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Resources, Community, and  
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May 19, 1998

The Honorable F. James Sensenbrenner, Jr.  
Chairman, Committee on Science  
House of Representatives

Subject: Results Act: NSF's Annual Performance Plan for Fiscal Year 1999

Dear Mr. Chairman:

As requested, this report summarizes our observations on the National Science Foundation's (NSF) annual performance plan for fiscal year 1999, which was submitted to the Congress in March 1998. As you know, the Government Performance and Results Act of 1993 (the Results Act) requires federal agencies, beginning with fiscal year 1999, to prepare annual performance plans covering the program activities set out in their budgets. To analyze NSF's performance plan, we condensed the requirements in the Results Act into three basic questions: (1) To what extent does the plan provide a clear picture of intended performance across the agency? (2) How well does the plan discuss the strategies and the resources the agency will use to achieve its performance goals? (3) To what extent does the plan provide confidence that the agency's performance information will be credible?<sup>1</sup> Enclosure I presents our detailed observations concerning how well NSF's plan answered these questions.

In summary, we found that NSF's performance plan for fiscal year 1999 (1) partially addresses annual performance issues across the agency, (2) partially discusses how the agency's strategies and resources will help it achieve its goals, and (3) partially provides confidence that its performance information is

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<sup>1</sup>These questions are based on criteria in the Results Act, the Office of Management and Budget's guidance to federal agencies on developing their plans, and a December 1997 letter to the agencies from eight congressional leaders on their expectations for these plans.

credible. The strengths of the plan are that it does a good job of describing performance expectations for the agency's scientific research and education programs, discussing how the agency's strategies and resources will help achieve scientific research and education goals, and providing some confidence that the agency's performance information for these programs will be credible.

However, the plan contains several weaknesses. In general, these weaknesses are related to areas that needed further attention in NSF's first strategic plan prepared under the Results Act. For example, the plan could more fully discuss the agency's contributions in meeting governmentwide goals for specific crosscutting programs and does not sufficiently develop strategies that address external factors that could influence NSF's ability to reach those goals. Without such information, it is difficult to understand NSF's relationship in crosscutting areas with other agencies that have similar programs or the overall reasonableness of NSF's annual performance goals. In addition, the plan does not present sufficient information on strategies, nonfinancial resources needed to achieve annual goals, and data verification and validation for management and other important activities that support NSF's programs—to explain the agency's expectations and needs in these areas.

On April 8, 1998, we spoke with NSF's Acting Deputy Director and Assistant to the Director for Science Policy and Planning to obtain the agency's comments on our observations. They told us that NSF generally agreed that our observations were legitimate and offered several explanations for the limited details presented in certain parts of the plan—namely, discussions of contributions to crosscutting issues, strategies to achieve annual goals in management and other activities, and data verification and validation. The officials told us that although the agency believed it had provided sufficient information, these sections were intentionally kept brief to reduce the size of the overall plan. The officials also told us that because they had presumed that the agency's Office of Inspector General would be involved in examining the agency's internal information systems to ensure data verification and validation, they had not explicitly addressed the Inspector General's role in the plan. As for the plan's limited discussion of the nonfinancial resources needed to achieve annual goals, NSF officials indicated that this information is discussed in the agency's fiscal year 1999 budget justification. Agency officials had initially intended to combine the budget justification with the performance plan in a single volume. However, after the performance plan was separated from the budget request, NSF officials inadvertently did not include the information in the performance plan.

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Finally, NSF officials said that, although not required by the Results Act, they will expand their discussions of external factors in future performance plans to describe NSF's annual efforts to address these factors. The officials also provided us with technical corrections and clarifications that we incorporated where appropriate.

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A list of GAO products related to this report is included at the end of this report. We conducted our work from February through April 1998 in accordance with generally accepted government auditing standards. We are sending copies of this report to the appropriate congressional committees; the Director, National Science Foundation; and the Director, Office of Management and Budget. We will also make copies available to others on request.

Please call me at (202) 512-3841 if you or your staff have any questions about this report. Major contributors to this report were Jeffrey Heil and Bob Lilly.

Sincerely yours,



Susan D. Kladiva  
Associate Director, Energy,  
Resources, and Science Issues

Enclosure

OBSERVATIONS ON THE NATIONAL SCIENCE FOUNDATION'S  
ANNUAL PERFORMANCE PLAN

The following presents our detailed observations concerning how well the National Science Foundation's (NSF) fiscal year 1999 performance plan addressed three basic questions inherent in the Government Performance and Results Act and related guidance for implementing the act. (1) To what extent does the plan provide a clear picture of intended performance across the agency? (2) How well does the plan discuss the strategies and the resources the agency will use to achieve its performance goals? (3) To what extent does the plan provide confidence that the agency's performance information will be credible?

NSF'S PERFORMANCE PLAN PARTIALLY  
ADDRESSES ANNUAL PERFORMANCE  
ISSUES ACROSS THE AGENCY

We found that NSF's plan partially addresses annual performance issues for scientific research and education programs. Also, the plan generally links performance goals with mission, strategic goals, and activities. However, the plan falls short of clarifying how its goals relate to those of other agencies with similar programs.

Defining Intended Performance

Overall, NSF's plan partially defines intended performance by using descriptive statements to describe its strategic goals for scientific research and education and by using quantifiable performance goals for management and other activities. However, the plan falls short in a third aspect of defining performance by frequently using output-oriented rather than outcome-oriented goals for its management and other activities.

Scientific Research and Education

For its scientific research and educational activities, NSF established annual performance goals in the form of statements that describe successful and minimally effective performance, an alternative format allowed by the Results Act and the Office of Management and Budget (OMB). These alternative statements reasonably define the type and level of annual performance that the agency expects for these activities. For example, NSF believes it will be successful in meeting its strategic goal of promoting scientific discovery when the agency's awards lead to important discoveries and new knowledge within and across traditional disciplinary boundaries. NSF will be

only minimally effective when there is a steady stream of outputs of good scientific quality.

Over time, NSF could improve its definition of expected performance by more thoroughly explaining its descriptive goals for science research and education activities so that those who evaluate the agency's performance can do so objectively and consistently. By establishing definitions for successful and minimal levels of performance, NSF's descriptive statements are only somewhat measurable in that they allow reviewers and decisionmakers who also evaluate the agency's activities to distinguish between two broad levels of performance. NSF intends to have experts from outside the agency use these statements each year to evaluate the extent that past, present, and possible future results from projects funded by NSF contribute to meeting these levels of performance. Agency officials believe that expert reviewers will reach a consensus on how to interpret these statements. However, experts using these statements to review NSF's performance may change from year to year. Also, decisionmakers within NSF, OMB, and the Congress who will use performance assessments prepared by these reviewers need to understand the basis for the reviewers' evaluations. To ensure consistent interpretations of the performance statements each year by reviewers and decisionmakers, NSF needs to better explain what it means by such phrases as "important discoveries" and "steady stream of outputs of good scientific quality." One way to do this would be to provide examples of past discoveries that illustrate each of the descriptive statements.

NSF officials told us that they have used similar broad terms to guide experts in their reviews of research proposals and have not experienced major problems with interpretation of the terms. However, because these terms are fundamental to reviewers' evaluation of NSF's annual performance, we continue to believe that NSF should better explain the subjective terms used to define annual performance goals for scientific research and education activities.

#### Management and Other Activities

For its management and other activities, NSF generally uses more quantifiable goals to define expected performance. For example, NSF expects that, during fiscal year 1999, it will train 95 percent of its staff in the use of a new electronic system for receiving and processing proposals and process 70 percent of the proposals within 6 months of receiving them. Because several of these goals directly indicate the type of information that NSF will use to measure actual performance, they are measurable and objective, and can be used with relative ease to compare actual and intended performance.

NSF's plan could be improved if it more fully used outcome-oriented goals when possible to define performance. NSF's goals for its management and mission-supporting activities are generally output-oriented in that they measure an expected level of activity for information systems training, the management of research facilities, or other activities. NSF officials generally agreed that many of the annual performance goals for these activities represent intermediate steps in longer-term strategies to achieve scientific research and education goals and that the agency's annual performance plan could be improved if it more explicitly explained these relationships. For example, the annual plan could explain that an expected intermediate outcome of decreasing the time lost at research facilities because of unscheduled problems would be an increase in the amount of research done at these facilities, which could, in turn, ultimately contribute to achieving NSF's programmatic goal of making important scientific discoveries.

### Connecting Mission, Goals, and Activities

NSF's performance plan generally connects the agency's performance goals to the mission, strategic goals, and program activities presented in its fiscal year 1999 budget request. The agency's annual performance goals are directly related to and consistent with NSF's mission and strategic goals that are presented in its strategic plan. Also, these goals encompass all program activities presented in NSF's budget request.

NSF uses two approaches to link its annual goals with its mission, strategic goals, and program activities. First, at the beginning of its performance plan, NSF repeats its mission statement, strategic goals for scientific research and education, and critical management issues, as defined in its September 1997 strategic plan. NSF also connects the science research and education areas of its strategic and performance plans by using the strategic plan's goals for these areas as the basis for the descriptive performance goals for fiscal year 1999.

NSF's plan covers the program activities described in its fiscal year 1999 budget by relating its program activities to four functions: (1) research project support; (2) the construction, operation, and maintenance of research facilities; (3) education and training; and (4) administration and management. These functional areas are then related to each of the plan's five primary goals for scientific research and education. According to the plan, each functional area includes activities that support at least one of the agency's major scientific research and education goals. For example, the plan indicates that portions of funding in all program activities promote NSF's research project support function. In addition, the plan explains that activities under this function most directly contribute to NSF's goals for discoveries and the use of discoveries in society and indirectly contributes to a diverse, globally oriented science and engineering workforce.

Recognizing Crosscutting Issues

NSF's performance plan falls short of clarifying how its goals relate to those of other agencies with similar programs. NSF's strategic plan identifies several interagency programs, ranging from scientific research into global change, computer networking, and environmental technologies to education issues associated with student and teacher training in science, mathematics, and engineering. However, the performance plan falls short because it does not discuss how its annual goals in these areas reflect coordination among the agencies.

The plan identifies four NSF programs that are similar or related to programs being implemented by other agencies. These include NSF's research into global change, a faster and larger capacity version of the Internet, education and training technologies, and the sequencing of genes in plants. The performance plan also identifies two examples of research themes (Life in Extreme Environments, such as the polar regions, and Nanoscience and Engineering) that include work being supported by several NSF divisions. The plan discusses other agencies' efforts for only one of these crosscutting programs, specifically, the federal government's efforts to improve the Internet. For other crosscutting programs mentioned in the plan, such as global change and plant genetic research, NSF states that its efforts are consistent with governmentwide plans for these programs but does not explain how its initiatives relate to other agencies' efforts.

Furthermore, while NSF's strategic plan indicates that the agency works with other federal agencies to conduct research, these efforts are not discussed in NSF's performance plan. For example, NSF's strategic plan states that, although the Departments of Health and Human Services and Defense provide the largest amount of federal funding for supporting graduate student training in science, mathematics, and engineering, NSF's graduate fellowship and traineeship programs make significant contributions as well. However, neither NSF's strategic plan nor its fiscal year 1999 performance plan discusses coordination among the three agencies to collectively use funds for graduate student training in an efficient manner, nor does NSF's performance plan discuss the agency's goal for its graduate student activities. Without an explanation of goals and the general approach that NSF and other agencies will take to promote graduate student training, it is difficult to (1) understand the relationship of NSF's program with those of other agencies and (2) have confidence that NSF's funds are not being spent for activities that unnecessarily duplicate those of other agencies.

Over time, NSF could improve the performance plan's coverage of crosscutting issues by including a more complete discussion of its goals in these areas and its general approach for achieving these goals. When discussing crosscutting issues, NSF

should clearly explain how its goals and efforts relate to those of other agencies with similar programs and explain the unique contribution that NSF intends to make in the area.

NSF'S PERFORMANCE PLAN PARTIALLY DISCUSSES  
HOW THE AGENCY'S STRATEGIES AND  
RESOURCES WILL HELP ACHIEVE ITS GOALS

NSF's performance plan partially discusses how the agency's strategies and resources will help achieve its goals. Specifically, the plan presents a list of strategies for NSF's scientific research and education goals but does not clearly describe the strategies the agency will use to achieve its goals for management and other activities. In addition, the plan does not discuss actions to address external factors that are likely to affect its performance. Also, the plan only partially discusses resources because it does not specifically describe the capital, human, and information resources that NSF will use to achieve performance goals.

Connecting Strategies to Results

NSF's performance plan partially presents clear and reasonable strategies that NSF will use to achieve its fiscal year 1999 performance goals. Specifically, the plan describes general strategies that NSF intends to use to achieve its five primary goals for scientific research and education. For example, NSF will use a competitive merit-based review process with peer evaluations to identify the most promising ideas from the strongest researchers and educators and will integrate research and education to strengthen both activities. These general strategies appear to be a continuation of the strategies that NSF presented in its September 1997 strategic plan. Overall, the general strategies seem to describe reasonable approaches for achieving NSF's fiscal year 1999 goals for scientific research and education.

However, NSF's general strategies (1) do not apply as directly to its goals for management and other activities that support the agency's broad research and education goals and (2) do not describe how the agency will achieve these supporting goals. In its fiscal year 1999 plan, NSF establishes 18 goals for management and other activities, processes, and functions. These include the timely construction of research facilities, preparing announcements to invite researchers and others to submit proposals, training staff to electronically process the proposals, and addressing the potential problems that the year 2000 may present for the agency's computer systems. In some cases, NSF provides a brief one-sentence explanation of how it intends to achieve these goals. However, with a few exceptions, these short explanations are not sufficient to clearly describe NSF's strategies for achieving the agency's goals.



NSF's performance plan could be improved beyond the requirements of the Results Act if the agency linked strategies that describe how it intends to achieve annual goals in the management and other areas to key strategies presented in the agency's strategic plan. For example, NSF's strategic plan describes operating a viable, credible, and efficient merit review system for research projects as critical to achieving its scientific research and education goals and describes several key strategies for improving the merit review process. The performance plan discusses annual performance goals for operating the system—such as increasing the average duration of awards for research projects. In commenting on our observations, NSF officials told us that increasing the duration of awards is related to a key strategy presented in the strategic plan of decreasing the burden on proposers and reviewers. It would be helpful to executive and congressional decisionmakers if NSF's performance plan explicitly explained such linkages between the agency's strategic and annual plans. Explaining such linkages would enable federal decisionmakers to better understand the importance of the agency's annual goals and strategies to improve management and other activities.

The plan is also silent on how it will address external factors that could affect the agency's performance during the coming fiscal year. For example, according to NSF's September 1997 strategic plan, cost-cutting efforts by colleges, universities, state and local education agencies, and other federal agencies could reduce the funding available to conduct research and to train students and teachers in science, mathematics, and education. If this occurs, the volume and quality of research and education could suffer and/or NSF's costs for supporting research and education could increase. Although NSF is not required by the Results Act to address such external factors, either scenario could directly affect NSF's goals of making important scientific discoveries and promoting the use of these discoveries. Yet, despite the potential ramifications of budget-cutting by other funding organizations, NSF's performance plan does not identify the efforts that the agency will take to monitor the extent to which budget-cutting is occurring and how it may affect the agency's fiscal year 1999 performance.

### Connecting Resources to Strategies

NSF's fiscal year 1999 performance plan partially discusses the resources needed to achieve its goals. The plan provides financial information by discussing the funds that NSF requested in its fiscal year 1999 budget request to achieve scientific research and education goals. After presenting the funding requested for specific NSF programmatic areas, the plan presents a second analysis that breaks down the amount requested by key NSF functions such as education and training and provides a table that identifies the relative extent to which each function supports the agency's five major scientific research and education goals. However, the plan does not identify

specific resources, other than funding, needed to implement its strategies. For example, although the plan discusses the importance of effectively managing construction projects and training staff in electronic processing, the plan does not specifically identify the capital, human, or information resources that will be needed.

**NSF'S PERFORMANCE PLAN PARTIALLY  
DESCRIBES THE VERIFICATION AND VALIDATION  
OF PERFORMANCE INFORMATION**

NSF's performance plan partially discusses the verification and validation of performance information by describing the agency's general processes for providing accurate and reliable information. However, NSF's plan would be strengthened if it provided information on the limitations that are likely to affect its performance information.

**Verifying and Validating Performance**

NSF's fiscal year 1999 plan describes general processes that it intends to use to collect, verify, and validate performance data. For scientific research and education goals, this discussion provides sufficient information to impart a degree of confidence that the information collected and reported will be accurate and reliable. However, for goals involving management and other activities, the performance plan does not provide sufficient information to impart confidence in the quality of NSF's performance information.

In the scientific research and education areas, NSF intends to collect performance data from (1) final project reports that grantees submit to program officials in paper form, (2) a new electronic information system for summarizing these reports, and (3) a data base on the effects of NSF's educational program to collect performance information and related indicators. The agency will then report the information and indicators to experts drawn from outside NSF, who will use the data and other information to evaluate the agency's performance. According to the plan, NSF's strategy for ensuring the accuracy of such information is to (1) rely on grantees to submit correct information that will be used in part to evaluate future requests for grants and (2) expect that because of their expertise in specific disciplines, NSF's reviewers will be able to identify inaccurate performance information submitted to them. To the extent that the experts live up to NSF's expectations and question the accuracy of the information provided them, this additional level of review adds credibility to NSF's performance information.

For goals involving management and other activities, NSF's fiscal year 1999 plan indicates that NSF will collect most performance information from existing

information systems and that these systems are subject to regular checks for accuracy and reliability. However, the performance plan does not describe NSF's general process for checking such systems. Also, the plan does not describe whether NSF staff or outside reviewers will be testing the data from these systems. Without additional details concerning the general types of checks performed, the frequency and results of recent tests, and whether the tests will be done by NSF staff or independent organizations, such as NSF's Inspector General, it is difficult to have confidence in the accuracy and reliability of NSF's performance information.

Additionally, NSF's performance plan does not describe the agency's efforts to develop the cost information necessary to relate costs to financial and program performance as well as to conform with federal cost-accounting standards. For example, when evaluating the agency's progress toward its goal of electronically processing 10 percent of its research proposals, it would be helpful if NSF managers and other decisionmakers knew the human resources and technology costs associated with electronically processing these proposals. NSF, executive, and congressional decisionmakers could use such information to evaluate whether the agency is efficiently using its resources and to estimate the cost of processing a larger percentage of proposals during future years.

#### Recognizing Data Limitations

NSF's performance plan falls short of identifying significant limitations with performance data and their potential implications for assessing the achievement of performance goals. Specifically, the plan provides examples of quantitative performance indicators but is silent on their limitations. Also, although the plan discusses its efforts to develop new information systems to collect performance information, the plan does not discuss the general risks associated with developing and maintaining new systems.

NSF intends to use its information systems to provide data on the journal publications, books, inventions, and other products emanating from its research projects and on the number of academic degrees received in mathematics to help expert reviewers gauge whether the agency is meeting the minimum or successful levels of performance in scientific research and education. However, as we reported in March 1997,<sup>2</sup> quantitative measures, such as the number of patents or citations in books and journals, were generally not designed to measure the long-term results of research and development, nor are they easily adaptable to such a purpose. In one

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<sup>2</sup>Measuring Performance: Strengths of Research Indicators (GAO/RCED-97-91, Mar. 21, 1997).

case, the frequency of citations in journals provides little indication of the research's innovation nature. Similarly, the number of mathematics degrees granted by universities receiving NSF grants implies a cause and effect relationship that may not exist. NSF's performance plan does not discuss these limitations or the strategies that NSF will use to enable its expert reviewers to overcome them. NSF officials told us that they did not discuss these limitations in the performance plan because (1) agency officials will rely on the judgment of expert reviewers to compensate for the limitations of research indicators and (2) experts and agency officials will use indicators only in conjunction with other performance information.

The plan does not discuss the risks involved in developing new information systems, such as NSF's new system for electronically summarizing project reports by grantees, that will collect performance information or strategies that NSF can use to minimize the risks. For years, we have considered the development of information systems to be a high-risk activity within the government and have reported on cost overruns during systems development, problems with ensuring the accuracy of the data that the systems collect and maintain, and the security weaknesses that could compromise information maintained by the systems. NSF's performance plan could be improved if it communicated that NSF managers are aware of these potential problems and are taking appropriate measures to protect the accuracy and reliability of the data generated by its information systems.

#### OTHER OBSERVATIONS

NSF's fiscal year 1999 performance plan describes the agency's plans to use expert reviewers to evaluate its research and education programs. NSF's tests of how to implement the performance evaluation system suggests that, although the experts are generally confident of their ability to evaluate NSF's programs, much needs to be done before the evaluation system can be fully implemented. For example, NSF believes that it must develop clear instructions for the experts to use to assess performance against descriptive standards, provide the reviewers with advice on how to properly use performance indicators, and develop a process for combining the experts' final evaluations of NSF's programs with self-assessments done by NSF staff. Because it may take several performance planning cycles to answer and refine these questions, NSF's fiscal year 1999 performance report will represent only a first step in providing executive and congressional decisionmakers with performance information needed to assess the agency's performance. To ensure that potential users of the fiscal year 1999 report fully understand the risks associated with developing a performance evaluation system, NSF should expand its performance plan for fiscal year 1999 to discuss its schedule for developing the system and its expectations for testing and refining the system.

## RELATED GAO PRODUCTS

Managing for Results: Agencies' Annual Performance Plans Can Help Address Strategic Planning Challenges (GAO/GGD-98-44, Jan. 30, 1998).

Results Act: Observations on the National Science Foundation's Draft Strategic Plan (GAO/RCED-97-203R, July 11, 1997).

Measuring Performance: Strengths and Limitations of Research Indicators (GAO/RCED-97-91, Mar. 21, 1997).

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