the engineering centers are involved in teacher training and may play a role in helping to get engineering into the curriculum. They also create win-win partnerships with industry and give their graduates exposure to innovation in practice.
- With the National Science Board's policy change to no longer require cost sharing, there is concern that there may be less incentive to promote partnerships with industry. People often place greater value on activities in which they share the costs. This change comes at a time when we need innovation and we need students to be entrepreneurial; other countries are being very aggressive in these areas. The AdCom recommends that NSF continue to encourage the centers to support and foster these relationships, which takes a lot of time and effort.
- Dr. Olsen highlighted the Grant Opportunities for Academic Liaison with Industry (GOALI) program, which gives students exposure to industry as well as to the academic environment. She noted that the centers still have cost sharing, but that it will no longer be required. However, awardees will be audited to ensure that they follow through on their cost sharing commitments.

The NSB Committee on Science and Budget has formed a new subcommittee to assess the implications of the change in the cost sharing policy. As part of this effort, NSF will provide the results of the ERC pilot for their

consideration and will provide additional data on the cost sharing issue (noted below and NSB presentation is attached).

- Dr. Olsen noted that NSF knows that not all of the “must fund” proposals are getting funded. NSF is looking at this foundation-wide with the Impact of Proposal and Award Management Mechanisms (IPAMM) effort. NSF conducted a survey of individuals who submitted proposals within the last three years and there was a response rate of more than 50 percent. For the first time, NSF will have data on the number of proposals individuals submit before they receive funding. A full report with recommendations will be provided to the NSB in August 2007.
- The average award size is also a concern; it is important that NSF provide enabling grants. Dr. Olsen said the goal is to get success rates back up to 28 percent and then to increase the award size. It is a constant balancing act.
- One member suggested that preproposals could be more widely used to reduce the burden on the community. Dr. Olsen noted that IPAMM is also looking at this. There are pros and cons. With preproposals, there is less information on which to base an assessment. NSF wants to make sure that efforts to promote broadening participation would not be negatively affected by greater reliance on pre-proposals. There is also a workload issue with preproposals.
- Dr. Olsen said that NSF needs more outstanding program directors. With the continuing resolution for FY 07, NSF cannot go to the full time equivalent (FTE) employee ceiling. For FY 09, NSF will try to ask for the number of positions that the agency actually needs--both FTEs and (Intergovernmental Personnel Act) IPAs. NSF is currently assessing the number of awards a staff member can manage effectively. One needs to take into account the range of responsibilities each person has and the amount of his/her experience. The data will be used to provide supporting arguments for the FY 09 budget.

The group thanked Dr. Olsen for meeting with them.

Wrap Up

The next ENG AdCom meeting is scheduled for October 24-25, 2007 at the National Science Foundation.

Dr. Miller thanked the ENG AdCom members for the opportunity to chair the group. Dr. Arun Majumdar will be the new chair.

Dr. Buckius emphasized that AdCom meetings are designed to get the committee’s advice. He thanked everyone for their input. He noted that this meeting was the first time that the new EFRI topics had been announced and he encouraged members to share this information with their colleagues.

Dr. Buckius thanked the ENG staff that assisted with the meeting.

The group had a moment of silence at noon in memoriam for Virginia Tech faculty and students killed on 4/16/07. The meeting was adjourned at 12:01 p.m.

Summary of Action Items

- The ENG AdCom recommended that Dr. Juhas look at the data by age as well as ethnicity and gender. They may find that most of the minority PIs are younger.
- ENG will forward Tom Cooley's presentation to the National Science Board on cost sharing to the ENG AdCom.
- ENG will forward the slide (per Kathie Olsen) of NSF's role in the "big picture" for education.
- Dr. Miller will circulate the letter to Virginia Tech's engineering department for comment.

**Directorate for Engineering Advisory Committee Meeting
National Science Foundation**

AGENDA

April 19-20, 2007

Day 1: Thursday, April 19, 2007, Room 375

- 8:00 AM Registration and Light Refreshments
- 8:30 Welcome, Introduction, Agenda, and Approval of fall 2006 Minutes
Richard Miller, Advisory Committee Chair
- 8:45 Directorate Update
Richard Buckius, Assistant Director
- 9:20 EFRI Update
Sohi Rastegar
- 10:00 BREAK**
- 10:15 Diversity and Broadening Participation
Mary Juhas
- 11:00 ENG Division Overviews
Usha Varshney, Judy Raper, Adnan Akay, Kesh Narayanan, Al Soyster
- 12:30 LUNCH**
NAE Project: Grand Challenges for Engineering
Randy Atkins, Senior Media Relations Officer, NAE
- 1:15 NAE Project: Understanding and Improving K-12 Engineering Education in the United States
Jacquelyn Sullivan
- 1:45 Engineering PhD Education
Adnan Akay and Al Soyster
- 2:15 BREAK**
- 2:30 Breakout Groups
Room 375, Engineering PhD Education
Room 580, Engineering Grand Challenges
- 3:45 Report back on breakouts
- 4:30 Update on Cyberinfrastructure Activities
Abhi Deshmukh
- 5:00 Prepare for discussion with Deputy Director
- 6:00 Wrap Up
- 6:30 Dinner at the P.F. Chang's China Bistro (901 N. Glebe Road)

Day 2: Friday, April 20, 2007, Room 375

- 8:00 AM Light Refreshments
- 8:30 Review of Today's Agenda
Richard Miller, Advisory Committee Chair
- 8:45 Overview of IIP Division
Kesh Narayanan
- 9:05 IIP COV Report
E. Jennings Taylor
- 9:30 NAE Project: Developing Effective Messages for Improving Public Understanding of
Engineering
Greg Pearson, NAE Program Officer
- 10:15 BREAK**
- 10:30 Final preparations for meeting with the Deputy Director
- 11:00 Meet with Deputy Director
- 11:30 Wrap Up
Richard Miller, Advisory Committee Chair
- 12:00 Adjourn