



UNITED STATES GOVERNMENT
M E M O R A N D U M

DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

Date: March 29, 2007
From: Assistant Director, MPS
Subject: **Response to the Division of Mathematical Sciences Committee of Visitors Report**
To: MPS Advisory Committee

Please find attached the MPS response to the Committee of Visitors (COV) report from the 12-14 February 2007 COV review of the Division of Mathematical Sciences. The review was thorough and insightful, and the findings will be very helpful to me and to the Division of Mathematical Sciences in fulfilling our responsibilities to the scientific community and to the nation.

The Division of Mathematical Sciences drafted the attached response, and I concur with its content. I therefore adopt it as the official response of the MPS Directorate. I hope the full MPS Advisory Committee finds this COV review and the MPS response useful and acceptable.

Tony F. Chan
Assistant Director

Attachment: Response to Division of Mathematical Sciences COV Report of 2007

Division of Mathematical Sciences (DMS) Response to Findings and Recommendations of the Committee of Visitors

February 12 – 14 2007

1 Preamble

The Division of Mathematical Sciences (DMS) received the report of the DMS Committee of Visitors (COV) and this memorandum represents the Division's required response. It takes the same form as the COV report itself and includes both comments and action items, as appropriate. Some actions will take time to implement and we expect to provide annual updates on our progress.

We would be remiss if we did not take this opportunity to express our gratitude to the Committee for a constructive report and to thank individual members for their thoughtfulness, dedication, and hard work on behalf of the national mathematical sciences community. We would also like to recognize the important contributions of the subcommittee chairs Harold Boas, Dusa McDuff, and Eugene Wayne whose steady hands guided the process. Finally, we express our deepest appreciation and warmest thanks to Margaret Wright whose leadership as chair of the Committee of Visitors was essential to its success.

2 Major Findings, Recommendations, and Concerns

The proposal review process. DMS notes the COV's general approval of its proposal review process. The Division concurs with the COV assessment that the Broader Impact merit review criterion is still not well understood by the mathematical sciences community and that action should be taken to improve that understanding. DMS resolves, in particular, that

- program officers will continue to stress to panels and reviewers that reviews and panel summaries must include analysis of the Broader Impact criterion written in terms that give constructive feedback to proposers
- program officers will continue to include broader impacts as an integral part of their review analyses
- DMS personnel will continue to stress broader impacts when making outreach visits to the mathematical sciences community
- the Division Director will undertake to write a Dear Colleague letter or similar article explaining the meaning of the Broader Impact criterion, one that takes the COV's suggestions (i) and (ii) (page 4, paragraph 6) into account.

The issue of identifying and supporting high risk, innovative proposals is a Foundation-wide concern that falls broadly under the heading of Transformative Research. DMS is working in collaboration with the Directorate for Mathematical and Physical Sciences (MPS) to develop an MPS plan for addressing the National Science Board report *Enhancing Support of Transformative Research at the National Science Foundation (NSB 07-6)*. MPS and DMS understand that more effort must be taken on their part to encourage the mathematical sciences community to submit its most creative, innovative, and potentially transformative ideas.

Too much unfunded excellence. DMS agrees with the COV's observation that the overall quality and strength of the proposal pool is so great that many excellent proposals go unfunded because of budget limitations. The Division also notes that the mathematical sciences community is divided in its understanding of and advocacy for an appropriate strategy to deal with the award size/funding rate tradeoff.

In addition we note that the COV "as a whole does not believe that, *as a general policy*, DMS should make more, but smaller, awards." DMS does not have and will not pursue such a policy. On the other hand, DMS agrees with the COV that, given the existing pool of scientifically excellent proposals, it is desirable to increase the number of awards made and notes that this will be more easily achieved in a period of rising budgets.

Pipeline issues. The COV addressed several issues here: new investigators, women and under-represented minorities, Ph.D. students, and faculty at primarily undergraduate or minority-serving institutions. DMS shares the COV's concerns and intends to devote time and effort to them.

New investigators. Achieving appropriate funding rates and providing adequate support mechanisms for new investigators is a DMS priority. The Division will study and consider "first grant" schemes such as the COV suggests. We note that the CAREER program is a Foundation-wide effort aimed at providing support to new investigators and is viewed in some directorates and divisions as an appropriate solution to the problem. For a variety of reasons, CAREER has not been as successful or effective in the mathematical sciences community and DMS will study this issue as well.

Women and under-represented groups. DMS understands the significance of the relatively strong language used in the sentence "The COV is unhappy with the lower-than-average success rates for women and under-represented minorities." The Division also notes that the COV "realizes these are long-standing and difficult problems to which NSF has devoted significant attention and resources..." DMS will examine the causes of lower-than-average success rates and will consider appropriate action, pending the study. In addition, we will study and consider other division's practice, for example the NSF/BIO solicitations suggested by the COV. The possibility of appropriate longitudinal studies in the mathematical sciences is more difficult and is addressed below in the section headed *Measuring the impact of student and postdoc support*.

Ph.D. students. Declining support for Ph.D. students in the mathematical sciences is a genuine concern and DMS will follow up with a study of the causes. One cause is clear, however. The period of flat budgets in FY2004-FY2006 coupled with rising salaries, stipends and benefits put strong pressure on the Division's budget in all areas including Workforce programs and graduate students on individual investigator awards. DMS will also consider the totality of mechanisms for support of graduate students across the portfolio as recommended by the COV report and by Subcommittee 3 in its answer to Additional Question 6. We do note here, though, that it is highly desirable to have a variety of mechanisms and programs to support Ph.D. students.

Undergraduate and minority-serving institutions. DMS notes the COV's suggestions with respect to increasing support of faculty through the RUI and other mechanisms and will take them into consideration.

The DMS institute portfolio. DMS notes that the COV "takes a very positive view of the mathematical sciences institutes". The COV recommends an analysis of the complete portfolio of institute activities be undertaken as soon as possible, a recommendation that the Division will act upon. For more discussion of institutes see Section 3, Additional Question 2 below.

Communication with the mathematical sciences community. DMS welcomes COV and community advice on improving communications in both directions and will carefully consider suggestions made in the COV report.

Some steps in this direction have already been taken in FY07:

- DMS convened a workshop at the Joint Mathematical Meetings in January 2007 to solicit input on potential changes to the EMSW21 workforce program.
- The Division Director, to the extent that schedules permit, visits each panel meeting at NSF to provide an overview of the Division and give panelists an opportunity to exchange information and opinion on substantive issues facing the community
- The Division Director has begun a program of outreach visits to each of the mathematical sciences institutes and to a significant fraction of universities and colleges housing mathematics and statistics departments

Measuring the impact of student and postdoc support. DMS agrees with the COV that longitudinal studies of the effect of NSF support on undergraduates, graduate students, and postdocs would be valuable. However, gaining a deeper understanding of treatment effects via longitudinal studies is properly an undertaking of the whole mathematical sciences community. DMS does not have the expertise or manpower to conduct such large-scale studies in house.

Still, DMS is able to solicit proposals for studies on a smaller scale. For example, Dr. Margaret Cozzens received an award in FY2006 to collect and disseminate VIGRE best practices. Also, an award was made in FY2007 to the Board on the Mathematical Sciences and its Applications of the National Research Council to undertake an evaluation of the VIGRE program.

3 Additional Questions for the COV

The COV's response to additional questions comes in the form of comments, observations, and recommendations by individual Subcommittees. Since many of these remarks are the basis for, or elaborations on, the major findings reported in Section 2 above, and since these have been addressed by DMS already, our remarks here will occasionally be brief.

AQ1. Please comment on the response by the Division of Mathematical Sciences to the previous Committee of Visitors report.

DMS notes the concern expressed by Subcommittee 1 that the issue of institute portfolio balance mentioned by the 2004 COV needs to be revisited. As noted above, the Division will undertake such a review. We also note the concern expressed by Subcommittee 2 that the Division report more frequently on the issue of broader participation by under-represented groups in the mathematical sciences.

AQ2. Please comment on the size, scope, and effectiveness of the portfolio of national mathematical sciences institutes.

The Division concurs with several key points in the COV response to this question:

- the institutes are a valuable asset to the mathematical sciences community
- the balance between institute and other programs in the DMS budget is appropriate
- the institutes should continue to be managed as a portfolio, with a premium placed on collaboration and cooperation among individual institutes

DMS also agrees that "it would be inadvisable to assign a rigid set of topics to each institute but equally inadvisable to expend scarce DMS resources on multiple programs with an unduly large overlap." Achieving the right programmatic balance is an ongoing concern that is a high priority for Division management of the institutes portfolio.

AQ3. Please comment on the size of DMS grants and on the tradeoff between grant size and number of grants.

DMS responded to the issues surrounding the grant size/funding rate tradeoff above in Section 2, *Too much unfunded excellence*. The various Subcommittees suggested a number of ways in which small amounts of support could be provided to larger numbers of researchers and the Division will take them into consideration.

AQ4. Is the current structure of subfields within DMS (i.e. Algebra, Number Theory and Combinatorics, Computational Mathematics, etc.), which has been in use for many years, still adequate in responding to changes in the field? What specific modifications would the COV suggest?

The Division's understanding of the COV's report is that it is satisfied with the status quo of slow evolution of core programs.

AQ5. Is the portfolio of research supported by DMS providing enough collaborative opportunities between the mathematical sciences and other fields, both within NSF and in other federal funding agencies?

The Division notes that "The COV was favorably impressed by DMS's efforts to expand collaborations within MPS and more broadly within NSF..." We will continue actively to seek collaborations across a wide spectrum of science and engineering wherever suitable scientific opportunities and appropriate partners can be identified.

AQ6. Given the strategic outcome goals of Discovery, Learning, and Research Infrastructure, formerly Ideas, People, and Tools, please comment on the balance of the Division's award portfolio among individual investigator awards, collaborative and small group grants, workforce, infrastructure, and institute awards. In addition, please comment on the impact of the Mathematical Sciences Priority Area (MSPA) on portfolio balance.

DMS notes that "The overall COV view was that NSF's Mathematical Sciences Priority Area (MSPA) has had a positive effect." It also notes that Subcommittees 1 and 2 agreed "DMS has done a good job with the difficult task of producing a balanced investment of its portfolio of resources."

The sense of the COV expressed by Subcommittee 3 that the variety of support for graduate students could be viewed either as "laudable flexibility and diversity" or as "an unfocused and somewhat haphazard approach" deserves comment.

In the divisional context, there are multiple goals for the support of graduate education that argue for multiple approaches:

- close apprenticeship experience with an advisor [via student support on an individual investigator award]

- opportunities to broaden experience, for example, to work in the context of a research team [via Research Training Groups (RTG) and Focused Research Groups (FRG)]
- distributed support based in the whole department [via VIGRE]
- developing the U.S. mathematical sciences workforce [via Enhancing the Mathematical sciences Workforce for the 21st Century (EMSW21)]

Similar remarks apply to postdoctoral support. *Mathematical Sciences Postdoctoral Research Fellowships* (or *MSPRF*, commonly known as NSF Postdocs) is a Workforce program restricted to U.S. citizens, residents and nationals. *Focused Research Groups (FRG)* is a highly competitive research program funded by the core disciplines that may provide postdoctoral support without citizenship restriction.

There may indeed be instances of individuals who were not awarded a MSPRF but who were supported on an FRG, a situation that Subcommittee 3 views as “troubling on the grounds of fairness and equity”. DMS, on the contrary, views this as *prima facie* evidence that a variety of approaches is needed. For just as there is too much unfunded excellence in the core programs there is, similarly, too much unfunded excellence in the MSPRF program. However, it is not the focused research group’s responsibility to pick the “next” unsupported candidate on the MSPRF panel’s list, no matter how worthy that candidate may be. Rather, its responsibility is to support the individual most appropriate to advance the group’s research project.

4 Summary

The Subcommittee’s responses to questions in the Audit Summary and Template contain numerous constructive observations and sensible advice, which are duly noted. There are occasional references to issues discussed in Sections 2 and 3 above and so they will not be addressed again here.

Following are the major action or study items that have been mentioned above and for which the Division expects to provide annual updates:

- Improve the community’s understanding of the Broader Impact criterion
- Assess the breath and scope of institute programs
- Broader participation by women, under-represented minorities, and institution-type
- Support of Ph.D. students, postdocs, and junior researchers.

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, their attention to the big picture as well as the gritty details, and to their drafting of a thoughtful, constructive report.