Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET)
Response to the 2019 Committee of Visitors (COV) Report

Introduction

The Committee of Visitors (COV) met on June 3rd and 4th, 2019 to review programs in the Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET) in the Directorate for Engineering (ENG). The COV covered CBET operations for the four fiscal years (FYs), 2015 through 2018. The Committee was Chaired by Dr. Jennifer Sinclair Curtis and co-Chaired by Dr. Christopher Roberts. They presented the COV report to the ENG Advisory Committee on October 24, 2019, and the advisory committee members voted unanimously to accept the report.

CBET wishes to thank the members of the 2019 CBET COV for their time and effort in carefully reviewing the activities of the Division. CBET is especially grateful to Drs. Curtis and Roberts for their leadership during the COV process. The final report consists of a thorough review with many clear and actionable recommendations.

The COV evaluated over 430 randomly selected proposal actions spanning the fiscal years mentioned above. The COV report addressed five topic areas: I. Merit Review Process; II. Selection of Reviewers; III. Management of the Program; IV. Portfolio of Awards; and V. Other Topics. Our response to each of these areas is listed below. Many of the COV comments in an early section of the report were repeated or restated in a substantially similar form in the latter sections of the report. We responded to the first occurrence of a comment and noted other sections of the report to which this response also pertains.

I. Merit Review Process

1. *Recommendation/Observation: The COV observed differences in internal review processes (specifically EAGER proposals). Some research ideas initially were submitted as unsolicited proposals, received reviews indicating that the work was too high risk, and then the research ideas were then resubmitted as an EAGER proposal. In other cases, the research idea was submitted directly as an EAGER proposal. The COV noted some variations in the reviews for EAGER proposals. [I.1, III.4]*

   Response: The NSF Policy on EAGER proposals, as described in the PAPPG, allows for variations on how research ideas are generated and invited for EAGER proposal submission. The policy requires, except under unusual circumstances, that the proposals be reviewed internally to NSF, and this review can take various forms.

2. *Recommendation/Observation: There were concerns about the panel process missing out on matching specific reviewer expertise to a proposal. The COV recommended the use of ad hoc reviewers when panel topics are very diverse [I.1, II.1]*

Response: Many of the research programs face the challenge of conducting merit review on proposals that span a broad range of research topics. When setting up a review panel, program directors address a constrained, multivariable problem in which they must balance the principal needs for specific reviewer expertise with other factors, such as conflicts-of-interest, prospective panelist availability, panel costs, and panel diversity (geographic, institutional, career stage, gender, race, and ethnicity, etc.). As a result, the program directors often have utilized ad hoc reviews to supplement the panel reviews and to ensure that additional specific expertise is brought to the merit review process when needed. The division will continue to encourage program directors to use ad hoc reviewers as a tool to enhance panel review where appropriate. It is worth noting that during FY 2019, the first year in which the division received unsolicited proposals throughout the year, program directors more frequently utilized ad hoc reviews to enhance panel review.

3. *Recommendation/Observation: The COV noted that some review analyses for declined proposals contained less information than seen for review analyses for awarded proposals. The COV encouraged POs to provide the PIs that are on the borderline for funding with more detailed feedback, such as using PO Comment tool, for improving the next iteration of their proposals [I.2, I.5, I.6, III.4]*

   Response: The division developed its current practices on review analysis and documentation in response to managing some of the highest proposal workloads in the Foundation. The aim was to balance providing constructive feedback to the PI with the need to handle significant numbers of proposals quickly and efficiently. CBET program directors also spend a significant amount of time fielding phone calls from declined PIs and providing detailed feedback on the reviews of their proposals. Such work is not captured in the documentation within the jackets. The division will take the COV's feedback under advisement and revisit its review documentation practices seeing where we can make additional changes that enhance communication with the PIs, particularly for declined proposals with ratings similar to those of awarded proposals.

4. *Recommendation/Observation: The COV recommended that CBET explore reviewer training as a means to ensure that reviewers understand both merit review criteria and their application, particularly the Broader Impacts review criterion. [I.1, I.7]*

   Response: The Foundation has been working on the issue of reviewer training and developed some reviewer training videos which the division made available to the COV before and during their meeting. The division will explore whether such videos can be incorporated into some stage of the panel set-up process or the panel meeting. The division has undertaken an effort to review and modify the content of the briefing presentations provided to panelists before the start of the panel meeting. We note that other pilot programs on reviewer training are ongoing around the Foundation, so the division will monitor the outcomes of these efforts. Where effective practices are demonstrated, the division will seek to adopt them.

5. *Recommendation/Observation: There were concerns about the construction of a few of the panel summaries and recommended that CBET emphasize to scribes the need to capture the panel discussion. [I.4]*

   Response: Our current practice is for program directors to emphasize to scribes the need to capture the panel's discussion for proposals on the discussion agenda. The division will emphasize this practice more in program director training. We note that some program directors are piloting the separation of scribe and reviewing duties into separate panel members.

6. *Recommendation/Observation: The COV observed that the PIs of a subset of competitively ranked proposals were asked to respond to panel-identified weaknesses in their proposals and recommended that CBET provide clarity on how this process impacts the award/decline decision. [I.5, I.7]*

   Response: At their discretion, program directors have the authority to seek feedback on specific reviewer/panel comments from the PI in order to reach fully informed recommendations. This authority is used judiciously and only in circumstances in which the program director believes that the feedback would assist in their decision making. Ultimately, award/declination decisions are made based upon the outcomes of merit review as well as programmatic factors, such as portfolio balance.

7. *Recommendation/Observation: The COV commented that "The average dwell time appears to be consistently increasing, particularly for funded proposals. The new 'no-deadline' system may impact this with even longer dwell times for all proposals." [I.7]*

   Response: In recent fiscal years, there have been extenuating circumstances, such as operating under multiple continuing resolutions to start the fiscal year as well as several lapses in appropriations, that contributed to increasing dwell times for proposals, particularly awards. The division notes that the dwell times for declined proposals remained constant over the review period, while the dwell time for awarded proposals was higher for the two years in which NSF operated under the aforementioned extenuating circumstances. The division aims to inform PIs on the disposition of their proposals in a timely manner, but also seeks to balance meeting this customer service standard with optimizing the use of taxpayer resources and funding the best possible portfolio of awards.

   The Directorate for Engineering is studying the impact removing deadlines had on the submission of unsolicited proposals to its core programs. This analysis will include the effect of this change on the dwell time for proposals. In preparation for removing submission deadlines for unsolicited proposals to its core programs, the Engineering Directorate examined the outcomes from various merit review pilots conducted across the

Foundation. Several divisions in other directorates that eliminated proposal submission deadlines found that the dwell time for proposals *decreased* afterward.

8. *Recommendation/Observation: The COV remarked that "the average number of reviews for declined proposals was higher than those for awarded proposals, but the reason for this was unclear. This is troubling as it suggests that the proposals which receive fewer reviews are the ones that are more likely to be awarded." [I.7]*

   Response: This difference likely reflects the effect of internally reviewed proposals (EAGERs, workshops, RAPIDs) in the analysis. The NSF Enterprise Information System (EIS) counts EAGER and workshop awards in the category of competitive awards, so the overall count of competitive awards for a given year includes primarily unsolicited, CAREER, EAGER, and workshop proposals. In each of the four years under review by the COV, approximately 10% of the total awards were made to EAGER and workshop proposals, while these proposals constituted a far smaller percentage of the declination recommendations. EAGER and (nearly all) workshop proposals are reviewed internally, so their jacket records would not include external reviews. Therefore, the reported average number of reviews for awards would appear to be lower than the average number of reviews for declines. Over several programs and fiscal years, there may be additional contributing factors to the averages cited by the COV in this observation, but the explanation provided here likely is the main contributor to the apparent discrepancy in the data observed by the COV.

9. *Recommendation/Observation: The COV noted that "While the quality and effectiveness of the COV review process do not seem to be affected, to date, by the change in the 'no deadline' policy, it will be important for future COV panels to evaluate the effect of this deadline change." [I.7]*

   Response: The Division assumes that the COV is referring to the quality and effectiveness of the "merit" review process here. The Directorate for Engineering is studying the outcomes of the first year of removing deadlines for the submission of unsolicited proposals to its core programs. This analysis will include looking into potential impacts on the merit review process.

10. *Recommendation/Observation: The COV made the comment, "In the Special Initiatives, the documentation reveals the variability in the quality of awarded proposals selected in different solicitations." [I.7]*

    Response: The division believes that it is difficult, if not unrealistic, to compare the quality of awarded proposals from different solicitations. First, the solicitation topics are in different research areas and sometimes require the involvement of multiple co-PIs from different fields. Additionally, the solicitation instructions often require the PIs to include different sections in their proposals. The end result of these separate processes is

research projects of very different subject matter and scope. Furthermore, anecdotal feedback from program directors indicates that proposals to multidisciplinary solicitations commonly have more varied reviewer scores for meritorious proposals. The division is confident that the merit review process in each competition resulted in the selection of competitive, high-quality projects appropriate to parameters set forth in their respective solicitation.

II. Selection of Reviewers

1. *Recommendation/Observation: The COV encouraged the divisions to increase the use of reviewers from industry and national laboratories. [II.3]*

   Response: The division's program directors regularly use expert reviewers from federal government agencies, national laboratories, and private sector companies. When and where appropriate, the division will endeavor to increase the use of expertise from these institutions.

2. *Recommendation/Observation: The COV observed, "While geographic diversity was generally achieved across CBET, this was not necessarily true in a given cluster." [II.3]*

   Response: The division will evaluate the geographic distribution of the reviewers invited to its panels. If there are any disparities, then the division will look into potential adjustments to its practices and will seek to enhance outreach efforts to institutions in underrepresented geographic regions as a means to expand the pool of expert reviewers.

3. *Recommendation/Observation: The COV commented, "Self-reported percentages of reviewers who are women or persons with disabilities should be contextualized. No data on the percentage of underrepresented minority (URM) reviewers were provided. A description is needed on the efforts made to ensure diversity and inclusion in the review process." [II.3]*

   Response: The COV report template indicated that the COV members were directed to the jackets as the data source for addressing questions about the selection of reviewers. The division supplied the self-reported percentages of reviewers who are women or persons with disabilities as a supplement to the information found in the jacket. The division did provide the self-reporting rate for gender and disabilities, both of which were low response rates. The corresponding data on the percentage of URM reviewers was not queried, and this was an oversight. The division will evaluate the diversity of reviewers invited to its panels and efforts to ensure diversity and inclusion in the review process.

III. Management of the Program

1. *Recommendation/Observation: The COV commented, "Extensive feedback on the annual reports and final reports is not typically given to the PI." [III.1]*

   Response: When a program director reviews an annual report, they typically provide feedback or requests for revision in a separate e-mail or a phone call. Therefore, the program directors quite often provide feedback to PIs on annual reports, but documentation of this feedback is not a required part of the award jacket record.

2. *Recommendation/Observation: The COV was concerned that program coherency would be lost through rotator turnover. They wanted to know how program officers are transitioned into the role. [III.1, V.3]*

   Response: Every effort is made to ensure that there is an overlap in the appointments of the incoming and outgoing program directors for a given program. In some cases when the incoming program director's appointment is scheduled to start after the incumbent program director will depart, the division has appointed the incoming program director as a part-time expert in order to allow the two program directors a couple of weeks to work together and transfer knowledge.

   In FY 2019, the division completed a transformation of its staffing plan to include an associate program director position in each cluster. This person is tasked with knowing the portfolio of the whole cluster and working with each program director in the management of their program. In some instances, the associate program director has stepped in to manage a program as the "acting program director" while the serving program director was absent for various reasons. This change has led to greater continuity of operations in the programs and better retention of institutional memory about the programs' objectives and research directions.

   CBET developed and implemented its own course for onboarding new program directors to the division. A series of five classes were designed around familiarizing new PDs with NSF policies and how they translate into the practice of running one of CBET's programs. Topics include the operational aspects of the program director position, how panels are set up by the division, the various steps involved in making and processing an award or decline recommendation, and common post-award actions. The classes were taught by current program directors, and more senior division members attended in order to add "institutional memory" to the discussions.

3. *Recommendation/Observation: The COV remarked, "Given the high proposal volume, additional staff may be needed," and "CBET contributes to a number of cross-disciplinary NSF big ideas. Given the disproportionally high proposal pressure for CBET, additional resources, in the form of staff and funding, should be provided." [III.1, V.3]*

Response: The division acknowledges the excellent work that the program directors and administrative professionals perform in handling some of the highest proposal volumes in the Foundation. The division has made every effort to structure the division staffing so that the work is distributed in a manner that provides staff sufficient time to process proposals as well as additional time to work on cross-Foundation activities, their own research work, or to perform outreach to and interact with the CBET community. The division continuously assesses whether additional resources would enhance the performance of the division and its mission to support the best engineering science research.

CBET also continues to investigate ways of streamlining the proposal review processes and to lead ongoing, directorate-wide efforts to standardize and simplify processes wherever possible. The Engineering Directorate's updated compliance process has helped significantly reduce proposal processing burdens on the staff. The division eliminated the "Administrative Review" step for all proposals being recommended for declination. CBET piloted, and the Engineering Directorate adopted, the elimination of submission deadlines for unsolicited proposals to its core programs. By accepting proposals at any time, Engineering Directorate afforded PIs the opportunity to think more creatively, build strong collaborations, converse with program directors and carefully prepare proposals with the potential to make significant research contributions to engineering. CBET has observed that the elimination of deadlines has reduced some burden on the division's workload (and on the research community) by spreading the work of proposal submission and processing over the course of the year.

4. *Recommendation/Observation: The COV noted one instance of the PO managing two programs and was concerned about how well the program office would be able to manage the workload. [III.1]*

   Response: The division is presently searching for a rotator program director to staff one of the programs in question and thereby relieve the incumbent program director from having to manage two programs simultaneously.

5. *Recommendation/Observation: "Overall, CBET has a well-defined process for planning and prioritization that includes revisions of program descriptions, an annual retreat, and workshops, as well as communication with the engineering research community. However, it is not clear how this planning, prioritization, and engagement with the community is done at the program or cluster level. It would be useful to have a mechanism for formally engaging with stakeholders, academic and industry, to determine areas of opportunity and impact of prior investments." [III.3]*

   Response: The division's process for planning and prioritization inherently involves the programs and clusters, because the process heavily involves program director participation. In terms of engaging with the research community, program directors participate in outreach activities to conferences, such as AIChE, BMES, and ASME, and

universities. They also attend conferences and workshops in their programmatic areas in order to stay current with the research trends in their fields and to engage with the various stakeholders. The division's programs also support several workshops per year in their respective fields to promote discussion about the forefronts of research and to learn more about new research directions. The division has also co-funded a few National Academies of Science, Engineering, and Medicine studies on emerging research opportunities.

The Engineering Directorate recently supported a workshop entitled, "NSF Engineering Research Framework Visioning Summit," that was intended to explore possible mechanisms for the engineering community stakeholders to regularly explore areas of opportunity for engineering science research.

6. *Recommendation/Observation: The COV wanted clarification on how CBET shifts its budget between and within clusters over the long term. [III.3, III.4]*

   Response: Because all four clusters in CBET support dynamic research communities that work at the forefront of engineering science research, the division has endeavored to maintain a stable balance of funding between the four cluster areas. Through its core programs, the division supports research with a longer-term outlook. The division uses set-aside funds in its budget to support special, shorter-term research initiatives and to partner with other divisions and directorates in exploring mutual strategic research objectives.

7. *Recommendation/Observation: The COV noted that from the last COV review period to this one, "Confusion and inconsistencies remain in how broader impacts are judged by panels. The broader impact criterion may benefit from more explanation and description, and clearer guidance as to how it should be assessed. There is evidence of a wide range of interpretation among both PIs and reviewers about what constitutes broader impact and how it should be weighted in the proposal ratings." [III.4]*

   Response: This remains an NSF-wide issue that is being addressed by the Foundation. Please see the response to item I-4 for ways in which the Foundation is exploring reviewer training, which includes information that describes and explains the broader impacts merit review criterion. The division is also revisiting its standard panel briefing presentation to incorporate the latest materials that describe the purpose and intent of the broader impacts merit review criterion.

IV. Resulting Portfolio of Awards

1. *Recommendation/Observation: The COV recommended that grants be of a larger annual amount and longer duration. [IV.2, V.4]*

Response: The division has revised its program descriptions to provide budget guidance to PIs in terms of graduate students supported and PI effort-months rather than in terms of a target overall budget amount. With this new guidance in place, the division aims to adjust upwards its annual award sizes over time. The division is also exploring mechanisms to support larger group research efforts.

2. *Recommendation/Observation: The COV thought that it was unclear why there is such a large variation in the EAGER funding rate among clusters. [IV.3]*

   Response: The data referred to by the COV contains a mix of EAGER proposals that were invited for submission on an individual basis and that were invited for submission by a Dear Colleague Letter (DCL). Special initiatives that used a DCL to invite EAGER proposal submissions brought in a bundle of proposals. The proposals were reviewed internally, and ultimately only a limited number of the EAGER proposals could be supported due to the availability of funds budgeted to the initiative. In contrast, EAGER proposals that were thoroughly vetted and invited for submission on an individual basis, exhibit a higher success rate. Consequently, clusters that were involved in one or two special initiatives that invited EAGER proposals via a DCL exhibited a lower overall EAGER funding rate than those that did not do so.

3. *Recommendation/Observation: The COV noted that "The balance of awards to different types of institutions looks to be reasonable although the awards to smaller, less well-known institutions are low. COV recommends evaluating this and set some goals." [IV.6]*

   Response: The division will evaluate this issue further.

4. *Recommendation/Observation: The COV offered the comment, "CBET is encouraged to pursue ways to develop early-stage and new investigators to help them be more successful in securing CAREER and other awards." [IV.7]*

   Response: In FY 2019, a CBET program director led an Engineering Directorate-wide effort to solicit and support a CAREER proposal writing workshop. The first NSF ENG CAREER Proposal Writing Workshop was held on April 1-2, 2019 in Alexandria, VA. Over 300 junior faculty from across all engineering disciplines attended the workshop and participated in activities to hone their abilities to develop research ideas and to write NSF proposals. They also participated in mock review panels to gain insights into how their proposals will be reviewed. The workshop was very successful and will be held again in 2020.

5. *Recommendation/Observation: The COV was concerned that for one cluster, the funding rate for three out of four programs is lower for proposals with the involvement of women and minorities than for proposals overall. [IV.9]*

Response: The division will evaluate this issue further.

V. Other Topics

1. *Recommendation/Observation: COV members recommend that NSF continually work on integrating the environmental questions with the process sciences. The EES cluster looks at the consequences of past and present issues (Environmental Engineering) and present and future issues (Environmental Sustainability). Effective integration with the process and fundamentals clusters is important to the vitality of them all. [V.1]*

   Response: The division recognizes the strategic value in supporting research that integrates the environmental engineering research disciplines with the process sciences across the division. CBET will study this issue in more depth and develop a response.

2. *Recommendation/Observation: There was a considerable discussion among COV members on the relative merits of initiating a peer-reviewed, pre-proposal process. Such a system may decrease the reviewing load on the community and the proposal evaluation load on the POs. [V.2]*

   Response: CBET and its sister division, Civil, Mechanical, and Manufacturing Innovation (CMMI), examined the outcomes from various merit review pilots conducted across the Foundation. Two divisions in the Biological Sciences Directorate (BIO) did solicit proposals to its core programs and review them using a two-step, pre-proposal/full proposal process. Based upon the impacts this type of review process had on their research communities and their internal administrative workloads, BIO discontinued using this system.

3. *Recommendation/Observation: The COV team noted CBET's participation in funding international collaborative research in special INFEWS initiatives with both China (NSF-C), focused on water-FEWS issues, and with the UK (EPSRC). The team advises the leadership team at CBET to assess the effectiveness of these collaborative international endeavors. The lessons learned here are likely to be valuable in deciding whether to expand such activities and involve other partners in the future. [V.3]*

   Response: CBET has been successful in leveraging funding with our international partners to support research projects that capture expertise and facilities that exist in other countries. The division believes that such funding opportunities benefit the CBET community, and we will look for additional opportunities to partner with foreign funding agencies where appropriate. We will consult with the NSF Office of International Science and Engineering to see if there are effective methods for assessing the outputs and outcomes of such international joint calls.