

**Directorate for Engineering (ENG) Advisory Committee
November 8-9, 2005**

**National Science Foundation
Arlington, VA**

MEETING SUMMARY

Members Present:

Dr. Gary S. May, Chair, Georgia Institute of Technology, Atlanta, GA
Dr. Lisa Alvarez-Cohen, Dept. of Civil & Environmental Engineering, Univ. of California, Berkeley, CA
Dr. Francine Berman, San Diego Supercomputer Center, University of California, San Diego, La Jolla, CA
Dr. James E. Bernard, Mechanical Engineering, Iowa State University, Ames, Iowa
Dr. Lesia Crumpton-Young, Industrial Engineering & Management Systems, University of Central Florida, Orlando, FL
Dr. Henry C. Foley, Dept. of Chemical Engineering, Pennsylvania State University, University Park, PA
Dr. Janie M. Fouke, University of Florida, Gainesville, FL
Dr. Patricia Galloway, The Nielsen-Wurster Group, Inc, Seattle, WA
Dr. Debra S. Knopman, RAND Infrastructure, Safety, and Environment, Arlington, VA
Dr. Enrique J. Lavernia, College of Engineering, University of California, Davis, CA
Dr. Larry V. McIntire, Dept. of Biomedical Engineering, GA Institute of Technology, Emory Univ., Atlanta, GA
Dr. Richard K. Miller (Vice Chair), Franklin W. Olin College of Engineering, Needham, MA
Ms. Susan Staffin Metz, Center for Innovation in Engineering & Science & Education, Stevens Institute of Technology, Hoboken, NJ
Dr. Cherri M. Pancake, School of Electrical Engineering & Computer Science, Oregon State Univ., Corvallis, OR
Dr. Winfred Phillips, University of Florida, Gainesville, FL
Dr. Jacquelyn Sullivan, Integrated Teaching and Learning Program/K-12 Program, University of Colorado, Boulder, CO
Dr. E. Jennings Taylor, Faraday Technology, Inc., Troy, OH
Dr. Judy Vance, Mechanical Engineering Department, Iowa State University, Ames, IA
Dr. Lilian Shiao-Yen Wu, IBM University Relations and Innovation, Yorktown Heights, NY

Members Absent:

Dr. Ashok Agrawal, Emerson Center for Engineering and Manufacturing, St. Louis Community College, St. Louis, MO (CEOSE Liaison)
Dr. Legand Burge, Jr., College of Engineering, Architecture & Physical Sciences, Tuskegee Univ., Tuskegee, AL
Dr. Marshall Jones, GE Global Research, Niskayuna, NY,
Dr. Linda Katchi (Past Chair), College of Engineering, Purdue University, West Lafayette, IN

ENG Senior Staff Present:

Richard Buckius, Acting Assistant Director of Engineering
Michael Reischman, Deputy Assistant Director of Engineering
Adnan Akay, Division Director, Civil and Mechanical Systems (CMS)
Charles Blue, Science Writer/Editor
Jo Culbertson, Staff Associate for Planning and Evaluation
Warren DeVries, Division Director, Design and Manufacturing Innovation (DMI)
Darren Dutterer, Staff Associate for Budget
Gary Gabriele, Division Director, Engineering Education and Centers (EEC)
Bruce Hamilton, Division Director, Bioengineering and Environmental Systems (BES)
Kesh Narayanan, Acting Division Director, Industrial Innovation (OII)
Geoffrey Prentice, Acting Division Director, Chemical and Transport Systems (CTS)
Usha Varshney, Division Director, Electrical and Communications Systems (ECS)
Deborah Young, Senior Administrative Officer

The fall meeting of the Directorate for Engineering's Advisory Committee (ENG AdCom) was held at the National Science Foundation in Arlington, VA on November 8-9, 2005. Details on the presentations were provided in the ENG AdCom meeting materials.

Tuesday, November 8, 2005

Welcome and Introductions

Dr. Gary May, ENG AdCom Chair, called the meeting to order at 8:35 a.m. and welcomed everyone. Introductions were made and the agenda was reviewed. Dr. May asked the ENG AdCom to review and provide comments on the draft report *The National Science Board 2020 Vision for the National Science Foundation* provided in the meeting materials.

Directorate Update and Reorganization

Dr. Richard Buckius, Acting Assistant Director for Engineering, provided an update of the ENG Directorate activities, including new staff introductions, updates and trends, and the planning process, reorganization and implementation.

Updates were provided on the ENG working groups for Cyberinfrastructure, Complex Systems and the ENG response to hurricane Katrina. The NSF and ENG budgets were shown, including FY2005 compared to the FY2006 Request and the NSF and ENG investments in FY2006 priority areas.

Data were provided on award trends. ENG received more proposals than any other Directorate within NSF yet the budget is the third smallest, resulting in a lower success rate. Supporting data slides were shown indicating potential explanations for the increase in the number of proposals submitted and the decline in the success rate. Directorates at NSF are implementing various strategies to improve success rates, including limiting the number of solicitations generated, restricting the number of proposals submitted (by PI or institution), and using pre-proposals.

The ENG AdCom requested additional data on awards for:

- The number of proposals (submitted) per PI and how this has changed over time.
- The number of non-engineering faculty applying for proposals over time.
- Funding rates by NSF Directorate/Office
- Constant dollars funded per PI per year.

The group discussed the need to communicate to Congress and NSF the importance of engineering for the nation and the need for adequate budgets to ensure that all excellent proposals are funded.

The reorganization of ENG was a main topic of discussion. The history of the ENG strategic planning process and external changes that have influenced engineering were reviewed. Internal and external reports also impacted the discussions/need for reorganization. Dr. Buckius presented the potential outcomes for the proposed reorganization, a "map" of the merging divisions and suggested priorities. The proposed organizational structure would include three disciplinary groups and three crosscutting areas that would be managed in a matrix fashion. A new Office of Emerging Frontiers in Research and Innovation (EFRI) has been proposed and details on the proposed activities and process for this office were presented. The importance of community identification of issues was stressed. ENG also has to pay attention to issues of "prenotification of solicitations" with ENG AdCom and EFRI Council input prior to a solicitation. ENG has vetted the proposed reorganization in outreach efforts to the ENG research community and the feedback from the community was summarized. Dr. Buckius reviewed the time frame for the reorganization process.

Discussion:

- The ENG AdCom questioned the desirability of limiting the number of proposals that are submitted by individuals or institutions. Also, allowing success rates to drive limits on solicitations can result in unintended consequences (e.g. not adequately encouraging new activity in emerging areas). For a future ENG AdCom meeting, it would be good to have Program Directors present their ideas for ways to improve proposal success rates.
- Funding for graduate students was a concern. ENG spends about 15% of its total funding for graduate students--higher than the 10% average for NSF. Is this enough? Advice from the ENG AdCom is welcomed.
- Where possible, efforts should be made to share infrastructure/CI costs with other directorates/agencies to free up more funding for research. The challenge is to find a balance between support for research and infrastructure.
- Dr. Buckius said Drs. Bement and Olsen support ENG's reorganization. The goal is to reduce barriers for frontier research. The impact on success rates is unclear but structurally, it will help support crosscutting activities. ENG wants the AdCom's advice and recommendations on the reorganization.
- The data presented showed the average award size in ENG was approximately \$118K per year (excluding centers). Dr. Buckius said the ENG average is lower than NSF's overall annual average by about \$25K. The ENG success rate is low and award budgets are restricted. What should ENG do in this environment? AdCom's advice is needed. The ENG AdCom supported ENG's efforts to get public comment on this issue. The group said that the Directorate needs to explore ways to have the maximum impact with a 13% success rate.
- The AdCom felt that some of the data presented did not offer a complete picture. Darren Dutterer, Staff Associate for Budget, noted that NSF collects and presents data in a consistent format to allow comparisons among the offices/Directorates.

Dr. May thanked Dr. Buckius for an excellent presentation.

Breakout Discussions: ENG Disciplinary Divisions

The ENG AdCom broke into groups to discuss ENG disciplinary division issues for:

- Division of Chemical, Biological, Environmental and Transport Systems (CBET)
- Division of Civil, Mechanical and Manufacturing Innovation (CMMI)
- Division of Electrical, Communications and Cyber Systems (ECCS)

Overview of the Division of Electrical and Communications Systems

Dr. Usha Varshney, Division Director, provided an overview of the Electrical and Communications Systems (ECS) Division. Her presentation covered the mission, vision, programs, and management within ECS. Key technologies and focused areas for research were listed as well as the distribution of program investments as of December 2004. The former and current organization structure were illustrated and the anticipated outcomes presented. ECS investments in ENG and NSF priority areas were shown for FY2005 and highlights of recent projects, workshops, and Katrina Small Grants for Exploratory Research (SGERs) were provided. A briefing was provided on the Graduate Research Supplement program. ECS also plays a lead role in the National Nanotechnology Infrastructure Network (NNIN) and has key roles in NSF Center activities, including management oversight and technical support. Data were displayed on the ECS budget, funding rates for CAREER and Research grants and award size. Dr. Varshney summarized the ECS goals and challenges.

ECS is planning a workshop on Broadening Diversity in March 2006 in Alabama. Individuals from underrepresented minorities will be invited to hear presentations by current ECS grantees.

To help address workload and funding rate issues, ECS has encouraged PIs to submit only one proposal for each deadline. The ENG AdCom asked if this limitation might drive PIs to submit to other divisions.

ECS Committee of Visitors (COV) Report

Dr. May, who chaired the ECS COV, summarized the report findings. The ECS Division has been highly successful in meeting its program goals and objectives and processes are carried out with the highest integrity. ECS program areas are increasingly important to the nation and the world. Key recommendations include seeking additional funding, increasing support for innovative projects, addressing gaps in the ECS research portfolio and fostering emerging activities. Continued efforts for elaborating on Criterion 2 efforts and reviewer diversity should also be pursued.

Dr. May asked for a motion to accept the COV report. The ENG AdCom accepted the ECS COV report.

Status of NSF Cyberinfrastructure (CI) Activities

Dr. Deborah Crawford, Acting Director, NSF Office of Cyberinfrastructure (OCI), updated the ENG AdCom on the activities within the new office and ongoing and future NSF-wide activities in Cyberinfrastructure. Dr. Crawford compared CI to Schumpeter's ideas for innovation in "Gales of Creative Destruction" which said innovation destroyed old ways of doing business and created new ones. OCI has a separate budget line and an Advisory Committee. It works closely with the CI Council and seeks broad input from NSF staff on CI issues. OCI is focused on "production-quality" CI for research and education. CISE remains focused on basic research, education, and future generations of CI technologies and capabilities.

A strategic planning process is underway for OCI with four components: 1) Collaboratories, Observatories, and Virtual Organizations, 2) High Performance Computing (HPC), 3) Learning and Workforce Development, and 4) Data, Data Analysis and Visualization

To date, the High Performance Computing strategic plan has been drafted and is available on the NSF web site for public comment. The ENG AdCom members were encouraged to review the draft plan. The draft strategic plan for Data, Data Analysis, and Visualization is projected to be available for public comment by January 15, 2006. NSF hopes to leverage interagency and international input and to think about an international "system" of data collection. Drafts of the other two strategic plans are expected to be available by March 15, 2006. A final CI Vision Document that pulls together all four strategic plans is planned for early summer 2006 so that it can inform the FY2008 budget request. There is a HPC solicitation currently issued with a February 2006 closing date.

Discussion:

- The ENG AdCom suggested that a strategic plan was needed for the "science of complex infrastructures". Dr. Crawford said that this was an excellent suggestion that she will take it to the CIC. SBE and ENG would play an important role in this activity.
- The group asked how much of the \$125M OCI budget was for High-Performance Computing. Dr. Crawford said the HPC budget is about 35-40% of the total OCI investment. NSF estimates that about \$500M is funded in CI activities across all directorates.
- Dr. Wu asked about private sector partnerships for CI (like the e-Science project in the UK). Dr. Crawford said she envisions partnerships with as open a model as possible. CI provides an opportunity for very different types of partnerships between academia and the private sector. CI is exceedingly expensive and NSF will never be able to do all that they need to do. Opportunities for efficiencies and ways to deliver CI are sought. Any insights the ENG AdCom could offer would be welcome.

Dr. Crawford said OCI hopes to begin implementation of the strategic plans and funding for new programmatic activities starting in FY2006. NSF is also interacting with other agencies. The National Science and Technology Council has a subcommittee on data stewardship with all federal agencies participating. Sustainability is also being discussed. NSF has a role to play for CI that is national in nature and that cannot be provided by individual institutions. Some aspects of CI can be maintained at the institutional level and these costs will eventually be embedded in the indirect cost rates. Different models are needed to support different kinds of infrastructure. In data areas, costs for maintaining databases will most likely be incurred by the institutions generating the data.

The ENG AdCom thanked Dr. Crawford for her presentation.

ENG Advisory Committee Subcommittee on Cyberinfrastructure

Dr. Francine Berman summarized the preliminary report from the ENG AdCom Cyberinfrastructure (CI) subcommittee. A first draft of the report has been developed. The plan is to submit the final report in the first quarter of 2006. Dr. Berman reviewed the focus and structure of the report. She highlighted some of the recommendations in the draft that include evolving a set of Engineering User Requirements and Engineering CI Resources in a state-of-the-art document.

Both research and infrastructure funding models are needed to help frame key decisions for developing a balanced and enabling portfolio of programs. Examples were provided of “framing decisions” that have to be made and metrics for measuring success of ENG CI. Dr. Berman concluded by posing questions to the ENG AdCom for discussion during the afternoon breakout session. Comments can be provided to the ENG AdCom CI subcommittee at eac-ci@sdsc.edu.

Dr. Buckius noted that the CI discussions at NSF have addressed issues including funding, priorities, infrastructure, and mortgages. ENG management is dealing with the same issues. Prioritization and balance are important not only for CI, but across all activities in which ENG is engaged.

Outgoing ENG Advisory Committee Members

Dr. Buckius noted the importance of the ENG AdCom and how much ENG appreciates their input and advice. Outgoing members Deborah Knopman and Larry McIntire were presented with a token of appreciation.

Breakout Discussions: ENG Crosscutting Activities

The ENG AdCom broke into groups to discuss ENG crosscutting activities for:

- Office for Emerging Frontiers in Research and Innovation
- Engineering Education and Centers/Industrial Innovation and Partnerships
- Cyberinfrastructure

At the conclusion of the breakout sessions, the meeting was adjourned at 5:00 p.m.

Dr. Kathie Olsen presented during the group dinner.

Wednesday, November 9, 2005

Dr. May reconvened the meeting at 8:05 a.m. Dr. May asked for a motion to approve the May 11-12, 2005 minutes. They were approved.

Breakout Discussions Report: ENG Disciplinary Divisions

The ENG AdCom members reported to the group on discussions from the ENG Disciplinary Division breakout sessions. Suggested discussion questions and group member assignments were provided in the meeting materials.

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

Lisa Alvarez-Cohen summarized the CBET group discussions. The group discussed the motivations for merging BES and CTS: consolidation to create a stronger case for resources, better alignment with the evolving Engineering community, coordination of intellectual approaches, and the opportunity to change intellectual directions in the future. Mergers are successful when the final product is an improvement over the individual organizations.

CTS currently has 4 themes encompassing 8 programs with a single Program Officer. BES has 3 clusters each containing two or more Program Officers. The new proposed division structure has 4 themes: Chemical and Biochemical Systems, Transport Phenomena, Biomedical Engineering, and Environmental Engineering. With the clusters agreed upon, more thought can be given to specific programs.

The group encouraged ENG to think about the merger and ways to ease transition in the research community. ENG's objectives for the merger should be clearly articulated. Is the reorganization intended to be evolutionary or revolutionary? Are improvements structural or simply a consolidation? Are programs of the two divisions organized in an equivalent way? For examples, how would a research area like Systems Biology fit into the new structure if it were not specifically identified? What is the effect of funding activities at the cluster level versus at the program level?

Funding at higher levels (clusters) promotes interdisciplinarity and mobility. Funding at lower levels (programs) promotes Program Officer (PO) independence and empowers rotators. Each approach has advantages and disadvantages. The group did not recommend a specific funding model. However, they suggest that ENG consider funding objectives carefully.

The "name" for the program was a focus of the discussion. The name is important to the community since it conveys a perception of a topic's importance. The group recommended that the name include hyphens (e.g. Chem-, Enviro- and Bio-Engineering) to get around the Bioengineering/Biology in Engineering concern. They also encouraged ENG to find a good acronym or to list the terms alphabetically (so order is not an issue).

Division of Civil, Mechanical, and Manufacturing Innovation (CMMI)

Dr. James Bernard summarized the discussions from the CMMI breakout group. They encouraged ENG to provide more details on the Frontier and Innovation Goals for CMMI. The proposed structure and the name for CMMI were discussed. The proposed name does not seem forward thinking with manufacturing (which many individuals considered to be "dated") in the title. The group suggested two other division names:

- Division of Civil, Mechanical & Enterprise Innovation (enterprise innovation is where the US is likely to be successful)
- Division of Engineering Infrastructure and Enterprise Innovation

Several ENG AdCom members felt that the second suggested title was more radical and forward thinking for the "external" division name but that time should be spent expanding on the program titles underneath the division titles. The world is moving beyond manufacturing to include services, enterprise, supply chains, etc.

Division of Electrical, Communications and Cyber Systems (ECCS)

Cherri Pancake summarized the discussions from the ECCS breakout group. She noted that the group did not discuss the name. Her summary focused on the discussion points, not the background as it was already presented to the group.

The group discussed relationships within ENG between this division and other divisions. What is the relationship between CI activities in ECCS and other CI efforts? ECCS participates in ENG's CI working group and will be a focus for enabling research for CI. Other divisions will be homes for domain specific applications. The integrative hybrid complex systems field is just emerging. ECCS's part is at the level where devices are integrated into systems. The group noted that using the term "complex systems" at different scales will confuse people and suggested that the ENG website and presentations state clearly what "level" they are referring to.

The group asked how funds will be distributed across the three programs. Will the distribution be based on success rates or be pre-apportioned?

The group wanted to know if the new OCI was aware of "cyber systems" activities in ECCS. ECCS needs to be proactive in communicating to OCI - not just in articulating ENG application needs, but also defining ways to engineer (structure, model, implement, and operate) complex systems. The group suggested that ENG and ECCS should contribute to the overall CI effort by leading "the science/engineering of complex infrastructure". It is important to step up and provide leadership at the definition phase of how CI is structured, modeled, implemented, and operated. GEO and SBE persons have been assigned to OCI; ENG must push to have someone there as well.

The Division asked what metrics should be used to evaluate success of their mission. Clearly multiple models of success are needed. Should the focus be on defining better metrics or on applying metrics? Post-award evaluation is a serious issue Foundation-wide. The group suggested that ENG start putting muscle behind metrics and really hold PIs accountable. ENG doesn't have to wait for NSF to take action; they can take the lead here too.

The EFRI proposed flowchart looked good for high-risk areas, areas meriting seed funding, and emerging priorities. However, EFRI should support activities that are of Directorate-level importance. The group raised several issues: Will there be flexibility in the process? What happens when a disaster or other national priority occurs? How will that be incorporated? Given NSF's funding cycle, it is hard to hold back funding for potential emerging things. Flexibility in the process is needed so emerging issues can be funded without waiting for the next year's budget. How will priorities be balanced? EFRI funds should be used to lower barriers to collaboration, both within and outside ENG. Incentives should be provided to promote cross/multidisciplinary engineering and working with other Directorates. The program should also facilitate partnering with NIH and other agencies.

AdCom members supported the recommendation that ENG take the lead and be proactive in CI issues.

Breakout Discussions: ENG Crosscutting Activities

The ENG AdCom reported back on breakout group discussions on ENG crosscutting activities.

Office for Emerging Frontiers in Research and Innovation (EFRI)

Judy Vance summarized the group discussions. Should there be an ENG-wide program to "identify important emerging areas in a timely manner"? There was general support from the group, however, the "devil is in the details". One concern is that money needed for this program will add to the already significant amount of NSF ENG money that is fenced. The recommendation is to not reduce the percentage of resources allocated to unsolicited awards, but to improve the solicitation process and reduce the number of solicitations.

EFRI provides an opportunity to support cross-division/multidisciplinary projects. The group stressed that the program should not fund big projects or ERC-type infrastructure but should fund emerging frontier research and multidisciplinary efforts. Big money does not always result in more impact. All the EFRI resources should not be awarded to one idea. There is a need to fund intermediate-sized, multi-PI proposals.

The group recommended that EFRI fund standard, not continuing grants. They felt the EFRI Council, as proposed, was not needed. Research ideas will come from constituents and Program Directors, and they can be taken to the AdCom for advice.

The AdCom echoed concerns about fewer funds being available for unsolicited research. In addition to looking to improve the solicitation process, the review process should also be considered. In general the AdCom liked the concept of the EFRI office, but wanted to have ways to ensure that the unsolicited funding levels would not decrease.

Engineering Education and Centers/Industrial Innovation and Partnerships (EEC/IIP)

E. Jennings Taylor summarized the EEC/IIP group's discussion, which focused on the themes of education and innovation. The group looked at NSF's vision statement: Enabling the Nation's Future through Discovery – Learning – Innovation. Discovery research is where dollars are turned into knowledge and innovation is where knowledge is turned into dollars. The learning/education crisis in the S&E workforce is the shortage of people that conduct discovery and innovation.

What should be the role of ENG in innovation? ENG should effectively invest in fundamental engineering innovation that has potential for high impact in meeting national and societal needs. The group recommended the following:

- Expand the number of ENG supported collaborations between industry and universities by 25%
- Catalyze industry-university partnerships to develop a new generation of intellectual property (IP) policies.
- Cultivate student interest in engineering and technological innovation (K-12 and beyond).

What is EEC/IIP's role in innovation? The division should look for additional synergies between existing partnership programs (ERC, SBIR/STTR, PFI, GOALI) and expand experience in innovation into other divisions within ENG.

To enhance synergy, discovery, learning and innovation are needed.

- Discovery: Innovation research is needed to explore models in other countries that work and don't work.
- Learning: It is important to benchmark best practices for current innovation and entrepreneurship programs.
- Innovation: ENG should require the participation of industry, universities, and investment entities in solicitations.

The group recommended that the requirement for innovation be expanded across all programs. Criterion 2 could be expanded to explicitly require the inclusion of components of innovation. An external Innovation Working Group should also be formed to advise NSF on how to embed innovation throughout the Foundation.

Cyberinfrastructure (CI)

Dr. Berman summarized the CI group discussions. The group agreed that there is a potential expanded leadership role for ENG in CI and the Office of CI. It is important for engineers to be "at the table". ENG has a lot to offer and was encouraged to step up and take leadership. The breakout was focused on giving the AdCom CI subcommittee information to make sure that their report is well grounded with ENG needs.

The group structured their discussion around the identification of "engineering moon shots". A moon shot is a high impact activity that's a "reach" and that will require substantial CI to accomplish. Four "moon shots" were identified:

A natural disaster. Example: A severe thunderstorm hits Dulles Airport. How can air travel be rescheduled? Potential CI requirements include the ability to run accurate models (weather, airline scheduling) in real-time; integration of data sources in real-time; the ability to revise a model in real-time and/or to precompute revised airline schedules; the ability to run "what if" scenarios (e.g. power outages). Real-time control, command, and decision-making strategies are important, as is the integration of all of the components in the context of CI.

Bioterrorism. Example: How soon would a biological weapon spread throughout an urban area? Potential CI requirements include the development of sensor data with fluid dynamics models; decision support tools; integration of tools and facilities (e.g. hand-held devices, data storage, computational modeling tools, command centers, hospitals) across different scales.

Smart Spaces/Intelligent Systems. Example: How to develop a “smart house” for aging parents (related efforts include smart nurseries, hospital ICUs, etc.). Potential CI requirements include remote sensing for health; models that can recognize/distinguish between normal and abnormal behavior; simplified APIs for users and the linking of sensors and communication systems. To be effective, one would need to implement a continuous loop - environmental input → processing of data → actuation → environmental input.

Cyber-Education. Example: a 3D gaming cyber classroom environment where instructors and student “avatars” meet and work together in Cyberspace. Potential CI requirements include a 3D environment that is real-time, latency-tolerant, adaptive, linked to instruments/experts for real-time cyber field trips and experiments, and provides scalable interactive collaboration tools that support multi-modal communication.

Many CI-enabled applications will need access to data management systems; access to computational facilities for modeling and analysis; tools to facilitate the transition from data to models to information; ways to close the loop by doing actuation; multiscale data integration systems; and multi-modal communication systems. Some of the distinguishing parameters for different applications may include power requirements; control features; the knowledge level of the users; data integration and usage models, and expert vs. expert systems.

Other discussion topics included CI business models, industry partners that should be included from the beginning, data sharing, and open source software. Engineering should take the lead in devising mutually beneficial partnerships with industry.

Should OCI support “service providers” and “infrastructure providers” and Directorates support research? For example, should training be funded through OCI and education research through EHR? Should organizational research be done through SBE? This was posed as a question for the ENG AdCom – where should those lines be drawn?

Discussion. Dr. Wu said IBM is doing joint projects with universities and other government mission agencies. Dr. Kathie Olsen added that bringing in other agencies might be a natural way to go from ENG research to innovation that matters.

ENG and the Division of Academic Science support a center with NOAA to predict hazardous weather that includes CI activities. The ENG AdCom asked for more information on this project and the leadership of this program. Background on the center is available at <http://www.casa.umass.edu/>.

The group encouraged ENG to look at ways to leverage more matching funding from industry. How much can industry support? This would probably be variable depending on the project and type of industry.

The ENG AdCom agreed to recommend that NSF/ENG pursue the idea of convening a group of industry thought leaders to look at ways to leverage industry funding/participation in research. The Industrial Research Institute might be a potential partner for a workshop/task force in this area. In the future, other mission agencies could be included in the discussion.

CI is not just big things. It is made up of a wide variety of small/medium/large things to be used as needed. The purpose is to provide the glue to coordinate things in a functional way.

The AdCom expressed concern about placing limits on the number of submissions from universities and making decisions about strategies to reduce proposal submissions without having the data to support them. Limiting submissions from universities requires universities to decide what research gets put forward to NSF. Furthermore,

imposing the same absolute limit on all institutions regardless of size creates equity issues. There are many different opinions on this topic and ENG is struggling with how best to address these issues.

Dr. Buckius thanked the ENG AdCom for the excellent feedback from the breakout group reports. He also thanked the ENG staff that helped organize and support the AdCom meeting.

Issues for Discussion with the Director/Deputy Director

The ENG AdCom identified issues to discuss with the NSF Director and Deputy Director. They also recognized the commendable effort the ENG staff has made with the proposed reorganization plans.

Meeting with NSF Director and Deputy Director

Drs. Arden Bement, Jr. and Kathie Olsen met with the ENG AdCom. Dr. May thanked them for their support of engineering.

Dr. Bement briefly summarized the NSF budget. The ENG request for FY06 is an increase of 3.5% over FY05. The budget has not been finalized but it is hoped that ENG will have a slight increase.

Dr. Bement asked the ENG AdCom for their questions.

ENG Reorganization. The ENG AdCom supports the ENG reorganization in general with more buy-in than at the previous meeting. It is an opportunity to improve ENG and to position the directorate to take more risks. The names for the divisions are clearly important in the engineering community. The ENG AdCom also noted the importance of being clear in how a term is meant to be used. Words like systems and infrastructure mean different things at different scales. It is also important that metrics of success be embedded in the reorganization process.

The group looked at the both the new divisions and the crosscutting aspects of the reorganization. The emerging frontiers office is a good idea with lots of possibilities, but there is concern about reduced funding for unsolicited proposals. ENG seems to have a plan in place to keep this from happening.

Dr. Bement responded that NSF is fully committed to the principles of the ENG reorganization and hopes to implement it within FY2006. Allocating funds among 7 divisions and offices (especially with cross cutting activities) is difficult. He asked the ENG AdCom to focus on frontier research and how best to address this going forward. Division titles are important. More work is also needed to define program descriptions. The research community likes to see themselves in the titles and needs to know who to contact at NSF for their research area. NSF depends on professional societies to represent the programs in NSF to their constituents and to give NSF input so the reorganization must be understandable to them. NSF is eager for the ENG AdCom to fully vet the reorganization before it goes out for public comment.

Search for Assistant Director for Engineering. The search committee to recruit the next Assistant Director for Engineering will be chaired by Dr. Henry Yang, Chancellor of the University of California, Santa Barbara. The search committee is now being formed, and it will include ENG Advisory Committee representation.

A Dear Colleague Letter will be issued announcing the chair and seeking nominations. The committee will identify potential candidates and consider all individuals that have been suggested by professional societies, ENG AdCom and other organizations. The committee will screen potential candidates, developing a list of three to five names that they will submit to the Office of the Director. Dr. Olsen hopes to have several names for consideration by early spring.

Cyberinfrastructure. CI can address grand challenges and ENG can play a vital role in helping to shape the strategic directions for CI. In addition to the four strategic planning areas currently under development by the NSF Office of Cyberinfrastructure, the ENG AdCom noted that there is also a need for a strategic plan for the Science of

Complex Infrastructure. Dr. Bement said the plans have to be tailored by the research communities they serve and the directorates will take leadership in that area.

Dr. Bement noted that the draft CI subcommittee report from ENG was very good and that ENG's strategic plan for CI will be incorporated into the CI Council planning process. Two of the document's strengths are the discussion of opportunities in engineering simulation and engineering education. The role of engineering in developing the infrastructure in the first place (e.g. infrastructure for petabyte computing) is missing. Science and engineering does not have the packaging concepts yet for what will eventually be needed to support infrastructure (e.g. pumps, heat exchangers). This is a ripe area for ENG. On the networking side, there are other problems and critical design issues such as cache memory, bandwidth, and switching. Dr. Bement encouraged ENG AdCom to include these issues in their CI report. Dr. Bement also encouraged ENG to get good people involved with the OCI office.

Agency and Industry Collaboration. The AdCom asked about opportunities for more collaboration with other agencies and industry. CI is an opportunity to bring in more partnerships, not only with industry, but also with other mission agencies. Dr. Wu said that in IBM's experience the best projects involve small companies, government agencies, large industry, and groups of universities. Dr. Bement suggested that the AdCom ask for a briefing on the NSF CI collaborations at a future meeting. He said there is interagency participation in all of the High-Performance Computing Centers. With industry, NSF is working to provide the right architecture for people that are proposing to work with industry, following an approach similar to that of DARPA. The National Science and Technology Council has formed several working groups, including one on data that involves all federal agencies.

Industry Cost Sharing. The ENG AdCom noted their appreciation for NSF's efforts to increase the NSF budget. They also recognize that the budget can't grow quickly enough. Thinking outside the box, can ENG break some of the paradigms as to how matching funds are made? Would NSF be supportive of a workshop or meeting with industrial thought leaders across the country to look at ways to collaborate and match government funding for research? Dr. Bement encouraged this idea. ENG is at the front line for innovation and growing the economy. He also encouraged the group to bring in state and local governments. Innovations ought to start at the state and local level. NSF is focused on development of new concepts through frontier research and integrating education and research.

Workforce Development. Workforce development can be thought of as a large systems challenge. Is there a changing role for NSF or ENG in breaking barriers? What does the frontier look like in terms of workforce? Dr. Bement said NSF is looking at a new initiative in K-8 to get more students engaged in science, math, and engineering activities. A number of programs to develop curriculum for high schools are starting to take effect. Professional societies can also help. The next major focus is on interfaces between high schools, community colleges, and four-year programs and retention rates. NSF is finding that many community colleges are beginning to get involved and are more plugged into communities. This works in motivating bright young talent to excel and to matriculate. Dr. Bement said that he is encouraged that figures for the science and engineering workforce are beginning to show an upward trend.

Proposal Success Rates. The ENG AdCom discussed success rates and how to improve them. One way is to limit submissions by institutions. Currently, there are some solicitations that limit the number of proposals each campus can submit. The group felt that this treats the larger universities unfairly. It places the onus of assessing the quality of proposals on the universities' research offices. Has NSF considered other types of mechanisms for addressing the issue of success rates? For example, one option might be to factor the size of the faculty into the limit on the number of proposals per institution. Dr. Bement said that this issue is under continual evaluation at NSF. Directorates like ENG that are solicitation-intensive attract large numbers of proposals and have lower success rates. (Solicitations, however, have some advantages, such as the ability to focus the research topics). Emerging fields will also attract more proposals and enthusiasm. NSF is looking at all the ways the agency can potentially address this issue and it will be an ongoing effort.

Dr. May thanked Dr. Bement for his time. He also recognized and thanked the ENG Interim AD, Dr. Buckius, and the program staff for their efforts. Dr. Bement thanked the ENG AdCom for their contribution to NSF and ENG.

Wrap Up

The next ENG AdCom meeting is May 3-4, 2006 at NSF. With no further discussion, the meeting was adjourned at 12:00 noon.

November 8-9 ENG AdCom Meeting Action Items Summary

- Dr. May asked the ENG AdCom to review and provide comments on the draft report *The National Science Board 2020 Vision for the National Science Foundation* which was provided in the meeting materials. Dr. May will draft a response based on feedback and send to the ENG AdCom members via email for review prior to submitting the response to NSF.
- The ENG Ad Com requested additional data (see details in Directors Update, page 2).
- ENG AdCom members were encouraged to read the Office of Cyberinfrastructure's High Performance Computing strategic plan draft that is available on the NSF web site for public comment.
- Input to the Cyberinfrastructure Subcommittee report can be provided to the ENG AdCom CI subcommittee at eac-ci@sdsc.edu.
- Names for potential Assistant Directors for ENG can be provided to Dr. May who is on the search committee.
- At a future meeting, it would be useful for Program Directors to present their ideas for ways to improve proposal success rates.
- The ENG AdCom agreed to recommend that NSF/ENG pursue the idea of convening a group of industry thought leaders to look at ways to leverage industry funding/participation in research. The Industrial Research Institute might be a potential partner for a workshop/task force in this area.
- Dr. Bement suggested that AdCom ask for a briefing on the NSF CI collaborations taking place with industry and other federal agencies.