

Report
NSF CISE Committee of Visitors
for the Divisions of
Computing and Communication Foundations
Computer and Network Systems
Information and Intelligent Systems

November 11, 2014

Executive Summary

The 2014 CISE Committee of Visitors (CoV) examined the merit review process, program management, and resulting portfolio of three divisions within the NSF Computer and Information Science and Engineering (CISE) Directorate, namely the Computing and Communications Foundations (CCF), Computer and Network Systems (CNS), and Information and Intelligent Systems (IIS) Divisions, for the period 2010-2013. This report describes the CoV's findings and summarizes its recommendations.

This CoV review takes place at a time when rapid advances in computing and information sciences and technology are transforming all aspects of our society. While this broad impact is exciting, it also leads to a several challenges for CISE. For example, the accelerating pace of innovation means that CISE needs to rapidly adapt its research portfolio while also maintaining a long-term research focus. Another implication is the expanding role of CISE in support of research and education, e.g., through the development of tools supporting inter-disciplinary research, and the education of an increasingly diverse group of students.

The CoV's major findings and recommendations can be summarized as follows.

First, all CISE activities evaluated by the CoV were of very high quality: the review process is effective, panels are qualified and balanced, and the CISE program portfolio addresses national priorities and the agency mission. The CoV has several focused recommendations to increase efficiency and further improve quality. Some of these changes are motivated by the unique challenges associated with managing crosscutting programs.

Second, the current high level of performance may not be sustainable in the face of growing demands on CISE resources. The expanding role of CISE is increasing the workload for CISE staff, for example through a steady increase in the number of proposals and from the increased complexity of managing crosscutting programs. Another challenge is that it will become increasingly difficult to maintain a balanced portfolio with strong synergy between core and crosscutting programs. These factors call for an increased investment in CISE supported research and a corresponding increase in CISE staff and infrastructure to effectively manage it.

Finally, improvements in information communication and systems and technologies can improve the efficiency and quality of the merit review process, and further improve the quality of the CISE management and planning processes at all levels in the organization. Examples include both proven solutions for basic activities associated with the merit review process and IT tools for data analytics to improve program planning and assessment.

This report elaborates on the broader context for CISE, describes the CoV's findings, summarizes major recommendations, and makes suggestions for future CoVs. Detailed findings and recommendations for each of the three divisions can be found at the end of the report.

1. Broader Context

This CoV review comes at a time of significant and exciting changes in the landscape affecting the CISE research community. Before presenting the CoV findings, it is important to discuss some of the major changes afoot.

The implication of CISE research on national competitiveness: Advances in computing and information science and technology have been producing transformative changes in all fields of research, in the economy, and in societal interaction and governance. In order to maintain national competitiveness, US investment in research funding needs to grow, particularly in light of sharp increases in research funding for CISE disciplines in South and East Asian countries.¹ The fact that foreign universities are increasingly competitive in attracting top international PhD students is a worrisome trend given that the US needs to maintain strong academic research programs to retain its leadership in knowledge creation and high-skill employment.

Impact of the accelerating pace of technological innovation: The rate with which new computing and information technologies are introduced and adopted has significant implications on the ability of the research community, as well as society at large, to assimilate and appropriately adjust to these advances. The examples are many. At the time of the last CoV, cloud computing was correctly predicted to catalyze “dramatic and disruptive change.” In a period of less than five years, cloud computing has become a mainstream technology with researchers and practitioners alike adjusting to that reality. The same can be said about the explosive growth of social networking technologies and the societal challenges they pose related to issues of security, privacy, and public policies, and the opportunities for socio-technical basic and applied research. The fast-paced nature of technological innovation and adoption risks putting academic institutions and funding agencies in a continually “reactive” mode, rather than fostering the creation of unanticipated future innovations (for which they are better-suited).

Implications from the expanding role of CISE in support of research and education: Increasingly, the CISE community is engaged (as it should) in research, education, and training activities that go well beyond the traditional boundaries of CISE core disciplines. This includes the development of software tools and artifacts that are enabling advances in many scientific disciplines, and involvement in education and training initiatives in support of the need for computational and data science competencies across all disciplines. This brings to question the implications from this expanded “supporting role,” not only on CISE academic departments (as they leverage other departments within a university setting) but also on the CISE directorate at NSF (as it contributes to advancing disciplines that are under the purview of other directorates or federal funding agencies). The impact of this expanding role must be carefully examined and deliberately managed to ensure continued support of CISE’s core research mission, which provides a necessary foundation for all of the aforementioned outreach.

¹ Figures from the National Science Board (NSB) *Science and Engineering Indicators 2014* suggest a declining share of global R&D performed by the US (from 37% in 2001 to 30% to 2011) and a significant increase in the share of global R&D performed by countries in South and East/Southeast Asia rise (from 25% to 34%). See Chapter 4 of the report at <http://www.nsf.gov/statistics/seind14/index.cfm/chapter-4/c4s2.htm>.

Sustaining long-term basic research that leverages industrial assets: Supporting academic basic research has been and will continue to be the purview of NSF. However, in an increasing number of CISE areas, the ability of CISE researchers to pursue basic research depends on access to assets that are not (and cannot be made) available in a university setting. Examples include access to proprietary data sets, access to operational data of cloud-scale infrastructures, access to cyber-physical infrastructures, among others. This trend is expected to increase, bringing to question the need for a symbiotic relationship that enables basic research that leverages such assets. While short-term applied research that uses such assets could be (and perhaps should be) the purview of industrial research, longer-term research is not likely to be. Enabling and sustaining such long-term basic research will require novel models for industrial engagement, and will necessitate a deliberate prioritization of such research (over shorter-term research).

Sustaining the expected growth of the CISE academic community in the US: Over the last few years – and as documented in a number of recent studies² and media reports³ – academic institutions in the US are reporting an unprecedented surge in demand for CISE undergraduate and graduate degree programs. This is likely to be a consequence of the expanding role of CISE already mentioned above. This exciting surge, which continues unabated (and is in fact accelerating) is fueling a wave of faculty recruitment across the board, which in turn translates to an increased capacity for academic research, and a corresponding increase in research proposals to (and competition for funding from) the CISE Directorate. Sustaining this growth will be crucial for maintaining the vitality of the CISE academic community in the US.

All of the above speak to the importance of the research that CISE supports, and the need for increased investment in it. It also highlights a number of key issues for CISE in years to come: (1) the capacity and efficiency with which CISE can respond to the above changes given its already strained resources, (2) the need to ensure that CISE's response to these added needs does not compromise the strong synergy between core and crosscutting programs in the current program portfolio, (3) the importance of continuing to foster long-term basic research that is less likely to be impacted by fast-changing technological churn, and (4) the importance of developing partnerships with other NSF directorates and funding agencies in supporting CISE activities that are primarily leveraging non-CISE constituencies.

An important consideration within this context is that the field of computer science depends more heavily on support from NSF for academic basic research than do many of the NSF-funded disciplines of science and engineering. Specifically, 87% of federal support for academic research in computer science comes from NSF, whereas the average for all science and engineering fields is 24%⁴. As result, flat funding for CISE research would have a significant negative impact on the field.

² According to the latest Taulbee survey (which is a lagging indicator given the two-year delay between reporting and publication), total undergraduate enrollment in computing majors among U.S. computer science departments rose by double digits for six years in a row, with a whopping 29.2% increase in 2013 alone (for details, check <http://cra.org/govaffairs/blog/2013/03/taulbeereport/>).

³ See “The exploding demand for computer science education, and why America needs to keep up” by Taylor Soper (available at <http://www.geekwire.com/2014/analysis-examining-computer-science-education-explosion/>).

⁴ NSF/National Center for Science and Engineering Statistics, Survey of Federal Funds for Research and Development, FY 2011.

2. Findings

The CoV was charged to provide a report on three aspects of the operations of three of CISE's divisions. A first area is the integrity, efficacy, and quality of the processes used to solicit, review, recommend and document proposal actions. A second area is the quality of project management, monitoring, and evaluation of funded proposals. Finally, the CoV was asked to provide input on the directorate's balance, priorities, and strategies for realizing the potential of CISE, and any other issues relevant to the review. The preparation and discussions of the CoV were aided by a template that includes questions on a broad set of processes used by the CCF, CNS, and IIS divisions in the CISE directorate.

The detailed findings of the CoV can be found in the three templates (enclosed as appendices) that were completed based on discussions in parallel breakout sessions discussing the CCF, CNS, and IIS divisions during the CoV meeting. The findings for the three divisions are very similar and can be summarized as follows:

- The merit review process is strong and working well and CISE has been continuously and proactively making refinements that improve its quality and efficiency.
- Review panels generally have well-qualified and balanced sets of panelists.
- Management is grounded in effective processes and an exceptional team.
- CISE programs as a whole address national priorities, agency mission, and relevant fields of research. To the degree that the CoV was able to assess, the portfolio is also well-balanced along a number of dimensions.

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 directorates, the directorate also faces a number of major challenges:

- The changes identified in Section 1 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 immediately if we are 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.

In the remainder of this section, we elaborate on the key findings, discussing both strengths and concerns. Next, we summarize a number of recommendations, noting that several of these recommendations address foundation-wide issues. We conclude with a short overview of the organization of the CoV, the first cross-divisional CoV for NSF, and recommendations for future CoVs in Section 4.

2.1 Quality and Effectiveness of the Merit Review Process

The merit review process is of high quality. The core is a well-functioning panel review process in which each proposal receives substantial feedback. Proposals generally receive a sufficient number of quality reviews, which are supplemented by detailed and informative panel summaries. There is a thorough post-panel process whereby program directors and division directors collaboratively reach decisions on award recommendations. This process appropriately considers both merit and portfolio balance and diversity.

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. Examples of improvements since the 2009 CoVs include improved review templates, the use of virtual panels to reduce the cost and overhead of panels, early requests for panelists for groups of programs, “triage” of proposals with uniformly low ratings to make panels more efficient, and transferring proposals to more appropriate programs for review. Such innovations are often first used on a limited basis in one division to evaluate their effectiveness before more widespread use.

While the merit review process is working well, further improvements depend critically on having access to appropriate IT tools and capabilities. CNS’s experience with a trial to have asynchronous discussions before panels to improve pre-panel preparations is a good example. While the trial showed the benefit of this process improvement, it could not be adopted because the available software was not suitable. Interesting enough, several software packages are available that help chairs and reviewers prepare for program committees for conferences (e.g., START, EasyChair, HotCRP), a process that is similar to panels. These tools provide support for tasks such as assigning reviewers and asynchronous discussion of papers before the committee meeting. While they could be applied almost “as is” to better prepare for panel review meetings, it can be challenging to get such software approved for use at NSF in the face of security and other considerations and the limited resources available for acquiring software, all of which hinders the fast adoption of “new” technology. Similarly, tools and services for “group writing” and document sharing could make panels (and CoV meetings!) more efficient, but adoption is difficult.

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. Example challenges include how to calibrate review scores across communities, composing panels and identifying reviewers with the right expertise, and differences in the nature and level of detail of reviews. This additional complexity adds to the workload of program directors. Not surprisingly, while the CoV is very impressed with the quality of the merit review process used in CISE as explained earlier, we observe that occasional issues with specific proposals or panels were more common in cross-cutting programs than in core programs. We believe that some of the recommendations listed below will be especially useful in that regard.

Recommendations. The current merit review process works well, but it is a time-consuming activity for both program directors and reviewers/panelists and the CoV worries about CISE’s ability to maintain quality and responsiveness in the face of an increasing load. The CoV has a number of recommendations that can further improve the efficiency and quality of the merit review process:

- **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.
- **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.
- **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.
- **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).
- **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.

2.2 Selection of Reviewers

Overall, the CoV finds that CISE is doing an excellent job recruiting high-quality panelists and reviewers. Jackets showed that for the vast majority of proposals, reviewers had appropriate expertise and were collectively qualified, including many senior personnel and recognized leaders. 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, some programs appear to have a hard time recruiting panels with sufficient expertise. This is particularly the case with interdisciplinary programs (as expected given our observations in Section 2.1), but it also occurs with some core programs. For example, some programs are 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.

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.

Recommendations. The CoV has two recommendations that could further improve the process of selecting reviewers:

- **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.⁵
- **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, AAI, SIAM, etc.) to increase acceptance rates and expand the reviewer pool.

2.3 Program Management

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, and NSF personnel evaluations.

⁵ The development and/or adoption of tools (such as ETBLAST and ArnetMiner) could be effective for the identification of expert reviewers (see <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1933238/> for an example).

CoV members were 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 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 sabbaticals as another way for scientific staff to engage and work with the research community.

However, 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% annually⁶, 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 changes noted in Section 1 suggest that both trends will continue and may even accelerate.

To retain and recruit top talent, 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. We already provided specific recommendations to help with the last issue in Section 2.1. An important part of professional development is allowing program directors to connect and interact with the research communities they support. We are 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, program directors cannot always use these opportunities because of the high workload and general restrictions on travel. It is important that CISE continue to ensure that NSF is represented and perceived to be in touch with the community. The CoV 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.

As with the scientific staff, the administrative staff 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, it is a general issue that must be addressed. Another issue, related to the need for the use of more sophisticated data analytics in CISE program management, is that there is a

⁶ Report to the National Science Board on the National Science Foundation's Merit Review Process, fiscal year 2013.

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.

Recommendations. The CoV has the following recommendations with regard to program management:

- **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).
- **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.

We commend the CISE management for effectively responding to many of the recommendations of the 2009 division-level CoVs, particularly in areas that are under their control. We observe that those actions resulted in improvements in several areas of concern identified by those CoVs, while there is still work to be done in others:

- **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.
- **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.
- **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.

More details on the responses in each division can be found in the templates.

2.4 Resulting Portfolio of Awards

At the level of portfolio planning, the CoV finds 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. Examples of programs that are closely matched with national priorities include Secure and Trustworthy Cyberspace, Cyber-Physical Systems, National Robotics Initiative, Exploiting Parallelism & Scalability, Smart & Connected Health, and Integrative Strategies for Understanding Neural and Cognitive Systems⁷. Community-driven/bottom-up approaches are informed by submissions to the core programs as well as by a number of activities that are meant to 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. 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 (such as the Communications, Information Theory, and Signal Processing area), so we encourage 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. We were limited in our 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 us to obtain (or even formulate). Nevertheless, based on the limited information available to us, the portfolio balance and diversity generally looked appropriate. In addition, we 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 merit is the primary criterion and 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. 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, we found the sizes of awards to be appropriate. 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. This trend is clearly a direct result of the rapid pace of innovation in, and the significant

⁷ See OSTP PCAST reports <http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports>. Additional references can be found in the templates.

impact of, the technology areas that are part of CISE's mission as discussed in Section 1. This diversification also results in an expanded role for CISE in several areas. For example, there is a growing need to educate an increasingly diverse set of students in how to use computational tools. CISE has historically played a big role in training large numbers of teachers, e.g., the Education and Workforce Programs (EWF). Another example is that, in addition to developing research infrastructure for the CISE community, CISE researchers in cross-cutting programs increasingly need to develop and maintain tools and infrastructure for use by other communities, e.g., sensor nodes for CPS research infrastructure or "big data" tools supporting research in other areas. Finally, the CoV learned that CISE is increasingly supporting researchers in other domains. For example, 61% of the PIs and Co-PIs on FY 2013 awards funded by CISE were from departments in Computer Science, Information Science, and Computer Engineering, while other PIs and co-PIs came from departments in Science & Humanities and other Engineering disciplines, and interdisciplinary centers. 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.

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.

3 Summary of Recommendations

Here we summarize our main recommendations for improving processes within CISE:

- **Suggestions to improve merit review process.** While the merit review process in CISE is of very high quality, the CoV identified a number of changes that could further improve quality. As discussed in Section 2.1, these recommendations include suggestions for improving existing practices, the quality of individual reviews, the documentation of post-panel processes, and the interpretation of broader impacts. While each proposed change is modest, the overall impact of implementing several of these can be substantial.
- **Provide resources for the adoption of IT tools and capabilities and streamline the software approval process.** CISE and NSF should find ways to streamline the process of approving software. As described in Section 2.1, faster adoption of software (e.g., to allow asynchronous discussion, reviewer tracking and assignment, efficient collaboration, etc.) would allow NSF to keep pace with other organizations in terms of using state-of-the-art tools. The CoV also notes that adopting new tools requires resources (e.g., staff time and funding to acquire the software) in the short term, but can save substantial resources in the long term.
- **Utilize data analytics.** The CoV encourages CISE (and NSF) to explore the adoption of data analytics to improve the efficiency of its processes and quality of the outcomes. This technology has proven its value in many organizations and the CoV identified several areas (see Section 2) and at all levels in CISE (e.g., AD, DD, PD, and CoVs) where it can potentially help. The CoV realizes that this is a long-term effort that may need to be initiated at the NSF level. It will also require specialized staff.

Throughout Section 2, we also provided a number of other, more specific, recommendations for expanding the review pool (Section 2.2), and for attracting high-quality scientific staff through improved professional development and support for rotators (Section 2.3). The individual division templates contain additional recommendations, as well as more explanatory details.

4 Organization of the CoV Recommendations for Future CoVs

The 2014 CISE CoV was the first cross-divisional CoV for the Foundation. The CoV reviewed three divisions in CISE, namely CCF, CNS, and IIS, and it was also asked explicitly to comment on cross-divisional issues as appropriate. The charge was to focus on processes, not outcomes. The meeting of the full CoV was held October 22-23 in Arlington. The chair and vice-chairs also met on October 24 to complete a draft of the CoV report.

Considering the broad scope of the CoV, the chairs decided to ask CoV members to not only read the CoV material, as is traditionally done, but to also prepare two documents for use during the CoV meeting. First, CoV members were asked to fill out the template for their division-level breakout with their personal observations for each question and to include references to material in eJackets and other readings relevant to the question. CoV members used these filled-in templates during the breakouts to avoid spending time on reading or locating relevant material. Second, we asked CoV members to keep track for each question in the template how many of the jackets they reviewed would need to be discussed at the meeting. The chairs for each division aggregated this information for the members in their breakout. This information was used for time-management purposes.

The full CoV meeting combined two elements. First, we had three periods each with three parallel breakouts focused on the individual divisions, using the template as a way to organize the discussion. Because CoV members were well-prepared, the breakouts were dedicated to in-depth discussion. Second, each session with parallel breakouts was followed by a plenary meeting to report division-level findings and recommendations back to the full CoV and to discuss cross-divisional issues. The CISE staff's preparation for the CoV and open information sharing throughout the process was impressive and commendable.

Looking forward, the CoV makes the following recommendations for improving future CoVs:

- **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,” as described above, 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).
- **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.

- **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.

Finally, this CoV was an experiment in performing a cross-division review, rather than focusing on individual divisions. While it is too early to fully evaluate the benefits and drawbacks of this approach, we are able to make some preliminary observations:

- **High-level review and observations cut across divisions.** Only a cross-divisional CoV can review and provide suggestions regarding cross-divisional processes. The majority of the observations and recommendations of this CoV are common to all three divisions, and reviewing three divisions allows these commonalities to be noted and also leads to improved and hopefully more useful recommendations. For example, the use of data analytics to aid and evaluate program planning is especially relevant at the cross-division level.
- **Improved efficiency.** The size of this CoV was comparable to the sizes of the previous division-level CoVs. Hence, a single CoV reduces the load on CISE and the community.
- **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.

REPORTS OF THE SUBCOMMITTEES:

**DIVISION OF COMPUTING AND
COMMUNICATION FOUNDATIONS**

**DIVISION OF COMPUTER AND NETWORK
SYSTEMS**

**DIVISION OF INFORMATION AND INTELLIGENT
SYSTEMS**

CORE QUESTIONS and REPORT TEMPLATE for FY 2014 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2014 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2014. Specific guidance for NSF staff describing the COV review process is described in the “COV Reviews” section of NSF’s Administrative Policies and Procedures which can be obtained at <https://inside.nsf.gov/aboutnsf/hownsfworks/rolesresponsibilities/Pages/Committee-of-Visitors.aspx>¹.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and (2) managerial matters pertaining to proposal decisions.

The program(s) under review may include several sub-activities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs – a portfolio of activities integrated as a whole – or to provide answers specific to the sub-activities of the program, with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. NSF staff should work with the COV members in advance of the meeting to provide them with the report template, organized background materials, and to identify questions/goals that apply to the program(s) under review.

Suggested sources of information for COVs to consider are provided for each item. As indicated, a resource for NSF staff preparing data for COVs is the Enterprise Information System (EIS) –Web COV module, which can be accessed by NSF staff only at <http://budg-eis-01/eisportal/default.aspx>. In addition, NSF staff preparing for the COV should consider other sources of information, as appropriate for the programs under review.

For programs using section IV (addressing portfolio balance), the program should provide the COV with a statement of the program’s portfolio goals and ask specific questions about the program under review. Some suggestions regarding portfolio dimensions are given on the template. These suggestions will not be appropriate for all programs.

Guidance to the COV: The COV report should provide a balanced assessment of NSF’s performance in the integrity and efficiency of the **processes** related to proposal review. Discussions leading to answers of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. **COV reports should not contain confidential material or specific information about declined proposals.** The reports generated by COVs are made available to the public.

We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see <http://www.nsf.gov/od/oia/activities/cov/>.

¹ The COV Reviews section has three parts: (1) Policy, (2) Procedures, and (3) Roles & Responsibilities.

**DIVISION OF COMPUTING AND
COMMUNICATION FOUNDATIONS**

FY 2014 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below was completed by program staff.

Date of COV: October 22-24, 2014			
Program/Cluster/Section: Core Programs: <ul style="list-style-type: none"> • Algorithmic Foundations • Communications and Information Foundations • Software and Hardware Foundations Cross-Cutting Programs: <ul style="list-style-type: none"> • Expeditions in Computing (EIC) • Exploiting Parallelism and Scalability (XPS) • Cyber-Enabled Sustainability Science and Engineering (CyberSEES) • Failure-Resistant Systems (FRS) • Interface between Computer Science and Economics and Social Science (ICES) 			
Division: Computing and Communication Foundations			
Directorate: Computer and Information Science and Engineering			
Number of actions reviewed:			
Awards: 75			
Declinations: 67			
Total number of actions within Program/Cluster/Division during period under review:			
	# of Actions	# of Awards	# of Declinations
FY 2010	1480	428	1052
FY 2011	1311	387	924
FY 2012	1248	418	830
FY 2013	1629	428	1201
Manner in which reviewed actions were selected: The actions selected were in two cohorts: <ol style="list-style-type: none"> (1) random selection from bins by divisional program and fiscal year, evenly divided between awards and declinations and (2) as requested by the COV members, 12 projects on either side of funding cutoff. 			

COV Membership: CCF Subcommittee

	Name	Affiliation
COV Chair or Co-Chairs:	Overall COV Chair: Peter Steenkiste Vice Chair for CCF: Salil Vadhan	Carnegie Mellon University Harvard University
COV Members:	Allan Borodin Michelle Effros Kathleen Fisher Rajesh Gupta Dan Gusfield Howard Karloff Ananthram Swami Avi Wigderson David Wood	University of Toronto California Institute of Technology Tufts University University of California, San Diego University of California, Davis Georgia Institute of Technology Army Research Office Institute for Advanced Study University of Wisconsin, Madison

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments: The vast majority of proposals to CCF are evaluated by external reviewers, with an average of roughly 4 reviewers per proposal. There are some categories of proposals (EAGERS, RAPIDs, small workshops, REU supplements) that are reviewed internally at NSF. Of those receiving external review, almost all are discussed by a panel; only 3-3.5% are evaluated using solely ad hoc mail reviews. Some of the panel evaluations are augmented by ad hoc mail reviews; the fraction of proposals for which this is done has varied significantly over the 4-year period we studied. Most panels have their discussions physically at NSF, but CCF has been experimenting with virtual meetings for some smaller panels. Site visits are used for very large awards, such as those in the Expeditions in Computing program.</p> <p>We believe that the above combination of review methods, as utilized by CCF, is very appropriate and effective. Discussions by panels enable experts to compare the relative merits of different proposals (given that there is not sufficient funding to support all worthy projects), and to make sure that consistent standards are being applied. Ad hoc mail reviews are an excellent way to augment panel discussions when there is insufficient expertise on the panel, or to entirely replace panel review in rare cases where there are too few related proposals to form a panel. The use of site visits for very large awards and of internal review for select categories for very small awards effectively balances efficiency and community time with the level of scrutiny that is appropriate for different award types.</p> <p>At the same time, we recommend that CCF continue to experiment with</p>	<p>YES</p>

<p>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.</p> <p>The COV subcommittee had extensive discussions on ways to reduce the workload of reviewers, panelists, and the community at large to keep up with the growing review burden as the CCF-supported research community continues to grow with the success of computer and communications field in general. The idea of a whitepaper phase was deemed not appropriate for unsolicited proposals. CCF is currently experimenting with different forms of triage (e.g., proposals that are rated uniformly low and unlikely to be competitive are not discussed at panel meetings unless requested by a panel member). We consider this to be a positive development, as panelists sometimes spend too much time on poorly ranked proposals that are not viable for funding for multiple reasons.</p> <p>Physical meetings are valuable but impose significant travel and financial burden. These should be used judiciously and CISE should continue to experiment further with virtual panels and make the appropriate technology investment to make this feasible and effective. In the experience of COV members, NSF CISE's current technology for virtual panels is not effective and mature enough to be more widely adopted. COV members also noted that physical panels have beneficial side effects for panelists, especially young researchers, that would not accrue from a virtual panel.</p> <p>Despite their significant value, evaluation of interdisciplinary proposals presents a special challenge for NSF since a panel is unlikely to include all necessary expertise. To improve quality of reviews the committee recommends that increased use of external, <i>ad hoc</i> mail reviews to augment and inform the panel discussions. CISE should ask panelists to return reviews at least two weeks before the panel meeting; this would provide PDs sufficient time to recruit <i>ad hoc</i> reviews if needed and have them available at the panel meeting. It would also be beneficial to have reviewers provide a confidence rating (as done by major conferences in Computer Science) for reference by the program directors and panel (but not returned to the PI) and also give panelists the option to decline to rate a proposal without prejudice if his or her expertise is insufficient.</p> <p>Data Source: Jackets, Table in Self-Study on Review Methods</p>	
<p>2. Are both merit review criteria addressed</p> <ul style="list-style-type: none"> a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses? <p>Comments: All NSF proposals are required to be evaluated through use of the two National Science Board approved merit review criteria: Intellectual Merit, which encompasses the potential to advance knowledge, and Broader Impacts, which</p>	<p>YES</p>

<p>encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.</p> <p>Both review criteria were universally addressed in reviews and in panel summaries. However, these were not always addressed in the program director analyses, which sometimes focused on the review process and the panel's ranking of the proposal rather than the merit criteria themselves.</p> <p>The intellectual merit criterion is well-understand by reviewers and PIs, and plays a very clear and consistent role in the evaluation process. For broader impacts, however, we found large variability in how the criterion is interpreted by reviewers and PIs. It 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 (and instead it can create noise that adversely affects the quality of panel evaluation). Despite NSF and CISE efforts, there continues to be confusion (among PIs, reviewers, and our COV) about what sorts of activities constitute broader impacts, and in particular whether they need to be specifically related to the research aspects of the proposal. If broader impacts are expected to refer to specific activities to be undertaken, then there should also be an opportunity to request funding for those activities (which we understand is often not the case). Assuming that broader impacts must remain a major criterion, we recommend that NSF and CISE continue efforts to clarify its meaning to the research community.</p> <p>Data Source: Jackets, Table in Self-Study on Fraction of Reviews Addressing Both Merit Criteria</p>	
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<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: Many reviews are substantive; some amazingly so. There are also some reviews that lack substance, perhaps due to lack of reviewer expertise or time or a very poorly written proposal. We make a number of suggestions for addressing this situation. First, encourage panelists to submit the reviews well in advance of the panel meeting to enable the solicitation of additional reviews and to enable to program director to ask for more detail on some reviews. Second, identify <i>ad hoc</i> reviewers to fill in missing expertise in the panel. Third, require reviewers to indicate their confidence level in the review (for reference by the panel and program director). Fourth, encourage a more uniform structure to reviews by instructing reviewers to follow more detailed templates (customized by the program director); this can also improve the readability of reviews for program directors. CCF has recently introduced such a template by asking reviewers to answer 5 specific questions about each of the two NSF-wide merit criteria. While this change was too recent for us to fully evaluate, our impression is that the specific questions introduced did <u>not</u> necessarily elicit better reviews. It is important to have questions that elicit the reviewers' <i>analysis</i> of the proposal (rather than merely restating the intellectual merit and broader impacts claims made in a proposal).</p>	<p>YES</p>
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<p>Data Source: Jackets, Conversations with Program Directors</p>	
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: Yes, the 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. Indeed, the panel summary often provides better rationale than individual reviews. Our conjectured explanation for this phenomenon is that panelists do often read and evaluate proposals carefully and come to panel meetings prepared to discuss the proposals thoughtfully, but do not always put the time into writing detailed reviews before the meeting.</p> <p>Data Source: Jackets</p>	<p>YES</p>
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments: Good rationale is generally included in the program director’s review analysis in cases where the funding is recommended. In some cases, in particular for declined proposals, more details on rationale would be useful.</p> <p>A panel's ranking of the proposal (e.g., “this proposal was tied for k’t h place out of n proposals reviewed by the panel”) is often included in the program director's review analysis. We find this practice useful and recommend its systematic use (e.g., by having a specific field for this in e-Jacket). In some cases, the program director rates the proposal differently from the panel -- due, for example, to factors that lie outside of the panel discussion (such as diversity or the PI’s funding history) or the program director’s judgment about panel biases (e.g., biases against ‘risky’ proposals that that may be less likely to succeed, but have a bigger payoff potential if they do). Discussion of such discrepancies is often included in the program director’s review analysis.</p> <p>Through conversations with NSF staff, we also learned about the decision process that takes place after the panel meetings. There is a cluster meeting, where the program directors handling a given proposal category decide on a prioritized list for which proposals to fund, taking into account considerations such as portfolio balance and diversity in addition to the panel evaluation. Then the cluster meets with the Division Director to decide on funding recommendations, as well as a list of proposals for which more information is needed (e.g., additional reviews) or an award might be made based on future funding.</p>	<p>YES</p>

<p>The above decision post-panel process seems very appropriate and appears to work quite well. We recommend that more of this process be documented in eJacket (for example, with brief diary notes), including the healthy disagreements that may arise along the way (and are typically resolved appropriately). Currently, only the final review analysis and consensus recommendation appears in eJacket for the vast majority of proposals.</p> <p>Data Source: Jackets (including additional ones requested where final decision went against panel recommendation), conversations with NSF management staff, requested description of CCF post-panel decision process</p>	
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<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments: Good rationale is generally made available to the PI in cases where the proposal is funded. This rationale comes in the form of the reviews and the panel summary. In some cases, more details on rationale would be useful when the proposal is <u>rejected</u>, particularly when this occurs for reasons that do not appear in the panel summary but do appear in the program director’s review analysis. In some cases, rationale for rejected proposals may be communicated to the PI by phone or email. <u>We recommend documenting such conversations more consistently in e-Jacket as diary notes or communications.</u> The more detailed the feedback that can be provided to PIs, the better it is for the community and for NSF future workload.</p> <p>Data Source: Jackets</p>	<p>YES</p>
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<p>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</p> <p>We applaud the clear and coordinated processes that CISE has for transferring jackets from one program to another: there is a window of a few weeks after the common proposal submission deadline within which program directors are supposed to identify transfer candidates among the proposals they have received and offer them to other programs. Despite this process, in the jackets we reviewed, we did see some interdisciplinary proposals (e.g., in computational biology) that might have been better fit for a different division</p>	<p>NOT APPLICABLE</p>
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(e.g., IIS). We understand that in such cases, it is likely that transfers were considered, but this was not apparent from the documentation in the jacket. Thus, we recommend that such steps be documented in eJacket (e.g., with a brief diary note).

Current review process considers every proposal in isolation without any reference to its evolution in response to earlier review(s) or relationship of other activities by the PIs. While this is useful, it can be potentially improved by exposing some more memory about the PI's proposal submission history, feedback received on past submissions, annual reports, etc. to the panels. We understand that currently such information is taken into account by program directors, but it is not available to panelists. In particular, a reviewer with access to proposal history, prior panel feedback on related proposal(s) by the PI, could make a more informed judgment on the approach taken and potential impact of a proposed effort. This is in part a suggestion for improving the IT infrastructure associated with the project review process (in place of the *ad hoc* Google searches that reviewers sometime do to compensate for the missing information).

We encourage the CCF to continually think about ways to reduce workload on the CCF community (CCF staff, PIs, and reviewers) while maintaining the high quality of the portfolio. Possibilities to be considered include increasing award durations, decreasing the page length of proposals (especially on smaller awards), and/or encouraging greater use of accomplishment-based renewals.

II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Overall we felt that the expertise and qualifications of the reviewers was quite good in the jackets we read, despite the challenges presented by an increasing number of proposals and the strict Conflict-of-Interest policies of NSF. At the same time, there is room for further improvement. In particular, cross-disciplinary panels tend to give shallower reviews (perhaps due to lack of expertise). Thus, we recommend that CISE consider greater use of the hybrid model of ad hoc reviews and panel reviews, as discussed in answers to earlier questions.</p> <p>There is considerable variability in terms of reviewer quality, expertise, and seniority across the different programs led by CCF. The reviewer quality in some programs appears to be uniformly high, partly because of strong community involvement. In other programs, it is less consistent, and CISE is encouraged to engage the corresponding communities to encourage greater participation and engagement with panels; this is a community as well as a CISE issue.</p> <p>Indeed, there should be an expectation that funded PIs will serve on panels. CISE is encouraged to explore ways to improve responsiveness of the community to participate in peer reviews. Perhaps history of past panel participation should be considered in proposal reviews. Perhaps there should be an honor roll, listing all the panelists who served in the last 3 years.</p> <p>We recommend that NSF provide program officers with a tool for systematically tracking the panelist and reviewer pool, as journals use for tracking their reviewer pool. The tool could provide information about how often people have accepted and declined invitations, their areas of expertise, and notes on the quality of their reviews. This will help program officers in identifying suitable reviewers, distributing workload more evenly across the research community, and making the case to some communities that their panel participation rate needs to be improved.</p> <p>Virtual panels (see our response to Q1 of Part I) and holding panels in different locations (west coast, or co-located with major conferences) can also help with recruiting high-quality panelists. We understand that there are NSF restrictions</p>	<p>YES</p>

<p>on where panels can be held, and ways to overcome these restrictions should be explored.</p> <p>Data Source: Jackets</p>	
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <p>Yes, NSF handles conflicts of interest well.</p> <p>Data Source: Jackets, Table in Self-Study on Number of COIs</p>	<p>YES</p>
<p>Additional comments on reviewer selection:</p>	<p>NOT APPLICABLE.</p>

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

NSF staff and Program Directors are doing an amazing job given very tight resources. They are remarkably committed, conscientious and professional.

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.

Maintaining a reasonable workload, offering professional development opportunities, and minimizing frustrating bureaucracy (such as with the travel system) are essential for CISE to continue to attract high-quality program directors and staff.

The combination of permanent staff and rotators (IPAs) on the CCF staff provides a healthy mix of institutional memory and novel ideas, but naturally leads to some challenges in integrating these two perspectives. 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).

Data sources: data requested on staff size vs. number of submissions in CCF, CCF program manager survival guide

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

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)).

The workshops and special programs that CCF runs seem effective in keeping CCF current on emerging research and education topics. The process for deciding when to run such workshops should be widely publicized to ensure that emerging areas are not inadvertently overlooked (which is a particular risk given the wide breadth of areas covered within CISE).

Continuing to bring in top researchers as rotators is another method to ensure responsiveness to emerging opportunities.

At the same time as 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.

Data Sources: Presentations by CISE management, List of workshops run by CCF,

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

NSF's proactive approach to gathering input from the community on emerging research opportunities, through interaction with external organizations such as the Computing Community Consortium (CCC) and the Computing Research Association (CRA) and through the workshops it runs, is very effective. However, 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.

CISE should make sure it is systematically gathering input from all communities under its umbrella, by reaching out to professional societies associated with communities not represented by the CCC and CRA (e.g., the IEEE Communications, Information Theory, and Signal Processing Societies), by ensuring sufficient representation of all communities on its staff and advisory committee, and by making sure that the process by which workshops are run and new programs developed is transparent and widely known.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

The 2009 and 2014 Responses to the 2009 CCF COV report show that CISE did take the COV recommendations quite seriously. The responses give justification for the actions taken and not taken (though in some cases we believe that the recommendations need to be considered again). For example:

1) The 2009 report expressed concern over the significant cuts to proposed budgets (e.g., "almost 30% of the proposals were cut in half"). Data that we were provided on the AF and SHF programs shows that CCF has responded to this concern, with 90% of awards receiving at least 80% of their requested budget and 91% funding rate overall.

2) The creation of the Expeditions in Computing program is a significant response to the COV comment regarding a need to support larger, more ambitious projects. However, as discussed in the answer to Q2 in Part IV, the funding rate for ordinary large awards has dropped over the last few years, and should be monitored.

3) CISE has been clearly working on the materials provided to reviewers to improve the quality (particularly the level of detail) in the reviews, as evidenced by the more explicit template questions. But more work needs to be done, as noted in our answer to Q1 in Part I.

4) NSF is also clearly working to clarify expectations with respect to the Broader Impacts criteria, as requested in the previous COV report, but more work needs to be done (cf. our answer to Q2 of Part I).

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.

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.

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.

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).

Data source: September 2014 updated response to 2009 CCF COV report

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

<p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p>	<p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments: CCF houses a very broad range of research areas, which makes assessing balance an apples & oranges comparison. We noted differing success rates between different programs, but it was not clear whether or not this should be a concern (as success rates need to be interpreted based on a number of other factors, such as the quality of proposals being submitted and the number of proposals being submitted by each PI).</p> <p>Data Source: table of success rates per program in self-study</p>	<p style="text-align: center;">YES</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: We observe that 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.</p> <p>We observe a significant decline in the funding rate of Large proposals over the past four years. We were not able to determine an underlying cause, but hypothesize that it may be a combination of the introduction of the EiC program and/or the desire to give a greater number of smaller awards to a greater number of investigators. We recommend that the CCF program staff monitor the situation and continue to ensure that Large proposals are properly evaluated.</p> <p>We asked for historical data on award size, but this data was not provided in time for our review.</p> <p>Data Source: Table in self-study on success rates broken down by size of award, additional data requested on distribution of (award sizes)/(requested budget).</p>	<p style="text-align: center;">YES</p>
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p>	<p style="text-align: center;">YES</p>

<p>We considered it out of scope and infeasible for the COV to re-evaluate the contents of awarded projects, but instead we examined whether the process sought projects that were innovative and potentially transformative. We found direct evidence that the innovativeness and potentially transformative nature of proposals were regularly a factor in the recommendation for funding. In at least one jacket, the program director went against the panel to recommend funding for a high-risk innovative project.</p> <p>Data Source: Jackets</p>	
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments: Yes, we saw a number of interdisciplinary and multidisciplinary projects among the jackets we examined.</p> <p>Data Source: Jackets</p>	YES
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments: We did not feel equipped to answer this question (or Q7 or Q9) as stated, as the definition of “appropriate” is a subtle policy question, and any reasonable definition would require more sophisticated data analysis than was available to us.</p> <p>Instead, we evaluated the <u>process</u> by which considerations of geography, institution type, and diversity are taken into account... The review process in CCF focuses first on the merit of the project (e.g., in panel recommendations), and then during the post-panel decision process, the program directors and division director use these factors as secondary balancing criteria (cf., our answer to Q1 of Sec. I). In some cases, there are extra incentives in place for balancing, such as EPSCoR funding. We find this approach to be very appropriate.</p> <p>Data Source: jackets, requested description of post-panel decision process</p>	YES
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments: See answer to Q5.</p>	YES
<p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a</p>	YES

<p>previously funded NSF grant.</p> <p>Comments: Yes, the data provided to us shows that new investigators are being funded at nearly the same rate as repeat investigators (and the two rates have been getting closer over time).</p> <p>Data source: table in self-study on funding rates of new and repeat investigators</p>	
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments: Essentially all of the jackets reviewed discuss integration of research and education in some way, though the “education” component is not necessarily innovative. This seems appropriate for CISE researchers who do not have an expertise in education research.</p> <p>Data Source: Jackets</p>	YES
<p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>Comments: See answer to Q5 above. In addition, we note that women and underrepresented groups are being funded at approximately the same rate as all investigators.</p> <p>Data source: tables in self-study on funding rates of women and underrepresented groups.</p>	YES
<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments: Yes, the CCF portfolio is highly relevant to national priorities, agency mission, relevant fields, and other constituent needs.</p> <p>The PCAST Report “Designing a Digital Future: Federally Funded Research and Development Networking and Information Technology (NIT)”, December 2010 describes the importance of many areas of research that CCF supports:</p> <ul style="list-style-type: none"> • CyberSEES & CIF contribute to NIT for Energy & Transportation • AF, SHF, FRS, and CIF contribute to NIT for National & Homeland Security. 	YES

² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<ul style="list-style-type: none"> • AF and ICES contribute to NIT for Digital Democracy • ICES contributes to NIT & People • CIF contributes to NIT & The Physical World. • XPS, SHF, and CIF contribute to Scalable Systems & Networking • SHF contributes to Software Creation & Evolution • SHF contributes to High-Performance Computing • EiC contributes to all of the above. <p>PCAST Report on the National Nanotechnology Initiative - 5th Review (Oct 2014): the SHF program supports research on emerging technologies, including nanotubes and nanophotonics.</p> <p>PCAST Report on Big Data and Privacy (May 2014), PCAST Report on Cybersecurity (Nov 2013): the AF program supports foundational, algorithmic work on cryptography and privacy, and the SHF program on formal verification and language-based security.</p> <p>PCAST Report on Climate Change (March 2013): The CyberSEES program supports computational approaches to sustainability.</p> <p>Data Source: Program solicitations and PCAST reports</p>	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>We found that a high percentage of the projects funded by CCF are very strong. CCF is doing a great job in managing the enormous intellectual breadth covered by its programs.</p> <p>Data Source: Jackets</p>	NOT APPLICABLE

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
2. Please provide comments as appropriate on the program’s performance in meeting program-specific goals and objectives that are not covered by the above questions.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

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.

4. Please provide comments on any other issues the COV feels are relevant.
5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

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. While unforeseen circumstances led to delays this time, 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.

SIGNATURE BLOCK:

A handwritten signature in black ink, appearing to read 'Salil Vadhan', written over a horizontal line.

For the CCF Subcommittee of the 2014 CISE COV
Salil Vadhan, Harvard University, COV Vice-Chair for CCF Subcommittee

**DIVISION OF COMPUTER AND NETWORK
SYSTEMS**

FY 2014 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below was completed by program staff.

Date of COV: October 22-24, 2014																				
Program/Cluster/Section: Core Programs: <ul style="list-style-type: none"> • Networking Technology and Systems (NeTS) • Computer Systems Research (CSR) Cross-Cutting Programs: <ul style="list-style-type: none"> • Cyber-Physical Systems (CPS) • Computing Education for the 21st Century (CE21) • Network Science and Engineering (NetSE) • Secure and Trustworthy Cyberspace (SaTC) • Trustworthy Computing (TC) 																				
Division: Computer and Network Systems																				
Directorate: Computer and Information Science and Engineering																				
Number of actions reviewed: Awards: 78 Declinations: 85																				
Total number of actions within Program/Cluster/Division during period under review: <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 20%;"># of Actions</th> <th style="width: 20%;"># of Awards</th> <th style="width: 20%;"># of Declinations</th> </tr> </thead> <tbody> <tr> <td>FY 2010</td> <td>2775</td> <td>671</td> <td>2104</td> </tr> <tr> <td>FY 2011</td> <td>2209</td> <td>507</td> <td>1702</td> </tr> <tr> <td>FY 2012</td> <td>2339</td> <td>577</td> <td>1762</td> </tr> <tr> <td>FY 2013</td> <td>2512</td> <td>560</td> <td>1952</td> </tr> </tbody> </table>		# of Actions	# of Awards	# of Declinations	FY 2010	2775	671	2104	FY 2011	2209	507	1702	FY 2012	2339	577	1762	FY 2013	2512	560	1952
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FY 2013	2512	560	1952																	
Manner in which reviewed actions were selected: The actions selected were in two cohorts: <ol style="list-style-type: none"> (1) Random selection from bins by divisional program and fiscal year, evenly divided between awards and declinations and (2) As requested by the COV members, 12 projects on either side of funding cutoff. 																				

COV Membership: CNS Subcommittee

	Name	Affiliation
COV Chair or	Overall COV Chair: Peter Steenkiste	Carnegie Mellon University
Co-Chairs:	Vice Chair for CNS: Azer Bestavros	Boston University
COV Members:	CNS Subcommittee: Kenneth Calvert Teresa Dahlberg Serge Fdida Ann Gates Loretta Moore J. Christopher Ramming Christoph Schuba David Taylor	University of Kentucky Cooper Union Université Pierre et Marie Curie (UPMC) University of Texas at El Paso Jackson State University Intel-University Collaboration Office Ericsson University of Waterloo

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Overall the CNS CoV found that the review methods used are quite appropriate.</p> <p>Comments:</p> <ul style="list-style-type: none"> • The jackets show that review methods and selection processes are chosen and adapted to fit the characteristics of the program, proposal, and panel results. For example, some programs with larger proposals used a multi-phase review process to more thoroughly examine and consider the merit of all aspects of the submissions. 	<p>YES</p>
<p>2. Are both merit review criteria addressed</p> <p style="margin-left: 20px;">a) In individual reviews? b) In panel summaries? c) In Program Officer review analyses?</p> <p>The CNS CoV found that the two merit review criteria were uniformly addressed in individual reviews, panel summaries, and review analyses.</p> <p>Comments:</p> <ul style="list-style-type: none"> • Many solicitations include additional review criteria. The CNS CoV was pleased to find that coverage of these additional criteria in individual reviews as well as in panel summaries has improved as a result of changes to the review template on FastLane that asks specifically about these criteria. 	<p>YES YES YES</p>

<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>The CNS CoV noted that the panel system works well: In the few proposals where individual reviews were not substantive, other reviews of the same proposal were substantive and sufficient for the panel to reach well-informed decisions.</p> <p>Comments:</p> <ul style="list-style-type: none"> • In the great majority of cases, reviews were substantive. In addition, the reviews have been improving over time as a consequence of the NSF’s continual attention to evolving review criteria (e.g., introducing the five elements that make up intellectual merit) and educating the reviewer community on these criteria. • In tandem, the FastLane review templates have been updated in ways that increased the quality of reviews over the period since the last CoV in 2009. Rather than merely recapitulating proposal claims in response to general questions regarding “intellectual merit” and “broader impacts” (as was the case before the change), the current review template asks reviewers to explicitly comment on “strengths and weaknesses” of the proposal with respect to these review criteria (as well as additional review criteria as appropriate). • Given that CISE in general (and CNS in particular) is trending towards larger, collaborative awards, increased review attention will be needed concerning the intrinsic merits of a proposed collaboration, including a more critical review of proposed collaboration plans. Reviewers of larger proposals should be asked to pay increased attention to that aspect. Along these lines, the CNS CoV believes that NSF should inform the community by promoting best practices regarding collaboration plans and the Science of Team Science. • The CNS CoV felt that it is important to convey to reviewers the various phases of proposal processing. This would help reviewers appreciate the contexts in which their assessments will be used, especially as it relates to post-panel consideration of these reviews. (e.g., to secure concurrence of Division Director). 	<p>YES</p>
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <ul style="list-style-type: none"> • The CNS CoV believes that the quality of panel reviews is improved by the current practice (by Program Directors) of impressing on reviewers the importance of justifying their individual and collective ratings. 	<p>YES</p>

<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>Comments:</p> <ul style="list-style-type: none"> The CNS CoV found that the review analyses (and the justifications documented in these analyses) were overwhelmingly comprehensive in nature and well written. The CNS CoV also found that extra care was taken by Program Directors to review panel decisions where the justification for individual reviews might not have sufficed. 	<p>YES</p>
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>Comments:</p> <ul style="list-style-type: none"> The CNS CoV was very satisfied with the level and quality of the communication between NSF and PIs. In many cases program officers exceeded expectations in transmitting reviewer concerns and opportunities for growth to principal investigators. 	<p>YES</p>
<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <ul style="list-style-type: none"> The CNS CoV was pleased to see and encourages the division's ongoing exploration of innovative review processes, e.g., the use of triage, the use of virtual panels, and the use of hybrid panels (and even game-theoretic experiments conducted in other directorates). The CNS CoV supports the continued funding of high-risk proposals, and commends the practice of providing seed (EAGER) funding to investigators who have submitted high-risk proposals, or those who are interested in subjects or approaches that may not find resonance with the typically conservative panel decision-making processes. The fact that most seed-funded efforts end up resulting in follow-up proposals that are well-received by panels is indicative of the value of this practice. The CNS CoV considered the question of whether panels (and peer-reviewing in general) are inherently conservative, and if so, whether unconventional high-risk/high-reward proposals were being inappropriately penalized. The CNS CoV did not find evidence to that end. The CNS CoV was pleased by the multiple mechanisms and practices employed by Program Directors to vitiate the potential downsides of a panel process. These include: the fact that panels do not require consensus; the fact that proposals declined despite an "E" rating require specific explanation as to why not; the fact that Program Directors specifically challenge panels that are trending toward "group think"; and the fact that panel evaluations are merely advisory as opposed to compulsory on the Program Director. 	

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| <ul style="list-style-type: none">• The CNS CoV noted that consideration of results from prior support (which is a mandated element of any proposal) is distinct from evaluating a PI's capacity to pursue research. The CNS CoV noted that reviewers seldom comment on results from prior support in their evaluation or in panel summaries. This suggests that it may be useful to include that element explicitly in the criteria for evaluating intellectual merit, and to prompt reviewers for this information using the FastLane review template.• The CNS CoV found that some analyses of the awards could not be performed easily because of limitations in the underlying information systems and technologies. Recognizing that an overhaul of the software systems for managing proposals and awards may not be feasible, it may 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.• The CNS CoV discussed at length whether proposals that are important due to their broader impacts (as opposed to their intellectual merits) are negatively impacted when reviewed by panels subject to the standard criteria that require an innovative dimension. Examples of such projects include successful REU sites, test-beds, data repositories, large educational activities, and broadening participation alliances – all of which contribute to the national priorities by maintaining essential infrastructure and repositories, or building the computing human capital. A perception that intellectual merit criteria are critical for funding such initiatives may cause PIs to expand (and dilute) their focus with subsequent grants. 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. Clearly, this is an NSF-wide issue and not unique to CISE or to CNS. | |
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <ul style="list-style-type: none"> The committee was generally pleased with the quality of reviews, especially in view of the well-understood challenge of recruiting reviewers. Jackets showed that reviewers had appropriate expertise and were collectively qualified, including many senior personnel and recognized leaders. Program Director efforts to ensure reviewer diversity in all dimensions (seniority, industry/academia/government, geography, gender, race, and ethnicity) were impressive. We encourage continuation of those efforts. 	<p>YES</p>
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p> <ul style="list-style-type: none"> There were no issues identified in all the jackets under consideration. All conflicts of interest detected late were resolved appropriately. 	<p>YES</p>
<p>Additional comments on reviewer selection:</p> <ul style="list-style-type: none"> The CNS CoV noted that progress has been made on ensuring the diversity of panels. We 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. These efforts will not only contribute to the diversity of panels, but will also greatly assist in increasing awareness of NSF processes and may contribute to the submission of competitive proposals from groups that are underrepresented in computing. 	

III. Questions concerning the management of the program under review. Please comment on the following:

MANAGEMENT OF THE PROGRAM UNDER REVIEW

1. Management of the program.

Comments:

Management of the CISE programs is grounded in solid, well-functioning processes and exceptional staff. Such processes include, for example, evaluation of proposals, funding decisions, and NSF personnel evaluations, especially those of Program Directors. The CNS CoV noted the exceptional manner in which the proposal review process is managed. Processes are sound, and Program Directors have ensured the quality of the review process with the selection of reviewers and the management of this process. A feather in the cap of the CNS division is the “team work” nature of how program officers collaborate in various clusters.

The CNS Division is well organized: All CNS CoV members were impressed with the management of the Division and all of its programs. CNS-managed programs have contributed to notable successes. This includes both programs supporting the core areas of research (CSR and NeTS) and all crosscutting programs managed through CNS.

The CNS CoV finds that the model of complementing permanent staff with rotators (IPAs) works very well, especially since great care is taken to transition newly recruited IPAs into their role through mentoring, overlapping assignments with their predecessors, and overall strong help within the applicable clusters. The on-going development of an onboarding guide for new program officers is an important complement to these practices.

While permanent staff members and rotators are talented, highly respected, and perform extremely well, attention must be given to their increasing workload. There has been a trend of increasing numbers of proposal submissions that is likely to continue. However, there has been no increase in the number of staff or funding for software tools to reduce workload due to the desirable objective of keeping administrative costs low. This trend could potentially impact the ability of program officers to respond to inquiries from current PIs and from potential proposers and to be effective in their tasks. The CNS CoV recommends the identification (or development) and adoption of tools to increase efficiencies and optimize processes.

CNS has maintained an appropriate mix of permanent staff members and rotators. The panel noted that one challenge in recruiting some rotators is the transition back into academia after the rotation period has ended. A recommendation offered by the panel is to provide an incentive fund after the rotation completes to support a transition back to active research programs. Furthermore, it was noted that administrative rules can make it difficult to permanently hire IPAs who are willing to continue in the Program Director role at NSF after the end of their IPA term. We encourage the Foundation to review these requirements and to make it easier to retain key, proven talent.

Program Directors must connect and interact with the research community, which they support. The CNS CoV was pleased to learn that support is provided to Program Directors for both travel to conferences connected with the programs that they manage as well as support for professional development. The CNS CoV commends the division’s attention to the important aspect of a Program

Director's presence and visibility in the community. It is important for this practice to continue and to be encouraged (and for any hurdles that may exist to be removed) to ensure that NSF continues to be represented and perceived to be in touch with the community.

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

At a portfolio level, the CNS division does an outstanding job of balancing top-down priorities with a bottom-up community-driven process and then bringing the community into alignment around those priorities. CNS' primary tools for community-building and leadership include: Program Director presentations, workshops to stimulate interest in new areas, community whitepapers, individual solicitations, and an ever-evolving portfolio of crosscutting programs.

At the level of individual research ideas, the CNS division has multiple mechanisms for ensuring that risky, novel proposals are funded in a timely fashion through the core programs; as a result it is highly responsive to emerging opportunities in research and education.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

CNS uses both strategic/top-down and community-driven/bottom-up activities to engage the community and set program priorities. These are exemplified by visioning workshops, requests for white papers, CCC workshops and reports, interactions with the CISE Advisory Committee, and consideration of studies by the National Academies.

Perhaps the most important bottom-up input that informs (and should continue to inform) CNS comes through trends observed in submissions to the CNS core programs, which are crucial to the Division's mission. CNS has an effective internal process for setting program priorities based on these inputs.

The CoV feels that community engagement could be further enhanced by taking 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 these processes and mechanisms for up-streaming ideas/input/opportunities to CNS.

The CNS CoV noted that the use of independent third parties to assess the impact of some large programs is very important and should be continued.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

CNS has responded to the previous CoV'09 comments and recommendations over those items in which it has control. Below, we highlight some of the commendable responses that have resulted in improvement:

- CoV'09 concerns about stretching limited funds and raising proposal rates by negotiating budgets and timelines: POs are now required to report rationale for budget cuts of more than 10% in their review analysis. The CNS COV found only a few cases in which budgets were cut and, in all cases the rationale was given.
- CoV'09 concern regarding overly harsh ratings: CNS has created a practice of discussing the NSF rating scale and how it is normally used at the beginning of all panels. The effect is already measurable: average review scores from 2005-2010 were 3.06 in CISE and 3.4 foundation-wide; average review scores from 2011-2013 were 3.23 in CISE and 3.35 Foundation-wide.
- CoV'09 concern regarding the quality of reviewers in the education and workforce cluster: In response to this concern, the EWF implemented an online repository to maintain information on reviewers with expertise.
- CoV'09 suggestion to quantify effectiveness of research programs in support of CNS research as perceived by those doing research: CNS gathers feedback through various mechanisms that engage the community, e.g., PI meetings, workshops, and informational webinars.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

<p align="center">RESULTING PORTFOLIO OF AWARDS</p>	<p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Based the (necessarily limited) sample of jackets it considered, the CNS CoV believes that the portfolio includes a reasonable balance of awards across the various CNS sub-disciplines.</p>	<p align="center">YES</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>The CNS CoV found that award sizes and durations were generally appropriate, according to program objectives.</p> <p>Comments:</p> <ul style="list-style-type: none"> • CNS CoV noted that during the four-year period FY 2010 to FY 2013, the number of awards exceeding \$250,000 increased dramatically, providing appropriate support to the typically larger “team-style” nature of projects in CNS areas (e.g., typical emphasis on development of experimental systems and networks in CNS projects). • In the jackets reviewed by the CNS CoV, when budget cuts occurred, they were appropriate and well justified, and the corresponding modification in the scope of projects was also appropriate. • Changes in average award duration were noted, presumably arising from the changing mixture of programs. 	<p align="center">YES</p>
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>The sampled jackets do contain awards for projects that were judged by the panels and confirmed by CNS CoV members to be innovative and potentially (and in cases actually) transformative.</p>	<p align="center">YES</p>

<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>The CNS program portfolio appears to have a healthy ratio of inter/cross/multi-disciplinary projects as reflected by the number of medium/large awards as well as the inflow and outflow of co-funding from other CISE divisions and from other directorates.</p>	<p>YES</p>
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>The CNS CoV did not find any indications that suggest an inappropriate geographic distribution of PIs.</p> <p>Comments:</p> <ul style="list-style-type: none"> • The data made available to CNS CoV indicates that the level of funding varies across states, which is likely dependent on many factors such as the number and type of institutions contained within a particular state. • The CNS CoV commends CISE and the CNS division for engaging in practices that help with outreach to under-represented groups in many states, e.g., by actively seeking and securing co-funding from the EPSCoR program for proposals recommended for funding located within EPSCoR states. 	<p>YES</p>
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>The CNS CoV did not find any indications that suggest an inappropriate balance of awards to different types of institutions.</p> <p>Comments:</p> <ul style="list-style-type: none"> • The data made available to CNS CoV indicates that the level of funding varies across institution types. For example, during FY13, approximately 92% of the funding went to PhD-granting institutions, which seems quite reasonable given the intensity of research at these institutions. Whether such level is “appropriate” is hard to judge without proper, agreed-upon metrics for “appropriateness”. This might be a good subject for further analyses to determine the appropriate balance of awards by matching the types of institutions and the types of projects and programs for which these institutions are best suited, and/or have the capacity to successfully pursue. 	<p>YES</p>
<p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>The CNS CoV observed a nearly constant overall success rate (of about 20%) for new investigators. This is a commendable and healthy rate.</p>	<p>YES</p>

<p>Comments:</p> <ul style="list-style-type: none"> The CNS CoV encourages the CNS division to maintain this healthy success rate for new investigators – especially in its core programs. This is particularly important for faculty beginning their research careers. 	
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>The program portfolio includes projects that integrate research and education.</p> <p>Comments:</p> <ul style="list-style-type: none"> The CNS CoV noted that integration of research and education are the most-commonly cited broader impacts in the sampled jackets. 	YES
<p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>The CNS CoV did not find any indication or evidence that suggests an inappropriate level of participation by underrepresented groups.</p> <p>Comments:</p> <ul style="list-style-type: none"> The data made available to the CNS CoV suggests participation by underrepresented groups. Whether this participation is “appropriate” is hard to judge without proper, agreed-upon metrics for “appropriateness” – including analysis of the merit/competitiveness of proposals submitted by underrepresented groups, and also accounting for underreporting of demographic data by PIs. This might be a good subject for further analyses to determine the appropriate balance of awards by considering such factors to determine whether or not the CNS portfolio contains an appropriate balance of awards to a diverse group of researchers. 	YES
<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments:</p> <ul style="list-style-type: none"> Based on our interactions with Program Directors, as well as our (limited) study of the relevant data, we are confident in the relevance of the current portfolio to national priorities, agency mission spelled out in its strategic 	YES

² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<p>plan, and other constituencies. Moreover, our understanding of the processes leads us to expect that this assessment will continue to hold.</p>	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <ul style="list-style-type: none">• The relevance of the CNS portfolio is only likely to increase in the future, given accelerating trends – e.g., cloud computing, software-defined infrastructures, Internet of things, systems and network security, and big-data computational platforms.	

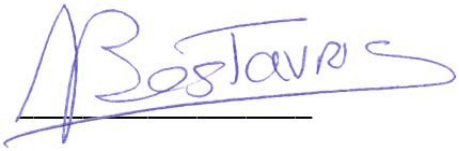
OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.
 - The CNS CoV did not have any actionable recommendations along these lines.
2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.
 - The CNS CoV did not have comments regarding program performance that were not covered by earlier comments.
3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.
 - The CNS CoV agrees that merging educational programs, e.g., CE21 and MSP, from CISE and ERH, respectively, is a good thing. The CoV encourages the Foundation to ensure that EWF continues to be actively involved in the merged program.
 - The CNS CoV recognizes the importance of supporting programs that scale efforts (whether related to infrastructure, education, or broadening participation). Investigators must address the impact of scaling and must assess what will be learned from scaling. Recognition of the importance of these types of proposals is critical and panels should be informed during the review process.
4. Please provide comments on any other issues the COV feels are relevant.
 - The CNS CoV commends the division (and CISE in general) for its use of creative approaches to streamline the review process – e.g., though the use of “triage”, the use of pre-panel and/or post-panel ad-hoc reviews, and the use of virtual panels. During its discussions with program officers, the CNS CoV suggested that some of these approaches be combined – for example:
 - By allowing ad-hoc reviewers to make themselves available to panelists for answering questions, or
 - By imposing earlier deadlines on panelists to submit their reviews through FastLane to allow program officers to seek additional/ad-hoc reviews in cases the received reviews are deemed not substantive enough, or
 - By using tried-and-tested best practices and software tools for reviewing academic research (e.g., EasyChair) to allow for asynchronous reviewing and/or pre-panel exchange of reviews.
 - By using data and document analytics to distill trends in project portfolios or to assign proposals and reviewers to panels.
5. NSF would appreciate your comments on how to improve the COV review process, format and report template.
 - The CNS CoV committee believes that conducting its review in tandem with other CISE divisional CoVs is a good practice (compared to the independent divisional COVs from 2009). This format of a CISE-wide CoV with subcommittees for the different divisions could

be further improved by dedicating breakout sessions to allow members from different subcommittees to compare notes regarding programs and issues that are common to or that crosscut all divisions (e.g., core programs, cross-cutting programs, educational programs).

- The CNS CoV feels that the presentations and discussions with cognate Program Officers during the CoV visit and in particular during the CNS subcommittee meetings were very informative and indeed crucial to its deliberations. The Program Officers' engagement and impressive responsiveness in answering (or trying to answer) every question we asked were instrumental (and of course commendable).
- The CNS CoV feels that it would be better to provide separate statistics for peer-reviewed proposals and non-peer-reviewed proposals (e.g., RAPID, EAGER, workshops, etc.) Also, the CNS CoV feels that it would be better for data to be uniformly reported across awards, projects, and proposals (to allow comparative analysis and allow easier consideration of trends).
- The CNS CoV believes that it would be much more efficient if data is provided in a form that allow for manipulation/processing/graphing (i.e., in spreadsheets as opposed to PDFs).
- The CNS CoV feels that answering some of the questions in the CoV evaluation template required subjective assessments – specifically as it relates to the “appropriate” balance of projects in a portfolio along dimensions of geographical and/or demographic diversity. The CNS CoV suggests that appropriate metrics be developed to objectively answer these questions, or else to change the questions to ones that ask about “evidence to the contrary”.

SIGNATURE BLOCK:



For the COV CNS subcommittee
Azer Bestavros
Chair

**DIVISION OF INFORMATION AND INTELLIGENT
SYSTEMS**

FY 2014 REPORT TEMPLATE FOR NSF COMMITTEES OF VISITORS (COVs)

The table below should be completed by program staff.

Date of COV: October 22-24, 2014			
Program/Cluster/Section: Core Programs: <ul style="list-style-type: none"> • Cyber-Human Systems (CHS) – formerly Human-Centered Computing (HCC) • Information Integration and Informatics (III) • Robust Intelligence (RI) Cross-Cutting Programs: <ul style="list-style-type: none"> • Critical Techniques and Technologies for Advancing Big Data Science and Engineering (BIGDATA), formerly Core Techniques and Technologies for Advancing Big Data Science and Engineering (BIGDATA) • Cyberlearning and Future Learning Technologies (CFLT), formerly Cyberlearning: Transforming Education (CTE) • Collaborative Research in Computational Neuroscience (CRCNS) • Graphics and Visualization (G&V) • National Robotics Initiative (NRI) • Smart and Connected Health (SCH), formerly Smart Health and Wellbeing (SHB) • Social-Computational Systems (SoCS) 			
Division: Information and Intelligent Systems			
Directorate: Computer and Information Science and Engineering			
Number of actions reviewed: Awards: 62 Declinations: 62			
Total number of actions within Program/Cluster/Division during period under review:			
	# of Actions	# of Awards	# of Declinations
FY 2010	2231	486	1745
FY 2011	2476	484	1992
FY 2012	3354	508	2846
FY 2013	3069	450	2619
Manner in which reviewed actions were selected: The actions selected were in two cohorts: <ol style="list-style-type: none"> (1) random selection from bins by divisional program and fiscal year, evenly divided between awards and declinations and (2) as requested by the COV members, 12 projects on either side of funding cutoff. 			

COV Membership: IIS Subcommittee

	Name	Affiliation
COV Chair or Co-Chairs:	Overall COV Chair: Peter Steenkiste Vice Chair for IIS: Nancy Amato	Carnegie Mellon University Texas A&M University
COV Members:	Eric Brown Dieter Fox Mark Guzdial Julia Hirschberg Joseph Konstan Michael Lesk Bernard Moret Marjorie Skubic Jakita Thomas	IBM, Watson Technologies University of Washington Georgia Institute of Technology Columbia University University of Minnesota Rutgers University École Polytechnique Fédérale de Lausanne (EPFL) University of Missouri Spelman College

INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

I. Questions about the quality and effectiveness of the program's use of merit review process. Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments:</p> <p>Generally, the reviewing methods are appropriate. The panel process is strong and working well.</p> <p>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, e.g., virtual panels, asynchronous panels, calls for panelists. To reduce costs and make the reviewing process more attractive and feasible to panelists, IIS is encouraged to explore further increasing the use of virtual panels.</p> <p>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 they reviewed is discussed.</p> <p>Some additional suggestions for further improving the review process and quality are provided in the response to question I.7.</p> <p>Data Source: EIS/Type of Review Module</p>	Yes
<p>2. Are both merit review criteria addressed</p>	Yes

<p>a) In individual reviews? Yes. b) In panel summaries? Yes. c) In Program Officer review analyses? Yes.</p> <p>Comments: Although many declined proposals have boilerplate review summaries, program officers ensure that the feedback to proposers (i.e., reviews, panel summaries, and program officer comments) addresses both criteria.</p> <p>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 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)</p> <p>Data Source: Jackets</p>	
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<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments: The majority of reviews are substantial, with at least 2-3 sufficiently detailed reviews per proposal. In combination with the panel process, each proposal receives substantial feedback.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
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<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments: 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.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
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<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>[Note: Documentation in the jacket usually includes a context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.]</p> <p>Comments:</p> <p>The decisions are well documented in the jackets.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
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<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>[Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written in the PO Comments field or emailed with a copy in the jacket, or telephoned with a diary note in the jacket) of the basis for a declination.]</p> <p>Comments:</p> <p>Overall, the documentation to the PI provides detailed and useful rationale for the award/decline decision.</p> <p>However, there were some infrequent situations in which a clearer rationale could have been provided to the PI. For example, not every declined Highly Competitive proposal had a panel summary that made the reasons for the decline clear. In these cases, the PO Comments are a good mechanism to communicate the rationale for the decision and they could be used more systematically.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
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<p>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Although the current process works very well, the IIS COV has some suggestions to further improve the quality of the individual reviews:</p> <ul style="list-style-type: none"> • 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 	
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<p>check them and request revisions or ad hoc reviews in advance of the panel meeting;</p> <ul style="list-style-type: none"> Investigate mechanisms to facilitate discussion among the panelists after reviews are submitted but prior to the panel meeting. <p>NSF should consider offering PIs submitting revised proposals the option of having their previous reviews presented to the new reviewers and panelists. This is done by other agencies (e.g., NIH) and by some computer science conferences (e.g., SIGGRAPH), and it has proven to be a useful practice that increases the consistency in the feedback to the submitters and decreases the effort required on the part of the reviewers. This option might be used strategically, at least at first, e.g., by restricting it to proposals recommended for this by the previous panel.</p>	
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II. Questions concerning the selection of reviewers. Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments:</p> <p>We commend the program officers for identifying appropriate experts for the reviews, including for the many interdisciplinary proposals handled by IIS. In some cases, however, an additional ad hoc reviewer could have been beneficial, e.g., in one case a particular technology was central to the proposal but no reviewer familiar with it had reviewed the proposal.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments:</p>	<p>Yes</p>

<p>Yes, the COV found that the recognized COIs were resolved appropriately and it found no evidence that any conflicts of interest were not recognized or resolved.</p> <p>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.</p> <p>Data Source: Jackets</p>	
<p>Additional comments on reviewer selection:</p> <p>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.</p>	

III. Questions concerning the management of the program under review. Please comment on the following:

<p>MANAGEMENT OF THE PROGRAM UNDER REVIEW</p>
<p>1. Management of the program.</p> <p>Comments:</p> <p>Management of IIS programs is working well. Mechanisms are in place for collaborative management, both within IIS and within CISE as a whole.</p> <p>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 POs (e.g., NRI, Smart & Connected Health, and Big Data).</p> <p>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.</p> <p>The fact that IIS functions so well with such 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 continued increase in</p>

proposal submissions. Even at the current level, the staff have had to cut back on outreach and engagement with the community

Recommendations:

Develop more effective mechanisms to support telecommuting.

Enhance programs 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

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, e.g., by inviting CISE AC participation.

Track topics funded across different IIS/CISE/NSF programs where there is overlap (e.g. robotics, machine learning, computational biology, etc.). This would be particularly useful for CISE as a whole and its divisions when doing portfolio assessment and program planning. It would also allow future COVs to get a more accurate picture of what the funding level is in each area.

2. Responsiveness of the program to emerging research and education opportunities.

Comments:

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. 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 (e.g., Ebola).

New programs are responsive to emerging opportunities and have helped attract top people to serve as program officers, e.g. NRI, Smart Health and Big Data. This has helped in rapidly responding to new areas.

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The program planning and prioritization process in IIS works very well.

CISE uses a good mixture of community outreach and internal communication to plan new initiatives.

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

Yes, IIS was quite responsive to previous COV reports. Examples include reducing cuts in funded proposals and establishing the new Research Initiation rewards.

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. See response to last question in Part II.

IV. Questions about Portfolio. Please answer the following about the portfolio of awards made by the program under review.

<p style="text-align: center;">RESULTING PORTFOLIO OF AWARDS</p>	<p style="text-align: center;">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>This is 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 that CISE and IIS, as well as the next COV can assess the balance of awards more easily.</p> <p>There is no longer a program for computing education research that is independent of a specific intervention.</p> <p>Data Source: EIS/Committee of Visitors Module. From the Report View drop-down, select the Funding Rate module to see counts of proposals and awards for programs. The Proposal Count by Type Report View will also provide a summary of proposals by program.</p>	<p style="text-align: center;">Data Not Avail able</p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p>	<p style="text-align: center;">Yes</p>

<p>Most awards are at or near the level requested; general award durations are considered to be appropriate. This was a noted improvement that addressed concerns noted by previous COVs.</p> <p>Data Source: EIS/Committee of Visitors Module. From the Report View drop-down, select Average Award Size and Duration.</p>	
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p> <p>Comments:</p> <p>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.</p> <p>However, 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.</p> <p>Data Source: Jackets</p>	<p>Yes</p>
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>Yes, the IIS portfolio very clearly includes inter- and multi-disciplinary projects.</p> <p>Data Source: If co-funding is a desired proxy for measuring inter- and multi-disciplinary projects, the Co-Funding from Contributing Orgs and Co-Funding Contributed to Recipient Orgs reports can be obtained using the EIS/Committee of Visitors Module. They are available as selections on the Report View drop-down.</p>	<p>Yes</p>
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>The geographical diversity of the IIS award portfolio has increased since 2010.</p> <p>The EPSCOR process aims at further reducing possible imbalances.</p>	<p>Yes</p>

<p>Data Source: EIS/Committee of Visitors Module. Select Proposals by State from the Report View drop-down.</p>	
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p> <p>Comments :</p> <p>The balance of awards to different types of institutions is acceptable and is consistent with NSF’s goal of funding excellent research.</p> <p>Data Source: EIS/Committee of Visitors Module. Select Proposals by Institution Type from the Report View drop-down. Also, the Obligations by Institution Type will provide information on the funding to institutions by type.</p>	<p>Yes</p>
<p>7. Does the program portfolio have an appropriate balance of awards to new investigators?</p> <p>NOTE: A new investigator is an investigator who has not been a PI on a previously funded NSF grant.</p> <p>Comments:</p> <p>Over all, it appears that the IIS portfolio has a reasonable balance of awards to new investigators.</p> <p>The new CISE Research Initiation Initiative (CRII) for new investigators is an excellent program to further increase the availability of funding to new investigators.</p> <p>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.</p> <p>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.</p> <p>Data Source: EIS/Committee of Visitors Module. Select Funding Rate from the Report View drop-down. After this report is run, use the Category Filter button to select New PI for the PI Status filter or New Involvement (PIs & coPIs) = Yes.</p>	<p>Yes</p>
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>In addition to projects that directly involve educational research, computing</p>	<p>Yes</p>

<p>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.</p> <p>Data Source: Jackets</p>	
<p>9. Does the program portfolio have appropriate participation of underrepresented groups²?</p> <p>Comments:</p> <p>The success rate of PIs by gender for IIS managed programs suggests appropriate participation.</p> <p>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. This includes workshops and training for PhD students and junior faculty members, and support for mentoring programs managed by organizations such as CRA-W and the Coalition to Diversity Computing (CDC) that are supported by the NSF BPC Alliance program. These efforts are valuable and should be continued.</p> <p>Data Source: EIS/Committee of Visitors Module. Select Funding Rate from the Report View drop-down. After this report is run, use the Category Filter button to select Women Involvement = Yes or Minority Involvement = Yes to apply the appropriate filters.</p>	<p>Yes</p>
<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments:</p> <p>A majority of the recent reports from PCAST (http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports) clearly identify the importance of IIS topics to national priorities, as do many National Academy Reports. A sample of such recent reports includes:</p> <ul style="list-style-type: none"> • <i>Report on Education Technology - Skills & Jobs (2014, 2013)</i> • <i>Big Data and Privacy (2014)</i> • <i>Report on Systems Engineering in Healthcare (2014)</i> • <i>Report on Cyber Security (2013)</i> • <i>Network and Information Technology (2013)</i> 	<p>Yes</p>

² NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<ul style="list-style-type: none"> • <i>Advanced Manufacturing (2012,2011)</i> • <i>Health Information Technology Report (2010)</i> <p>Data Source: Jackets</p>	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>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.</p>	

OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The IIS COV 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.

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

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.

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.

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

NSF should consider expanding the eligibility requirements for REU funds to include high school students and international undergraduate students pursuing degrees at US institutions. Allowing REU funds to be used to support research experiences by high school students can provide early engagement opportunities that would particularly impact the selection of major by groups underrepresented in computing, which is a necessary first step toward their entry to the research community. International students pursuing degrees at US institutions are excellent candidates for

graduate studies in US institutions and allowing REU funds to be spent on them would improve the preparation and quality of graduate students in US institutions.

4. Please provide comments on any other issues the COV feels are relevant.

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.

5. NSF would appreciate your comments on how to improve the COV review process, format and report template.

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, 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.

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.

SIGNATURE BLOCK:



For the NSF Committee of Visitors IIS Sub-Committee
Nancy M. Amato
Vice-Chair for IIS