National Science Foundation

Directorate for Computer and Information Science and Engineering

Division of Computing and Communication Foundations
Division of Computer and Network Systems
Division of Information and Intelligent Systems

Management Response to the Committee of Visitors Report
April 2015

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[1] **"CISE Management Response" in this document refers to the coordinated response to the overall findings contained in the COV Report Executive Summary for the three CISE divisions participating in the COV.**

National Science Foundation
Directorate for Computer and Information Science and Engineering
Division of Computing and Communication Foundations
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Division of Information and Intelligent Systems

CISE Management Response[2] to the Committee of Visitors Report Executive
Summary
April 2015

Introduction

Three divisions of the Directorate for Computer and Information Science and Engineering (CISE) at the National Science Foundation (NSF) - the Divisions of Computing and Communication Foundations (CCF), Computer and Network Systems (CNS), and Information and Intelligent Systems (IIS) - held a three-day Committee of Visitors (COV) meeting on October 22-24, 2014, covering the period of FY 2010 through FY 2013.

NSF relies on the judgment of external experts to maintain high standards of program management, provide advice for continuous improvement of NSF performance, and ensure openness to the research and education community served by the Foundation. COV reviews provide NSF with assessments of the quality and integrity of the program operations and program-level technical and managerial matters pertaining to proposal decisions and portfolio balance.

The COV consisted of 30 members, including a Chair and a CISE Advisory Committee Member, selected for their expertise in areas of CISE research and education. The COV was divided into three subcommittees, one for each of CCF, CNS and IIS. Each subcommittee had a Vice Chair and was responsible for completing a report template for its assigned Division. In advance of the meeting, each COV subcommittee was provided with a comprehensive set of materials on a web-based portal, including (1) divisional annual reports covering the period FY 2010-2013, (2) a template for the COV report that included a detailed self-study with an overview of the Division activity and management during the review period together with statistical data relevant to specific questions; (3) the last COV report for each division and the divisional management response to its report; and (4) other material relevant to divisional activities. Also in advance, through the COV module in eJacket (an NSF electronic system for managing proposal review and post-award actions), each subcommittee was provided a random sample of the proposals received by its division during the review period. Upon request, access to additional proposal jackets was provided. This was the first CISE COV that provided the members with prior access to jackets.

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At the beginning of the meeting, the COV heard presentations from the CISE Acting Assistant Director (C. Suzanne Iacono), COV Chair (Peter Steenkiste), and the CISE COV coordinator (Deborah Lockhart) in a plenary session, followed by the Division Directors in subcommittee breakout sessions. Over the course of the meeting, the COV had the opportunity to talk with CISE staff and were provided with additional information as requested. We are extremely grateful to the members of the COV, particularly the Chair and the Vice Chairs, for their commitment and willingness to serve NSF and for the energy and enthusiasm that they brought to this activity.

Note: There are frequent references to "CISE" and "CISE staff" in the text below. It should be noted that, in most cases, these terms collectively refer to the three divisions in CISE covered by this COV: CCF, CNS, and IIS. The programs in the Division of Advanced Cyberinfrastructure (ACI) were not within the scope of this COV.

This response will consist of four sections: (1) A response to the overall findings of the COV contained in the report's Executive Summary and responses by each of the three divisions to the subcommittee findings for (2) CCF, (3) CNS, and (4) IIS.

Major Findings

The COV reported a number of major findings in the executive summary as follows:

- *"The merit review process is strong and working well, and CISE is continuously and proactively making refinements that improve its quality and efficiency.*
- *Review panels generally have well-qualified and balanced sets of panelists.*
- *Program management is grounded in effective processes and an exceptional team.*
- *CISE programs as a whole address national priorities, the agency's mission, and the needs of their constituents. To the degree that the COV committee was able to assess, the portfolio is also well-balanced along a number of dimensions."*

CISE is pleased with these findings and accepts them with no further comments.

The COV also found that:

"While CISE is doing very well and CISE-funded research is having a tremendous impact on society, both directly, and indirectly through inter-disciplinary research activities with many other NSF directories, the directorate also faces a number of major challenges:

- *The changes identified in Section 1 of the executive summary underscore the expanding intellectual breadth of CISE's mission, placing a tremendous pressure on the organization. Examples include a research portfolio that is covering an increasingly diverse set of research areas, an expanded role in education and infrastructure development, a steady increase in the number of proposal submissions, and new challenges in managing complex cross-cutting programs that involve other divisions, directorates and agencies. In contrast, funding levels have been relatively flat. For example, between 2010 and 2014, the combined budget of the CCF, CNS, and IIS divisions, increased on average by 2.4% annually. This will make it difficult, if not impossible, for CISE to maintain a strong balance of programs consistent with a long-term research agenda.*

- *One particularly urgent challenge is that the workload of CISE staff has significantly increased. Measures need to be taken if we want to sustain the same level of quality in the future, especially in light of the expected trends identified in Section 1.*
- *There are significant (lost) opportunities to increase efficiency and further improve quality by deploying a number of IT solutions, including both proven solutions supporting basic activities and support for business intelligence to improve program planning and assessment. These technologies need to be quickly adapted to NSF's processes and deployed for use in CISE and other directorates."*

Management Comment: The three CISE divisions under review have limited the number of submissions per investigator for nearly all of their programs. Several programs have ended and been transitioned to other programs, including core programs. We have introduced some efficiencies into the review process, e.g., more "boilerplate" documents and automated compliance checking, where appropriate. We have also recruited and appointed rotators with specialized knowledge to lead a number of our new cross-cutting programs. We are continuing to pilot activities that will lead to increased efficiency and quality of the merit review process. More details are provided below.

Findings in the COV Report Executive Summary

I.   Quality and Effectiveness of the Merit Review Process

Overall, the COV found that "*the merit review process is of high quality"* and that *"the core is a well-functioning panel review process in which each proposal receives substantial feedback."* It also found that *"CISE is proactive in investigating new approaches to further improve the quality and efficiency of the review process and to expand the pool of reviewers."* It added that *"while the merit review process is working well, further improvements depend critically on having access to appropriate IT tools and capabilities."* The COV also observed that *"reviewing cross-cutting proposals involves unique challenges that result from the fact that different, often radically different communities are involved."* CISE Management acknowledges these findings and will focus on the specific recommendations and issues raised in this section of the report that relate to improving the efficiency and quality of the merit review process.

COV Recommendation: *"Support for Modifying Existing Practices. Experimenting with new models for proposal review and for running panels requires resources, including staff, IT tools and technology, and data. As discussed above, it is often difficult to get approval to use new technologies, even those that are inexpensive and in widespread use in the research community. It is imperative that CISE invest the resources necessary to enable these activities and to adopt those determined to be most effective."*

Management Response: We agree that experimentation with new models and tools enhances our effectiveness and efficiency. For example, we are currently piloting the use of analytical tools in the portfolio analysis of several CISE programs, and we are studying and identifying best practices for some proposal documents (e.g., data management plans). We will continue to pilot promising new tools, taking into account cost-effectiveness and quality, through various CISE programs.

COV Recommendation: *"Fine-tune the Panel Review Process. While proposals generally receive a sufficient number of substantial reviews and panel summaries, not all reviews are sufficiently informative or address all necessary review criteria. While this is often addressed by obtaining additional ad hoc*

reviews after the panel meets, there is an opportunity to further improve quality and efficiency by proactively adjusting the review process. Examples include the use of customizable review templates and earlier deadlines for reviews. The former could be used to ensure that all criteria important for a specific program, e.g., the suitability of "collaboration plans", are addressed. The latter would facilitate pre-panel discussion, and would allow the program director to identify problems with expertise or review quality, and request improvements and/or solicit ad hoc reviews prior to the panel meeting."

Management Response: The current review template, accessed by reviewers through FastLane, is the same for all NSF proposals; however, some CISE programs already send additional questions on a form to reviewers that they can add to their reviews. We will look into whether this can be expanded further. We are already using specialized templates for panel summaries that address all the criteria for the given program. We will continue to request reviews well in advance of the panel meeting.

COV Recommendation: *"Systematic Use of Ad-Hoc reviews ahead of Panel meetings when Appropriate. Obtaining ad-hoc reviews ahead of panel meetings will augment and inform panel discussions, especially for interdisciplinary and cross-cutting programs (such as CPS) where it might be necessary to consult domain experts who are not suitable as panelists. CISE should also explore allowing ad-hoc reviewers to call in to panel meetings, ideally via videoconferencing, when the proposal they reviewed is discussed."*

Management Response: We agree that the use of ad hoc reviews is helpful as a means of ensuring thorough scientific and technical coverage particularly in the review of multidisciplinary proposals. Program officers will continue to be encouraged to consider inclusion of more ad hoc reviews for such proposals. While often a program officer can anticipate the need for ad hoc reviews in configuring such panels, it is true that at times additional needs are discovered after reviews are submitted and gaps in expertise are better understood. We agree that the inclusion of ad hoc reviewers in panel discussion can be very helpful in ensuring that this specialized perspective is taken into full account in panel discussion. Some program officers already make use of this practice where practicable occasionally, but it should be noted that there are some logistical issues to overcome, including scheduling of calls. We will continue to leverage this approach when practicable and reasonable, while balancing all requirements.

COV Recommendation: *"Documentation of Post-panel Process. The process by which CISE staff decides on recommendations after all panels have finished their work (cluster meetings, informal discussions with the DD, consideration of balance and other issues, etc.) appears to work very well. It would be good for this process to be systematically documented in eJacket (which in the jackets we reviewed usually contained only the final review analysis and consensus recommendation)."*

Management Response: We agree that documentation of the post-panel discussions of award recommendations at the cluster/program level and with the Division Director is a good idea and we will implement this in our context statements.

COV Recommendation: *"Interpretation of Broader Impacts. NSF and CISE have made substantial efforts to improve the understanding of the "broader impacts" criterion by PIs and reviewers, but the reviews in eJacket show that there is still great variability in its interpretation. We recommend that CISE continue its efforts to help reviewers and PIs understand what qualifies as broader impact, by continuing to support the development of explanatory materials (such as those available from the website http://cisebroaderimpacts.org/) and making sure that reviewers and PIs are aware of such materials."*

Management Response: We agree that more effort to help reviewers and PIs understand what qualifies as broader impact would be highly desirable. We will continue to refer PIs to the recently-developed enhanced descriptions of broader impacts available from the *Grant Proposal Guide* (www.nsf.gov/pubs/gpg/broaderimpacts.pdf). Panelists will continue to be briefed on both merit review criteria when reviews are originally requested and again at the start of panel meetings, and they will be pointed to this new material. CISE will also support the development of explanatory materials (such as those available from the aforementioned website http://cisebroaderimpacts.org/) and will encourage program officers to make reviewers and PIs aware of such materials. We will also continue to discuss broader impacts during outreach to the PI and reviewer communities.

II.   SELECTION OF REVIEWERS

Overall, the COV found *"that CISE is doing an excellent job recruiting high-quality panelists and reviewers"* and that the *"jackets showed that for the vast majority of proposals, reviewers had appropriate expertise and were collectively qualified, including many senior personnel and recognized leaders."* It also stated that *"program director efforts to ensure reviewer diversity in all dimensions – seniority, industry/academia/government, geography, gender, race, and ethnicity – are impressive."*

At the same time, it found that *"some programs appear to have a hard time recruiting panels with sufficient expertise, particularly in the case of interdisciplinary programs but also in some core programs. For example, some programs were anecdotally reported to have panelist acceptance rates of less than 20%. Recruiting qualified panelists is clearly a difficult and time-consuming process for program directors, and low acceptance rates can also affect the quality and balance of panels."* It stated that *"CISE is employing a variety of mechanisms to help address these problems. These include the use of ad hoc mail reviews to supplement the expertise provided by a panel, experimentation with virtual panels to reduce the time and travel required of panelists, and transferring proposals between programs to obtain a more appropriate review.   Each program director also seems to have developed his or her own system for tracking and inviting potential reviewers."*

We acknowledge these findings and will focus on the specific recommendations and issues raised in this section of the report that relate to the selection of reviewers.

COV Recommendation: *"CISE-level, if not NSF level, support for tracking and inviting reviews. Appropriate software support would reduce the burden on individual program directors, in terms of both the time and knowledge required to identify appropriate reviewers. Examples include software that identifies potential reviewers for a proposal by matching keywords or information extracted from publications, and tools to help in tracking and cultivating the pool of reviewers and panelists they can use in the merit review process."*

Management Response: There are new tools becoming available through the website Research.gov that are intended to provide NSF staff with search capabilities for NSF reviewers, and CISE intends to explore these as they are made available. Some CISE programs are also piloting approaches for aligning reviewers with panel dates and we will continue to explore these and related strategies. We also plan to share "best practices" across the directorate in order to increase the adoption of effective tools.

COV Recommendation: *"Outreach to expand reviewer pool. Expanding the reviewer pool is an effective way of improving panel expertise and balancing reviewing load across the research community. There is evidence that research communities where the community leadership has stressed the importance of serving on panels and where NSF program directors are invited to give presentations at major conferences have greater success in obtaining strong panels. We recommend extending such efforts, for example by establishing relationships with professional societies (ACM, IEEE, AAAI, SIAM, etc.) to increase acceptance rates and expand the reviewer pool."*

Management Response: We will continue our efforts through outreach to increase our pool of reviewers. Our outreach efforts include presentations at a wide variety of venues (meetings of professional societies, research conferences and workshops, NSF outreach forums, etc.) to urge prospective reviewers to volunteer by emphasizing the importance of their participation.

III.   Program Management

Overall, the COV found that *"the management of CISE programs is grounded in solid, well-functioning processes, exceptional staff, and effective management. These processes include: proposal evaluation processes, coordination of program clusters, proposal funding decisions…" "COV members were also impressed with the management of CISE and its various programs across all three divisions (both core and cross-cutting), which has contributed to notable successes. The most important contributor to these successes is the quality and hard work of program directors. The COV finds that the model of complementing permanent staff with rotators (IPAs) works very well, providing a healthy mix of institutional memory and "know-how" with new questions that lead to novel ideas. CISE has various mechanisms in place to enable each of these groups to work effectively from when they arrive and throughout their time at NSF. These mechanisms include mentoring, overlapping assignments, collaboration within clusters, and professional development opportunities (research, travel).   The COV was also happy to learn that CISE has reintroduced longer term professional development opportunities as another way for scientific staff to engage and work with the research community."*

However, the COV also found that *"workload and quality of life remain as issues of concern for program directors. Between 2009 and 2013 the number of proposal submissions increased by 6.8% annually, but it has not been accompanied by a commensurate increase in the number of staff or of funding for IT tools and infrastructure to reduce workload. NSF has been very successful in limiting the administrative overhead to a relatively low percentage of its budget. This is great since it leaves more resources for the research community, but in a period of relatively flat funding levels it also means that resources for staff are relatively flat as well and the size of the scientific staff is not keeping up with the increasing workload. The workload depends not only on the number of awards and their budgets, but also on the complexity of the programs (cross-cutting programs, which are growing in number, tend to have unique requirements and require coordination with other divisions, directorates and organizations) and on the number of proposals, both of which have increased. The COV stated that the changes noted in Section 1 of its report suggest that both trends will continue and may even accelerate."*

"To retain and recruit top talent," the COV stated that *"it is important to ensure that program directors have sufficient professional development opportunities, support from a strong administrative staff, and IT tools and capabilities that enhance their ability to complete their work."* It provided specific recommendations to help with the last issue in a prior section of the report. *"An important part of professional development is allowing program directors to connect and interact with the research*

communities they support." The COV was *"aware that CISE provides support to program directors for travel to conferences connected with the programs that they manage as well as for other professional development. However,"* it found that *"program directors cannot always use these opportunities because of the high workload and general restrictions on travel."* The COV stated that *"it is important that CISE continue to ensure that NSF is represented and in touch with the community."* It *"also identified some challenges specific to rotators, mainly around transitioning from their home institution to NSF and back, and improved mechanisms to allow them to maintain their research program while at NSF."* The COV noted that, *"as with the scientific staff, the administrative staff members are stretched thin since their numbers have not always tracked the workload, e.g., number of proposal submissions and panels. While the degree of the problem varies by division, the COV believes that this is a general issue that must be addressed. Another issue"* identified by the COV, *"related to the need for the use of more sophisticated data analytics in CISE program management, is that there is a need for staff with particular skills, such as data analysts and staff trained in IT technologies that will continue to see increased use in, e.g., virtual panels, review/reviewer management, and award administration."* CISE Management acknowledges these findings and will focus on the specific recommendations and issues raised in this section of the report that relate to program management.

COV Recommendation: *"**Expand support for rotators.** Attracting high-quality and respected rotators is crucial to maintaining the high quality of CISE's program management. CISE, and NSF, should address the disincentives hindering recruiting. First, support for rotators to maintain their research programs while at NSF and when they return to their home institutions would be beneficial. Such support could include increasing the use of continuation funding awards or a "restart" package that would ease the return to their home institution. We also recommend removing some of the barriers that exist for rotators who wish to transition to a permanent position at NSF (e.g., the requirement that they spend one year away between the two positions)."*

Management Response: We agree that it is of the utmost importance to recruit high quality program directors, and CISE will continue to make every effort to do so pursuant to NSF's existing policies. Some comments:
- Many of our scientific staff members (including nearly all rotators) have Independent Research and Development (IR/D) Plans that allow them to continue their research while they are at NSF, including travel funds for rotators to return home to work with their students or collaborators.
- Telework is an option used by many program directors (both rotators and permanent staff members); this permits flexibility in the location of the work site.
- While at NSF rotators may, through a substitute PI, submit a proposal, subject to the merit review process, for *continuation support for expiring grants.*
- Rotators who have returned to academia are immediately eligible to submit proposals to support their work; the only restriction is that someone else must serve as a negotiating PI for those who are within a year of their NSF departure.

COV Recommendation: *"**Improve existing mechanisms for training and professional development.** A few concrete recommendations in this area include: offering the onboarding training programs throughout the year in recognition that many program directors do not arrive in the fall; using more systematically (and periodically updating) the "Program Manager Survival Guide"; developing practices for program hand-off to facilitate periodic transitions in program management necessary to maintain freshness."*

Management Response: We agree that training and professional development are crucial for the CISE workforce. Some comments:

- A "survival guide" for program directors is currently being revised and updated, based on an earlier version.
- The cluster arrangement for the core programs is well-suited to mentoring new program directors by more experienced colleagues. Peer mentors are assigned, as needed.
- Since most program directors in CISE's research divisions work in clusters that include permanent staff, we are able to facilitate handoffs with minimal loss of continuity as rotators transition. This is sometimes accomplished, where feasible and practicable, by either continuing departing program directors or starting arriving program directors as part-time experts in advance of their full-time appointment.
- NSF-wide training in merit review and NSF policies has been readily available to new program directors in the fall; the NSF Academy is now offering them twice in the winter-spring timeframe.
- We have revived a long-term professional development program for permanent staff.

COV Recommendation: *"Size and type of Research Awards. The 2009 COVs noted that many proposal budgets were reduced and that there was a need for additional programs for new investigators. We note that the average size of the awards has increased and applaud the establishment of a Research Initiation Initiative for new investigators."*

Management Response: We will continue to monitor the size of awards to make sure that they are commensurate with the needs and scope of the projects. We have implemented the new CISE Research Initiation Initiative (CRII) and have made the first set of awards in early 2015.

COV Recommendation: *"PD recruitment, training and professional development. The 2009 COVs noted challenges in recruiting and onboarding of program directors, and the lack of resources for professional development. We observe that while progress has been made in many areas, the large increase in proposal submissions without a corresponding increase in staff levels has left CISE staff with an unsustainable workload given the current working environment."*

Management Response: As mentioned above: (1) The three CISE divisions under review have limited the number of submissions per investigator for nearly all of their programs, (2) Some programs have ended and been transitioned to other programs, including core programs, and (3) We have introduced efficiencies into the review process, e.g., more "boilerplate" documents, where appropriate. As we have expanded our portfolio of programs to take advantage of new scientific and educational opportunities and to develop new collaborations, we will continue to explore ways of accommodating these. In terms of staffing, we have, as appropriate, recruited outstanding candidates in specific areas as rotators and have used part-time experts to help during particularly busy periods. We continue to balance investments across our programs, including those for core and cross-cutting research, education, and infrastructure, mainstreaming special programs as appropriate.

COV Recommendation: *"Increased use of technology in support of proposal review. The 2009 COVs encouraged the adoption of reviewer expertise tools to facilitate panel formation and other common practices in conference and journal paper review systems, such as reviewer confidence ratings. We note that some tools are being used in some CISE programs."*

Management Response: Prior to final assignment of proposals to panelists, many program directors routinely ask the panelists to self-assess their level of expertise for each proposal using a simple scoring system; this enables us to assign reviewers with a high degree of confidence. We will continue to encourage program directors to continue this practice and to pilot additional methods for addressing reviewer expertise.

IV.   Resulting Portfolio of Awards

"At the level of portfolio planning, the COV found that CISE has done an outstanding job of balancing strategic, top-down priorities with bottom-up community-driven initiatives, and then bringing the community into alignment around those priorities." It also found *"that community-driven/bottom-up approaches are informed by submissions to the core programs as well as by a number of activities that gauge and build community interest around emerging topics, including program director presentations at professional meetings, funding of workshops to stimulate interest in new areas, and the use of RFIs and calls for community whitepapers."* The COV believed that *"CISE also works very effectively with other bodies, such as the National Research Council and the Computing Community Consortium (CCC), in identifying opportunities for new programs.   However, the COV also noted that some of these bodies may not encompass all of the research areas within CISE,"* so it encouraged *"CISE to explore additional means to systematically reach out to all of its constituent communities."*

Some questions asked the COV to evaluate various aspects of the balance, diversity, and substance in CISE's portfolio of awards.   The COV stated that it *was "limited in its ability to address these questions by the fact that the work of the COV focused primarily on process rather than outcomes, and a proper evaluation of balance and diversity issues requires nuanced statistical analyses (as well as policy decisions as to what constitutes an "appropriate" balance) that were not feasible for the COV to obtain (or even formulate). Nevertheless, based on the limited information available"* to the COV, it found that *"the portfolio balance and diversity generally looked appropriate."* In addition, it *"found that the CISE processes are well-designed to consider a range of criteria such as proposal merit, program balance, diversity, etc. In particular, the COV confirmed that"* intellectual *"merit"* and broader impacts are *"the basis of panel review, and that issues such as diversity, career stage, institution type, and geography are then taken into account by the program director and division director as they choose to make funding recommendations among the high-quality proposals."*

"The COV also found evidence in the jackets that reviewers and CISE staff were looking for innovative and potentially transformative projects. Many of the cross-cutting programs in CISE elicit multidisciplinary and interdisciplinary projects. It found that essentially all of the jackets reviewed discuss integration of research and education in some way, though the "education" component is not necessarily innovative (and this seems appropriate for CISE researchers who do not have an expertise in education research). Finally, it found the sizes of awards to be appropriate and that, in particular, most awards are being funded at levels close to the requested budgets."

"The COV also observed that CISE's program portfolio is rapidly becoming more diverse with important consequences." It believed that *"this trend is clearly a direct result of the rapid pace of innovation in, and the significant impact of, the technology areas that are part of CISE's mission as discussed in Section 1"* of the report. *"This diversification also results in an expanded role for CISE in several areas"* mentioned in the report and the COV stated that *"additional funding will be needed so CISE can contribute in these areas and further expand its impact without having to cut back on long-term research."*

CISE Management acknowledges these findings and will focus on the specific recommendations and issues raised in this section of the report that relate to the resulting portfolio of awards.

COV Recommendation: *"The COV was concerned that CISE staff did not appear to have access to sufficient data to answer important questions about the program portfolio. The COV observed that fairly basic data analytics tools could be very useful for spotting trends and providing CISE staff with insights about incoming proposals and the project portfolio (e.g., the correlation between number of submissions and the size/period of support in a given program, the extent to which unsuccessful proposals submitted to a core program are resubmitted to a cross-cutting one or vice versa, and the impact of changes in the portfolio on funding distribution across types of institutions). Industry has widely adopted such data analytics to optimize their processes and outcomes. Such technology could also be very useful to CISE, and NSF in general, for example to help understand how outcomes are impacted by changes in programs or process (e.g., how does an increase in large awards impact the funding distribution across states or types of institutions), information that can feed into portfolio optimization. It can also be useful in other areas, such as improving the efficiency and quality of the review process (e.g., by matching reviewers to proposals). Of course data analytics requires data. Unfortunately, it is not clear that the computing infrastructure offers easy access to relevant data, suggesting that wide-scale adoption of analytics technology may be a major challenge for NSF. The COV suggests that CISE develop a strategy for adopting data analytics to improve program planning and other activities."*

Management Response: As mentioned earlier, we are piloting the use of analytical tools in some of our programs to better understand their portfolios. We also expect that Research.gov, as it evolves, will be a useful platform and will enable us to perform additional pilots, as opportunities arise.

Organization of the COV Recommendations for Future COVs

Looking forward, the COV made the following recommendations for improving future COVs:

COV Recommendation*: "Do more work in advance of the in-person COV meeting. Because of unexpected circumstances, the preparation schedule for the COV was very compressed. Our experience confirmed the conclusions from previous COVs that the COV should be given access to the data, jackets, and other necessary information earlier, say, 2 months before the meeting at NSF. The COV also felt that asking members to do "homework" improved the efficiency of the breakouts significantly. It allowed the COV to use the time at NSF for discussion of the more substantive issues with the CISE staff and among the COV members. The use of online asynchronous discussion, virtual meetings, and collaborative document-editing space can further enhance preparations (and the subsequent drafting of the report)."*

Management Response: See below.

COV Recommendation: *"Provide more data analytics and documentation of processes. There are a number of questions that the COV is asked to comment on that would benefit from more detailed statistics regarding proposals and awards, which were requested during the process; it would be useful to provide as much of this information as possible at the beginning of the process. Also, given that much of the COV charge is to comment on processes, the COV would benefit from descriptions of these processes at the start of its work (prior to reading jackets), e.g., the post-panel award process, the PD*

recruitment and training process, the process for creating new programs, a description of governance and strategic planning processes at both the division and directorate level, etc."

Management Response: See below.

COV Recommendation: *"Clarify questions and instructions. Some questions are vague and/or difficult to answer with the data provided, e.g., requests to evaluate the appropriateness of geographic distribution of awards. Other questions (such as whether the portfolio contains projects that are innovative or potentially transformative) seem to require an evaluation of the outcomes of review process, rather than the process itself (which is the main focus of the COV's work). Clarification of what is expected of the COV in such cases would be useful. In other cases, providing clearer or easier-to-find directions on how to extract the data would be helpful to COV members."*

Management Response: See below.

COV Recommendation: *"Opportunities for additional benefits. While most of the time of this COV was spent in division-specific breakouts with plenary report-backs, future COVs could allocate some of the meeting time to cross-divisional breakouts and plenary discussions that focus on topics such as cross-cutting programs, the CAREER program, division director recruitment, cross-division programmatic planning, etc. Performing more of the COV work in advance of the in-person meeting at NSF as recommended above would free up more time at NSF for discussion of such issues. It would also be useful to present and discuss the directorate-level budget and program planning process, a topic that this COV had very little information on, but plays a critical role in, for example, the planning of crosscutting programs."*

Management Response: We greatly appreciate the substantive and constructive suggestions made by the COV in regard to the organization of future COVs. We have learned a great deal from the planning of our first multi-divisional COV. For example, as we responded to one subcommittee's request for data or other information, we provided the corresponding information to the other subcommittees about their divisions. We also, for the first time, provided access to the jackets prior to the on-site meeting and held an introductory webinar for the COV members several months before the on-site meeting. There were multiple teleconferences held in advance of the on-site meeting including ones for the COV leadership (the chair and vice chairs) and for each subcommittee. Should a multi-divisional COV be held in the future, we will explore means of having more discussion of cross-cutting programs. This will likely involve a restructuring of the meeting to allow for discussion of cross-cutting programs across subcommittees and more in-depth analysis. More generally, we will also convey the suggestions regarding the language in the COV template to the NSF officials responsible for developing and maintaining the templates.

National Science Foundation
Directorate for Computer and Information Science and Engineering
Division of Computing and Communication Foundations

CCF Management Response to the Committee of Visitors CCF Subcommittee Report

Introduction

The Division of Computing and Communication Foundations (CCF) of the Directorate for Computer and Information Science and Engineering (CISE) at the National Science Foundation (NSF) participated in a three-day Committee of Visitors (COV) meeting on October 22-24, 2014.

This section of the response will specifically address the findings of the CCF Subcommittee; the response to the COV summary has been presented earlier. The CCF Subcommittee consisted of 10 members, including Chair Salil Vadhan of Harvard University (who was a Vice Chair for the full COV), Allan Borodin of the University of Toronto, Michelle Effros of the California Institute of Technology, Kathleen Fisher of Tufts University, Rajesh Gupta of the University of California, San Diego, Daniel Gusfield of the University of California, Davis, Howard Karloff of the Georgia Institute of Technology, Ananthram Swami of the Army Research Office, Avi Wigderson of the Institute for Advanced Study, and David Wood of the University of Wisconsin, Madison. Over the course of the meeting, the CCF Subcommittee members had the opportunity to talk with CCF staff and were provided with additional information as requested.

We are extremely grateful to the members of the entire COV, especially the members of the CCF Subcommittee, for their commitment and willingness to serve NSF and for the energy, enthusiasm, experience, and insights that they brought to this activity.

CCF SUBCOMMITTE FINDINGS

I.   QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESSES

We are pleased at the number of positive comments in this section of the report: The subcommittee found that:

- The review methods used during this period (for example, panel, ad hoc, site visits) were *"very appropriate and effective."*
- The use of triage is an effective measure to reduce the workload of reviewers, panelists, and the community at large to keep up with growing review burden.
- *"Both review criteria were universally addressed in reviews and in panel summaries,"* and that the intellectual merit criterion *"plays a very clear and consistent role in the evaluation process."*
- Many reviews of proposals were found to be substantive; *"some amazingly so."*

- *"Panel summaries generally do an excellent job of providing the rationale for the panel recommendation, both highlighting points where the panel agrees and making note of cases where a difference of opinion persists even after the discussion."*
- *"Good rationale is generally included in the program director's review analysis in cases where the funding is recommended,"* and *"good rationale is also generally made available to the PI in cases where the proposal is funded."* Additional comments for cases where the proposal is declined appear below.

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: The CCF Subcommittee recommended that *"CCF continue to experiment with modifications to the review methods in order to both increase the effectiveness of the review process and decrease the workload of the community and the CCF staff."*

Management Response: CCF appreciates the positive feedback on the effective combination of panel reviews, ad hoc reviews, and site visits as mechanisms for merit review. The division will continue to seek the most effective combination of these methods, and where prudent, revise methods and pilot innovative methods to ensure the highest quality merit review.

COV Finding: The CCF Subcommittee suggested the following measures to improve the quality of review for interdisciplinary proposals:
- *"Increased use of external, ad hoc mail reviews to augment and inform the panel discussions."*
- That *"CISE should ask panelists to return reviews at least two weeks before the panel meeting"* to *"provide PDs sufficient time to recruit ad hoc reviews if needed."*
- That program officers invite ad hoc reviewers to call in to the panel meeting where possible and practicable.
- That *"reviewers provide a confidence rating for reference by the program directors and panel (but not returned to the PI) and to give panelists the option to decline to review a proposal without prejudice if his or her expertise is insufficient."*

Management Response: CCF will seriously take into consideration the recommendations of the COV related to timeliness of reviews and integration of ad hoc reviews into the merit review process. The CISE Management response points out that it is the practice of many program officers in the Directorate to encourage submission of reviews well in advance of the panel. However, we are also attentive to tradeoffs associated with such a practice. It is the experience of many program officers in CCF that on the day of a panel, panelists who have submitted their reviews well in advance exhibit less familiarity with both the proposals and their reviews of those proposals. We acknowledge that, on occasion, having access to reviews two weeks in advance might allow a program officer to recognize the need for an ad hoc review and obtain that review in time for the panel. We encourage program officers to take these experiences into consideration and to balance these considerations as appropriate for the particular circumstances of individual competitions and panels.

CCF acknowledges the value of considering the confidence of reviewers. At present, this is a practice that is normally employed by program officers in the assignment of proposals to reviewers. The typical process followed by program officers is to obtain confidence ratings on a three- or four-point scale and, on this basis, make review assignments in such a way that maximizes the expertise on the panel and

ensures that proposals do in fact receive expert reviews on the full breadth of scientific claims. The exact procedure used by program officers in the division varies. While most ask reviewers for their confidence (or level of self-reported expertise) to review the proposal, others simply ask for a preference (which may or may not be useful as a less direct indicator of confidence or expertise). CCF will examine the techniques used in the division and standardize the practice of obtaining such ratings in advance of the panel, providing suggestions within that policy that avail program officers of best practices while granting needed flexibility. CCF will document this as a division standing operating procedure.

We recognize that the aforementioned procedure is not the same as requesting that the reviewers submit confidence ratings as an element of the review itself. While it would be additionally informative to obtain a rating as a required data element in the review process, FastLane currently lacks a mechanism to collect this in a reliable and uniform way. Program officers currently assess the strength of the review record based on the written reviews and panel discussion. Until FastLane supports the submission of confidence ratings as a data element, we will continue this practice.

COV Finding: The CCF Subcommittee found that at times review analyses addressed only review process and panel outcome, and did not specifically address merit review criteria.

Management Response: CCF Management agrees that best practice is to consistently address the intellectual merit and broader impacts of a proposal in the review analysis. While this is done in most cases already, CCF will make sure that this is a standard practice for all awards and competitive declinations. In the case of declinations that are judged by the panel to be low competitive or not recommended for funding, the CISE practice is to use a standard review analysis that refers to the deficiencies in these merit criteria already specified in the individual reviews and panel summary(ies). We believe that this practice should be maintained in an effort to manage the ever-increasing workload of CCF program officers and staff.

COV Finding: The CCF Subcommittee *"found large variability in how the broader impacts criterion is interpreted by reviewers and PIs."* The committee also found that this criterion is *"often addressed with generic text that could be applied to almost any proposal, so it is not clear how it can play a meaningful role in proposal evaluation."*

Management Response: CCF Management agrees with the overall CISE Management response related to helping reviewers and PIs to better understand what qualifies as broader impact. We also observe that PIs often address broader impacts in a very general way. We agree that more effort to help reviewers and PIs understand what qualifies as broader impact would enhance all of these efforts. CCF will continue to refer PIs to the recently-developed enhanced descriptions of broader impacts available from the Grant Proposal Guide (www.nsf.gov/pubs/gpg/broaderimpacts.pdf). CCF will also support the development of explanatory materials (such as those available from the website http://cisebroaderimpacts.org/) and will encourage program officers to make reviewers and PIs aware of such materials.

COV Finding: The CCF Subcommittee noticed some written reviews that lacked adequate substance, and offered a number of suggestions for ensuring more informative reviews:
- *"Encourage panelists to submit the reviews well in advance of the panel meeting to enable the solicitation of additional reviews and to enable [the] program director to ask for more detail on some reviews.*

- *Identify ad hoc reviewers to fill in missing expertise in the panel.*
- *Require reviewers to indicate their confidence level in the review (for reference by the panel and program director).*
- *Encourage a more uniform structure to reviews by instructing reviewers to follow more detailed templates (customized by the program director)."*

Management Response: The first three recommendations are identical to corresponding recommendations in the earlier section dealing with review quality for interdisciplinary proposals, and for those items, we refer the reader to our response in that section. In addition, we agree that detailed and customizable templates can be a useful tool to encourage complete and substantive reviews. We concur with the CISE Management response on this topic regarding our current use of templates for reviews and panel summaries. In CCF, we will continue to refine such review templates to best suit particular programs.

COV Finding: The CCF Subcommittee made a number of recommendations to improve the documentation of rationale for award/decline decisions:
- In some cases, in particular for declined proposals, *"more details on rationale would be useful."*
- More systematic documentation of a panel's ranking of the proposal is recommended for the program director's review analysis.
- That the division discussions which are undertaken subsequent to panel outcomes and prior to award recommendations be documented in eJacket

Management Response: We agree that it is desirable that program officers document in full detail the rationale for both awards and declinations. This will be accomplished in part through aforementioned planned efforts to consistently address the intellectual merit and broader impacts of a proposal in review analyses.

Regarding documentation of a panel's ranking of a proposal in the review analysis, CCF recognizes that this information about a proposal's relative ranking can provide valuable context to understand the rationale behind recommendations to award or decline a proposal. Many of the panels don't assign exact ranks to the proposals, however. In most cases, program officers can distinguish whether a proposal is in the upper or lower half of a category. When this information is critical in the rationale for a recommendation, the program officer will include this information in the Review Analysis. In addition, the panel findings are advisory to NSF and other factors may be taken into consideration as the program officer formulates a recommendation. This policy is consistent with that of the other divisions in CISE and other NSF directorates.

Finally, we will add to the context statement (that is part of the proposal record in eJacket and that accompanies every review packet) documentation of the discussion process that is undertaken by program officers and division management subsequent to panel outcomes and prior to award recommendations.

COV Finding: The CCF Subcommittee noted that at times a proposal might be rejected for reasons that go beyond what is documented *"in the panel summary,"* but may be apparent in *"the program director's review analysis."* In such cases, *"rationale for rejected proposals may be communicated to the PI by phone or email."* The subcommittee recommends *"documenting such conversations more consistently in e-Jacket as diary notes or communications."*

Management Response: We agree that it is prudent to more consistently document, in eJacket, the email and phone conversations that may take place between the program officer and PI regarding these decisions, and we will require this as a standard practice among program officers. In addition, program officers will be reminded that they also have the "PO Comments" mechanism available to them in eJacket. When such rationale is recorded proactively as a PO comment, it is both part of the record and automatically forwarded to the PI as part of the review packet.

COV Finding: The CCF Subcommittee found *"some interdisciplinary proposals (e.g., in computational biology) that might have been better fit for a different division."* On the assumption *"that in such cases it is likely that transfers were considered,"* the subcommittee recommends *"that such steps be documented in eJacket."*

Management Response: The efforts related to the potential transfer or sharing of proposals will be documented in the review analysis where applicable, or as a diary note if necessary.

COV Finding: The CCF Subcommittee recommends providing reviewers with access to a PI's prior *"proposal history"* and relevant *"panel feedback on related proposal(s) by the PI, leading to a more informed judgment on the approach taken and potential impact of a proposed effort."*

Management Response: While we appreciate the Subcommittee's perspective, this practice would also introduce the potential to bias the panel, undermining the principle of evaluating the merits of a proposal as it stands, without direct comparison to other proposals (even if those proposals were from the PI's history). It is unavoidable that on occasion reviewers may recall having reviewed previous incarnations of proposed research ideas. However, those reviewers have no access to either those proposals or the related reviews. In other cases, PIs themselves elect to devote space in a proposal to explain their responsiveness to prior review feedback. This might introduce additional burdens to managing conflicts of interest in the panel, as new sources of potential COI could arise from institutions and senior personnel in such proposals from the PIs' proposal history (depending on the level of detail expected in this process). In any case, while reviewers are free to take such information into account, they are nonetheless charged with judging the intellectual merit and potential broader impact of the proposal under consideration, as presented, since NSF policy requires that each proposal be evaluated on its own merits.

COV Finding: The CCF Subcommittee encouraged *"CCF to continually think about ways to reduce workload on the CCF community (PIs, reviewers, and CCF staff) while maintaining the high quality of the portfolio."* Possibilities offered by the subcommittee are:
- *"increasing award durations*
- *decreasing the page length of proposals (especially on smaller awards)*
- *encouraging greater use of accomplishment-based renewals."*

Management Response: CCF is committed to managing workload for PIs, and reviewers, and CCF staff. CCF will continue to make use of process improvement and standardization, and to continue to look for opportunities to pilot or adopt new technology as it comes available. CCF will also periodically assess proposal requirements, award sizes, award durations, and success rates, striving for an appropriate balance across these dimensions. For example, increasing award durations could in turn result in decreased success rates. Similarly, as accomplishment-based proposals are paneled with all other proposals, these will require considerable education of the PI and reviewer community.

II.   SELECTION OF REVIEWERS

We are pleased with the positive comments in this section of the report. The CCF Subcommittee reported that:

- Overall *"the expertise and qualifications of the reviewers evident in the reviewed jackets was found to be, quite good."*
- Conflicts of interest were recognized and resolved appropriately.

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: The CCF Subcommittee reiterated that *"cross-disciplinary panels tend to give shallower reviews (perhaps due to lack of expertise),"* and thus recommended *"that CISE consider greater use of the hybrid model of ad hoc reviews and panel reviews, as discussed in answers to earlier questions."*

Management Response: Please see the corresponding response in Section I of the CCF response.

COV Finding: The CCF Subcommittee recommended that CISE engage the communities in which recruiting strong panelists is an ongoing challenge, *"to encourage greater participation and engagement with panels."* The committee went further in recommending that CISE provide incentive for funded PIs to serve on panels, such as consideration of the PI's *"history of past panel participation in proposal reviews"* as well as the establishment of *"an honor roll, listing all the panelists who served in the last 3 years."*

Management Response: We agree with the CISE Management response to this topic, and intend to fully participate in adopting new tools and strategies, as they are made available to us. In addition, we note that overall in CCF, the quality of panelists in each cluster of CCF is high and the acceptance rate in response to panel invitations is very good. CCF will continue to engage the communities in emphasizing the value and importance of such NSF panel service. CCF will explore the concept of an honor roll with the rest of CISE. However, the recommendation that panel service be used as a discriminator in evaluating or recommending a proposal runs counter to NSF policy about preventing any forms of bias from appearing in the review process.

COV Finding: The CCF Subcommittee recommended *"that NSF provide program officers with a tool for systematically tracking the panelist and reviewer pool."*

Management Response: CCF fully concurs with the CISE Management response (to the COV summary report) pertaining to this item.

III.   MANAGEMENT OF THE PROGRAM UNDER REVIEW

We are pleased at the number of positive comments in this section of the report. The CCF Subcommittee reported that:

- Management of CCF programs is working well. NSF staff and Program Directors were judged to be *"doing an amazing job given very tight resources… remarkably committed, conscientious and professional."*
- *"The combination of permanent staff and rotators (IPAs) on the CCF staff provides a healthy mix of institutional memory and novel ideas."*
- *"CCF is very responsive to emerging research and education opportunities, as evidenced by the workshops it has run and the special programs we reviewed (such as Cyber-Innovation for Sustainability and Engineering (CyberSEES), Expeditions in Computing (EiC), Exploiting Parallelism and Scalability (XPS), Interface between Computer Science and Economics (ICES))."*
- Activities designed to obtain *"input from the community on emerging research"* were seem as *"very effective."* These include *"interaction with the Computing Community Consortium (CCC) and the Computing Research Association (CRA) as well as CCF-sponsored workshops."*
- CCF was quite responsive to previous COV reports. Examples include reducing cuts in funded proposals, support to larger, more ambitious projects, and providing materials to reviewers and guidance on broader impacts.

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: *"It is important for CISE to pay close attention to quality of life issues for program directors, including workload and professional development. The number of submitted proposals to CCF increased significantly in 2013, but the number of program directors has not significantly increased and the amount of administrative support has declined. As the number of CISE researchers and hence the number of proposals will very likely grow significantly in the next five years, we believe that the workload issue needs to be addressed. Possible remedies include increasing staff levels or decreasing proposal pressure by increasing the duration and amount of awards."*

Management Response: CCF agrees with the CISE Management response to the COV summary report, and has nothing to add.

COV Finding: *"CCF should continue to look for ways to help the permanent staff retain freshness (e.g., by giving them the opportunity to work with different people or programs), and for the rotators to quickly acquire some of the institutional memory (the "program manager survival guide" is an excellent example)."*

Management Response: CCF agrees with the CISE Management response to the COV summary report, and has nothing to add.

COV Finding: The subcommittee added that while CCF has excelled at *"identifying new opportunities, it is important that CCF continues to invest in its Core Programs, as research on foundational topics remains an important and necessary foundation for addressing emerging issues."*

Management Response: CCF agrees that it is important to maintain support to the core programs even as we respond to innovative research trends through crosscutting programs. We are pleased that the COV noted the overall consistency of funding rates in the core programs, and we will continue to manage this balance in close consultation with the CISE budgeting process.

COV Finding: The subcommittee noted under program planning and prioritization that,

"It is important to note that organizations such as the CCC and CRA do not represent all of the communities in CISE, which covers more than just computing research. In particular, the Communications, Information Theory, and Signal Processing Communities (corresponding to the CIF program in CCF) are not represented by these bodies. In addition, this community has no representation on the CISE advisory committee, and has never had a representative on the CISE staff above the program director level."

Management Response: CCF recognizes the importance of engaging the full breadth of disciplines represented in the division's research portfolio. In particular, we will continue all efforts to engage the CIF communities through their professional organizations. More broadly, the CISE Directorate as a whole is committed to representation from the breadth of the CISE community in its panels and workshops (when appropriate) and advisory committee.

COV Finding: The subcommittee provided a range of comments pertaining to responsiveness to previous COV comments and recommendations. In most cases, we provide no further comment on items that were addressed elsewhere in the report (and in this response). The remaining items are addressed in turn (with the COV's original numbering for ease of reference):

"5) The suggestion to solicit confidence ratings with reviews was not adopted. The justifications given were that (a) panelists already indicate review preferences before being assigned proposals to review, (b) program directors can assess confidence during the panel discussion, and (c) this information should not be provided to PIs. Regarding (a), we believe that review preferences based only on titles are not an adequate substitute for confidence ratings after reading a proposal. Regarding (b), the panel discussions are too late for a program director to request additional reviews (if those are to be available at the panel meeting), and also the confidence portrayed during discussions may be a reflection of personality as much as expertise. Regarding (c), it was not suggested that this information be made available to PIs – it is to assist the program director and the rest of the panel in calibrating the review. Thus we repeat this suggestion in our answer to Q1 of Part I."

Management Response: As noted in the CCF response to the referenced COV subcommittee report under Quality and Effectiveness of the Merit Review Process, program officers do solicit, in advance, confidence ratings (or sometimes, alternatively, "preferences") from panelists for this purpose. CCF's action plan for this item is contained in that previous section.

"6) Another recommendation was that panels be given sufficient time prior to the meeting to read all relevant materials. The CISE management response is that the policy is now that proposals are made available to reviewers 6 weeks in advance of the panel meeting. However, the experience of COV members is that the actual assignment of jackets to individual reviewers occurs later and is often not sufficiently in advance of the meeting."

Management Response: CCF concurs with the CISE practice to make proposals available to reviewers well in advance of the panel meeting (at least four and usually six weeks before reviews are due). We will monitor this practice and make every effort to afford panelists ample time to review assigned proposals.

"7) The 2009 COV recommended that CISE initiate a study of per-PI funding. The updated response

indicates that this is now possible, but when we requested such data, we were told that it is too difficult to obtain. Such data would be helpful to both CISE and the COV in assessing the health of the portfolio and the workload on the CISE community that comes from PIs submitting multiple proposals."

Management Response: CCF regrets any misunderstanding on what is available in reporting modules related to "per-PI funding," that is, the distribution of PIs with respect to annual NSF funding. We will continue to make available appropriate data to future COVs.

COV Finding: *"One significant 2009 COV comment that was not addressed in the response, and which we repeat in our answer to Q3 of Part III, is that the CISE advisory committee should be representative of all of the communities involved in CISE - in particular, information theory, communications, and signal processing (the "I" in CISE)."*

Management Response: CCF acknowledges the importance of representing the disciplinary communities comprising the "Information" component of CISE. For example, a prominent researcher from the fields of communications and information theory has very recently been a member of the CISE advisory committee. Additionally, while significant contributions indeed come from the Communications and Information Foundations (CIF) program in CCF, we also acknowledge that the theme of information is pervasive throughout CISE, and touches more than just the CIF disciplines listed by the COV subcommittee. "Information science," for example, plays a dominant role in the Information and Intelligent Systems (IIS) division of CISE.

Beyond this specific concern, we take the spirit of the recommendation to be that the CIF community should be as engaged as any others in CISE, and on this we agree. We would like to point out that an NSF Science and Technology Center (STC) award in the field of Information Theory places this discipline in the company of a very small number of large, flagship grants for the Directorate. And this upcoming year, the CISE Distinguished Lecture Series will feature eminent representation from that community with the visit of Professor Arogyaswami Paulraj. We remain committed to full engagement with all communities represented in the CCF portfolio.

IV.   RESULTING PORTFOLIO OF AWARDS

We are pleased at the number of positive comments in this section of the report. The CCF Subcommittee reported that:

- The program portfolio was found to have an appropriate balance of awards across disciplines and sub-disciplines of CCF.
- *"CCF is awarding budgets that are a significant fraction (91%) of the requested budgets. Over 90% of the awards receive at least 80% of their requested funds."*
- The CCF program portfolio includes awards for projects that are innovative or potentially transformative, and *"the innovativeness and potentially transformative nature of proposals were regularly a factor in the recommendation for funding."*
- The CCF program portfolio includes inter- and multi-disciplinary projects.
- The process used to consider the geographical distribution of Principal Investigators and institution type was judged to be appropriate.

- New investigators are being funded in *CCF "at nearly the same rate as repeat investigators (and the two rates have been getting closer over time)."*
- *"Essentially all of the jackets reviewed discuss integration of research and education in some way."*
- The process used to consider the participation of underrepresented groups was judged to be appropriate.
- *"CCF portfolio is highly relevant to national priorities, agency mission, relevant fields, and other constituent needs."* Cited were many CCF programs that respond to PCAST Reports,
    - "Designing a Digital Future: Federally Funded Research and Development Networking and Information Technology (NIT)", December 2010
    - PCAST Report on the National Nanotechnology Initiative - 5th Review (Oct 2014)
    - PCAST Report on Big Data and Privacy (May 2014), PCAST Report on Cybersecurity (Nov 2013)
    - PCAST Report on Climate Change (March 2013)
- *"A high percentage of the projects funded by CCF were found to be very strong. CCF is doing a great job in managing the enormous intellectual breadth covered by its programs."*

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: The committee *"observed a significant decline in the funding rate of Large proposals over the past four years,"* and recommended that *"the CCF program staff monitor the situation and continue to ensure that Large proposals are properly evaluated."*

Management Response: We, too, observe the decline in the funding rate of Large proposals. CCF will closely monitor the review and funding recommendations related to proposals in this competition to take into account the value of large-scale efforts in consideration of portfolio balance. CCF will also engage the PI community on best practices for developing and proposing Large projects through an upcoming CISE workshop designed for that purpose.

V.   OTHER TOPICS

We are pleased at the number of positive comments in this section of the report. The CCF Subcommittee reported that, *"The CISE staff worked very hard to provide us with lots of data that we requested on very short notice in preparation for the meeting."*

We acknowledge the above comment without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: *"The program would benefit greatly from being able to adopt any of many widely available software tools to better manage its review process and activities."*

Management Response: CCF fully concurs with the CISE Management response (to the COV summary report) pertaining to this item.

COV Finding: *"Future COVs would benefit greatly from being able to start its work much earlier. Descriptions of the decision processes in CISE and the CISE organization chart and updated responses to the previous COV report should be provided to COV members before they start reviewing jackets (which*

should start at least 2 months before the COV meeting). This would enable many parts of the evaluation to be already discussed (by conference call) and additional data requested well in advance of the physical meeting, leading to less of a scramble for the CISE staff, a more productive use of the time at NSF (focusing in issues that require discussion with the CISE staff or other COV subcommittees), and ultimately higher-quality feedback."

Management Response: CCF fully concurs with the CISE Management response (to the COV summary report) pertaining to this item.

**National Science Foundation
Directorate for Computer and Information Science and Engineering
Division of Computer and Network Systems**

CNS Management Response to the Committee of Visitors CNS Subcommittee Report

1. Introduction

The Division of Computing and Communication Foundations (CCF) of the Directorate for Computer and Information Science and Engineering (CISE) at the National Science Foundation (NSF) participated in a three-day Committee of Visitors (COV) meeting on October 22-24, 2014.

This section of the response specifically addresses the finding of the CNS subcommittee. The CNS subcommittee consisted of nine members, including Chair Azer Bestavros of Boston University (who was a Vice Chair for the full COV); Ken Calvert of the University of Kentucky; Teresa Dahlberg of The Cooper Union (also a member of the CISE Advisory Committee); Serge Fdida of Université Pierre et Marie Curie; Ann Gates of the University of Texas at El Paso; Loretta Moore of Jackson State University; J. Christopher Ramming of Intel Labs; Christoph Schube of Ericsson; and David Taylor of the University of Waterloo. Over the course of the meeting, the CNS Subcommittee members had the opportunity to talk with CNS staff and were provided with additional information as requested.

We are extremely grateful to the members of the entire COV, especially the members of the CNS Subcommittee, for their commitment and willingness to serve NSF and for the energy, enthusiasm, experience, and insights that they brought to this activity.

2. CNS Subcommittee Findings

2.1 Quality and Effectiveness of Merit Review Processes

In general, the COV praised the quality and effectiveness of the merit review process as followed in CNS. Of particular note was support for the innovations made in the panel review process, the practice of funding high-risk proposals and providing seed funding via EArly-concept Grants for Exploratory Research (EAGER) awards, and the practices used to mitigate the potential downsides of the panel process (e.g., challenging "group think" and ensuring that the program director, as well as the division director, treat the panel as advisory).

Some specific issues were raised:

i. The COV noted that "... *increased review attention will be needed concerning the intrinsic merit of a proposed collaboration, including a more critical review of the collaboration plans*." We agree. As well as co-funding a NAS study into the Science of Team Science, CNS program directors have been talking with researchers in the area of the Science of Team Science on the possibility of holding a workshop, attended by principal investigators (PIs) and program directors (PDs) alike, to address these issues.

ii. The COV felt "*it is important to convey to reviewers the various phases of proposal processing*" because "*it would help reviewers appreciate the contexts in which their assessments will be used, especially as it relates to the post-panel consideration of these reviews*." We will augment our panel briefing to include this information.

iii. The COV noted that "*it may be useful to include* [the results of prior research] *explicitly in the criteria for evaluating intellectual merit, and to prompt reviewers for this information using the FastLane review template*." We will discuss this idea within CNS and with the other divisions of CISE, since doing this would be best done uniformly across CISE.

iv. The COV observed that "*it would be valuable for NSF to seek ways to modernize its ability to track and interpret 'big data' about its programs and expand the capabilities of the 'Award Manager Dashboard'. The availability of such capabilities would be quite valuable not only to NSF personnel, but also to future COVs*." We agree that such tools would be valuable. We will continue to experiment with new approaches for tracking our investments.

v. The COV suggested that "*NSF may realize a greater impact by sustaining some successful initiatives because of their demonstrated broader impact, rather than focusing solely on new initiatives with high intellectual merit*." We agree. Indeed, CISE issued a Dear Colleague Letter (DCL) titled "Sustaining CISE Research Infrastructure" (NSF 15-007: http://nsf.gov/pubs/2015/nsf15007/nsf15007.pdf) stating, "*CISE recognizes the importance of stable community infrastructure ... [and] notes particular interest in proposals that aim to sustain existing community research infrastructures that have provided, and continue to be of, significant value to the CISE research community*." CNS will evaluate the impact of releasing this DCL, and consider the COV's recommendation in future activities.

2.2 Selection of Reviewers

The COV was generally pleased with the quality of reviews. It found that reviewers had appropriate expertise and were collectively qualified, including many senior personnel and recognized leaders.

The COV did recommend that "... *NSF continues its efforts to work in partnership with minority groups and organizations to identify and select individuals from underrepresented populations to serve on panels*." We will indeed strive to identify and select reviewers from a diverse population, including reaching out to such organizations.

2.3 Management of the Program Under Review

The COV was emphatically positive in its evaluation of CNS's management of its programs, saying that it is "*grounded in solid, well-functioning processes and exceptional staff*," and explicitly calling out the efforts of the CNS program directors. It also complemented CNS on its response to the 2009 COV comments and recommendations, noting significant progress in several areas.

The COV raised the following comments and recommendations:

i. It noted that attention must be paid to the increasing workload on program directors. The COV recommended that NSF identify (or develop) tools that would increase efficiencies and optimize processes. We will continue to monitor workload and look for innovative solutions that can be implemented within the constraints of NSF's rules and policies.

ii. It asked CNS to take steps to "*disseminate information (e.g., Presentations or panels at conferences, Dear Colleague communications, Editorials in widely-read magazines such as CACM) that remind the community of [portfolio planning and prioritization] processes and mechanisms for up-streaming ideas/input/opportunities to CNS*." We will continue to expand our efforts in this direction.

2.4 Resulting Portfolio of Awards

While the COV felt that CNS's portfolio was strong and balanced – with inter- and multi-disciplinary research, broad geographical distribution, inclusiveness of new investigators – it did note that questions about "appropriate balance" were hard to answer with respect to institution type and under-represented groups lacking "*proper, agreed-upon metrics for 'appropriateness'*." The COV observed that, for both institution type and under-represented groups, *"this might be a good subject for further analysis to determine the appropriate balance of awards."* We appreciate the difficulties faced by the COV in terms of how these questions were framed and will pass this feedback on to the NSF Office of Integrative Activities (OIA), which oversees the COV process. At the same time, we note that there has been, and continues to be, considerable study into the importance of diversity in science, technology, engineering, and mathematics (STEM) research and pipeline development. As a recent example, the Council of Independent Colleges (CIC) released a report in April 2014 on the contribution of small and mid-sized private, nonprofit colleges to the STEM pipeline (see http://www.cic.edu/Research-and-Data/Research-Studies/Documents/STEM-Report.pdf), noting that such institutions have an important role in preparing the nation's scientists.

2.5 Other Topics

The CNS COV noted that the coordinated COV was a good practice, and offered a few suggestions on how it could be improved (e.g., ways to compare observations and recommendations for cross-cutting programs). The COV also made other concrete suggestions:

i. It encouraged CNS to continue to innovate in the review process.

ii. It observed the importance of scaling efforts (infrastructure, education, and broadening participation), and asked that we ask proposers to clarify the impact of scaling and lessons to be learned from it. This also impacts the review process of such proposals.

iii. It asked that data presented to the COV be done so uniformly across awards, projects, and proposals to allow comparative analysis and allow easier consideration of trends. It also noted that receiving data as spreadsheets rather than as PDFs would allow for better manipulation and analysis.

iv. It asked that, rather than asking whether there was an "appropriate" balance, future COVs should be asked whether there is "evidence to the contrary."

These topics cut across all CISE divisions that participated in this COV and will be considered by the directorate. When appropriate, CNS will gladly take a leadership role in running pilots along the lines of these suggestions.

National Science Foundation
Directorate for Computer and Information Science and Engineering
Division of Information and Intelligent Systems

IIS Management Response to the Committee of Visitors IIS Subcommittee Report

Introduction

The Division of Information and Intelligent Systems (IIS) of the Directorate for Computer and Information Science and Engineering (CISE) at the National Science Foundation (NSF) participated in a three-day Committee of Visitors (COV) meeting on October 22-24, 2014.

This section of the response will specifically address the findings of the IIS Subcommittee; the response to the COV summary is provided in a separate section. The IIS Subcommittee consisted of 10 members, including Chair Nancy Amato of Texas A&M University (who was a Vice Chair for the full COV), Eric Brown of IBM, Dieter Fox of the University of Washington, Mark Guzdial of the Georgia Institute of Technology, Julia Hirschberg of Columbia University, Joseph Konstan of the University of Minnesota, Michael Lesk of Rutgers University, Bernard Moret of École Polytechnique Fédérale de Lausanne, Marjorie Skubic of the University of Missouri at Columbia, and Jakita Thomas of Spelman College. Over the course of the meeting, the IIS Subcommittee members had the opportunity to talk with IIS staff and were provided with additional information as requested.

We are extremely grateful to the members of the entire COV, especially the members of the IIS Subcommittee, for their commitment and willingness to serve NSF and for the energy, enthusiasm, experience, and insights that they brought to this activity.

IIS SUBCOMMITTE FINDINGS

I.   QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESSES

We are pleased at the number of positive comments in this section of the report. The IIS Subcommittee reported that:

- *"The reviewing methods are appropriate"* and *"the panel process is strong and working well." "CISE is proactive and innovative in investigating new approaches to further improve the quality and efficiency of the review process and to expand the pool of reviewers."*
- *"Program officers ensure that the feedback to proposers … address both merit review criteria."*
- The majority of reviews are substantial … in combination with the panel process, each proposal receives substantial feedback.

- *"Panel summaries were detailed, thorough, and valuable. The summaries provide "added-value" beyond the individual reviews by highlighting the main points that lead to the final assessment."*
- *"The decisions are well documented in the jackets."*
- In most cases, *"the documentation to the PI provides detailed and useful rationale for the award/decline decision."*

IIS is pleased to acknowledge the above findings without further discussion, and will focus on the recommendations and issues raised in this section of the report.

COV Finding: *"IIS should consider making more systematic use of ad hoc reviews to address the increasing interdisciplinarity of the IIS portfolio. To improve the effectiveness of ad hoc reviews, the reviewers could call-in to the panel when the proposal is discussed."*

Management Response: We agree with the COV that the use of ad hoc reviews is particularly effective as a means of ensuring thorough scientific and technical coverage, particularly in the review of multidisciplinary proposals. Program officers will continue to be encouraged to consider inclusion of ad hoc reviews for such proposals when needed. While often a program officer can anticipate the need for ad hoc reviews in configuring panels, it is true that at times additional needs are discovered after reviews are submitted and gaps in expertise are better understood. In those cases, additional reviews are often sought after the panel concludes in order to address specific issues. We also agree that the inclusion of ad hoc reviewers in panel discussion has the potential to be helpful in some cases to ensure that this specialized perspective is taken into full account in panel discussion. Some program officers occasionally make use of this practice but it should be noted that there are some logistical issues to overcome, including scheduling such calls. We will encourage efforts to include ad hoc reviewers in this manner when practicable and reasonable.

COV Finding: The IIS subcommittee recommended that *"CISE continue its efforts to help reviewers and PIs understand what qualifies as broader impact by continuing to support the development of explanatory materials (such as those available from the website http://cisebroaderimpacts.org/) and by making sure that reviewers and PIs are aware of such materials. It might also be useful to ensure PIs are aware of the relevant portions of the Grant Proposal Guide for guidance: (http://www.nsf.gov/pubs/policydocs/pappguide/nsf13001/gpg_3.jsp#IIIA2b)"*

Management Response: This finding was, in part, addressed in the CISE Management response to the overall summary of the report. We agree that more effort to help reviewers and PIs understand what qualifies as broader impact would be highly desirable. We will continue to refer PIs to the recently-developed enhanced descriptions of broader impacts available from the Grant Proposal Guide (www.nsf.gov/pubs/gpg/broaderimpacts.pdf). Panelists are briefed on both merit review criteria at the start of panel meetings and we will also continue to provide this information when reviews are originally requested and to point reviewers to this new material. CISE will also support the development of explanatory materials (such as those available from the aforementioned website http://cisebroaderimpacts.org/) and will encourage program officers to make reviewers and PIs aware of such materials. We will also continue to discuss broader impacts during outreach to the PI and reviewer communities at conferences, workshops, PI meetings, NSF outreach meetings, and other venues.

COV Finding: *"There were some infrequent situations in which a clearer rationale could have been*

provided to the PI" (e.g., a declined Highly Competitive proposal). *"The PO comments are a good mechanism for this and they should be used more systematically."*

Management Response: As stated, we have been using PO comments when a proposal ranked as Highly Competitive is being declined. We will make every effort to ensure that this practice is more systematically followed in the future.

COV Finding: Although it found the current process to work very well, the IIS subcommittee had some suggestions to improve the quality of the individual reviews:

- *"Make sure that reviewers are aware of and address any additional review criteria, particularly for new solicitations.*
- *Investigate the use of more detailed review forms that provide specific guidance / questions*
- *Make an earlier deadline for the reviews so the program officer can check them and request revisions or ad hoc reviews in advance of the panel meeting.*
- *Investigate mechanisms to facilitate discussion among the panelists after reviews are submitted but prior to the panel meeting."*

"NSF should consider offering PIs submitting revised proposals the option of having their previous reviews presented to the new reviewers and panelists. This option might be used strategically, at least at first, e.g., by restricting it to proposals recommended" … *"for this by the previous panel."*

Management Response: We are already using specialized templates for panel summaries that address all the criteria for the given program. The current standard review template, accessed by reviewers through FastLane, is the same for all NSF proposals, and does not specifically accommodate additional review criteria for special solicitations, However, some CISE program directors have sent modified templates, including space for addressing additional issues, to panelists and others have sent additional questions in a form to reviewers that they can add to their reviews. We will look into whether this can be expanded further, especially for new solicitations. We agree that the use of ad hoc reviewers is particularly effective as a means of ensuring thorough scientific and technical coverage in the review of many proposals, particularly those that are multidisciplinary. In many cases, the program directors recognize the need for ad hoc reviews well in advance of the panel. Some of the issues regarding ad hoc reviews are addressed in prior comments in this section (see above). We will continue to encourage program officers to seek ad hoc reviews prior to the panel where appropriate. Encouraging reviewers to submit their reviews on time is an ongoing process and we recognize the advantages of continuing to ask for reviews well ahead of panel meetings. Another CISE division has experimented with asynchronous discussions among panelists prior to the panel meeting; issues regarding software arose and this type of effort is being revisited. Finally, in general, NSF policy does not permit sharing reviews of prior declined proposals with panelists reviewing the revised proposals because of confidentiality issues. In some cases, PIs elect to call specific attention to their responsiveness to prior review feedback. While reviewers may take this information into account, they are nonetheless charged with judging the intellectual merit and potential broader impact of the proposal under consideration, as presented.

II.   SELECTION OF REVIEWERS

We are pleased at the number of positive comments in this section of the report. The IIS Subcommittee

reported that:

- *"It commends the program officers for identifying appropriate experts for the reviews, including the many interdisciplinary proposals handled by IIS."*
- *"The recognized COIs (conflicts of interest) were resolved appropriately and found no evidence that any conflicts of interest were not recognized or resolved."*

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: *"Improved processes to assist PIs and POs in managing COI would be beneficial, e.g., listing institutional conflicts and individuals conflicts from other institutions, and putting in place systems that would facilitate recording/updating conflicts."*

Management Response: We are looking into ways of more efficiently seeking information through automatic checking about potential conflicts of interest for submitted proposals and will look for innovative solutions within the constraints of NSF's policies and resources.

COV Finding: *"With more interdisciplinary proposals anticipated, selecting reviewers with appropriate expertise is of growing importance and difficulty. NSF should investigate the use of innovative technologies to improve reviewer selection, e.g., mine potential-reviewers' publications to determine areas of expertise and match to proposals, as is already being done by several computer science conferences."*

Management Response: We agree that experimentation with new models and tools is desirable. We will continue to looks for promising new tools, taking into account compliance with NSF policy, cost-effectiveness and quality, through various CISE programs. We also plan to share "best practices" across the directorate in order to increase the adoption of effective tools.

III.   MANAGEMENT OF THE PROGRAM UNDER REVIEW

We are pleased at the number of positive comments in this section of the report. The IIS Subcommittee reported that:

- *"Management of IIS programs is working well. Mechanisms are in place for collaborative management, both within IIS and within CISE as a whole."*
- *"IIS effectively uses different funding mechanisms to support long term and short term research and other synergistic activities. IIS has led and participated in successful new programs that have attracted top people in those fields to serve as Program Officers."*
- *"Responsiveness of the program to emerging research and education opportunities is viewed as a particular strength of IIS. The core programs are broad and flexible enough to embrace emerging research areas and they often fund exciting new opportunities."*
- *"IIS cultivates new initiatives by supporting workshops in emerging areas, doctoral symposia, etc. These also include inter-directorate collaborations. The RAPID and EAGER programs are used effectively to quickly respond to emerging needs. The use of Dear Colleague Letters has*

permitted fast response to specific problems."

- *"New programs are responsive to emerging opportunities and have helped attract top people to serve as program officers. … This has helped in rapidly responding to new areas."*
- *"The program planning and prioritization process works very well."*
- *"CISE uses a good mixture of community outreach and internal communication to plan new initiatives."*
- *"IIS was quite responsive to previous COV reports. Examples include reducing cuts in funded proposals and establishing the new Research Initiation rewards."*

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: *"For the most part, program officer transitions have been handled well. However, the recruitment of rotators still faces challenges, e.g., relocation to NSF, proposal submission restrictions, effective telecommuting, etc. Moreover, delays in filling positions have led to gaps in program coverage and confusion in the transition of portfolios from one IPA to the next."*

"The fact that IIS functions so well with a small staff speaks to excellent leadership. For example, the preparation and open information sharing with the COV was impressive and commendable. However, the CISE staff is already stretched thin and there is a concern that the current high level of performance cannot be sustained with the anticipated increase in proposal submissions. Even at the current level, staff members have had to cut back on outreach and engagement with the community."

Recommendations:

- *"Develop more effective mechanisms to support telecommuting."*
- *"Enhance program for rotator training and program hand-off, particularly for rotators that start at times other than the fall, and explore programs to better help rotators resume active research after the end of their term."*

Management Response: Currently all of the IIS program officers have active telework agreements and most of them make frequent use of telework. There are periods, particularly during snowstorms, when the number of remote users causes the NSF electronic systems to slow down; our understanding is that NSF is working on this issue. Regarding training and the transition of program officers to and from NSF, the following comments may be useful:

- A CISE "survival guide" for program directors is currently being revised and updated, based on an earlier version.
- We have found that the cluster arrangement for the core programs and the management team arrangement for cross-cutting programs are well-suited to mentoring new program directors by more experienced colleagues. Peer mentors are assigned, as needed.
- Since most program directors work in clusters or programs that include permanent staff, we will make sure that handoffs as rotators leave are performed with no loss of continuity. This is sometimes accomplished, where feasible and practicable, by continuing departing program directors as part-time experts to assist in the transition.
- NSF-wide training in merit review and NSF policies is readily available to new program directors in the fall; the NSF Academy is now offering them twice in the winter-spring timeframe.

- Most of our scientific staff members (including nearly all rotators) have Independent Research and Development (IR/D) Plans that allow them to continue their research while they are at NSF, including travel funds for rotators to return home to work with students or collaborators, as well as funds to attend research conferences in their fields.
- As mentioned above, telework is an option used by many program directors (both rotators and permanent staff members); this permits flexibility in the location of the work site.
- While at NSF, rotators may, through a substitute PI, submit a proposal, subject to the merit review process, for *continuation support for expiring grants.*
- Rotators who have returned to academia are immediately eligible to submit proposals to support their work; the only restriction is that someone must serve as a negotiating PI for those who are within a year of their NSF appointment.

COV Finding: *"IIS is encouraged to institute an annual retreat to allow strategic planning covering aspects such as recruiting program officers, new programs, community engagement, etc. Community input to the process could be provided."*

Management Response: We agree that this is a good idea and have planned a division-wide retreat to take place in June 2015.

COV Finding: *"Track topics funded across different IIS/CISE/NSF programs where there is overlap (e.g. robotics, machine learning, computational biology, etc.)"*

Management Response: We are currently using tools for some of our programs in order to better understand their award portfolios. We would like to continue and expand this practice.

COV Finding: *"The previous COV recommended the establishment of reviewer databases. While the existing reviewer databases are a step forward, we encourage further development of these activities."*

Management Response: We will continue to look for innovative solutions that can be implemented within the constraints of NSF's rules and policies and that are high quality and cost-effective.

IV.   RESULTING PORTFOLIO OF AWARDS

We are pleased at the number of positive comments in this section of the report. The IIS Subcommittee reported that:

- *"Most awards are at the level requested; general award durations are considered to be appropriate. This was a noted improvement that addressed concerns noted by previous COVs."*
- *"The IIS portfolio includes awards for projects that are innovative or potentially transformative. The COV noted such awards among the regular awards, and also that EAGER awards frequently fit this category."*
- *"Yes, the IIS portfolio very clearly includes inter- and multi-disciplinary projects."*
- *"The geographic diversity of the IIS award portfolio has increased since 2010; the EPSCoR process aims at further reducing possible imbalances."*
- *"The balance of awards to different types of institutions is acceptable and is consistent with NSF's goal of funding excellent research."*
- *"Over all, it appears that the IIS portfolio has a reasonable balance of awards to new investigators.*

- *"The new CISE Research Initiation Initiative (CRII) for new investigators is an excellent program to further increase the availability of funding to new investigators."*
- *"Cross-cutting programs such as BIGDATA, NRI and the now-departed SoCS seem to be quite effective in bringing in new researchers to IIS and CISE."*
- *"In addition to projects that directly involve educational research, computing education, and educational outreach, IIS has a very strong emphasis on the training of graduate and undergraduate students as part of nearly all of its research projects."*
- *"The success rate by gender suggests appropriate participation."*
- *"There are still few proposals submitted by under-represented minorities. However, NSF is working hard to improve the situation by running or supporting a number of good programs that are aimed at increasing the researcher population among these groups. … These efforts are valuable and should be continued."*
- *"A majority of the reports from PCAST clearly identify the importance of IIS topics to national priorities, as do many National Academy reports."*

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: As to whether the program portfolio has an appropriate balance of awards across disciplines and sub-discipline, the IIS Subcommittee found it *"difficult to assess, since some sub-disciplines are represented in several programs (e.g. machine learning in RI and Data Mining in III; robotics in RI and in NRI). It would be useful for CISE to report on topics funded by sub-discipline within CISE as a whole as well as by program so the next COV can assess the balance of awards more easily."*

Management Response: This issue cuts across all CISE divisions. In fact, there is some overlap of ideas both within and across CISE divisions and programs. This is not duplication of effort; the overlap represents different emphases within the existing programs where a particular idea or set of ideas is used. It often demonstrates the importance of certain ideas, such as the ones mentioned above, that have an impact in a variety of fields. Identifying the appropriate subfields, as well as the resulting analysis, will require effective tools and commitment of time; we will look at the feasibility of such an effort.

COV Finding: *"There is no longer a program for Computing Education research that is independent of a specific intervention."*

Management Response: All NSF programs evolve over time and CISE continues to manage programs dealing with various aspects of computer science education. NSF's Directorate for Education and Human Resources has been increasing its emphasis on research in education and learning and provides opportunities for researchers in this important area.

COV Finding: *"We do wish that panelists were less hesitant to support high risk/high reward ("transformative") projects and less inclined to favor less risky projects that represent more incremental advances. This is something that PDs should continue to point out to reviewers/panelists and is something that the research community leadership could assist in promoting."*

Management Response: This is an important issue. We agree that bringing this to the attention of our reviewers and panelists should continue to be encouraged. Program officers are encouraged to detect

high risk/high reward projects and give them careful consideration. The NSF-wide EAGER and INSPIRE mechanisms are additionally available to support such research. IIS has been one of the most active NSF divisions in its use of EAGER and INSPIRE awards to support potentially transformative research.

COV Finding: *"While it is laudable that the success rate of about 20% for Career awards in IIS is higher than for non-Career awards in IIS, it is not as high as the success rate of approximately 30% for CAREER awards in other parts of CISE. This disparity should be examined by CISE."*

Management Response: While the actual funding rate in IIS is lower than the other CISE divisions, IIS receives the most CAREER proposals by far in CISE and provides more funding in terms of both dollars and numbers of awards in this programs. We do consider the CAREER program to be a high priority and try to balance the IIS investment in CAREER with the other programs we support.

COV Finding: *"Overall, the IIS COV was impressed by the quality of the projects funded and by the overall balance of the portfolio. However, the COV was concerned to note that since the increased number of submissions for IIS managed programs has not been matched by a comparable increase in funding, an increasing number of high quality proposals, both in the standard programs and in special programs such as the CAREER program, have not been funded due to lack of funds. If this trend is not corrected, the health of the IIS research community will be negatively impacted."*

Management Response: We agree that there are many high-quality proposals that we have not been able to support. On the positive side, there are several new cross-cutting programs that have provided beneficial funding to various segments of the IIS research community. Overall, however, the IIS research community has been growing more rapidly than other areas, in a time of relatively flat budgets. IIS will continue to seek additional resources to equitably support the innovative research proposed by the IIS research community.

V.   OTHER TOPICS

We are pleased at the number of positive comments in this section of the report. The IIS Subcommittee reported that:

- It *"did not identify any program areas in need of improvement. The program areas span the field well and the program portfolio is flexible, adapting quickly as the field adapts."*
- *"The efforts by CISE in general, and by IIS in particular, to expand into new areas (e.g., to encourage and support CS collaborations with other areas) and new people (as PIs, reviewers, and participants in workshops) are commendable and should be continued."*

We are pleased to acknowledge the above findings without further discussion, and focus on the recommendations and issues raised in this section of the report.

COV Finding: *"The IIS community benefits from greater participation of doctoral students at conferences and the support of this by IIS POs using their discretionary funds is commendable. The COV noted that attendance at the more general conferences is important for students, and supports the continued support of travel grants for such conferences in addition to the more focused conferences."*

Management Response: IIS supports student attendance at a wide variety of conferences and workshops and we agree with the COV that this type of support is extremely important for the development of the doctoral students. NSF policy states that conferences will be supported only if equivalent results cannot be obtained at regular meetings of professional societies. We assume that this finding is not directed at the support of professional society meetings. It is the case that each conference proposal is evaluated on its merits and that there is no guaranteed permanent support for any single set of meetings. In addition, those conferences/workshops that provide special activities for students tend to be given a higher priority for funding. That said, we will look into the balance of support between general conferences and more focused conferences.

COV Finding: *"NSF should consider expanding the eligibility requirements for REU funds to include high school students and international undergraduate students pursuing degrees at US institutions."*

Management Response: This particular issue must be addressed at the NSF-wide level because the REU program eligibility requirements cannot be changed at the division level. There are, in fact, other mechanisms to fund high school and international undergraduate students, for example, by requesting support for these through regular grants programs without using the REU designation.

COV Finding: *"The efficiency of the merit review process has been constrained by the now typical annual budget delay. While this is beyond the control of CISE or NSF, it is an unfortunate fact that the IIS COV felt should be noted."*

"The IIS COV noted that the number of proposals submitted in IIS areas has been growing significantly – with 3069 proposals submitted to IIS managed programs in FY13, representing a roughly 50% increase since 2009 and a 38% increase since 2010. Given the increasing importance of computing and IIS related areas, and the anticipated growth in the number of computing faculty, these increases are expected to continue. Since the available funding has not grown commensurately, the success rate of proposals has been decreasing. If additional funding for IIS related areas is not increased, many excellent research projects will not be funded and the overall health of the IIS research community will suffer."

Management Response: This issue was addressed above at the end of Section IV. To reiterate, we agree that there are many high-quality proposals that we have not been able to support. On the positive side, there are several new cross-cutting programs that have provided beneficial funding to various segments of the IIS research community. Overall, however, the IIS research community has been growing more rapidly than other areas, in a time of relatively flat budgets. IIS will continue to seek additional resources to equitably support the innovative research proposed by the IIS research community.

COV Finding*: "The shift in the focus of the COV to concentrate on process-related evaluations was good. For the most part, data was available to enable assessments. However, in some cases, the data was not available or the question asked for a subjective assessment. For example, there were questions related to the ``appropriate'' geographic or demographic diversity of awards. While these are certainly important topics, it is difficult for the COV to respond to the questions asked with the available information. Instead, NSF may consider if there are alternative questions to pose to the COV that could address these issues."*

Management Response: We appreciate the difficulties faced by the COV in terms of how these questions were framed and will pass this feedback on to the NSF Office of International and Integrative Activities (OIIA), which oversees the COV process.

COV Finding: *"The work of the COV was greatly facilitated by providing access to the jackets and reports in advance of the in-person meeting at NSF. This trend could be pushed even further, thereby allowing more time to meet with the NSF staff at the COV meeting, which the IIS COV found to be an extremely valuable experience."*

Management Response: As mentioned, the COV was provided access to considerable material in advance of the on-site meeting. We will be looking forward to discussing the issue of providing additional material in advance, based on this experience, for the next COV.