

Update

Division of Mathematical Sciences Response to the 2013 Committee of Visitors Report

Introduction

The Division of Mathematical Sciences (DMS) received the report of the 2013 Committee of Visitors (COV) and thanks the COV for a thoughtful and constructive document. The Division agrees with the Committee's comments about the importance and centrality of the mathematical sciences in modern scientific advances, and the Division is pleased with the report's statement that the Committee "found the quality and significance of the division's programmatic investments to be extremely high. Award decisions and the goals of the division's programs are well integrated into the goals of the National Science Foundation and to national needs and priorities." The COV report also contains a number of findings and recommendations, to which we respond in the numbered sections below. Quotations from the report are italicized.

DMS wishes to express its gratitude to the chair, Dr. Mark Green, and the sub-committee chairs, Dr. Bjorn Engquist, Dr. Javier Rojo, and Dr. Karen Vogtmann, whose effective leadership of the 2013 Committee of Visitors was essential to its success.

1. 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.

1.1 Workforce Program Structure

- *The workforce programs put in place by DMS have great value. The 2010 COV described them as constituting a "rich tapestry," and this remains a cogent description. DMS has shown laudable initiative in creating new programs and in scuttling those that do not draw a sufficient number of strong proposals. In some cases, some of the discontinued workforce programs strike us as having been needlessly complex and overly restrictive. These restrictions sometimes arise from a broader context than DMS, while others are specific to a particular program. We suggest that in designing workforce programs, where possible, DMS follow Einstein's dictum of making them "as simple as possible, but not simpler."*

DMS is pleased to hear that COV values highly the Workforce program, which is evolving according to the needs of the community. DMS continues to accept unsolicited proposals to the Workforce program, as explained on the program's web page. DMS agrees that some of the legacy Workforce program activities are restrictive; looking forward, DMS is supporting a project, "Investing in the Next Generation through Innovative and Outstanding Strategies" (INGenIOuS), to establish a virtual community (www.ingeniousmathstat.org) for exploring key challenges and to implement a community workshop for the production of recommendations for future initiatives to develop the mathematical sciences

workforce. DMS hopes to use the input from this activity to revise the Workforce program offerings, keeping in mind the need for straightforward program solicitations.

2014 Response Update:

At the time of the COV assessment in February 2013, the DMS Workforce program comprised five structured calls for proposals for training activities:

- Mathematical Sciences Postdoctoral Research Fellowships (MSPRF)
- Research Training Groups in the Mathematical Sciences (RTG)
- Mentoring through Critical Transition Points (MCTP)
- Expeditions in Training, Research, and Education for Mathematics and Statistics through Quantitative Explorations of Data (EXTREEMS-QED)
- Research Experiences for Undergraduates – Sites (REU)

as well as an option for unsolicited proposals to the program.

The INGenIOuS project took place during the period April 2013 through July 2013 and issued a draft report in August 2013 (with a final report in January 2014). Taking into account the information provided by the INGenIOuS report and several other sources, including the publications "Fueling Innovation & Discovery" (National Academies Press 2012), "The Mathematical Sciences in 2025" (National Academies Press 2013), "Engage to Excel" (PCAST 2012), and the OMB/OSTP 2015 Funding Priorities Memo, the Division conducted extensive planning exercises for the Workforce program during the period October 2013 through April 2014. As a result, the Division discontinued the solicitations for the MCTP and EXTREEMS-QED programs effective FY 2015, and the Division also redesigned the RTG solicitation by disaggregating it into two distinct funding opportunities that separately call for (1) proposals to support vertically-integrated research-group training activities that span all levels of research seniority, from undergraduate, through doctoral, to postdoctoral; and (2) proposals to support efforts to enrich research training in the mathematical sciences by moving beyond the common paradigm of training in a single, tightly-focused topical area to include a broader range of graduate research experiences that prepare doctoral students for a spectrum of career paths, including both academic and non-academic employment. These two new program solicitations are currently undergoing clearance procedures.

2015 Response Update:

The Division implemented the Enriched Doctoral Training (EDT) program effective July 2014. The long-range goal of the EDT program is to strengthen the nation's scientific competitiveness by increasing the number of well-prepared U.S. citizens, nationals, and permanent residents who pursue careers in the mathematical sciences and in other professions in which expertise in the mathematical sciences plays an increasingly important role. The EDT program aims to achieve this by supporting efforts to enrich research training in the mathematical sciences at the doctoral level by preparing Ph.D. students to recognize and find solutions to mathematical challenges arising in other fields and in areas outside today's academic setting. Graduate research training activities supported by EDT will prepare participants for a broader range of mathematical opportunities and career paths than has been traditional in U.S. mathematics doctoral training.

The DMS Workforce program now comprises four structured calls for proposals for training activities:

- Mathematical Sciences Postdoctoral Research Fellowships (MSPRF)
- Enriched Doctoral Training in the Mathematical Sciences (EDT)
- Research Experiences for Undergraduates – Sites (REU)
- Research Training Groups in the Mathematical Sciences (RTG)

as well as an option for unsolicited proposals to the program. The MSPRF, EDT, and REU programs concern training of postdoctoral researchers, doctoral students, and undergraduates, respectively, while the RTG program supports vertically-integrated training activities that span all levels of research seniority, from undergraduate, through doctoral, to postdoctoral.

1.2 Workforce Program Assessment

- *This COV still has some questions about whether DMS is doing enough to try to gather data about the results of their programs, in particular diversity issues and longer-term impacts of the program on the workforce, for example 10 years down the line. Assessment should continue to be an important component of every program.*

DMS agrees that assessment of the long-term impacts of the Workforce program investments is an important activity. DMS commissioned and received studies on the impact of its VIGRE program. DMS also considered a study, which turned out to be prohibitively expensive, of the impact of its investments in postdoctoral research. The Division is currently soliciting community input on assessment of workforce programs through the Measurement & Evaluation component of the INGenIOuS project and anticipates that this activity will result in ideas for accomplishing assessment of the DMS Workforce program investments in a cost effective manner.

2014 Response Update:

The INGenIOuS project report mentioned previously includes a white paper developed by the INGenIOuS subgroup working on Measurement and Evaluation that addresses a set of questions intended to provide a basis for the design and evaluation of future projects and programs that aim to enhance training of mathematics and statistics students at the undergraduate and graduate levels. The Division's two new Workforce program funding opportunities, mentioned previously, call for evaluation and assessment activities as part of proposed projects.

2015 Response Update:

The Division led the formation of an external REU PI Group that meets regularly to share best practices and develop materials of common interest. The group has implemented a pilot assessment project using the Undergraduate Research Student Self-Assessment (URSSA) tool. A common group assessment was used by ten DMS-supported REU sites during the summer of 2014. The group repeated the assessment activity during the summer of 2015.

The new Enriched Doctoral Training (EDT) program requires plans for assessment in each funded project. Grantees are asked to help inform and participate in a coordinated assessment in order to ensure that NSF can understand the impact of the EDT-funded projects in the aggregate. The Division has begun development of a cluster assessment activity for the EDT program.

1.3 Mathematical Sciences Postdoctoral Research Fellowships (MSPRF) Program

- The report contains several suggestions for the MSPRF program, including additional documentation of the panel deliberation process, potentially forming (smaller) subpanels for review of applications, insuring evenhanded review of those applications with a cross-disciplinary focus, and documentation of the effectiveness of the MSPRF program through longitudinal studies.

The Division is reassessing the review procedures for the MSPRF program with an eye towards more effectively serving the community. Improvements will be undertaken as part of an overall Workforce program review to take place after conclusion of the INGenIOuS activity in FY 2013.

2014 Response Update:

The Division assembled a team of program directors to observe the FY 2014 MSPRF program competition and to develop recommendations for improvement. After the conclusion of the FY 2014 MSPRF program review activity, the team reported its recommendations to the Division. These recommendations are separated into three levels: (1) recommendations that can be implemented in the FY 2015 MSPRF review activity without change to the program solicitation; (2) recommendations that require changes to the MSPRF solicitation but could be implemented prior to the FY 2015 review activity; and (3) recommendations that require more extensive modifications to the program solicitation and supporting web materials and thus additional time to implement. It was decided by the Division to implement the first set of recommendations (concerning panel sizes, feedback to the applicants, and additional involvement of DMS disciplinary programs in selecting reviewers and recommending awards) immediately. The Division is also revising the MSPRF solicitation to include additional guidance for the letter from the applicant's sponsoring scientist.

2015 Response Update:

The Division implemented in the FY 2015 MSPRF competition the recommendations concerning panel sizes, feedback to the applicants, and additional involvement of DMS disciplinary programs in selecting reviewers and recommending awards. The Division also revised the MSPRF program solicitation to include additional guidance for the letter from the applicant's sponsoring scientist. Survey of the panelists indicated that smaller panel sizes had improved the review process, and internal evaluation of the results suggested additional improvements for feedback to the applicants that will be introduced in the FY 2016 competition.

1.4 Research Training Groups (RTG) Program

- *The RTG program is a strong and effective component of the workforce portfolio. It was felt that the review process was thorough. The combination of mail reviews and management team discussions were deemed effective. However, there was concern about a lack of clarity concerning the mission of the RTG. Furthermore, in reading the reviews of proposals that were accepted and declined, there did not seem to be a consistent set of criteria that were uniformly applied in the evaluation process.*

The Division plans to improve the design of the Workforce Program activities currently implemented through the RTG and MCTP programs, with clarified goals and more straightforward review criteria that DMS will ensure are applied consistently.

2014 Response Update:

Panelists reviewing proposals submitted to the FY 2014 RTG competition received additional instruction concerning the focus of the RTG program on the research training activities and concerning the current solicitation's requirement for vertically-integrated research-group activities. The Division believes the FY 2014 RTG awards reflect well the program's mission. As mentioned previously, the RTG program solicitation is undergoing revision to sharpen the goals and clarify the language.

2015 Response Update:

The Division revised the RTG program solicitation to clarify the language and to emphasize that funded RTG projects involve vertically-integrated training activities that span all levels of research seniority, from undergraduate, through doctoral, to postdoctoral.

2. Support for Segments of the Mathematical Sciences Community

The COV report addressed aspects of DMS support of particular segments of the Mathematical Sciences Community.

2.1 Mid-Career Mathematical Scientists

- *There is a part of the mathematical sciences pipeline which the COV felt is not adequately addressed—mid-career mathematical scientists. There is a substantial falloff in proposals from researchers 10-15 years out from the PhD. Often even a small amount of money for conferences and travel matters. A first step to improve this situation would be to allow for conference and summer school grants to request funding in this category, and to encourage the mathematical sciences institutes to do so as well. For example, an invitation to an institute is frequently helpful in the success of a sabbatical application. The COV is mindful that resources are limited, but a modest move in this direction would have a leveraged impact.*

DMS agrees with the finding of the COV and recognizes that many of the researchers in this category belong to the group the COV labeled as unfunded PIs who are excellent. The Division has attempted to find innovative mechanisms to provide more support for this group; for example, the program solicitation "Conferences and Workshops in the Mathematical Sciences" expresses the desideratum "most funds are expected to be devoted to the support of participants who have no other federal support and participants who are students, post-doctoral scholars, or members of groups that are underrepresented in the mathematical sciences," which was put in place to ensure priority be given to researchers without other federal funding. DMS also invests in programs such as the CISE-MPS Interdisciplinary Faculty Program in Quantum Information Science, which provide professional

development opportunities for mid-career faculty. DMS will continue to explore new ways to broaden the participation in NSF supported activities, including working with the Directors of the Mathematical Sciences Research Institutes to encourage more participation by mid-career researchers.

2.2 Underrepresented Minorities

- *A different aspect of the pipeline is the issue of increasing the number of underrepresented minorities in the mathematical sciences. DMS has made great efforts in this direction. That said, the number of PhD's annually in this category is woefully small. Care is needed to nurture promising underrepresented students and researchers as they move along the pipeline, with especial attention to seeing that they are recruited to the next step in their careers while in each DMS program. Fresh ideas are needed to make a breakthrough here.*

DMS appreciates the recognition of DMS efforts by the COV and agrees with its statement that “Promoting diversity is a shared responsibility of the entire mathematical sciences community, not only of mathematical scientists who are women or underrepresented”. Increasing diversity and broadening participation in the mathematical sciences continue to be priorities for the Division of Mathematical Sciences. DMS pursues these goals in all aspects of its operations: the language of solicitations; the organization of panels; the review and recommendation of proposals; the management of Mathematical Sciences Research Institutes; and the recruitment of program directors. This is an ongoing long-term effort, not a one-time occurrence. In addition, DMS annually funds several broad-impact awards specifically aimed at broadening participation in the mathematical sciences. DMS will enhance its web site to highlight these awards and spur additional community activity. DMS welcomes additional constructive suggestions from the mathematical sciences community to increase the number of underrepresented minorities in the mathematical sciences. The Division is receptive to ideas submitted through any existing funding modality; in particular, DMS is always open to unsolicited proposals for workshops and other new activities aimed at broadening participation in the mathematical sciences.

2014 Response Update:

In FY 2014, the Division is piloting a new internal activity to enhance the diversity of participants in awards to DMS research proposals. Eligible for co-funding in this activity are research proposals that include activities that broaden participation of women or members of other groups that are underrepresented in the mathematical sciences. The Division plans to assess the success of the activity at the end of the fiscal year.

2015 Response Update:

The Division assessed the first year of its internal activity to identify and formally co-fund research proposals that include activities that broaden participation of women or members of other groups that are underrepresented in the mathematical sciences. The activity was deemed successful in raising program director awareness of diversity aspects of proposals, has been repeated in FY 2015, and continues in FY 2016.

2.3 Overburdening Women with Requests for Review Activities

- *Promoting diversity is a shared responsibility of the entire mathematical sciences community, not only of mathematical scientists who are women or underrepresented minorities. Mathematical scientists who are women or underrepresented minorities are burdened by a level of service on panels which, while beneficial to the peer review process, takes an inordinate amount of time away from their own research. The issue was raised by some of the women on the COV whether a better balance might be struck in the case of women between ensuring robust representation on panels and not overburdening women with panel service, since promoting diversity is a shared responsibility of the entire mathematical sciences community.*

DMS is acutely aware of the fact that most researchers are heavily invested in research, teaching, and other services; program directors do try their best not to overburden community members with panel services. The Division has been employing more teleconferencing panelists to broaden the pool of those who can serve without travel away from home, and every panel is briefed in the importance of diversity. Among the approximately 420 female panelists who served on DMS review panels during the fiscal years 2010 – 2012, about 10 served on more than one panel per year on average, and about 25 served on one panel each year. It appears that the high level of panel service by some individuals resulted from DMS program directors, while trying to ensure broad representation on the panels they were organizing, being unaware of other invitations having been issued to the same individual. DMS will put in place better mechanisms for internal communication to obviate this situation.

2014 Response Update:

In FY 2014, DMS program directors redoubled efforts to add records of panelist invitations to a central database as soon as the invitations were issued, allowing others to check for this status prior to issuing independent invitations.

2015 Response Update:

DMS program directors continue to coordinate panelist invitations to avoid overburdening members of the community.

3. Proposal Review Process

3.1 Feedback to Principal Investigators

- *The feedback that panels give to declined proposals is of variable quality. Given the high cutoff for funding, good feedback about the shortcomings of a proposal is crucial to encourage researchers, especially new researchers, to come back with a revised proposal in the next round. DMS program directors are proactive in attempting to ensure that panel summaries are substantive and clearly indicate where improvement is needed, but reviews prepared before the*

panel arrives at NSF are less likely to do this. We would like to see DMS experiment with new ways to educate reviewers about the importance of giving substantive and useful feedback.

Panelists are asked to submit reviews a week before the panel meeting. This allows the program director to discover non-substantive reviews and to communicate with panelists to request revision of such reviews prior to the panel meeting. This procedure results in more substantive reviews and more useful feedback to the principal investigator. However, it has proven a challenge to implement this practice due to typically busy schedules of panelists, who too often submit reviews immediately prior to the panel meeting. DMS plans to experiment with briefings on writing effective reviews and panel summaries, including the use of webinars in advance of a panel meeting. There also has been recent experimentation within the NSF with pilot activities for asynchronous panel review, in which reviews are posted, discussed, and refined by panelists on-line prior to the panel meeting. DMS is monitoring asynchronous panel review pilots and will adopt this practice if feasible.

3.2 Documentation of Equalization Proceedings

- *While the electronic jackets show how proposals were ranked during [program] equalization meetings, better records of the rationale for these decisions from the equalization meetings would be helpful.*

DMS appreciates the suggestion and plans to prepare more informative minutes for programmatic equalization meetings.

4. General Assessment of Program Effectiveness

- *Finding meaningful methods to assess the effectiveness of DMS programs in a way that captures multiple layers of outcomes is by its nature difficult, and DMS to its credit has not jumped at easy answers. This is an area where, carefully and deliberately, further progress needs to be made.*

Although previous Committees of Visitors were charged with assessment of program effectiveness, this activity is no longer within the scope of the Committee of Visitors charge. Nevertheless, DMS plans to explore the feasibility of technology-based methods to measure the impact of its investments in support of research and the training of the next generation of mathematical sciences researchers.

5. Involvement of Rotators in Formulating Initiatives and Policy

- *The quality of the program directors and DMS management, both career and rotators, is excellent. They are overworked. The COV values the balance between career program directors, who are the institutional memory of DMS and who train new program directors, and the rotators, who bring fresh ideas and a first-hand knowledge of the latest trends and developments in the mathematical sciences community. We would not want to see this balance tilt too far in either direction. The rotators are given considerable independence and are involved in working groups across DMS. Nevertheless, we would like to see them consulted more*

consistently about major policy initiatives and decisions, since the viewpoint they bring is different from that of the career program directors and is extremely valuable.

The Division greatly values its rotators, who bring fresh ideas, new perspectives, and the most up-to-date knowledge to the Division. DMS has been fortunate to be able to recruit excellent rotators to serve as program directors. Within DMS, formulation of new initiatives and management decisions are typically done by management teams composed of program directors. Composition of the teams, based on preferences solicited from program directors, is done by the Division Director and Deputy Division Director. Efforts are made to balance the composition of each management team in terms of permanent staff and rotators. DMS will ensure that the perspective of rotators continues to be included in working group deliberations.

2014 Response Update:

In FY 2014, rotators were included in all management teams concerned with major policy initiatives and decisions.

2015 Response Update:

In FY 2015, DMS continues to include rotators in all management teams concerned with major policy initiatives and decisions. Management teams are structured to balance membership among new program directors and those more experienced.

6. Mathematical Sciences Research Institutes Competition Schedule

- *The COV is concerned about the spacing of the two Institute proposal cycles: the two 10-year cycles are set off by two years, so that there is one 2-year gap and one 8-year gap between proposal deadlines. The COV realizes that this timing arose as a historical accident beyond the control of the DMS, but it would be distinctly preferable to have either a single 10-year cycle (if the DMS wishes to have all competitive proposals evaluated simultaneously) or two cycles spaced at approximately 5-year intervals (we realize that evaluating all of the institutes in the same year would be a very heavy burden on the DMS program directors, so a slight offset in the intervals between open competitions, such as 4 years/6 years would be reasonable). The COV leaves it to DMS to work out the best method to move to a better alignment of these cycles.*

The Division will discuss a change to a Mathematical Sciences Research Institutes competition schedule with four- and six-year intervals or other intervals between open competitions, and the impact such a change will have on the current institute awards.

2014 Response Update:

The DMS Institutes Management Team has implemented the change to a Mathematical Sciences Research Institutes competition schedule with four- and six-year intervals.

2015 Response Update:

Upon review of the Mathematical Sciences Research Institutes portfolio, the DMS Institutes Management Team considered again the competition schedule and has revised the schedule to bring all of the Mathematical Sciences Research Institutes into a common cycle. The next open competition of the Mathematical Sciences Research Institute Program will have a submission deadline in the spring of 2019. Following this there will be an open competition every five years.

7. The Committee of Visitors Process

The COV report contains several suggestions for improvement of the COV process, including structure and timing of the meetings with program directors and administrative staff, Information Technology system issues, COV subcommittee composition, and preparation by the COV Chair and COV subcommittee chairs.

DMS welcomes the suggestions to improve the COV process, and DMS plans to implement the suggested changes in subcommittee composition and meeting structure and scheduling for future DMS Committee of Visitors reviews. The Information Technology system issues may be more difficult because these systems are not under DMS control. However, DMS will transmit the committee's suggestions for improvements to the NSF-wide Committee of Visitors management group.

Acknowledgement

The Division of Mathematical Sciences wishes to express again its gratitude to the Committee of Visitors for the effort expended by individual members in their preparations for the visit, in their attention to the big picture as well as the details, and in their drafting of a thoughtful, constructive report.