Report from the 2008-2010 Electrical, Communications and Cyber Systems (ECCS) Committee of Visitors (COV)

Engineering Advisory Committee Meeting
October 27, 2011
NSF

Charge to the ECCS COV Review

- *The integrity, efficacy, and quality of the processes used to solicit and review proposals and the documentation of funding decisions.*
- *The quality of project management, monitoring, and evaluation of funded proposals.*
- *The quality and significance of the results of the Division's programmatic investments in terms of the NSF strategic goals (NSF 2006-2011 Strategic Plan).*
- *Opportunities to more fully realize the potential of the Division's current programs and future directions for the ECCS Division.*

Charge to the ECCS COV

- ***PART A.*** *INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT*

- ***PART B.*** *RESULTS OF NSF INVESTMENTS*

- ***PART C.*** *OTHER TOPICS*

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- ~~***PART B.*** *RESULTS OF NSF INVESTMENTS*~~

- ***PART C.*** *OTHER TOPICS*

Members of the ECCS COV

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Thanks to NSF ECCS and ENG!

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Dr. Zygmunt Haas, Dr. Andreas Weisshaar

National Nanotechnology Infrastructure Network (NNIN)

***Dr. Lawrence Goldberg**, Senior Engineering Advisor*

Process of the ECCS COV

1. *COV evaluated 180 proposal e-jackets and other data supplied by the division in advance to meeting at NSF.*
2. *COV met in person at NSF for 2.5 days from June 22-24, 2011 to hear presentations, discuss findings, draft report.*
3. *In June-July, finalized the report by e-mail.*
4. *Final report submitted to Professor Ilesanmi Adesida, Dean, College of Engineering, University of Illinois, and Chair of the NSF Engineering Advisory Committee.*

Main Findings I

- *The COV was very impressed by the active and thoughtful management, organization and new initiatives of the ECCS program. We commend the Division Director on the outstanding team he has assembled. The teamwork and strategic coordination involved in the management and operations of EPMD, CCSS, EPAS and NNIN by the Program Directors is impressive, effective, and visionary.*
- *All processes are well managed, staff morale is high and the leadership and enthusiasm of the Division Director and all the PDs help keep ECCS at the forefront of engineering science.*
- *The balance and breadth of the award portfolio is excellent, with a diverse awardee and reviewer base, and proposal dwell time well below foundation goals. The Division has also responded to the previous 2008 COV by increasing the average award size to >$300K, especially for experimental efforts.*

Main Findings II

- *Research supported by the Division is more critical than ever to our international competitiveness in engineering science and technological innovation. ECCS's proactive engagement in cross-disciplinary research initiatives with other NSF Divisions and agencies have helped diversify the research breadth of ECCS and have inspired new research frontiers.*
- *The COV was impressed with the responsiveness of ECCS to national priorities. Important initiatives championed by ECCS include science and engineering beyond Moore's law, flexible electronics with primary application emphasis on revolutionizing healthcare, efficient generation and management of energy from the environment, the continuous pursuit of cyber-physical systems to enable solutions to several of the NAE Grand Challenges, and enhanced access to the radio spectrum (EARS).*
- *The Division is also to be complimented for its continued successful management of the Foundation-wide NNIN program, that has had a tremendous impact on education, research and technology transfer.*

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS

- *The proposal review process is very appropriate, efficient and well-managed and commends ECCS for these efforts. In 2010, 84% of proposals were processed within 6 months, which compares very well with the 78% NSF-wide average. The proposal e-jackets which the COV examined were reviewed by at least 3 independent reviewers and then summarized by a member of a larger review panel.*
- *ECCS has taken the lead in modifying the review process in research areas that attract a large number of interdisciplinary proposals e.g. by conducting joint reviews with EPMD and DMR, and EPAS and DOE.*

SELECTION OF REVIEWERS

- *Reviewers come from all states in the US, with a higher rate of female (15%) and minority (8%) participation than in EE faculty as a whole (9.7% and 3.6% respectively). Overall, a quarter of the ECCS panelists are new to the task. These first-timers bring fresh perspectives and insights to their panels (while also becoming familiar with NSF and what it takes to write a good proposal). The one-in-four proportion seems about right to us. Approximately 9% of reviewers come from business, state, local and foreign institutions.*

PORTFOLIO OF AWARDS

- *The new ECCS organization has helped balance awards across the three ECCS program areas.*
- *Most awards are innovative or potentially transformative. Targeted funding through programs such as RAPID and EAGER (open to submissions all year) are very effective in quickly harnessing opportunities.*
- *Directed programs such as EFRI, MRI, NERCs, BIO FLEX, GOALI etc are also instrumental in helping awardees push the envelope.*
- *The NNIN is a highly commendable investment which establishes a broad network of state-of-the-art facilities that create the needed infrastructure to enhance the chance for transformative research.*
- *Identifying intelligent system-wide optimization as one of the critical enablers within the 4th generation smart grid development is an excellent example of the transformative component NSF could bring to bear on an issue of great national significance.*

PORTFOLIO OF AWARDS - diversity

- *The COV commends ECCS for an increase in the number of inter- and multi-disciplinary awards. Of 298, 398, and 292 awards made in 2008, 2009, and 2010, respectively, funding was contributed by other programs in ENG, other Directorates, and other agencies to 61, 67, and 53 projects.*
- *The geographic distribution of awards is appropriate, reflecting the locations that have multiple institutions supporting engineering and mirroring the locations of the submissions. From FY08-FY010, proposals were received from every state. Awards were made to investigators from 48 of 50 states.*
- *ECCS supports an appropriate balance between various types of institutions. 2 and 4-year institutions receive relatively few research awards because of their small number of ENG Departments.*
- *In 2010, approximately 22% of all proposals submitted by women and minorities were funded. This is somewhat higher than the rate of funding across all proposals submitted to ECCS at large, which was around 20% (unsolicited proposals have a lower funding rate in all cases).*

Main Concerns I – Low Award Rates

- *The increasing number of proposals (1400 annually in 2011 compared with 600 in 2001) combined with low award rates (16% for unsolicited proposals) and multiple low-quality submissions (≈1/3 from PIs who submit multiple proposals) could impact the quality of proposals and reviews. If award rates decline further, faculty may submit even more proposals, instead of developing and proposing their best ideas. Selection of the best proposals will be difficult, because review panels may also be influenced by low awards rates. Moreover, excessive faculty workload may reduce the quality of engineering, education, and broader impact in the US, particularly with increased budget pressures at the state/federal levels.*

Main Concerns I – Low Award Rates

- *The ECCS Division is already actively involved in devising ways to mitigate the low award rates. Clearly, decreasing award amounts to increase the funding rate will not work. It is vital that the division, the Directorate, and NSF act in a strategic and coordinated way - NSF Engineering reviews 25% of the proposals submitted to NSF, and therefore will need to deal with this issue first.*
- *The COV supports implementing a single grant deadline per year, or limiting the number of proposals a PI can submit annually to ENG. NSF can help by educating universities, PIs, and reviewers that high-quality ideas and broader impact (appropriate to the funding level) are the gold standard at NSF.*

Main Concerns I – Proposal Pressure

- *The COV suggests that ECCS and NSF Engineering try to understand from submission data what is driving the dramatic increase in the number of submissions. Is higher funding abroad causing the need U.S. researchers to submit more proposals in order to try to attract comparable funding to compete? Or is the increasing complexity and cost of advanced research driving the increased number of submissions? Are universities expanding the number of engineering faculty? Are more schools supporting research programs? Or perhaps faculty require more students in order to pursue interdisciplinary problems? Understanding the drivers will allow ECCS and NSF to take appropriate actions to maintain excellence in Engineering Science in the US, at a time when international competitiveness makes this imperative.*

Main Concerns II – Division workload and continuity

- *The significant growth in workload (from proposal pressure and the need to support interdisciplinary proposals) is stretching the ECCS PDs, whose number has not increased commensurately. Therefore, to maintain excellence in management and merit review it would be helpful if the number of ECCS program directors and science assistants increases – even if only a modest increase of one additional program director.*
- *It would also be very helpful for continuity and planning if ECCS had a Deputy Director, as is the case for other divisions within engineering.*

Main Concerns III – Broader impact review criterion

- *As is the case Foundation wide, there still appears to be confusion in the review base about what is meant by broader impact, what high quality broader impact might look like, and what scope is appropriate for different proposals (single-PI vs centers etc.). The PDs in ECCS and other divisions at NSF already inform panels in advance by directing them to appropriate web site locations. There is a need to continue and enhance these efforts.*
- *Some reviewers appeared inexperienced in BI e.g. could not decide if international experience/collaboration should be counted as Broader Impact or if "Good outreach activities, but already underway" deserved recognition because it was "not clear what the impact of this program will be." In one case, the reviewers did not seem to appreciate proposals that had great outreach, with specific programs involving undergraduates and minorities. In contrast, a proposal that had more vague ideas was praised e.g. mentioning a $100 Million University-wide program dedicated for K-12 outreach, but where the PIs individual effort was not well explained.* ***The COV feels that Broader Impact cannot be outsourced.***

Main Concerns III – Broader impact review criterion

- *The COV believes broader impact is very important for NSF funded proposals. It can be in many forms – such as effective outreach to K-12 or the public, increasing the number of women/URMs in ECCS at any level, technology or knowledge transfer to industry, solving a grand challenge problem that impacts other fields, or sparking new lines of experimental research motivated by theoretical breakthroughs etc.*
- *Perhaps a series of questions in the review form could prompt high-level critical evaluation of the proposal in terms of Broader Impact (the COV gave examples of such questions). Such questions might help first-time panel members (25%) understand broader impact, while reminding senior reviewers to look for breakthrough, high-impact research with significant broader impact. Assigning a senior experienced person per panel to specifically concentrate on Broader Impacts might also be helpful.*

SELECTION OF REVIEWERS

- *Suggestions from COV:* ***New panelists could be offered some training*** *in advance of arriving at NSF —perhaps NSF could conduct webinars for this purpose. All panelists could benefit from good examples of broader impact appropriate for the proposal type.*
- ***At least one representative from industry on most panels can add breadth and perspective and help determine impact****. Some COV members believe that the interest of industry in academic interactions and professional activities has increased in some research areas. Therefore, it might be possible to attract more industry panel members. For example, industries with experience with ERCs, STCs etc .*

SELECTION OF REVIEWERS

- *The COV recommends that NSF consider designating an experienced and broad expert member on each panel who would be specifically responsible for discussing broader impact and intellectual merit and who could help the panel in their deliberations (perhaps that expert member would not be assigned specific proposals to review). This might help to balance in-depth technical reviews with broader impact and high-risk, and place proposals in context.*
- *Metric grading might help panel members e.g.* ***for Intellectual Merit****, some questions could be asked in the "proposal review shell" that are appropriate for the type of proposal (single-PI, center, group, CAREER etc)*
- *Is the proposal high risk, high reward, at the forefront of engineering science?*
- *Does the PI have a track record as a graduate student or independent researcher for tackling and succeeding in challenging research?*

SELECTION OF REVIEWERS

- ***For Broader Impact**, one could ask about the quality, scope, and benefit of broader impact. For example, for a single-PI (center) proposal:*
- *Will the area/field change as a result of this research?*
- *Will this award result in significant and effective mentoring of women or minorities working in STEM?*
- *Will this award result in increased understanding of STEM by the public?*
- *Will this award result in technology transfer to industry?*
- *Will this award solve a grand challenge problem?*
- *Does the PI have a track record of achieving broader impact in prior work?*
- *Will this award impact other fields? etc.*

PORTFOLIO OF AWARDS

- ***The COV feels that to increase the percentage of transformative, highly-innovative awards, this issue needs to be addressed at the proposal submission stage.*** *That is, if measures are taken to assure fewer – but higher quality - submitted proposals, then presumably, a higher percentage of awards will be innovative or potentially transformative. For example, by limiting the allowed number of annual submissions for an individual PI, or proposal submission windows, or adding additional panel training, metric grading and senior advisors, the committee feels that average award quality will increase.*

NSF WIDE ISSUES – Quality of Merit Review

- *Increasing proposal overload for panelists and PDs NSF-wide may strongly reduce the quality of merit review going forward.*
- *To address this issue, in the absence of an increased level of funding, the COV supports proposal and PI limits in ECCS and ENG, since implementing such limits for ECCS alone would not be strategic. Any restriction in proposal submissions will need to be done in coordination with NSF leadership, to avoid the appearance of decreasing proposal pressure from engineering, when in fact NSF Engineering handles 25% of all NSF proposals.*
- *The COV strongly advocates that NSF work to develop an increased understanding in the community of what constitutes excellent broader impact, training new reviewers, adding senior reviewers who monitor broader impact, and adding example questions to prompt reviewers.*
- *Appropriate ECCS professional PD, DD support levels are required to best manage the program. A Deputy Director would be very helpful for continuity and for implementing long-term goals in ECCS.*

NSF WIDE ISSUES – Interdisciplinary Research

- *ECCS should continue to lead in and grow interdisciplinary research and program structures that facilitate interdisciplinary research. The research community and young faculty in particular continue to move in this direction. NSF funding and broad/joint panels will need to support this.*
- *How to embed interdisciplinary research in NSF without the need for PD champions? Consider some restructuring that has broader (or new) divisions/directorates when funding is available, and gather input from US science and engineering faculty through workshops, NAE/NAS reports etc.*
- *Consider the possibility of mid-scale research that lies between centers and single-PI grants.*

NSF WIDE ISSUES – Sustaining the Quality of US Science/Education to be Internationally Competitive

- *Core programs must be sustained at an adequate level.*
- *The current method of adding new targeted but sometimes narrow initiatives does not maintain the overall health of US engineering leadership.*
- *Need more multi-agency partnerships and coordination to adequately sustain a research area (while sustaining basic science and engineering without mission needs dominating the agenda).*
- *The COV is concerned that faculty workload may influence the quality of engineering science, education, and broader impact in the US. This situation may be even more challenging in the future with increased budget pressures at the state and federal levels. NSF can help by understanding the drivers for the proposal pressure, and by educating universities, PIs, and reviewers that high-quality ideas and broader impact (appropriate to the funding level) are the gold standard at NSF. Quality, not quantity, matters, and methods to ensure this should be pursued.*