

**Staff Response
To the Committee of Visitors (COV) Report
Math and Science Partnership (MSP) Program**

COV Meeting of May 16-18, 2005

A. Integrity and Efficiency of the Program's Processes and Management

In general, the Committee of Visitors (COV) found the integrity and efficiency of the Math and Science Partnership (MSP) program's processes and management to be successful. In specific, it found that (a) the review process was effective and efficient, with the addition of reverse site visits adding validity to the process; (b) reviewers had appropriate expertise and qualifications; (c) the NSF merit review criteria had been implemented; (d) the resulting overall portfolio of awards was of appropriate quality; and (e) the program "resonates with state standards and the national NCLB" [*No Child Left Behind*] and "is also making strong efforts to integrate research and education practices." The COV wrote that it "was unanimously impressed with the quality and level of management of the program, especially given the timeline" for its development, and commended the NSF for this.

The program very much appreciates the external lens brought to its work by the thoughtful members of the COV. Their expertise and experience are valuable resources in assisting the program to be of the highest quality possible. All concerns and suggestions of the COV, as well as its commendations, are taken very seriously, with the intent to be as responsive as possible.

Briefly, the MSP program at NSF is an important research and development effort for integrating the work of higher education – especially its disciplinary faculty in mathematics, the sciences and engineering – with that of K-12 to strengthen and reform science and mathematics education. In launching its MSP program in FY 2002, the NSF assumed important responsibilities for building the capacity to implement a key facet of the President's *No Child Left Behind* vision for K-12 education. The MSP responds to a growing national concern – the educational performance of U.S. children in mathematics and science – and seeks to improve student outcomes in mathematics and science for all students, at all K-12 levels. As overall student achievement rises, MSP projects are expected to significantly reduce achievement gaps in the mathematics and science performance of diverse student-populations.

To achieve its goals, the MSP program emphasizes (a) **partnerships** between institutions of higher education – especially their **disciplinary faculty** in mathematics, science and/or engineering – and local school districts; (b) **institutional/organizational change** in all core partners that ensures the sustainability of promising policies and practices derived from **evidence** collected in project work; and (c) scholarly engagement that builds on and extends the existing educational **research base**. These domains are the distinguishing characteristics of the MSP program and constitute its **key features**: partnerships that effectively engage science, technology, engineering and mathematics (STEM) disciplinary faculty; teacher quality, quantity and diversity; challenging courses and curricula; evidence-based design and outcomes; and institutional change and sustainability.

The MSP program is comprised of three distinct components: *Comprehensive and Targeted (C&T) Partnerships*, *Institute Partnerships: Teacher Institutes for the 21st Century* and *Research, Evaluation and Technical Assistance (RETA) awards*. *Comprehensive Partnerships* implement change across the K-12 continuum in mathematics, science or both. *Targeted Partnerships* focus on improved student achievement in a narrower grade range or disciplinary focus in mathematics and/or science. *Institute Partnerships*, the newest component of the MSP portfolio, build on the acknowledged strengths of the original NSF Teacher Institutes, while giving attention to the changing academic needs and situations of

teachers in our time. The *Institutes* develop school-based teacher intellectual leaders with deep content expertise in mathematics, science and related technologies who are excited about newer developments in these fields and who have the disciplinary depth and reputation to engage their colleague teachers and motivate students towards continued study of mathematics and science in advanced courses. The MSP-RETA component of the portfolio assists Partnership awardees in the implementation and evaluation of their work through (a) the conduct of focused research and studies designed to guide improvements in educational practice and learning, (b) the development of tools and resources to assess progress and make educational work more strategic, and (c) increased capacity-building to engage in educational evaluation and research. Collectively, the MSP portfolio of 80 projects represents an investment of almost \$ 590 million.

The MSP program is a coordinated effort between two federal agencies, the NSF and the U.S. Department of Education (ED), who have defined the program linkages necessary to manage this joint investment in mathematics and science education for greatest effectiveness. Beginning in FY 2002, the separate appropriations for the NSF and ED each included funds to support Math and Science Partnerships. In FY 2002, NSF's MSP appropriation was \$ 160 million and ED's was \$ 12.5 million. NSF and ED therefore elected to work in concert to administer a single MSP competition. Using the NSF model for external merit review, the two agencies collaborated on the identification of qualified reviewers, on the monitoring of panel discussions and on the subsequent selection of proposals for awards. NSF and ED staff agreed that the two agencies would co-fund two projects in which ED would invest its \$ 12.5 million and the two agencies have continued to co-manage these two awards.

Beginning in FY 2003, the ED appropriation exceeded \$ 100 million, thus triggering formula grants to the states, which then awarded the funds based on state priorities and guidelines. These projects are collectively referred to as "state MSPs." The two agencies have continued to cooperate and coordinate the work of their separate but complementary programs to date, with a focus at NSF on research and development at the national level and a focus at ED on state-level implementation.

The MSP program at NSF has conducted three competitions for Partnership awards, in FY 2002, 2003 and 2004. In FY 2005, the NSF/MSP appropriation of approximately \$ 80 million provided continued support of existing Partnerships, with no new Partnership awards to be made.

A summary of the COV's comments and responses from the staff follow.

Merit Review Procedures

1. The COV judged the merit review process to be efficient and effective, commenting, "[t]here is sufficient and detailed data and justification for the recommendation of the program officer." The Committee noted the strategic importance of Program Officers (POs) in a post-panel review process that is "well-developed and functional" and saw "the NSF program staff as vital to the negotiation and implementation of high quality STEM education proposals." The COV noted that 87.8% of proposals were awarded or declined within 6 months and 7% were awarded within 9-12 months. Although the Committee found the time to decision appropriate, it noted that solicitations 02-190 and 03-605 had a relatively longer response time and "did not find evidence to indicate a reason for these differences."

Response: A critical factor in the relatively longer response time for solicitations 02-190 and 03-605 was the addition of reverse site visits to the merit review process. Reverse site visits were initially added in the second year of the program. Following panel review of proposals submitted under these two solicitations, the Partnerships judged as most meritorious were sent an extensive package of questions with a request for written response within two weeks and an invitation to a reverse site visit in Arlington,

Virginia, for further discussion with a panel of external experts. This additional component to the merit review process significantly extended the time-to-decision for the most competitive proposals. Although program staff were aware that reverse site visits would add to the program's time to decision, they also felt that the value added to the process by this additional stage of review was of overriding importance. The staff appreciates the assessment of the COV that the "reverse site visits were particularly effective."

GPRA processing goals call for 70 percent of proposals to be processed within six months. In general, it has been the most competitive MSP proposals that have garnered the longest times to decision. "The COV noted that, following the panel review, the questions posed by the cognizant program officer and responses to those questions were both detailed and substantive," with "the attention to detail and level of specific probing" being "much more significant than is accomplished by the outside review panel collectively or individually." The complexity of the proposals for large-scale Partnerships and the commitment of POs in providing detailed questions/responses, unfortunately, add to the time required for decision-making. The program appreciates the intent of the COV to provide responses on proposals in as timely a way as possible and concurs with that intent.

2. The COV expressed concern that "in some cases individual [review] panel members gave undue weight to the reputations of the PIs in making their recommendations." The COV cautioned that NSF should continue to monitor the number of awards made to experienced Principal Investigators (PIs) and new PIs and ensure that "reputations do not have more force than they should." At the same time, the COV also recognized that "[b]ecause of the large scope of the comprehensive and targeted MSP awards, . . . it would not be appropriate to have a large number of new PIs in this portfolio."

Response: The program concurs with the importance of ensuring a fair playing field for both new and experienced PIs. The complexities and scope inherent in the nature of large Partnerships suggest the need for leadership teams able to provide an appropriate degree of experience in managing large awards. Any premium placed on experience must, however, be balanced by the value to be added in bringing creative, new PIs into the MSP portfolio. Through a series of workshops in FY 2002, 2003 and 2004, the MSP program sought to increase and improve proposals from new stakeholders. In March 2002, in advance of the due date for proposal submissions in the first MSP competition, the program held two workshops at NSF, each attended by approximately 300 potential awardees. In fall 2002 and fall 2003 – in advance of the due dates for the FY 2003 and FY 2004 solicitations – the program worked with two externally contracted organizations in providing 14 workshops strategically distributed for broad geographic access around the country.

The overall portfolio of 48 Partnerships includes a balance of new and experienced PIs: 26 of the 48 (54%) have PIs who have not previously been a PI on an NSF award. Of these, eleven Partnerships have PIs who have never been a PI or co-PI on any NSF award; an additional 15 Partnerships have PIs with prior experience as co-PIs on previous NSF awards but not as PIs, suggesting that previous experience as a co-PI may provide important opportunities for gaining experience and being successful in future NSF competitions. In addition to their primary leadership teams, the large and complex MSP Partnerships also include leadership teams for numerous, and often sizeable, subawards. The emphasis within the program on engaging substantial numbers of STEM disciplinary faculty further encourages core faculty in a Partnership to expand beyond the most experienced and provide opportunities for new STEM faculty to become engaged in the work. This mode of project leadership and management helps ensure that knowledgeable individuals lead/manage the Partnerships, while also providing fertile ground for new individuals to gain valuable experiences that may position them well for future project leadership.

Implementation of NSF Merit Review Criteria

3. The COV found that, in individual reviews (either mail or panel), there had been a “concerted effort” to address the merit review criteria but felt that, while most panel summaries commented on both merit criteria, they were often lacking in substance, similar to the individual reviews. The Committee commented that “[t]here appears to be some confusion by the proposers and reviewers on how to apply both of the merit review criteria” and that there were many instances “where the criteria of broadening the participation of underrepresented groups was neglected by the reviews.” The COV, however, noted that it *itself* had a difficult time in discerning exactly what qualified as “intellectual merit” and “broader impacts”: some committee members felt that some of the reviews paid only “lip service” to the two merit criteria, while other committee members felt that the criteria had been properly addressed. Specifically the COV recommended that EHR –

- continue to develop its own concepts of the merit review criteria and continue to educate the field about the nature and meaning of these criteria; and
- disseminate a broad view of these merit review criteria to prospective applicants and panelists.

Response: The difficulties of the COV in discerning exactly what qualifies as *intellectual merit* and *broader impacts* are not unique to the COV, or to proposers and reviewers for the MSP program. The *FY 2004 Report on the NSF Merit Review System* (NSB 05-12), an annual report to the National Science Board (NSB) from the NSF Director, notes, for example, that “[i]n the National Science Board discussions, members expressed concern that the broader impacts criterion was not being fully integrated into the review process, and that principal investigators and reviewers are unsure how it should be addressed” (p. 17). The Foundation has undertaken a series of actions designed to raise awareness of the importance and use of the merit review criteria, including the development of a draft set of examples that address the broader impacts criterion. These are currently disseminated via a link embedded in the *Grant Proposal Guide* (<http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>) and are, in addition, available to proposers and reviewers via FastLane. Foundation-wide, 92 percent of reviews addressed both intellectual merit and broader impacts in FY 2004, compared to 90 percent of reviews in FY 2003 and 84 percent in FY 2002. For the MSP program, 95 percent of reviews addressed both intellectual merit and broader impacts in FY 2004, compared to 94 percent of reviews in FY 2003 and 92 percent in FY 2002.

Bringing increased clarification to interpreting/applying the two merit criteria requires ongoing vigilance. Within the MSP program, the program will take two specific actions:

- In any future outreach efforts designed to assist the field in the preparation of proposals for submission to the MSP program, POs will address specifically the two merit criteria, with examples, in the context of MSP and EHR; and
- In any future panel meetings of reviewers for the MSP program, the orientation session will include a component that specifically addresses the two merit criteria in the context of MSP and EHR.

Selection of Reviewers

4. The COV found the numbers of reviewers and their expertise/qualifications to be appropriate. They also noted the diversity of organizations (e.g., higher education, K-12, business/industry, professional associations) from which reviewers had been selected. A change by NSF in the reporting of minority classifications made it difficult for the Committee to determine if an appropriate balance of underrepresented groups existed among reviewers, although the Committee noted a decline in the number of reviewers from underrepresented groups from 38.8% in 2002 to 24.7% in 2003. Some members were concerned about this decline, while others felt that 24.7% was “perfectly acceptable.” There was concern that the number of Native American reviewers had declined in 2003. Specifically, the COV stated that “NSF must continue the practice of inviting new reviewers to serve on panels with experienced reviewers . . . in order to positively affect both the number of reviewers and PIs from underrepresented groups or institutions.”

Response: The program concurs with the importance of broadening participation in all aspects of partnership work, including reviewers. In the first year of the MSP (FY 2002), the program made a three-year award for proposal development workshops targeting individuals from minority-serving institutions to the Quality Education for Minorities (QEM) Network, a Washington-based, non-profit organization dedicated to improving the education of underserved minorities. This collaboration with QEM not only enabled the MSP to reach out to new and underrepresented stakeholders for proposal preparation but, of equal importance, to identify new, prospective reviewers from underserved groups. To further broaden the pool of potential new MSP reviewers from underserved groups, MSP POs made specific contact with Deans of Colleges of Arts and Sciences and with Chief Academic Officers at minority-serving institutions to invite nominations of STEM faculty members at their institutions as reviewers.

The decline in percentage of reviewers from underrepresented numbers from 2002 to 2003 correlates with a transition in MSP programmatic emphasis away from partnerships where the lead institution/organization was partnership-determined – and could therefore be a K-12 school district or other organization – towards partnerships led by higher education. Although causality cannot be inferred, the correlation between the increasing programmatic emphasis on higher education and STEM disciplinary faculty in MSP, on the one hand, and a decrease in the percentage of reviewers from underrepresented groups, on the other, cannot be dismissed, especially since programmatic parameters and emphases are reflected in the expertise sought in reviewers.

The MSP program has a strong commitment to both broadening participation in funded Partnerships and broadening participation among MSP reviewers. The program concurs with the concern expressed by the COV about the paucity of Native American reviewers. Specifically, the MSP program will continue the practice of inviting new reviewers to serve with experienced reviewers with intent to build capacity in new reviewers and influence the numbers of prospective PIs from underrepresented groups or institutions. Further, should there be opportunities for future MSP competitions, the program will be vigilant in identifying and recruiting Native American reviewers through (a) Native American-serving institutions currently working with funded Partnerships and (b) other NSF programs (e.g., the Tribal Colleges and Universities Program).

Portfolio of Awards

5. The COV found the overall quality of projects supported by the program to be appropriate. The COV was especially impressed “with the overall quality, specific focus, and potential scalability of the teacher institutes,” as well as with the overall quality of the RETA awards. Some committee members questioned the value of calling for proposals (i.e., Comprehensive and Targeted Partnerships) of such large scope that “they demand a level of

commitment, expertise and leadership that very few potential PIs have.” Because of this complexity, the COV found it difficult to assess their overall quality. The COV noted, however, “NSF’s awareness of and reaction to this situation [of such large scale projects] was apparent in the discussion with the NSF program officers.” The Committee articulated an overall view that “[t]he quality of the projects seems strong but there is an inherent risk in programs of this complexity that major challenges will arise.”

Response: The program concurs with the COV’s assessment of the increased difficulties and inherent risk associated with projects of large scope and complexity, as well as with their management. The program also recognizes the critical contribution such projects make to a Research and Development portfolio where large-scale educational innovation in mathematics and science is an object of study; and made a strategic decision to fund a sufficient number (12) of Comprehensive Partnerships (the largest and most complex of the MSP efforts) in the first two years of the program, as necessary for generating adequate research and evaluative findings emanating from sufficiently varied contexts, project designs and strategies. With the introduction of Institute Partnerships in the third round of competition, the program made a commitment to advancing the knowledge base on the preparation and support of school-based intellectual leaders and master teachers in mathematics and the sciences. In any future funding for new Partnership awards, additional Institute Partnerships will receive a high priority.

The deliberate action by the program to support a broad portfolio of geographically and demographically diverse Partnerships that are large-scale and complex (i.e., the Comprehensive Partnerships), moderately sized and focused (i.e., the Targeted Partnerships) and modestly sized and ultra-focused (i.e., the Institute Partnerships) is commensurate with the program’s Research and Development nature. The outcomes and findings produced by the portfolio – by investment levels – are intended to collectively advance the nation’s understanding of what is necessary to introduce and sustain successful science and mathematics reform and its capacity to do the required work.

6. The COV had difficulty agreeing on exactly what was intended by “high-risk” in the context of a program such as the MSP. Some members of the Committee reflected on “high-risk” in terms of funding level and questioned whether NSF really wanted to spend considerable dollars in Comprehensive projects for high-risk ventures. The COV ultimately determined that an assessment of “high-risk” was more appropriate for other NSF programs and “not really applicable” to the MSP.

Response: The MSP program understands and appreciates the difficulties of assessing “high-risk” in a portfolio where substantial investments of dollars have been made in Comprehensive Partnership projects and where prudent judgment might suggest that high-risk is not appropriate. “High-risk” might also be framed in terms of “risk through innovation,” however, and the potential gains to be derived via innovation: “...the intent is to try innovative, ‘high-risk’ solutions to specific questions” [MSP Solicitation 02-061]. “All [MSP] projects incorporate a depth and quality of creative, strategic actions that *extend beyond commonplace approaches* to improve K-12 mathematics and science education” [Solicitations 02-190 and 03-605]. Consistent with this MSP intent to encourage “risk through innovation,” the degree of innovation was one of the review criteria on which reviewers of proposals were asked to comment. It was also a specific aspect of partnership work that, in the final stages of the review process for the second and third competitions, both the Partnerships invited for reverse site visits and their external reviewers/panelists were required to address.

Even within the lens of “risk through innovation,” however, the difficulties of getting agreement on what constitutes “high-risk” are not unique to the MSP COV. The *Report to the National Science Board on the National Science Foundation’s Merit Review Process, Fiscal Year 2004* (NSB 05-12), for example, notes (p. 22):

With respect to high-risk research, the Advisory Committee [NSF's Advisory Committee for Government Performance and Results (GPRA) Performance Assessment] urged a broader discussion of the issue, given the absence of a clear definition. In response to concerns about the uncertainty of what constitutes "high-risk" and "multidisciplinary," NSF is now collecting explanations of projects that program officers identify as either high-risk or multidisciplinary. Program officers will be asked to explain why the projects fit into those categories.

Discussion of projects identified as high-risk and the attributes that inform that characterization have continued as a topic under consideration by the Advisory Committee for GPRA Performance Assessment.

7. Although the COV found appropriate balance of projects in the portfolio along many dimensions (e.g., across disciplines/sub-disciplines, appropriate geographical distribution among PIs, innovation, new investigators), committee members expressed concern that HBCUs are not included as lead partners, that only five HBCUs are included as supporting partners and that the percentages of PIs and co-PIs in the overall MSP portfolio who are African American (6%) or Hispanic/Latino (6%) are not yet appropriate. The COV wrote, "NSF needs to continue to work to increase these numbers." The Committee commended the program for its efforts in "reaching out to diverse communities to serve the Hispanic population," noting that "[t]here appear to be a large number of Hispanic/Latino teachers being served" but lamented that "[t]he same cannot be said for African American teachers" and wrote that it was their "impression that a large number of African American teachers are not being served" by the portfolio.

Response: The MSP program has sharp foci on teacher diversity (an element of the MSP key feature on *teacher quality, quantity and diversity* expected in all funded Partnerships) and on the reduction of achievement gaps in the mathematics and science performance of diverse student populations. The first year of the core data collection in the MSP Management Information System (MSP-MIS) shows that over 56 percent of K-12 students and 34 percent of teachers in MSP schools are from underrepresented groups (i.e., Black or African American, Hispanic, American Indian or Alaska Native). Of these, a significant majority is Hispanic. In reviewing the program, the COV had access to summary data in the MSP-MIS and, as the COV correctly notes, the large "comprehensive projects in El Paso and Puerto Rico have a major impact on these numbers."

The first year of data collection includes only participating schools in the first two cohorts of Partnership projects (two years of data from Cohort 1 and one year of data from Cohort 2). As additional schools from Cohort 3 projects enter the MSP-MIS, the numbers of teachers and students who are African American or Native American are likely to grow, especially from Cohort 3 Partnerships that include urban populations in Birmingham, Boston, Houston, New York City and Philadelphia and rural populations from Arizona and Colorado. How much impact this will have on the overall relative percentages of teachers and students from particular underrepresented groups, however, is difficult to predict.

The MSP program is committed to broadening participation among Partnership organizations and among PIs/co-PIs. As noted earlier, in the first year of the program, MSP funded QEM for a series of workshops over three years to support minority-serving institutions and schools in developing competitive proposals for the MSP program. In addition to the efforts of QEM, NSF/MSP supported a host of other outreach efforts by NSF program staff and contractors. In cross-referencing available data on workshop attendees against proposals receiving awards, program staff believe the outreach efforts had positive effects. Seventeen of the 48 funded Partnerships include 36 minority-serving institutions as core partners. Five HBCUs (as noted by the COV), although not lead partners/fiscal agents, are core partners. The program also made special efforts to reach out to smaller baccalaureate institutions and community colleges: by

Carnegie classification, 19% of the IHE partners in MSP awards are baccalaureate-granting and another 13% are associate-degree-granting.

Subject to future funding/authorization for new Partnership awards, the program will engage in strong, focused outreach efforts to HBCUs and other minority-serving institutions and – in recognition of the eligibility requirements that the PI of each Institute Partnership must be a mathematics, science or engineering faculty member in a higher education core partner – to minority-serving professional societies (e.g., the National Society of Black Physicists, the National Association of Mathematicians, National Organization for the Professional Advancement of Black Chemists and Chemical Engineers).

Management of the Program

8. The COV noted that, “[i]n designing the MSP program, NSF has been responsive to its own experience over the past 10 to 15 years and to the opportunities and needs raised by NCLB. As the program has developed, NSF has responded nimbly to new opportunities and needs, as evidenced by the targeted funding of research and development of new tools in the RETAs, and as evidenced by the addition of the focused Teacher Institutes.” “The urgency with which this program was created made it difficult to think through the complexities; yet, the quality of the management reflects thoughtful, well organized, dedicated and systemic planning.”

Response: Program staff appreciate the confidence expressed by the COV in the overall management of the program. Complex research and development efforts, such as the MSP, call forth the extensive experience of the entire NSF. We are also very grateful for the intelligence, dedication and encouragement of the field, *broadly writ*, with which we work.

B. Results: Outputs and Outcomes of NSF Investments

The COV evaluated the outputs and outcomes of the MSP program. A summary of the Committee’s comments and responses from the staff follow.

1. The COV acknowledged that “[i]t is still too early to determine the overall impact of MSP on outcomes for people,” given that, in general, “these are five-year projects that have, as yet, gathered two years of data, at most.” The Committee also stated “it is vital that tools and systems be put in place now to enable NSF to answer questions about impact by the time the program has been in place for five years.” More specifically, the COV noted –

- **the importance of measuring student enrollment in challenging curricula and success in advanced courses, in addition to measuring gains in student achievement. The Committee cited specific RETAs and Partnership projects in the MSP portfolio that address student assessment or that have undertaken “novel methods of assessment” of students.**
- **“[p]rocesses for measuring growth in teacher content knowledge and effectiveness are less well-developed” and “NSF should pay attention to pre- and post-testing of teachers, to classroom observation, and in general to ensuring that across projects the growth of teacher knowledge can be measured.” Some RETAs are developing tools for assessing teachers’ growth in content knowledge and EHR/MSP “should ensure that tools such as these are incorporated into the targeted and comprehensive projects’ evaluation plans.” “The fact that NSF is offering assistance in this endeavor by funding such projects as Building Evaluation Capacity of STEM Projects [an MSP-RETA funded project] is an indication that such evaluations will take place across the board.”**

- **“in order to measure growth in the quality, quantity, and diversity of science and mathematics teachers, it will be very important for partner IHEs to track how many of their graduates obtain licensure, find jobs (especially in partner districts), and succeed in their initial mathematics and science teaching assignments.”**

Response: Deepening the MSP infrastructure for data collection, program evaluation, knowledge management and dissemination is an MSP priority. The program has funded umbrella projects for (a) an MSP Management Information System (MSP-MIS) that collects core data from all funded Partnerships; (b) overall MSP Program Evaluation (MSP-PE); (c) MSPnet, the electronic community for MSP projects; (d) knowledge management that synthesizes findings from MSP work and integrates them into the larger knowledge base for educational reform, thus strengthening the potential bonds between educational research and practice and contributing to the nation’s capacity to understand and engage in large-scale educational innovation; and (e) dissemination of key findings and promising practices derived from MSP project work and evaluation. The MSP-MIS has responsibility for collecting core data on student achievement across all funded Partnerships, as well as data on student enrollments and success in advanced courses and other student data needed to assess progress.

Many of the tools and instruments needed to assess progress in STEM education, especially those needed to assess teachers’ growth in mathematics/science content knowledge, were not in existence at the time the MSP program was launched at NSF. In fact, the need to develop and validate such tools/instruments and provide assistance in their implementation was a primary factor in initiating the RETA component of MSP. While a number of tools/instruments are currently under development, the development process itself requires several years. During this time, Partnerships may have some limited access to draft materials in the testing/validation phases of the development process but, as a general rule, these tools/instruments are not broadly available for use by Partnerships. The program therefore cannot reasonably require their use in project evaluation across the board.

At the present time, Partnerships are assessing teachers’ growth in content knowledge and effectiveness in a variety of project-specific ways, with some instruments being locally developed. The program concurs with the COV that NSF should pay attention to pre- and post-testing of teachers, to classroom observation and, in general, to ensuring that the growth of teacher knowledge can be measured across projects. The challenge is to do this using what is currently available, while higher quality instruments/tools are under development. It is worth noting that the work occurring within the NSF/MSP portfolio in the domain of teacher knowledge has gained a level of sufficiency that NSF/MSP Partnerships and RETAs will be sharing their work with the U.S. Department of Education’s State MSP Coordinators at a joint meeting hosted by NSF in October 2005.

While the program concurs with the importance of collecting data on the numbers of graduates who receive licensure, find jobs in MSP partner districts and succeed in their initial teaching assignments, it may not be feasible to require that all MSP institutions of higher education (IHEs) collect and report this longitudinal data. Each Partnership is required to address the MSP key feature of *teacher quality, quantity and diversity* in its work, but individual projects address teacher quantity using a variety of strategies, including many strategies not primarily in the domain of higher education (e.g., that are within school districts). The first year of core data collection in the MSP-MIS included items on the numbers of students in pre-service programs, graduation rates, pass-rates on licensure examinations and entry rates of new teachers in MSP schools. Those questions in the MIS proved to be among the least reliable and verifiable components of the entire data collection system. Simply put, the quality of the data reported from partnering schools and IHEs as core data in the MSP-MIS was sufficiently poor that it is not usable in a credible Research and Development effort.

The program has therefore turned to other mechanisms for the study of graduation and licensure rates and for findings that inform the initial years of teachers' induction into the profession. MSP-RETA intentionally funded a project to focus on the teacher induction period and its impact on retention in the profession. A number of the Partnerships are also documenting the effects of their work on this component of teachers' professional paths. Where Partnerships have a focus on the reform of STEM teacher preparation programs in their institutions of higher education, NSF/MSP is strongly encouraging data collection on graduation and licensure rates. NSF/MSP will also request that one of the MSP Program Evaluation substudies examine this work at the program level.

2. The COV noted that (a) one of the main goals of the MSP program is to increase the involvement of STEM disciplinary faculty from higher education in the work of K-12 education and (b) there is emerging evidence about the degree of engagement of STEM faculty in this work. At the same time, members of the Committee raised questions about how successful funded projects have been in the task of bringing new disciplinary faculty into their work. The Committee referred to the MSP-MIS report, which shows more than 500 disciplinary faculty, involved in MSP work, but questioned their level of involvement since approximately 100 of the respondents report their degree of involvement to be fewer than 40 hours per year. The Committee also cited three Partnerships in which five or fewer disciplinary faculty appear to be involved in each, suggesting that “[t]o better track level of involvement of STEM faculty, it would be useful to see the MIS report cross-tabulate field of research and teaching with hours of participation in MSP activities.”

Response: The engagement of STEM faculty in the work of K-12 is a hallmark of the MSP program. As a Research and Development effort, the interests of the MSP include not only the quantity of faculty involved and their degree of engagement, but also the *ways* in which they are engaged and, especially, the *effects* of their engagement on K-12. Such information is captured in the MSP-MIS and is also being studied in the Partnerships themselves. In addition, MSP-RETA specifically funded a project to focus on the effects of direct and substantial engagement of MSP STEM faculty on K-12 education. This RETA project is studying eight different Partnerships with a focus on such research questions as:

- What methods are being used by the Partnerships to engage STEM faculty in MSP work?
- How does faculty engagement vary by type of IHE?
- To what extent does STEM faculty involvement effect K-12 teacher content and pedagogical knowledge?
- To what extent does it effect student achievement in mathematics and science?

Since the beginning of the program, the engagement of disciplinary faculty has been an area of focus in the negotiation of competitive proposals for funding. Its importance to the MSP program is reflected in the Partnerships' strategic plans and is followed closely through annual reports, site visits, the MSP-MIS data collection and project evaluation. While most Partnerships have been successful in engaging the numbers of STEM disciplinary faculty needed to implement the work promised in their funded projects, POs are also aware of a small number of Partnerships that initially had limited success in engaging critical number of disciplinary faculty in their work. In these instances, MSP POs provide more intense oversight and guidance to Partnerships to ensure benchmarks are met. The MSP program expects that the numbers of disciplinary faculty will grow over time as the initial tiers of faculty assist in the recruitment of their colleagues. Projects that are successful in recruiting faculty to work in their partnerships share their strategies with other projects through MSPnet and the annual MSP Learning Network Conference/PI meeting. Some Partnerships also show early evidence of success in revising their tenure and promotion

policies to specifically recognize the value of participation in K-16 STEM education efforts, such as MSP, thus removing or lowering barriers to faculty participation.

MSP-MIS data from Cohorts 1 and 2 indicate that 74 percent of faculty in MSP Partnerships reported over 40 hours of effort on MSP activities during the last academic year and 34 percent reported more than 160 hours of engagement. Additional analysis on Cohort 1 faculty, the only cohort for which there is longitudinal (two years) data to date, indicates that participating faculty spent significantly more time on MSP work in their second year than in the first. This mirrors the program's expectation that, as the work of individual Partnership projects deepens and expands in successive years and as IHEs change their practices to reflect the importance of IHE partnership with K-12, the degree of faculty engagement will grow. The MSP program will continue to collect faculty data and, as suggested by the COV, will (through the MSP-MIS) specifically cross-tabulate faculty fields of teaching and research with hours of participation.

3. The COV commented that “[t]he MSP program will provide first-rate learning environments to hundreds of thousands of students and teachers,” citing four tools produced by a single Partnership project as an example and noting that “Cohort 1 and 2 RETAs have also produced a variety of new tools for evaluation, research, and technical assistance (19 instruments as of 4/05). These include, for example, instruments to assess teachers’ mathematical and/or scientific knowledge and pedagogy, a tool for measuring student and teacher motivation, one to measure students’ scientific knowledge, observation logs, a tool to analyze the alignment of standards and assessments, and a rubric for use in examining the content of mathematics instruction in videotapes.”

Response: The many new tools and instruments under development in both the Partnership projects and in RETA are critical elements for implementing and evaluating the quality of STEM educational work, especially in such complex domains as assessing teachers’ growth in the mathematical or scientific knowledge needed for teaching. As the development of these tools/instruments progresses and as they are validated and refined for use beyond their initial test beds, they become a major resource for the improvement of STEM education, *broadly writ*.

C. Other Topics

The COV was asked to comment on the performance of this program (a) as a major Research and Development effort in STEM education; (b) as compared with other programs having a focus on STEM educational efforts; (c) in meeting program-specific goals and objectives not otherwise covered; (d) in how best the program might focus its work at this time given that future funding is not assured; and (e) on any other issues the COV considered relevant. In addition, the COV was asked to comment on how NSF might improve the COV process, format and report template. A summary of the Committee’s comments and responses from the staff follow.

1. The COV commented that the “concept and drive” for the MSP originated outside the NSF and that, as originally formulated, MSP was “largely an implementation initiative” designed to improve the STEM teaching force and advance student achievement. As the program evolved, “[t]hrough the efforts of NSF leadership and program staff, MSP solicitations ultimately incorporated significant research components” in both the Partnership and RETA projects. “To its credit, NSF has . . . found ways to infuse the MSP programs and projects with significant research activities that will contribute to the enduring knowledge base for STEM education.”

Response: From its inception, the program has emphasized the importance of evidence in informing and refining work at both the project and program levels. The staff acknowledge the Committee’s observation

of the importance of fusing educational implementation with research/scholarship so that the knowledge base for educational reform is constantly being strengthened. As each successive MSP solicitation has been developed, the Research and Development nature of the program has been articulated with increasing clarity and its emphasis on evidence more carefully defined.

2. The COV lauded the “breadth in the MSP portfolio that supports the integration of research and implementation,” as well as capacity building, citing a number of specific examples (e.g., the MSP Learning Network Conferences, the NRC professional development efforts, the Institute Partnerships, the MSP evaluation framework) that speak to this breadth. The COV wrote that “[t]he scope and stature of the program has been sufficient to attract some interest by STEM disciplinary faculty. This success needs to be enhanced by analysis of the character of that involvement and the increased involvement of policy leaders of IHE partners to support long-term involvement and sustainability.” Noting further that the MSP evaluation framework “is a positive example of the combination of vision and practicality demonstrated by NSF program staff” and that “[t]here is a significant contribution to the evaluation literature beyond the needs of MSP,” the Committee also articulated the need for continued emphasis “on the generation of outcomes evaluation that can significantly influence fundamental structural, foundational aspects of K-16 curriculum and instruction.”

Response: Detailed analysis to understand more clearly the nature of disciplinary faculty engagement in STEM educational work is an important domain of investigation for the MSP program. The program has funded multiple efforts to ensure adequate data collection and analysis on behalf of this outcome:

- (1) The MSP-MIS collects from all Partnerships common data on faculty engagement in more than 30 specific types of MSP preservice and inservice activity and also asks faculty to provide a richer, narrative description of their roles in any such activities. These resultant data in the MSP-MIS are being analyzed by (a) the MSP Program Evaluation contractor, as well as (b) an MSP research project studying IHE institutional change that results from faculty engagement in MSP Partnerships.
- (2) An MSP-RETA project was funded to specifically study the effects of direct and substantial engagement of MSP STEM faculty on K-12 mathematics and science education. This project’s research is expected to investigate the various types of involvement by STEM faculty, the extent to which STEM faculty engagement contributes to increased K-12 teacher content and pedagogical knowledge and the extent to which STEM faculty engagement contributes to increased K-12 student achievement in mathematics and science.

The program acknowledges the imperative for ongoing attention to outcomes evaluation. Every effort will be made to evaluate outcomes, especially where innovation shows promise; synthesize outcomes/findings across projects; and translate findings to inform those who make policy and who are the practitioners in both K-12 and higher education, nationwide. It must also be acknowledged that “the generation of outcomes evaluation that can significantly influence fundamental structural, foundational aspects of K-16 curriculum and instruction” is dependent upon the availability of appropriately precise tools and instruments to measure these outcomes.

3. The COV remarked that “careful attention to the knowledge gained from the [Partnership] projects and the effort to package and communicate that knowledge” can extend the impact of these projects beyond the current MSP sites which effect 500 K-12 school districts, 140,000 teachers, and 4.2 million students to a national impact. The COV commented on the fact that progress is already evident with regard to the program’s goals to build the national capacity for large-scale reform and engage “a broad learning community in new knowledge being generated.”

“Just as the RETA program has made multiple connections with targeted and comprehensive MSP projects to carry out research and provide technical assistance, NSF program officers should continue to facilitate connections and cross-fertilization among MSP projects, Centers for Learning and Teaching, and Science and Learning Centers.”

Response: An important component of the MSP infrastructure, as noted earlier, is a set of umbrella funded projects that address MSP knowledge management and dissemination and extend the impact of individual projects. Knowledge management and dissemination efforts are expected to (a) synthesize findings from MSP work and integrate them into the larger extant knowledge base for educational reform, thus strengthening the potential bonds between STEM educational research and practice and contributing to the nation’s capacity to understand and engage in large-scale education innovation and (b) disseminate key findings and promising policies and practices derived from MSP project work and evaluation.

The program concurs with the COV’s encouragement to “facilitate connections and cross-fertilization among MSP projects” and other NSF-funded efforts. MSPnet; the MSP Learning Network of PIs, other project personnel and external experts; and MSP-RETA are important resources and vehicles by which the program facilitates connections among MSP projects. The experience and expertise of the MSP program staff that have previously worked in (or are currently working in) other NSF programs play an important role in facilitating cross-fertilization with other NSF-funded efforts. MSP projects, for example, collaborate with 7 of the 17 currently funded Centers for Learning and Teaching (CLTs). One CLT in the Appalachian region is, in fact, collaborating with three different MSP projects. The Science of Learning Centers (SLCs) came into existence only recently with awards to three Centers that were effective at the beginning of FY 2005 [14 catalyst projects had been awarded previously]. The new SLCs are funded to engage in basic research over a three-year period. Most MSP Comprehensive and Targeted Partnerships will have completed or be in the final stages of their five-year awards by 2007 when results from the work of the SLCS will be emerging. Opportunities to collaborate with the SLCs may therefore be limited. Nevertheless, the MSP program will explore any reasonable opportunities to collaborate with the SLCs.

4. The COV articulated several “focus areas that could be important” for the program in the event that funding is not available for new Partnership awards in the future:

- **Develop a process to research “the long-term effects” of MSP with longitudinal studies having an extended timeframe (five to seven years or longer) that could provide data important for determining causal effects from MSP work.**
- **Give priority to additional Teacher Institutes. “Although results are not yet available on the outcomes of the currently funded institutes,” the COV wrote that it “was sufficiently impressed with their potential to encourage the extension of the program.”**
- **Provide significant assistance to the larger Partnerships “in their efforts to institutionalize the improved practices associated [with] the MSP projects,” being cognizant of engaging university leadership, state leadership and foundation leadership.**
- **Develop mechanisms to mine NSF’s MSPs “in order to offer significant input to state MSPs. Efforts should also be made to inform state education leaders about the strategies and successes of the MSP program. Sustainability through ideas should be an important thrust. This could involve publications and workshops.”**

Response: Within funding available to the MSP program, a process for researching the long-term effects of MSP work, with attention to causal effects, where possible, has already been initiated, primarily through the overall MSP Program Evaluation (MSP-PE) awarded at the end of FY 2004. The MSP-PE is designed from both a *context of justification* (“intervention sensitive”) and a *context of discovery* (“R & D sensitive”). The evaluation will consist of a series of substudies across the complex array of MSP Partnerships and RETAs (that are already conducting cross-MSP studies). The MSP-PE will address evaluation questions not only about what impacts might have been produced by the MSPs but also about what contributions they may have made to advancing the knowledge base in mathematics and science education. In starting its work at the beginning of FY 2005, the MSP-PE is expected to research/evaluate the long-term effects of MSP work for five years, thus defining the overall timeline for MSP work and follow-up studies from early in FY 2003 (when the first funded Partnerships began their work) to at least the end of FY 2009, for a total of seven calendar years. In addition to the MSP-PE, some MSP-RETA projects and some Partnership projects have focused interests on longitudinal studies of long-term effects.

The MSP program concurs with the COV about the potential of the Institute Partnerships and their value to the overall MSP effort. Institute Partnerships are likely to be a high priority in the event that additional funding for new Partnerships becomes available.

The key features of the MSP program place an expected emphasis on *institutional change and sustainability* in all funded Partnerships. The Partnerships are experimenting with and implementing institutional change in a number of ways that acknowledge the importance of university leadership, local district and state leadership and foundation leadership. For IHEs, examples of institutional change include curricular changes in preservice courses, programs and requirements; encouragement of STEM faculty engagement in K-12 work through more supportive policies and practices; and organizational changes that elevate and facilitate work between STEM disciplinary departments and educational activity in mathematics and science education. In one Comprehensive Partnership, for instance, the lead IHE has already established a Partnership Institute for Mathematics and Science Reform, a cooperative effort between its College of Arts and Sciences and College of Education, with oversight through the Office of the Provost. For K-12 districts, examples of organizational change include the utilization of elementary specialists within schools, as well as the development and ongoing support of school-based learning communities. It is worth noting that MSP’s Comprehensive Partnerships are led by some of the most knowledgeable and creative PIs (STEM faculty and K-20 administrators and educators) in the field of mathematics and science education in the nation.

NSF/MSP supports and assists the larger Partnerships in their efforts to institutionalize improved practices through: (a) NSF/MSP oversight, especially through the required critical site visits with large teams of external expert reviewers who give their assessments of strengths and weaknesses and their advice for strengthening each of the large Comprehensive Partnerships; (b) RETA projects that provide technical assistance to the Partnerships (e.g., resources for school principals); and (c) dissemination efforts that, to date, provide useful tools or showcase promising strategies worthy of consideration for institutionalization. The MSP community of evaluators and PIs, for example, collaborated on the development of the MSP document *Evidence: An Essential Tool* (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf0531) that, if well used, frames an iterative process for improving and sustaining project work.

The engagement of state leadership is seen by a number of MSP Partnerships as critical to their work and to the institutionalization/sustainability of promising strategies and practices. A number of NSF/MSP Partnerships include State Departments of Education as important partners; this is especially so in those Partnerships with a strategic focus on the alignment of state standards and/or assessments with their work. NSF’s MSP Partnerships have been highly successful in leveraging ED’s state-level MSP dollars to deepen their work or expand into new districts not supported by NSF funds. The intellectual leadership

of NSF's established Partnerships has already achieved significant "spillover" into the efforts of the states: in 28 of the 48 NSF/MSP Partnerships, at least one partnering institution has been successful in obtaining/leveraging ED/MSP funds.

Beyond the Partnerships themselves, NSF's MSP program views the State MSP Coordinators as a strategic "pressure point" for implementing and sustaining those aspects of NSF/MSP work with greatest promise – in particular, compelling ideas and tools/instruments from the Partnerships and RETA. State MSP Coordinators selected by ED have presented at and participated in NSF's annual MSP Learning Network Conferences for PIs and other project personnel. As noted earlier, NSF is also hosting an October 2005 meeting with the State Coordinators to share the work to date of NSF's MSP projects in the domains of *developing effective partnerships* and *teachers as professionals: enhancing and assessing teacher content and pedagogical knowledge*. MSPnet is another potential vehicle for influencing ED's work in the states: the State MSP Coordinators will have opportunities to familiarize themselves with this useful resource during the October meeting and access it thereafter with their own common space.

Further institutionalization will also likely result from other MSP-co-funded efforts such as a recent statewide Science and Mathematics Education Summit in Florida which drew together legislators, the Governor's office, the state Department of Education, business and industry, and educational leaders to create a shared vision and develop specific, achievable policy and legislative outcomes.

Finally, the program concurs with the COV that "[s]ustainability through ideas should be an important thrust." Publications and workshops are important vehicles for such sustainability and the program is documenting this work by our projects. Beyond the publications from specific projects and the workshops conducted, MSP's efforts in knowledge management and dissemination, as noted previously, are expected to bring needed coherence to the important ideas that emerge from the overall program.

5. The COV noted the wisdom of NSF in assigning "only experienced program officers to this inherently difficult-to-manage program."

Response: Program staff very much appreciate the numerous instances in the report where members of the Committee have commented on the importance of the experience and expertise of program staff in leading and managing this highly visible, complex program. The entire process from solicitation development through proposal submission/negotiation to the implementation of high quality projects requires knowledge and expertise founded on a thorough understanding of the merit review process and NSF policies and practices, and developed and honed over years of reviewing and negotiating proposals and monitoring the resulting projects. With its multiple solicitations and multiple types of projects (i.e., Comprehensive and Targeted, Institutes, RETA, umbrella projects for data collection, evaluation, knowledge management and dissemination), the development of a coherent intellectual framework and logic model for the program has seriously utilized all of the past experiences and expertise of the entire program staff, with many POs commenting that this is perhaps the most challenging work in which they have been engaged at NSF. The staff is most appreciative of the commendations offered by the COV.

6. The COV found it difficult "to ferret out what is really important in the large amount of complex information available to the COV, especially in the comprehensive MSPs" and noted that "[o]ften reviewing only a sub-sample of a sub-sample, it is a challenge to draw meaningful generalizations and conclusions. The proposed E-jacket has the potential to greatly improve COV effectiveness, especially if it allows sorting, selecting and manipulation of the database. . . . The COV process would then resemble a research project and the results generated would be more solid and verifiable."

Response: The program understands and greatly sympathizes with the difficulties experienced by the COV in its attempts to navigate through the vast documentation in MSP's complex and cumbersome five-section, hard copy jackets. In response to the Paper Reduction Act of 1995, NSF designed and implemented an electronic platform, e-Jacket, which was launched in 2002. Because of the confidential nature of the material in e-Jacket, this application was initially designed for internal use at NSF. The Foundation is, however, currently pilot testing its use in the COV process with software designed to improve accessibility and ease of use. When completed and available for general COV use, NSF staff will be able to assign activation and deactivation dates for a particular Committee, applying appropriate conflict-of-interest protocols, providing access to the portfolio and to other associated documents now contained in program-specific COV Review notebooks. Lists of awards and declinations would be electronically linked, as are awards and associated supplements, for ease of navigation within the portfolio. Inside a specific award file, documents are separated by category and sorted chronologically, designed to enhance the logical use of the information. Users will have the ability to search for key concepts as well as the option of saving or printing a document in part or *in toto*. There is considerable potential for e-Jacket to positively affect both the COV process and results.