

Response of Division of Mathematical Sciences to the 2016 Committee of Visitors Report

The Division of Mathematical Sciences (DMS) wishes to thank the members of the 2016 Committee of Visitors (CoV) for the time and effort that were devoted to an extremely in-depth and detailed review of the activities of the Division during the period of FY 2013 through FY 2015. There was a great deal of material for the Committee to work through, and the Division appreciates the care that was taken in examining the material and in asking many probing questions over the three-day period. DMS wishes to express its gratitude to the chair, Dr. Peter Jones, and the subcommittee chairs, Dr. Jill Pipher, Dr. Jan Philip Solovej, and Dr. Richard Taylor, whose effective leadership of 2016 Committee of Visitors was essential to its success.

DMS is pleased that the committee finds “DMS is generally doing an excellent job of administering the programs and distributing the available funding to support extremely high quality research in a wide range of disciplinary areas.” The support given in the report is an expression of confidence that the Division is serving the community well. The CoV report also contains a number of other findings and recommendations, to which we respond in the numbered sections below. In the following quotations from the report are italicized.

1. The Mathematical Sciences Research Institutes Program

The CoV report includes a number of comments and suggestions concerning the Mathematical Sciences Research Institutes program, in particular, about the DMS decision to ramp down its support for two of the institutes, namely the Institute for Mathematics and its Applications (IMA) and the Mathematical Biosciences Institute (MBI).

A majority of the subcommittee on Research Institutes found that the process leading to these decisions was acceptable. The subcommittee did

have some concerns about the effectiveness of communication between DMS and the Institute leaderships.

The DMS award portfolio is continually evolving in response to developments in the mathematical sciences and new interdisciplinary opportunities. The DMS institute portfolio is no exception; in particular, recent programs across the spectrum of DMS institutes have emphasized new applications of mathematics in other disciplines. Most notably, the Institute for Computational and Experimental Research in Mathematics (ICERM) and the Institute for Pure and Applied Mathematics (IPAM) have expanded their reach in applied mathematics.

The continuing evolution of the DMS institute portfolio is reflected in the recent launch, jointly with the Computing and Communication Foundations (CCF) Division in CISE, of the new initiative “Transdisciplinary Research in Principles of Data Science (TRIPODS)” in September 2016. This new institute program aims to bring together the statistics, mathematics, and theoretical computer science communities to develop the theoretical foundations of data science through integrated research and training activities. DMS is also developing new programs with biological sciences partners.

DMS communicates with the institute leaderships in a variety of ways. Members of the DMS institute management team attend institute board meetings, organize institute site visits, and communicate with institute leaderships through emails and phone conversations on various issues. DMS leadership and the DMS institute management team attend the annual Meeting of Institute Directors (MID) and actively participate in the planning of these MIDs. DMS is always looking for ways to improve the effectiveness of communications with institute leaderships while balancing the workload for the members of the institute management team.

The next open competition will be in 2019. Moving forward, the review process will change due to the competition between established centers and new applicants. It is important that DMS considers this with care and communicates it clearly to the community.

The DMS institute management team is in the process of rewriting the Institute program solicitation to reflect the new competition schedule.

2017 update: [DMS released a new program solicitation \(NSF 17-553\) in April 2017](#)

for the *Mathematical Sciences Research Institutes* program. The solicitation calls for Letters of Intent due in December 2018 and Full Proposals due in March 2019. The new solicitation was a topic of discussion in the annual Meetings of Institute Directors in 2017. An informational online webinar is scheduled to be held by DMS in February 2018 to further disseminate information about the competition.

The CoV recommends that DMS clarify their selection criteria and procedures for investing in foreign Institutes.

The DMS support to foreign institutes is entirely for the support of US-based participants. DMS plans, if future demand requires, to implement a more formal mechanism for supporting US participation in foreign institute programs.

The CoV 2013 report concluded that

"Without substantial future increase in the DMS budget, the potentially painful decision to ramp down and not continue the funding of an existing institute must be considered in the mix along with the possibility of new ones."

In light of this and as a result of the 2014 non-competitive review of the Institutes, DMS recommended a staged discontinuation of IMA and MBI.

DMS continues to be committed to support the Research Institute portfolio at roughly a constant funding level, but as with any other program, DMS also has a responsibility to keep this program dynamic and open to new activities. Additional background information can be found at

<http://www.ams.org/journals/notices/201511/rnoti-p1375.pdf>

2017 Update: DMS introduced two new Center/Institute programs in its Research Institute portfolio. (1) The program in *Transdisciplinary Research in Principles of Data Science* (TRIPODS) (NSF 16-615), in collaboration with the NSF Directorate for Computer & Information Science & Engineering (CISE), brings together the statistics, mathematics, and theoretical computer science communities to develop the foundations of data science. The TRIPODS program held a Phase I competition with proposals due in March 2017; a total of twelve TRIPODS projects were funded. (2) The program *NSF-Simons Research Centers for Mathematics of*

Complex Biological Systems (NSF 17-560), in collaboration with the NSF Directorate for Biological Sciences and with the Simons Foundation Division of Mathematics and the Physical Sciences and Division of Life Sciences, aims to enable innovative collaborative research at the intersection of mathematics and molecular, cellular, and organismal biology, to establish new connections between these two disciplines, and to promote interdisciplinary education and workforce training. The program received proposals in September 2017 and intends to fund up to three new research centers in 2018.

The CoV recommends the DMS work with the Institutes to provide data that can be used to better evaluate the effectiveness of their activities.

DMS has been working with the institutes to improve methods of collecting data and has begun developing improved reporting requirements with the goal of furnishing a more uniform and accurate picture of each institute's effectiveness.

2017 Update: New awards made via the 2019 *Mathematical Sciences Research Institutes* (NSF 17-553) competition will require improved reporting of data on participants in all institute programs, to include a required ORCID identifier for each participant supported with NSF funds. In preparation for the enhanced reporting to be required, in May 2017 DMS established a working group of representatives from each of the currently-supported DMS Research Institutes to develop common software to streamline future reporting of participant data by all the DMS Research Institutes. The working group meets monthly via teleconference.

2. The Mathematical Sciences Workforce Program

The CoV made suggestions concerning the DMS Workforce Program, which has the long-range goal of increasing the number of well-prepared U.S. citizens, nationals, and permanent residents who successfully pursue careers in the mathematical sciences and in other NSF-supported disciplines.

On the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF) Program

We note that although the choice of mentor and host institution forms part of the application for a MSPRF, DMS allows awardees with a good reason to change mentor and institution after one year. We believe this flexibility is very important in a small number of cases. We commend DMS for extending this flexibility to fellows in their first year who wish to attend a special program at one of the mathematical institutes. We are aware of a number of unfortunate cases where this was previously not allowed. The subcommittee feels it would be useful, when there are extenuating circumstances, and with the approval of the program director, if MSPRF's could move their fellowship to a different institution with a different mentor, even before the start of their fellowship.

The current MSPRF solicitation states “If the Fellow plans an absence from the host institution of duration longer than one month during the first year of the Fellowship, the MSPRF proposal must fully describe in a supplementary document the rationale and plans for such an absence. Plans for long-term absences (which are expected to be uncommon) are subject to review together with the rest of the proposal. Program directors will not approve long-term absences of the Fellow from the host institution, unaccompanied by the sponsoring scientist, during the first year of a Fellowship unless plans for the long-term absence are spelled out in the proposal”. DMS is not inclined to extend this flexibility to a general change of mentor and institution in the first year, since (1) the mentor-mentee plans constitute a central aspect in the review of the MSPRF application and (2) unplanned changes of institution upon receipt of a MSPRF award could have a negative impact on the geographic diversity of the program and lead to an over-concentration of postdocs at a few institutions.

Regarding the funding rate of MSPRF proposals

The subcommittee has an extremely positive impression of the effectiveness of this program. It notes that the funding rate is at historic lows. For 30 years or so, the funding rate fluctuated between 20% and 40%. In 2010 it fell to 16% and in 2011 was 17%. We don't know the funding rate since then, but for the 2015 panel we were given access to the rate, which was less than 20%. Such a low funding rate for such a successful program is a serious concern. We urge the NSF to try to correct this.

The funding rates for MSPRF proposals vary over the years, depending on the number of proposals submitted. In view of the overall budgetary constraints and declining proposal funding rates in other programs, DMS does not see a particular need to address the MSPRF proposal funding rate.

On the Research Experiences for Undergraduates (REU) Program

Reviewers must be directed to evaluate proposals in light of the specific route to success that is sought. For example, it strikes us that a proposal that aims to involve in research students with less preparation should not be evaluated according to the number of publications the program produces. Second, for any proposals that constitute renewals of ongoing REU programs, reviewers must be encouraged to address the success of the prior REU awards.

The number of publications resulting from an REU is only one measure of success. Results under prior NSF support are part of the merit review criteria for all proposals. DMS appreciates the committee's calling attention to these important points and will redouble efforts to insure REU panelists are fully cognizant of these issues.

On the Research Training Group (RTG) in the Mathematical Sciences Program

The program solicitation states that "The RTG program is intended to help stimulate and implement permanent positive changes in research training within the mathematical sciences in the U.S." This seems to suggest that preference be given to newer initiatives than renewals of existing ones, however successful. If this is indeed the case, then it should be made clear to the community and the panels.

This is indeed part of the RTG solicitation, which states "The RTG program is intended to help stimulate and implement permanent positive changes in research training within the mathematical sciences in the U.S. Thus it is critical that an RTG site adequately plan how to continue the pursuit of RTG goals when funding terminates." This point has been emphasized by the program directors in their review instructions to RTG panelists. DMS will work on finding more effective ways to communicate this aspect to the community.

On the Enriched Doctoral Training in the Mathematical Sciences Program

The program is too young to yet judge its success. However we urge DMS to consider how it will, in the longer term, measure the success of this program.

DMS is currently reevaluating this program, which may result in revisions to the current solicitation.

2017 Update: DMS discontinued the program in Enriched Doctoral Training in the Mathematical Sciences as of FY 2018. DMS launched the new *NSF Mathematical Sciences Graduate Internship* program (see Dear Colleague Letter NSF 17-042) in partnership with the Oak Ridge Institute for Science and Education (ORISE), which is managed by Oak Ridge Associated Universities (ORAU) for the Department of Energy. This new program annually funds approximately forty summer internships, primarily at the National Laboratories, to introduce doctoral students in mathematics to interesting applications of mathematical or statistical theories outside of academia.

We urge DMS to collect data to judge the effectiveness of its various workforce programs. We feel that it is practical to collect such data that could be used to validate (or not) the various programs and to determine which approaches best achieve the stated goals.

DMS is working to improve evaluation of its workforce programs. There are limitations, however, in the NSF ability for data collection. By policy, demographic data is self-reported only -- the completeness and accuracy of such data relies on the participants in the programs. Concerning potential longitudinal studies, the NSF cannot require awardees to conduct activities beyond the expiration of an award period.

3. Merit Review Process

The CoV made a number of comments regarding the merit review process.

(concerning proposal review analyses (RA)) ... the details of the rationale for funding decisions in the RAs for “competitive” but “declined” category were more variable. Our committee appreciated the difficulty of the decisions by POs for proposals in this category, and we had ample evidence that tremendous thought and consultation occurred in this process. We recommend that the documentation of the POs internal process be uniformly complete.

DMS Program Officers have been working hard to improve transparency in their documentation of funding decisions. The division leadership requires that review analyses provide specific reasoning for declination of proposals that panels recommended for funding. In many cases these declinations were made simply because available program funds could only support a portion of the proposals ranked in the “Competitive” category.

The panel system for evaluation, supplemented by mail reviews, is working very well. The review analyses were not uniformly thorough. Particularly when funding decisions deviate from the panel orderings, the review analysis should contain as full an account as possible of the details that led to the final decision, including factors of which the panel was unaware and comparisons between specific proposals.

The subcommittee looked carefully at cases where the program officers funding decisions deviated from the panel ordering. In many cases the reasons for this reordering were not made clear in the review analysis. Usually, but not always, the subcommittee could think of good reasons for the reordering and were happy with the outcome. In no case was the subcommittee unhappy with the outcome. However we did feel that the reasoning should be better explained.

DMS is happy to see that the subcommittee was satisfied with the outcomes in their examination of cases in which a Program Officer’s funding decision deviated from the panel ordering. Such deviations should not be surprising, given the fact that the panel orderings are recommendations, but they should be sufficiently well documented that the reasoning can be reconstructed. DMS is always looking for ways to improve the documentation of funding recommendations and to

explain the rationale behind the decisions. An important concern is to identify improvements where the increased workload for Program Officers leads to significant benefits for the Mathematical Sciences Community.

The committee recommends that DMS provide the reviewers examples of good and bad reviews on broader impact.

The Broader Impacts review criterion is formulated in non-restrictive language to accommodate the wide range of activities present in proposals to the NSF. DMS is aware of the frustration of some reviewers with the general formulation of the Broader Impacts criterion. Examples of Broader Impacts natural in DMS proposals are provided to reviewers during panel briefing and proposal discussion. However, DMS hesitates to provide explicit example review language because it may lead to a “cookie cutter” approach in proposal evaluation.

We were distressed by cases in which one of three reviewers gave a grade of R, and explicitly reported that they lacked sufficient expertise. If the panel cannot supply three substantial reviews, then program directors should get mail reviews.

In some cases program officers base their funding recommendations on two substantive reviews and a substantive panel summary, if they believe that the reviews and the panel summary have provided enough information to inform such recommendations. The panel summary represents the opinions of all non-conflicted panelists and thus complements the opinions of the panelists who wrote reviews. In cases where the panel review does not adequately address the merit review criteria, external reviews are obtained. All recommendations are subject to concurrence by the Division Director.

When an excellent proposal is rejected due to insufficient funds, the applicant should be encouraged to submit a revised proposal in a future competition. An effort should be made to offer concrete suggestions for improvement.

DMS encourages Principal Investigators with promising projects to submit revised proposals after addressing the specific comments made by reviewers. However

Program Officers are not in the position to “offer concrete suggestions for improvement.”

(concerning interdisciplinary proposals) ... It is very important to put in place mechanisms that allow such proposals to also be judged on their interdisciplinary qualities, and not only on their merits in the individual disciplines.

DMS believes a proposal should be judged either by the strength of the application or the strength of the theoretical developments. It is not a DMS priority to fund the application of standard techniques to a standard problem (even though the particular combination may be unique). However, DMS is cognizant that special considerations may be required to promote interdisciplinarity, and DMS engages in extensive co-review and co-funding of interdisciplinary proposals. DMS support for interdisciplinary research may be gauged by the spectrum of crosscutting funding opportunities featured on the DMS web page <https://www.nsf.gov/funding/programs.jsp?org=DMS> . Additionally, DMS encourages and supports the initial involvement of mathematical scientists in interdisciplinary research across NSF programs through the Mathematical Sciences Innovation Incubator program.

DMS should pay special attention to make sure proposals from Primarily Undergraduate Institutions (PUIs) have at least one reviewer from a PUI.

The NSF Facilitating Research at Primarily Undergraduate Institutions: Research in Undergraduate Institutions (RUI) and Research Opportunity Awards (ROA) program solicitation states “RUI proposals are evaluated with all other proposals submitted to a given program in accordance with the Foundation's merit review procedures. The reviewers of these proposals usually include several individuals from predominantly undergraduate institutions, but also researchers from other institutions who are experts in the particular research area.” DMS requires program officers to provide specific instructions on reviewing RUI proposals to panelists and encourages program officers to invite panelists from Primary Undergraduate Institutions.

There was concern that over half of all those invited to serve on panels turn down the request to serve. The programs could experiment with methods to

increase the acceptance rate. These could include remote panels and more but shorter panels, though these all have potential downsides.

DMS does run a number of two-day panels, and the Division also offers panelists the option of serving “remotely” (via videoconference). However, many reviewers prefer the in-person panel experience. DMS is concerned about the high declination rate among potential reviewers. We feel the community could have a positive impact by instilling in its members the importance of serving when invited.

4. Demographic Diversity

The CoV raised some questions and made some recommendations regarding the demographic diversity of DMS program portfolios.

It would be useful to collect and analyze more data about the participation of women and minorities, both in proposals and awards. This may provide some guidance to help increase the number of proposals from underrepresented groups.

Questions were raised about whether women were applying in sufficient numbers, or whether “self-selection” in applying for grants was disproportionately impacting them. The subcommittee did not have the data available to answer this question. We recommend the collection of data to compare the percentage of tenure track/tenured positions in mathematics held by women with the percentage of grant applications in DMS with a female PI.

DMS gathers information about the success rates of various ethnic/gender and Ph.D age groups among proposers and does its best to ensure that proposals are reviewed, and awards recommended, without bias. DMS does not gather data about the professorate as a whole. American Mathematical Society does collect and publish data on faculty demographics in mathematical sciences departments of four-year colleges and universities.

The number of applicants who did not give their gender was large, and in fact comparable to the number of female applicants. This makes the data we did have difficult to interpret and may lead to erroneous conclusions.

By NSF policy, demographic data is self-reported only – the completeness and accuracy of such data relies on the participants in the programs. DMS will work with other parts of the Foundation to see if there are ways the situation can be improved.

In connection with the REU program, the CoV noted

There were a few proposals from minority- and women-serving institutions that did not receive funding. As noted in the previous CoV 2013 report, “Care is needed to nurture promising underrepresented students and researchers as they move along the pipeline, with special attention to seeing that they are recruited to the next step in their careers while in each DMS program.”

DMS is aware of these issues and is in collaboration with programs in the NSF Education and Human Resources (EHR) Directorate trying to develop guidelines to encourage proposals for effective, scalable “bridge” programs that enhance the preparation of young researchers for the next steps in their educations and careers.

2017 Update: In collaboration with the EHR Divisions of Graduate Education (DGE), Undergraduate Education (DUE), and Human Resource Development (HRD), in April 2017 DMS issued the *Dear Colleague Letter: Improving and Supporting the Transition to Graduate School in the Mathematical Sciences* (NSF 17-078) to encourage proposals that would improve and support student transition to and subsequent success in doctoral programs in the mathematical sciences.