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Report to the Chairman, Subcommittee on Science, Committee on Science, Space, and Technology, House of Representatives

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NATIONAL SCIENCE FOUNDATION

Better Use of Existing Resources Could Improve Program Administration

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Resources, Community, and
Economic Development Division

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The Honorable Rick Boucher
Chairman, Subcommittee on Science
Committee on Science, Space,
and Technology
House of Representatives

Dear Mr. Chairman:

The National Science Foundation (NSF), through its Directorate for Education and Human Resources (EHR), exercises the unique federal role of advancing science, mathematics, engineering, and technology education programs. For fiscal years 1990 through 1993, money available for these programs more than doubled, from $242.7 million to $511.6 million, while resources to administer and manage the programs grew by less than one-fourth, or from about $6 million to $7.3 million, adjusted for inflation.[1] Concerned with NSF's ability to effectively administer funds for these programs, you asked us to examine the administration of EHR and to concentrate on EHR's precollege programs. Specifically, you asked us to examine (1) how EHR establishes priorities for its education programs, (2) how EHR evaluates the results of its programs and how these evaluations are used in setting future priorities, and (3) whether EHR has obtained the resources it needs to administer its programs effectively. In order to fully evaluate the level of administrative resources provided to EHR, we had to develop performance indicators for all of NSF's directorates.

Results in Brief

EHR's Assistant Director sets priorities for its education programs primarily through an informal process involving a number of internal and external groups. For example, the primary means used to solicit external advice on establishing priorities is through EHR's advisory committee. In addition, the National Science Board (NSF's policy arm) approves all new programs and large awards—those having annual commitments of $1.5 million or more and multiyear awards with total commitments of $6 million or more. In addition, the Congress has directed that certain funds be spent on specific education programs.

Prior to fiscal year 1991, EHR relied primarily on external peer oversight groups to determine how well each of its education programs was

[1]Because of how NSF tracks expenditures, amounts describing EHR's resources amounts do not include charges for personnel benefits such as NSF's contributions to employee retirement and health insurance.

operating. In January 1991, EHR also initiated a comprehensive evaluation program that uses outside contractors to determine the education programs' effectiveness. However, because determining the impact of an education program is a complex and time-consuming task, most of the contractors' reviews have not been completed.

For more than a decade, increases in staff levels throughout NSF (not only in EHR) have not kept pace with the growth in workload. While EHR's Assistant Director told us that EHR does have sufficient administrative resources, he also said that additional resources would allow EHR to more effectively administer its programs. However, most experienced program officers responsible for administering EHR's precollege programs with whom we spoke told us that EHR is not effectively administering these programs. They cited their heavy workload, the lack of travel funds, and a high personnel turnover rate as key obstacles to effective administration.

The performance indicators that we developed to measure the impact of limited administrative resources on all NSF directorates since fiscal year 1987 showed that EHR was generally operating about the same as other NSF directorates. For example, while the growth in the average workload placed on EHR staff far outpaced that placed on staff in other NSF directorates, EHR's workload in fiscal year 1992 was no greater than the average for all of NSF's seven directorates.

Background

NSF is an independent federal agency that was created by the National Science Foundation Act of 1950 (P.L. 81-507). NSF's mission is to promote and advance scientific progress in the United States, which it does primarily through awarding grants for research and education in science and engineering. However, it does not conduct its own research. NSF has seven grant-making program directorates, each headed by an assistant director and each divided into divisions and offices. NSF is led by a presidentially appointed Director and a board of 24 member scientists and engineers who are responsible for, among other things, setting NSF's policies. Outside advisers, primarily from the scientific community, are often used to assist NSF staff by serving on formal committees or by serving as ad hoc reviewers of proposals. In addition, outside contractors are sometimes used to assist NSF staff in monitoring and evaluating projects and providing other types of technical assistance.

EHR, like other NSF directorates, selects proposals to support by means of an external merit or peer review process. The process is usually started by

an individual, known as a principal investigator or project director, who is normally associated with a university or other institution. The principal investigator prepares a project proposal in accordance with an NSF program announcement and submits the proposal to NSF for possible funding.[2] NSF assigns the proposal to an NSF program officer to review and to evaluate and recommend whether it should be funded. The program officer, in making an award recommendation, obtains advice from peer reviewers through ad hoc mail reviews, panel reviews, or both. The award generally is made directly to an organization rather than to the principal investigator, who carries out the project design. After the award is made, the program officer is also responsible for monitoring the scientific aspects of the project.

EHR's education programs are only one part of a large federal mathematics and science education initiative. The federal government expected to spend about $2.2 billion in fiscal year 1993 on this initiative. Of that amount, NSF's share was estimated at about $537.9 million, or about 25 percent of the government's share—the largest share among 11 participating agencies. Furthermore, estimates were that EHR—which funds the majority of NSF's science, mathematics, engineering, and technology education programs—would spend $442.5 million, or about 82 percent of NSF's total share.

Setting EHR's Education Priorities Is Generally an Informal Process Involving a Number of Internal and External Groups

According to EHR's Assistant Director, because of the large number of critical education demands, setting education priorities is a difficult and frustrating process that requires addressing as many high-priority education needs as possible to optimize the use of available resources. NSF's process in setting priorities for EHR's education programs is generally informal; basically, EHR's Assistant Director solicits advice from a number of different groups or individuals inside and outside of EHR. However, written procedures contained in NSF's Proposal and Award Manual specify the conditions for which the National Science Board must provide its prior approval for recommended awards. In addition, the Congress may direct that certain funds be used for specific education programs.

EHR's Assistant Director told us that he meets with his senior staff on a weekly basis and that planning and setting priorities for programs are often discussed. He added that retreats are used for in-depth discussions on, among other things, setting priorities for programs. In addition, EHR's

[2]A program announcement is the primary mechanism used by NSF to generate unsolicited proposals. The term includes program brochures, guidelines for submitting proposals, and published program plans, among other things.

policy group, composed of all NSF assistant directors, meets on a weekly basis to discuss education policy issues that cut across directorate lines.

According to EHR's Assistant Director, the primary means used to solicit external advice on establishing education priorities is through EHR's advisory committee. The committee, composed of about two dozen university presidents and other prominent officials, meets twice each year to review EHR's education programs and provide suggestions and recommendations for the programs' direction. The Assistant Director also told us that the results of reviews by external expert panels—which first require approval by this committee—are considered, among other things, in setting future priorities. EHR also plans to use the results of contractors' evaluations of programs (discussed in the next section of this letter) to assist in setting future priorities. Furthermore, workshops are held by some EHR divisions to obtain additional feedback from the external community.

The Director of NSF and the National Science Board also provide EHR's Assistant Director with some direction on setting priorities for education programs. The Director initially reviews all new programs, and the National Science Board—as specified in NSF's Proposal and Award Manual—provides prior approval for certain recommended awards, including all new programs and large awards, namely, those having annual commitments of $1.5 million or more and multiyear awards with total commitments of $6 million or more. Furthermore, to assist the National Science Board in its responsibilities, the Board's Committee on Education and Human Resources first reviews all items concerning EHR and requiring the Board's approval.

The Congress has, in the past, revised certain priorities of EHR by not appropriating funds for a given program or by appropriating more funds than requested and directing the funds to specific education activities. For example, in fiscal year 1992, the Congress appropriated $75 million above NSF's request of $390 million for EHR's activities. The conference report accompanying the legislation directed that the additional money be used for a number of specific EHR programs.

EHR's Evaluations of Education Programs Are Evolving

An important part of setting effective priorities consists of evaluating whether EHR's education programs are accomplishing their established goals. Prior to fiscal year 1991, EHR relied primarily upon reviews by external peer oversight groups—known as the Committee of Visitors—to

review each of its programs on a 3-year interval. Each review is supposed to address, among other things, the integrity and efficiency of processes used to solicit, review, recommend, and document proposal actions. A typical Committee of Visitors consists of a chairperson, who is also a member of EHR's advisory committee, and three or four members, who are selected for their expertise in the field under examination. The results of each committee's evaluation are documented in a report describing the method of review and any findings, conclusions, and recommendations.

In response to a September 1990 directive by the Senate Committee on Appropriations, EHR initiated a comprehensive evaluation of its mathematics and science education programs. Under that initiative, EHR's Division of Research, Evaluation, and Dissemination has the principal responsibility for overseeing the education programs' evaluations.

According to Division of Research, Evaluation, and Dissemination officials, three Division staff—two Intergovernmental Personnel Act employees[3] and one permanent employee—are currently responsible for, among other things, (1) managing the contractor-performed evaluations and (2) assisting program officers from other EHR divisions with evaluation activities related to their individual programs. A senior Division official told us that the Division requires five additional staff to effectively meet its evaluation responsibilities. While about 63 percent of EHR's estimated fiscal year 1993 budget funds precollege education programs, the Division devotes no staff to work full-time on evaluation activities related to these programs. According to this official, limited growth in the staff of the Division has prevented it from assigning any one staff member to work full-time on these programs.

Evaluating education programs can be a complex task that may take several years to complete. As a result, most of the contractors' evaluations of EHR's education programs are in the planning phase or are ongoing. According to Division of Research, Evaluation, and Dissemination officials, as of October 1, 1993, 2 evaluations of the programs had been completed, 15 were ongoing, and 13 were planned to start within the next few years. In addition, no plans exist to date to evaluate two relatively new programs. (See app. I for the schedule for these evaluations.)

[3]Intergovernmental Personnel Act employees are temporary employees assigned under title IV of the Intergovernmental Personnel Act of 1970. Initial assignments are for up to 2 years; the assignment can be extended to a maximum of 4 years.

NSF Has Concerns About Programs' Management Resources

According to NSF's budget documents submitted to the Congress, for more than a decade both NSF's budget for the programs and the primary measure of NSF's administrative workload—the number of proposals reviewed and awards managed—doubled while NSF's staffing remained virtually static. As a result, money for staff salaries and other operating expenses used to manage and administer NSF's responsibilities for the programs decreased from over 6 percent of NSF's overall budget in fiscal year 1983 to about 4 percent in fiscal year 1993.

EHR officials told us that problems resulting from this decline are more serious for EHR than for other directorates because education grants require more administrative resources to manage than grants for research—which are funded by other directorates. They cited, among other things, (1) EHR's large number of new awardees, which required more administrative resources, since first-time principal investigators need extra time to learn how to direct grants and (2) EHR's greater use of rotator staff (staff assigned to NSF on a temporary basis from other institutions), who require more training as a result of their higher turnover rate.

To further investigate these claims, we analyzed data on awards to first-time principal investigators in each NSF directorate for fiscal years 1987 through 1992. We found that EHR had the greatest number of awards to first-time principal investigators in each fiscal year since fiscal year 1988. We also analyzed data on rotator staff in each NSF directorate for fiscal years 1990 through 1992 and found that EHR had the greatest number of rotators in fiscal year 1992 and the second and third greatest number in fiscal years 1991 and 1990, respectively. Moreover, EHR's concerns about low levels of administrative resources are likely to increase. According to a June 1993 report by the NSF Task Force on Adaptability, NSF's budget for the programs and workload are expected to increase steadily over the next 5 fiscal years, while human resources and money for staff salaries and other operating expenses will remain at current levels.

Limited Travel Resources Restrict Monitoring of the Programs

EHR's Assistant Director told us that while EHR does have sufficient administrative resources, additional resources would allow EHR to more effectively administer its programs. Other EHR officials pointed out that because staff time and travel money to support EHR's activities are extremely limited, an appropriate number of visits to project sites to observe operations first-hand cannot be made. As a result, monitoring must generally be done by telephone, by written correspondence, and/or by outside contractors. NSF's Grant Policy Manual specifies that such visits

may be made by program officers to keep informed of the progress of the work but are not required.

An important factor causing the lack of sufficient travel funds in fiscal year 1992 was the large shortfall between NSF's travel budget submitted to the Congress and the amount that NSF later allocated to each directorate. For example, EHR's submitted travel budget was $331,000,[4] but EHR was allocated $277,000, or $54,000 (16 percent) less. NSF's other directorates had a combined travel budget of $2.67 million whereas NSF management allocated $2.1 million, or $577,000 (21.6 percent) less. NSF management redirected these funds to other competing demands such as staff salaries within the NSF Salaries and Expenses appropriation.[5]

We also found that not all money allocated to EHR for travel is used for that purpose. According to a June 1993 memorandum from NSF's Chief Financial Officer, insufficient travel funds stem from a management decision (at the directorate level) to use some money budgeted for travel to pay for other competing claims within the NSF Salaries and Expenses appropriation. Our analysis of NSF's travel data for fiscal year 1992 shows that EHR spent $13,833, or 5 percent, less on travel than it was allocated. Additionally, NSF's other directorates spent $98,296, or 4.7 percent, less on travel than they were allocated.

NSF Has Taken Actions to Improve Efficiency

To respond to increases in workload resulting from the rapid growth in funds for the programs, NSF managers have modified their management practices. For example, NSF has implemented a number of new electronic technologies to help offset the increases in workload. In addition, NSF has initiated or completed several agencywide task force studies to examine, among other things, how to more effectively manage proposals. But because some directorates are waiting for direction from the Director's Policy Group—a committee consisting of all assistant directors—few recommendations have been implemented agencywide.

Furthermore, EHR has also taken specific actions to more effectively administer its activities. For example, in June 1992, EHR was reorganized in order to create a more effective organization that would be better suited to

[4]Figure obtained from NSF's budget request submitted to the Congress as found in NSF's Justification of Estimates of Appropriations to the Congress for fiscal year 1993.

[5]While the Congress approves an overall salaries and expenses appropriation and funds for travel are included as part of this appropriation, NSF's request is not always approved in full. During fiscal years 1990-93, the Congress, on average, approved about 5 percent less than what NSF had requested for normal operating expenses, including money needed for travel.

address the rapid increase in EHR's funding and responsibilities over the past several years. According to EHR's Assistant Director, EHR divisions were reorganized to eliminate redundancy and ensure accountability. Furthermore, he said the reorganization has turned EHR into a flexible structure that can respond quickly and capably to change.

Since most NSF directorates have experienced double-digit or higher growth rates in the number of proposals reviewed and awards managed by program officers since fiscal year 1987, we also contacted each directorate to identify what specific measures are being considered or employed to better manage the increased workload. Each of the managers indicated that his/her directorate has (1) found it difficult to manage the increased workload of proposals and (2) begun considering or implementing measures to better manage the load. For example, four directorates (including EHR) are using or requiring the submission of preproposals to decrease the number of weak proposals submitted for peer review.[6] One recent study looking at the efficiency of preproposals in reducing the number of weak proposals found that 85 percent of those preproposals discouraged by program officers were not submitted for peer review. Of the preproposals encouraged, 74 percent were submitted for review. (See app. II for additional strategies that NSF directorates have taken to improve their administrative efficiency.)

Impact of Limited Funds for Administrative Resources Generally No Worse on EHR Than on Other NSF Directorates

While most program officers responsible for EHR's precollege education programs expressed significant concerns with EHR's ability to effectively administer these programs, reports prepared by external peer oversight committees on how well each of EHR's education programs is being administered cited few concerns. In addition, our review of project grant files did not identify any significant difficulties that would raise any concerns. Furthermore, the performance indicators that we developed to measure the impact of limited administrative resources on all NSF directorates showed that EHR was generally operating at the same level of activity as other NSF directorates.

EHR's Program Officers Express Concerns About Workload

The average number of proposals that each EHR program officer annually reviewed increased from 33 in fiscal year 1987 to 61 in fiscal year 1992—the fastest growth rate among all NSF directorates. To assess how this increase affected the administration of EHR's precollege programs, we

[6]Preproposals are brief informal documents describing, in concise terms, the essential features of a proposed project. They are usually reviewed only by program officers.

asked 18 experienced program officers responsible for reviewing these proposals and managing these grants to complete a questionnaire and meet with us to discuss their responses.[7] These officials worked on programs dispersed among four EHR units: the Division of Elementary, Secondary, and Informal Education; the Division of Human Resource Development; the Division of Undergraduate Education; and the Office of Systemic Reform.[8]

In response to our questionnaire, program officers with whom we spoke expressed the following concerns:

- The workload is too heavy. Ten of 18 program officers (56 percent) said they were assigned too many proposals to review; 12 of 18 (67 percent) indicated they had too many grants to monitor; and 13 of 18 (72 percent) conveyed they had to carry out too many administrative tasks. Given their typical workload, 13 of 18 (72 percent) responded that it was difficult to stay within the 6-month period allowed for the review of proposals. Furthermore, 12 of 18 program officers (67 percent) indicated that because of their current workload, the administration of EHR's precollege programs is ineffective.
- It is difficult to conduct site visits to adequately monitor projects' progress. In most cases, program officers are making fewer site visits than they would like to make. Ten of 18 (56 percent) said they conduct no site visits for a typical grant. When asked why they did not conduct enough site visits, 14 of 18 (78 percent) cited both limited time due to their heavy workload and the lack of travel funds as the primary reasons. In addition, 12 of 18 (67 percent) told us that hiring contractors to conduct site visits does not provide program officers with information necessary to monitor projects.
- Program officers do not always have time to determine whether a project has met its objectives. Eight of 18 program officers (44 percent) said that NSF seldom spends enough time reviewing summative evaluations and project results to determine if a project met its objectives. On average, program officers would like to spend more than double the time they currently spend on work related to summative evaluations.

[7]The responses of these program officers represent their views only and may not reflect the views of all program officers in EHR. (See app. V for a detailed discussion of our selection methodology.)

[8]Four of the 18 program officers administered the Statewide Systemic Initiative program, which is managed by the Office of Systemic Reform. This program differs in some key ways from those administered by the three divisions. To examine these differences, we analyzed the responses of these program officers separately from those of other EHR program officers. (See app. III.) However, because we generally found that program officers in this office expressed concerns and suggestions for improvement similar to those of other EHR program officers, we aggregated the responses of the two groups in this report.

- EHR's June 1992 reorganization has not reduced program officers' workload. Fourteen of the 16 (almost 90 percent) of the program officers who were employed before the reorganization thought the reorganization has not made their jobs any easier or allowed them to work more effectively.
- Frequent turnover of program officers reduces effectiveness of programs' management. Thirteen to 15 of 18 (72 to 83 percent) of the program officers, depending on the task in question, indicated that the turnover rate for program officers reduced their effectiveness in monitoring grants, conducting evaluations, and mentoring new program officers. Program officers with 3 or more years' experience viewed turnover as problematic more often than those with 1 to 2 years' experience.

To further investigate this issue, we analyzed turnover data for each NSF directorate for fiscal years 1990 through 1992. The turnover for program officers ranged from about 20 percent to about 36 percent, and the average rate was about 27 percent over the 3-year period. EHR's average of about 32 percent was exceeded by only two other directorates. We note, however, that because many program officers are nonpermanent NSF employees with an initial appointment of up to 2 or 4 years, double-digit turnover rates are not unusual.

Program officers with whom we spoke provided the following suggestions to address their concerns:

- Modify the review process to help reduce the workload. Some program officers (5 of 18, or 28 percent) told us that NSF's review process for proposals should be modified to help manage the increased workload for proposals. They suggested requiring preproposals, adopting electronic submissions for proposals, and clarifying announcements regarding the programs as the most useful mechanisms. However, most program officers said that preproposals would be more effective in reducing the overall workload associated with reviewing proposals received by EHR rather than in reducing their personal workload. Apparently, the program officers believed that while the increase in their workload related to reviewing the preproposals would be the same or greater than the decrease in their workload associated with having fewer proposals to review, the overall workload for reviewing proposals would be decreased because fewer proposals would require peer review.
- Increase the time spent in performing work related to summative evaluations. A few program officers stressed the importance of making sure that summative evaluations are done, reviewing them, and learning

from them in order to build a broader knowledge base of which projects work and why. This knowledge base would, in turn, enable them to make better funding recommendations when reviewing proposals.

- Reduce the routine administrative tasks that program officers must carry out. All program officers told us that mid-level professional program assistants would help program officers to reduce their workload. Ten of 18 program officers (56 percent) also said that support staff trained to coordinate communications with individuals outside of NSF, such as principal investigators and peer reviewers, would be useful in reducing program officers' workload.

Appendix III contains our detailed analysis of the program officers' responses to our questionnaire.

Committee of Visitors Reports Also Express Concerns

We asked EHR to provide us with copies of the most recent Committee of Visitors reports completed for each of its education programs (except those on graduate education). We reviewed all 19 reports provided to us, which addressed, among other things, how well certain education programs are being administered. The majority of the reports were of the programs' assessments done in fiscal year 1991, and over two-thirds of the reviews were for programs having a precollege component. A typical Committee of Visitors review takes from 1 to 2 days to complete and examines only the 3 most recent years of a program.

Our review of these reports found that

- 9 of 19 (47 percent) contained concerns about understaffing and/or high workload,
- 6 of 19 (32 percent) noted concerns about too little monitoring or not having enough site visits, and
- 14 of 19 (74 percent) reported that the proposal review process was fair, thorough, and well documented.

Our Review of Grant Files Raises Few Concerns

In an effort to further assess the impact of the slow growth in administrative funding on NSF's ability to effectively manage its education funds, we selectively reviewed 14 precollege grant files to determine if limited administrative resources are having an adverse effect on the oversight of these grants. Each project was either entirely a precollege project or had a precollege component and was managed by the Division of Elementary, Secondary, and Informal Education. Six projects were in

the Teacher Enhancement program, five were in the Instructional Materials Development program, two were in the Informal Science Education program, and one was in the Young Scholars program. Each file is supposed to contain all the information necessary to document the review process and the administration of the award.

Our review of the grant files found that each was generally well documented and in compliance with NSF's guidelines for what should be included in each file. However, four Teacher Enhancement program project files did not contain progress reports, the Young Scholars project file contained a progress report submitted about 2 months late, and two completed grants (one Teacher Enhancement and one Instructional Materials Development) did not contain final reports. According to the Division's management, the lack of progress reports for the Teacher Enhancement program was subsequently corrected by new EHR leadership in fiscal year 1991.

Other Indicators Show That While EHR's Workload Has Grown, EHR Is No Worse Off Than Other Directorates

For fiscal years 1990 through 1993, funds appropriated for EHR programs more than doubled, while resources to administer and manage these programs grew by 22 percent, adjusted for inflation. To help assess whether the growth rate in administrative resources was sufficient and to detect trends that may indicate a worsening or improving situation, we analyzed the processing time for proposals (the time it takes to review a proposal and decide whether to recommend the award of a grant) and the workload of staff (the number of proposals reviewed by a typical program officer) during fiscal years 1987 through 1992. Our analysis also compared EHR with other NSF directorates to measure how effective EHR was in using its administrative resources relative to the other directorates.[9] This comparison was also needed because any change in the level of resources provided to one directorate would likely have an impact on the amount of resources provided to other directorates.

We found that EHR

[9]We recognize that the nature of proposals or awards could differ significantly from directorate to directorate, thereby weakening the results of any such comparisons. However, in our analysis, we could not standardize these differences. Still, our indicators could be useful, since all directorates follow the same basic NSF procedures for reviewing proposals and administering grants. Furthermore, to strengthen the results of any such comparisons, we generated an average NSF directorate and avoided using direct comparisons of EHR and any other specific directorate and instead compared EHR with our average directorate—which better provides for any differences between directorates. (See app. V for a more detailed discussion of our methodology.)

- required an average of 176 days to process a typical proposal in fiscal year 1987 (the shortest time among all NSF directorates at that time),
- required an average of 212 days to process a typical proposal in fiscal year 1992 (representing the greatest increase since fiscal year 1987 among all directorates), and
- processed proposals at a pace no slower than the average for all directorates in fiscal year 1992.

This comparison indicated that while the processing time for proposals increased more in EHR than in any other directorate for fiscal years 1987 through 1992, EHR, in fiscal year 1992, processed proposals at a pace no slower than the average for all NSF directorates. (See app. IV for a more detailed discussion of the indicator of processing time.)

Since the primary measure of workload in NSF is the review of proposals, we compared the total number of proposals reviewed with the number of primary staff (i.e., program officers) responsible for reviewing the proposals. On average, each EHR program officer reviewed

- about 33 proposals in fiscal year 1987—the fewest number reviewed by any directorate,
- about 61 proposals in fiscal year 1992 (almost double the number of proposals in fiscal year 1987)—the greatest increase in workload experienced in all directorates—and
- no more than roughly the average number of proposals reviewed by all NSF program officers in fiscal year 1992.

This comparison indicated that while workload demands increased more in EHR than in any other directorate for fiscal years 1987 through 1992, the workload for each EHR program officer in 1992 was generally no greater than the average for all NSF program officers. (See app. IV for a more detailed discussion of the indicator of staff workload.)

Conclusions

Although EHR's workload has grown dramatically over the past few years, we believe that the EHR Assistant Director was correct in his assessment that EHR has sufficient administrative resources to effectively administer its education programs. However, we believe better use of existing resources would allow EHR to more effectively administer its programs. For example, more effective use of current resources would (1) ease the heavy workload placed on program officers responsible for administering EHR's precollege programs; (2) free up funds to travel to project sites,

which, according to most of EHR's precollege program officers we interviewed, is needed to effectively monitor and evaluate the progress and results of projects; and (3) increase precollege program officers' effectiveness in monitoring grants, conducting evaluations, and mentoring new program officers.

Furthermore, we believe EHR is not the only directorate that would benefit from finding better methods to manage its administrative resources. On the basis of our work comparing EHR with other directorates, we believe that if NSF's workload for its research and education programs continues to grow faster than its administrative resources—an assumption NSF made in a recent report examining this issue—then all of NSF's directorates may begin to experience problems that will reduce their ability to effectively oversee their grant programs. These problems, however, may first affect EHR's education programs because they are growing the fastest.

Although NSF has introduced a number of new electronic technologies and has implemented some organizational changes, much remains to be done to prepare it for the years ahead. NSF directorates recognize this need and, in some cases, have begun to independently explore new ways of improving the effectiveness of NSF's current administrative resources, such as requiring the submission of preproposals in order to reduce the number of weak proposals submitted for peer review. NSF has also initiated or completed several agencywide studies to examine various aspects of more effectively administering proposals, but few recommendations have been implemented. These are steps in the right direction; however, we believe, as a next step, the National Science Board—NSF's policy arm—needs to examine the ideas developed by these groups to determine which ones should be implemented agencywide in order to improve NSF's overall administration of its current resources.

Recommendation

In order to improve overall operations in a period when the workload and growth of NSF's programs are increasing while staff levels and funds to administer these programs are lagging behind, we recommend that the Director, NSF, request the National Science Board to study ways to better utilize NSF's current administrative resources to more efficiently and effectively manage NSF's review and awards process. As a first step, a review should be performed of NSF's ongoing or recently completed studies to determine which suggested measures can be pilot tested or implemented immediately so that productivity gains can be accomplished as quickly as possible. Furthermore, the study should not be limited to

fine-tuning the current system but should identify those areas where changes to the current modes of operation are necessary to allow NSF to operate more effectively in the future.

Agency Comments and Our Evaluation

Copies of a draft of this report were provided to NSF for comment. Overall, NSF said that our study did not fully demonstrate an understanding of the three issues we were asked to address—the setting of priorities for the education programs, evaluation of the programs' results, and availability of resources for administering the programs. NSF based this view on what it said are (1) our contradictory statements regarding the setting of priorities for the programs (i.e., that EHR's process is informal) and our omissions regarding the setting of priorities for the programs, (2) a lack of attention given to NSF's evaluation efforts, and (3) a lack of bold conclusions and recommendations to address what it perceives as a "gap" between current funding for administration and the amount that would be needed to most effectively manage EHR and other NSF programs.

We disagree with NSF's overall assessment of our draft report and believe that NSF's comments can be primarily attributed to two factors. First, in its comments, NSF repeatedly misstated and misinterpreted our objectives, findings, and/or conclusions. For example, the comments stated that we did not mention NSF's leadership role on the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET) on the evaluation of education and human resources programs throughout the federal government. We did not discuss NSF's role on FCCSET because our objectives were only to examine how EHR evaluates its education programs. We were not asked to examine what NSF or FCCSET is doing to evaluate similar programs outside of NSF. Second, NSF's comments contained inconsistent and inaccurate statements. For example, the comments stated that exact counts of program officers were available. However, NSF later reversed its position when we asked for the exact counts and told us that the draft report correctly stated the fact that exact counts of program officers were not available. While we have made some changes to the report, we rebutted the vast majority of the specific comments NSF raised to support its view of the report. The following addresses NSF's principal concerns. Appendix VI contains the complete text of NSF's written comments and our detailed evaluation of those comments.

NSF criticized the draft report for describing the process that EHR uses to set priorities for the programs as informal and for not mentioning the

formal NSF-wide long-range planning procedures. In regard to setting priorities for the programs, EHR does not have formal (i.e., written) procedures. During our review, EHR did not provide us with any established (i.e., written) procedures on this process, and its Assistant Director told us that none existed. EHR's Assistant Director also told us that the process he uses to set priorities for the education programs is his own and may not necessarily be followed by his successor. In regard to the formal NSF-wide planning procedures, EHR officials told us that the long-term result of this process is the development of a 5-year strategic plan. We did not mention this plan in our report because, during the period of our review, we found that the most current plan was not being used and the process to update the plan was not being followed.

We disagree with NSF's position that the draft report did not provide sufficient attention to NSF's evaluation efforts. We believe that the draft report's discussion of NSF's evaluation efforts is fair and complete. The report discusses how NSF's evaluation program has evolved from primary reliance on Committee of Visitors reviews to the use of contractors to conduct detailed evaluations of the education programs. NSF criticized the report for not discussing how the results of the contractors' evaluations are used to set future priorities. Since only a small number of these evaluations have been completed (i.e., 2 of 30), discussing how they are used to set future priorities is premature. Rather, the report devotes a separate appendix (app. I) to listing the status of each program's evaluation by a contractor.

In commenting on our draft report's conclusions and recommendation for excluding the necessary guidance to remedy the situation caused by the gap between resource needs and administrative realities, NSF questioned the reliability of the indicators of quantitative resources that we used for, among other things, not considering preliminary proposals, using estimates of the number of program officers when exact counts were available, and not considering the complexity of the proposals. NSF also maintained that the report's conclusions about program officers' perceptions are based on a very small sample of interviews from EHR only, although comparisons were made for the workload across NSF.

We disagree with these criticisms for several reasons. First, the report concludes that available evidence does not yet indicate that such a gap exists (a conclusion shared by the head of EHR when we interviewed him and not disputed in NSF's comments). Second, we could not include preliminary proposals in our workload indicators because data such as the

number of preliminary proposals reviewed by EHR in fiscal year 1992 were incomplete. We also could not use exact counts of the number of program officers because these data were unavailable. (We asked NSF to provide us with the exact counts referred to in its comments and were told that our draft correctly stated the fact that exact counts of the number of program officers were not available.) In addition, we could not consider the complexity of proposals in developing our staff workload indicator because of limitations of the available data from NSF. However, we did mention this limitation in several parts of the draft report (formerly on pp. 20, 76, 79, 81, and 93 of the draft; now on pp. 12, 61, 62, 64, and 72).

Furthermore, the draft report's conclusions about program officers' perceptions were not based on the responses of a very small sample of program officers. Also, our interviews with these program officers were not related to our comparisons of the workload across NSF. Our objective was to gather information on the views of experienced precollege EHR program officers. We met this objective by interviewing 18, or about 72 percent, of the program officers that NSF identified as meeting this criterion. We believe that the results of these interviews are very informative and should help NSF identify problems and possible solutions for improving its precollege programs, and we have included a detailed analysis of them in appendix III. However, our analysis of the workload across NSF was not connected to our interviews of program officers, and we make no direct link between our conclusions about the program officers' responses and those about the workload across NSF.

NSF also disagreed with our recommendation on who (i.e., the Director or the National Science Board) should be asked to study ways to increase the programs' efficiency. We believe that the National Science Board is the appropriate body to conduct such a study because the Board, under the National Science Foundation Act of 1950, as amended, is responsible for establishing NSF policy. Since NSF will likely need to make changes beyond the fine-tuning of the current system, we believe direct involvement by the National Science Board is needed. Furthermore, our audit work indicated that NSF has had difficulty implementing measures designed to improve efficiency agencywide. Therefore, because of the unique capabilities vested in the National Science Board, we believe it can successfully determine what improvements are needed and have them implemented.

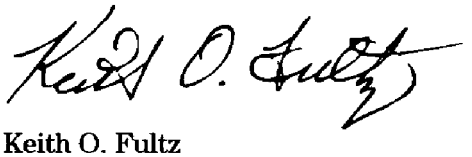
To assess whether NSF has obtained the resources it needs to administer its education programs effectively, we, among other things, asked most

experienced program officers responsible for reviewing proposals and managing grants for EHR's precollege education programs to complete a questionnaire. We then met with them to discuss their responses to the questionnaire and used their responses to evaluate the amount of their resources. We also developed quantitative resource indicators to assess changes in key measures of staff performance, such as the time it takes to process grant proposals. We used the indicators to evaluate how effective EHR was in using its administrative resources compared with other NSF directorates. We conducted our review from December 1992 through April 1994, in accordance with generally acceptable government auditing standards. (See app. V for a detailed discussion of our objectives, scope, and methodology.)

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies of this report to the Director, NSF; Chairman, National Science Board; appropriate congressional committees and subcommittees; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

This work was performed under the direction of Victor S. Rezendes, Director of Energy and Science Issues, who may be reached on (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix VII.

Sincerely yours,



Keith O. Fultz
Assistant Comptroller General

Contents

Abbreviations

AAT	Application of Advanced Technologies
BIO	Directorate for Biological Sciences
CISE	Directorate for Computer and Information Science and Engineering
DUE	Division of Undergraduate Education
EHR	Directorate for Education and Human Resources
ENG	Directorate for Engineering
ESIE	Division of Elementary, Secondary and Informal Education
FCCSET	Federal Coordinating Council for Science, Engineering and Technology
GAO	General Accounting Office
GEO	Directorate for Geosciences
GERD	Division of Graduate Education and Research Development
HRD	Division of Human Resource Development
MPS	Directorate for Mathematical and Physical Sciences
NSF	National Science Foundation
OSR	Office of Systemic Reform
PI	Principal Investigator
PO	Program Officer
RED	Division of Research, Evaluation, and Dissemination
RTL	Research in Teaching and Learning
SBE	Directorate for Social, Behavioral, and Economic Sciences
S&E	Salaries and Expenses
SMET	science, mathematics, engineering, and technology
SSI	Statewide Systemic Initiative

Evaluation Efforts

The Senate Committee on Appropriations directed the National Science Foundation (NSF) in September 1990 to, among other things, initiate a comprehensive evaluation of its science, mathematics, engineering, and technology (SMET) education programs. In response, the Directorate for Education and Human Resources's (EHR) Division of Research, Evaluation, and Dissemination was put in charge of managing these evaluations, which are performed by outside contractors on a 5-year cycle. According to the Division's officials, as of October 1, 1993, 2 program evaluations had been completed, 15 were ongoing, and 13 were planned to start, with some as early as fiscal year 1994. We were also told that no current plans exist to evaluate two relatively new programs. Table I.1 lists each program and includes the schedule and status of its contractor evaluation.

Table I.1: Status of Contractor-Performed Program Evaluations in EHR

Program's name	Div.	Start date[a]	End date[b]	Report date[c]	Planned evaluation date[d]
Applications of Advanced Technologies[e]	RED	N/A	N/A	N/A	1994
Research in Teaching and Learning[e]	RED	N/A	N/A	N/A	1994
Studies and Indicators[e]	RED	N/A	N/A	N/A	1994
EPSCoR	OSR	1993	1996	N/A	N/A
Statewide Systemic Initiatives[e]	OSR	1992	1997	N/A	N/A
Faculty Awards for Women Scientists & Engineers[f]	GERD	N/A	N/A	N/A	N/A
Graduate & Minority Graduate Fellowships	GERD	1991	1993	1994	1997
Graduate Research Fellows	GERD	1991	1993	1994	1997
Graduate Traineeships	GERD	N/A	N/A	N/A	1994
NATO Postdoctorate	GERD	N/A	N/A	N/A	1994
Presidential Faculty Fellows	GERD	N/A	N/A	N/A	1996
Visiting Professorships for Women	GERD	1992	1993	1994	N/A
Informal Science Education[e]	ESIE	N/A	N/A	N/A	1994
Instructional Materials Development[e]	ESIE	N/A	N/A	N/A	1994
Presidential Awards for Excellence in Science and Mathematics Teaching[e]	ESIE	1991	1994	N/A	N/A
Teacher Enhancement[e]	ESIE	1990	1993	1994	N/A
Young Scholars[e]	ESIE	N/A	N/A	N/A	1996
Collaboratives for Excellence in Teacher Preparation[e]	DUE	1994	1998	N/A	N/A
Instrumentation and Laboratory Improvement	DUE	1990	1991	1992	1995
Teacher Preparation[e]	DUE	1991	1993	1994	1994

(continued)

Program's name	Div.	Start date[a]	End date[b]	Report date[c]	Planned evaluation date[d]
UCC Calculus Initiative	DUE	1992	1994	N/A	N/A
Undergraduate Course and Curriculum Development[e]	DUE	1993	1995	N/A	N/A
Undergraduate Faculty Enhancement	DUE	1991	1992	1993	1995
Alliance for Minority Participation	HRD	1992	1993	1994	1996
Comprehensive Regional Centers for Minorities[e]	HRD	N/A	N/A	N/A	1996
Minority Research Centers for Excellence	HRD	N/A	N/A	N/A	1996
Partnerships for Minority Student Achievement[e]	HRD	N/A	N/A	N/A	1996
Programs for Persons With Disabilities	HRD	1994	1996	N/A	N/A
Research Careers for Minority Scholars	HRD	1993	1996	N/A	1996
Research Improvement in Minority Institutions	HRD	1993	1996	N/A	1996
Summer Science Camps[e]	HRD	N/A	N/A	N/A	1996
Women's Programs[e,f]	HRD	N/A	N/A	N/A	N/A

Legend

Div. = division.
DUE = Division of Undergraduate Education.
EPSCoR = Experimental Program to Stimulate Competitive Research.
ESIE = Division of Elementary, Secondary and Informal Education.
GERD = Division of Graduate Education and Research Development.
HRD = Division of Human Resource Development.
N/A = not applicable.
NATO = North Atlantic Treaty Organization.
OSR = Office of Systemic Reform.
RED = Division of Research, Evaluation, and Dissemination.
UCC = Undergraduate Course and Curriculum.

[a]Start date of contractor's evaluation.

[b]Actual or estimated completion date of contractor's evaluation.

[c]Actual or estimated report publication date of contractor's evaluation.

[d]Estimated planning date of contractor's evaluation.

[e]Program is either all precollege or has some parts that are precollege.

[f]Program is too new to have a planned evaluation.

Source: NSF.

NSF's Efforts to Manage the Increased Proposal Workload

Since most NSF directorates have experienced double-digit or higher growth rates in the number of competitive proposals reviewed and in the number of competitive proposals awarded, we contacted each directorate to identify what strategies they are considering or using to more effectively manage their increased workload and to compare EHR's efforts in this area with those of other NSF directorates.

All managers with whom we spoke indicated that their directorate has found it difficult to manage the increased proposal workload and that they are considering a number of measures that might be adopted to help manage the load. However, most directorates are not adopting directoratewide measures but allowing each division within the directorate to independently consider how to manage its increased load. All but one directorate have begun implementing some measures through their division initiatives.

In addition, NSF has initiated several studies to examine various aspects of managing proposals.[1] Some directorates are waiting for comments by the Director's Policy Group on the results of these ongoing projects before they employ additional measures to manage their increased proposal load.

The key measures currently being considered, tested, or implemented by one or more divisions within each directorate are listed in table II.1 and explained in the following sections.

Table II.1: Measures to Manage the Increased Proposal Workload

	Directorates						
Measures	**BIO**	**CISE**	**EHR**	**ENG**	**GEO**	**MPS**	**SBE**
Preproposals	I	a	I	I	I	T	a
Letters of intent	I	I	a	a	a	I	a
Refine program description	I	I	I	a	I	I	a
Coordinating program deadlines	a	a	I	a	a	a	a
Increasing grant period	I	I	I	I	I	I	a
Contractor support	a	I	I	I	I	C	a
Standardize proposal format	a	I	a	a	a	a	a

(continued)

[1]These studies include Enablement of Science and Engineering by the NSF task force charged with examining the concerns voiced by the National Science Board Commission on the Future of NSF about "enabling" principal investigators, and The Final Report of the Task Force on Adaptability, dated June 7, 1993, which was conducted by the NSF task force charged with providing practical suggestions for making NSF a more adaptable organization.

Measures	Directorates						
	BIO	CISE	EHR	ENG	GEO	MPS	SBE
Electronic proposal review	[a]	T	I	C	[a]	I	[a]
Electronic proposal submission	[a]	C	[a]	C	[a]	I	[a]
Reduce external reviews	[a]	C	[a]	[a]	[a]	T	C
Fixed-price grants	[a]	[a]	[a]	[a]	[a]	[a]	C
Block grants	[a]	[a]	[a]	C	[a]	[a]	[a]
Support staff overtime	[a]	[a]	I	I	[a]	[a]	[a]
Part-time program officers	[a]	[a]	I	I	[a]	[a]	[a]
Increased use of program assistants	[a]	I	C	C	C	C	[a]

Legend

BIO = Directorate for Biological Sciences.
C = considering.
CISE = Directorate for Computer and Information Science and Engineering.
EHR = Directorate for Education and Human Resources.
ENG = Directorate for Engineering.
GEO = Directorate for Geosciences.
I = implemented.
MPS = Directorate for Mathematical and Physical Sciences.
SBE = Directorate for Social, Behavioral, and Economic Sciences.
T = testing.

[a]Directorate is neither considering, testing, nor implementing this measure.

Preproposals

NSF sometimes requires principal investigators to submit preliminary proposals, or "preproposals," which are informal documents describing in concise terms the essential features of a proposed project.[2] The preproposal allows NSF staff to determine and comment upon the proposed project's responsiveness to NSF's goals and current priorities and its likely competitiveness with respect to other competitive proposals. A preproposal is treated as an informal document involving no commitment on the part of either the applying organization or NSF. Submission of a

[2]Principal investigators are normally associated with colleges, universities, or other organizations. Awards primarily go to organizations rather than directly to principal investigators, who write the project's proposals and carry out the project's designs.

preproposal can be a great help to proposers in deciding whether to undertake the expense involved in the preparation and submission of a competitive proposal.[3] However, NSF generally does not, in any directorate, forbid a proposer from submitting a competitive proposal based on the content of the preproposal. Four directorates (including EHR) are currently using preproposals as a mechanism to manage the increased proposal workload; one directorate is testing them.

One recent EHR study looking at the efficiency of preproposals in reducing the number of weak competitive proposals submitted found that 85 percent of the preproposals discouraged by program officers were not submitted as competitive proposals.[4] Of the preproposals encouraged, 74 percent were submitted as competitive proposals. The authors of the study concluded that preproposals are an efficient measure to aid in managing the load of proposals. The Division of Elementary, Secondary, and Informal Education (ESIE)—the division in which the study was conducted—is increasing its use of preproposals. For example, all programs required them by the fall of 1993. (The Young Scholars program, which is managed by ESIE, currently requires preproposals only for first-time or new principal investigators.)

The Directorate for Engineering (ENG) often uses "Concept Papers," which are short position papers similar to preproposals, to describe projects that potential principal investigators would like to submit as competitive proposals. Concept Papers differ from preproposals in that outside panels, rather than program officers, review the papers and select those that should be submitted as competitive proposals. NSF then encourages the authors of the selected Concept Papers to submit competitive proposals.

Letters of Intent

NSF sometimes requests potential principal investigators to submit "Letters of Intent," which are brief descriptions of project proposals that principal investigators would like to submit as future competitive proposals. While Letters of Intent are similar to preproposals, they differ in that NSF usually solicits them in response to a new NSF program announcement to help estimate the likely number and type of competitive proposals that will

[3]Competitive proposals include only those proposals processed through NSF's merit or peer review process. They do not include small increases in money for existing awards, interagency agreements, or funds to pay for annual increments to existing multiyear awards.

[4]"Proposal Process Efficiency, 1991-1992," Instructional Materials Development program, ESIE.

likely result from the announcement.[5] This allows NSF to better plan and prepare for the process of reviewing all resulting competitive proposals. Letters of Intent are also used by NSF to sometimes inform proposers of whether the projects described in their letters are likely to be competitive with respect to other competitive proposals.

Refining Program Description

This strategy refers to describing programs in greater detail in program announcements to enable potential principal investigators to write proposals that better target the goals and objectives of these programs. The goal of refining programs' descriptions is to reduce the number of tangential proposals—proposals that do not align with the program's objectives—submitted for review. Five directorates are currently refining their programs' descriptions, including EHR. The Directorate for Mathematical and Physical Sciences (MPS) has only recently begun using program announcements at all (we spoke with MPS' management in July 1993); it plans, however, to use specific program descriptions in these announcements.

Coordinating Program Deadlines

EHR has begun coordinating, among its divisions, program deadlines for proposal submissions to help manage its increased proposal workload. Coordinating deadlines for submitting proposals is helpful because it reduces overlapping deadlines, which allows support staff who support several programs to work more efficiently. EHR has achieved this coordination by combining divisions' program announcements.

Increasing Grant Periods

To help manage their increased proposal workload, six directorates (including EHR) have increased their average period for grants awarded to individual principal investigators. In most cases, this has involved an increase from 2- to 3-year award periods.

Contractor Support

Using contractors to help manage proposals has become more and more commonplace in NSF; five directorates (including EHR) are either using or considering using them. Contractors are usually not involved with the actual review of proposals. Rather, their responsibilities include tasks

[5]NSF uses three basic mechanisms to obtain proposals: Program Announcements are formal NSF publications that describe NSF's programs and provide information and general guidance on preparing and submitting proposals; Program Solicitations are used to stimulate proposals in targeted or focused program areas to which NSF wishes to give special emphasis; and Requests for Proposals are usually generated for one specific project in which applicants are in direct competition with each other.

such as assisting with managing incoming proposals (assigning proposal numbers) and arranging panel reviews (reserving facilities and transporting documents needed for these reviews).

Standardizing Proposal Format

For its programs that receive the largest number of proposals, the Directorate for Computer and Information Science and Engineering (CISE) uses standard proposal formats. These formats often include a series of questions that proposals should address. CISE also tries to change the announcements for these programs as seldom and as little as possible so that the formats will be familiar—to both the potential principal investigators and program officers.

Electronic Proposal Review

This strategy includes electronic transmission or electronic readings of typed reviews composed by ad hoc reviewers and/or the use of computers during panel reviews to record comments and decisions as they are made. Four directorates (including EHR) are implementing, considering, or testing this option to manage their proposal load.

Electronic Proposal Submission

Electronic proposal submission is being considered by two directorates and implemented by one and involves the submission of proposals using computers and/or facsimile machines. MPS is testing an incentive program whereby principal investigators will be given a shorter review period than the standard 6-month period if they submit proposals electronically.

Reducing External Reviews

Reducing external reviews is a strategy that would allow program officers to review certain proposals rather than sending them out for external review. Such designated cases may include grants of a certain (usually small) size or proposals that clearly will not be awarded. MPS has begun using internal review only for certain grant proposals, such as those for less than $50,000.

Fixed-Price Grants

Fixed-price grants would entail making awards on a fixed price, rather than cost reimbursement, basis and using progress payments rather than "full" payment advances. This mechanism is designed to reduce the overall administrative burden both on awardees and NSF and shift award payment to actual performance. The Directorate for Social, Behavioral, and Economic Sciences is considering use of this mechanism.

Block Grants

Under a block grant program, NSF would provide grant money directly to an institution, such as a university, which would, in turn, distribute funds to principal investigators. NSF would not carry out its traditional peer review process for each of these principal investigators. Only one directorate is considering using this approach.

Support Staff Overtime

Two directorates (including EHR) have begun using support staff overtime to help manage their increased proposal workload.

Part-Time Program Officers

Part-time program officers, currently employed by two directorates (including EHR), are typically former program officers that assist when the proposal load is heaviest. They usually help full-time program officers set up review panels; sometimes, they manage a program's entire proposal review process themselves.

Increased Use of Program Assistants

Increasing the use of professional program assistants trained to carry out some of the substantive administrative tasks necessary to process grants is under consideration by four directorates (including EHR) and being used by one. The managers of these five directorates indicated that there was a strong need for these assistants and voiced their support for increasing the use of assistants.

Program Officers' Questionnaire Responses

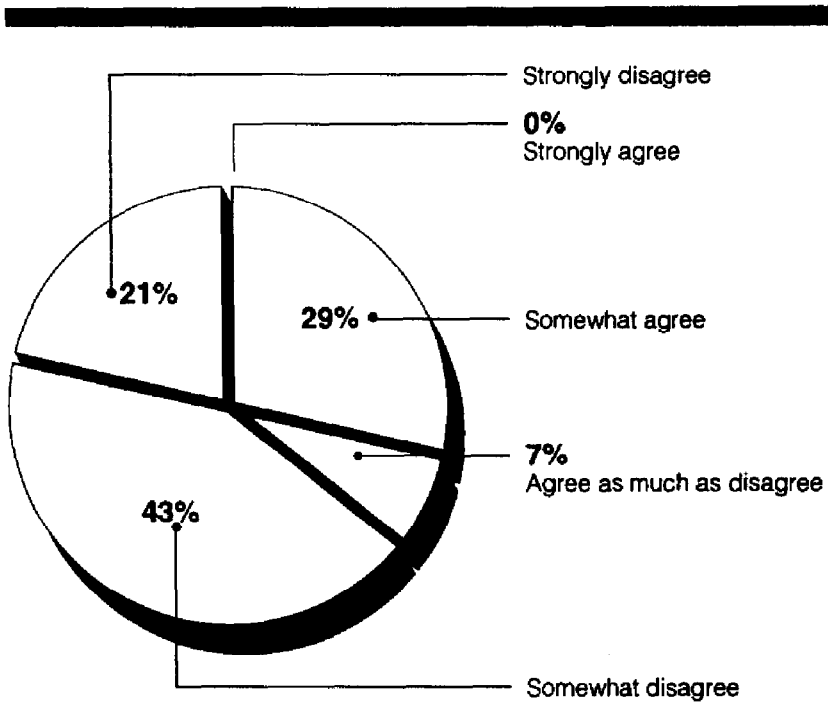
As part of our efforts to determine whether NSF has obtained the resources it needs to administer its precollege science, mathematics, engineering, and technology education programs effectively, we asked 18 experienced program officers responsible for managing these programs in EHR to complete a questionnaire concerning their workload. We also met with each program officer individually to discuss his/her questionnaire responses. (See app. V for a more detailed discussion of our methodology.) Fourteen of the program officers were from the Division of Elementary, Secondary, and Informal Education (ESIE); the Division of Human Resource Development (HRD); or the Division of Undergraduate Education (DUE). The remaining four program officers administered the Statewide Systemic Initiatives program (SSI) in the Office of Systemic Reform (OSR). The SSI program is unique from most other EHR programs because of the complexity of its goal to effect systemic change in school systems statewide and its longer grant periods (awards are made for 5 years). As such, the responses of OSR program officers for certain questions differed from those of other EHR program officers. To examine these differences, we analyzed the responses of the program officers in each of these two groups separately, the results of which are discussed below.

Responses From Program Officers in ESIE, HRD, and DUE

Program Officers' General Views

To obtain a general sense of program officers' views on EHR's administration of its precollege science education programs, we asked them if they agreed or disagreed with the following statement: "EHR is effectively administering its precollege science education programs with its current number of program officers (and their typical workload)." Nine of 14 (64 percent) disagreed with this statement. Figure III.1 shows the full range of responses given by the program officers.

Figure III.1: Extent of Agreement That EHR Is Effectively Administering Its Precollege Science Education Programs



Note: Fourteen program officers responded.

In a further effort to assess program officers' overall views of EHR's precollege science education programs, we asked them to list their two or three most serious concerns related to one or more of their principal responsibilities. These concerns are listed in table III.1.

Table III.1: Program Officers' Most Serious Concerns Related to Their Principal Responsibilities

Concerns	Number of POs citing concerns
Lack of interaction with or guidance to principal investigators	5
Limited time spent on primary responsibilities due to heavy workload per program officer	3
Lack of time to advise potential new principal investigators	3
Difficulties in using mainframe computer/other technologies	3
Too few program assistants	2
Lack of travel funds for site visits	2
NSF's nonuser-friendly software	2
Lack of capable administrative staff	2
Lack of communication between POs and management	1
POs required to do too many administrative tasks	1
Working to "just get by" because of time constraints	1
High turnover among temporary POs	1
No knowledge base about successful projects	1
Too little dissemination of projects' results	1
Systemic change difficult in academic culture	1
Lack of coordination/communication within NSF	1

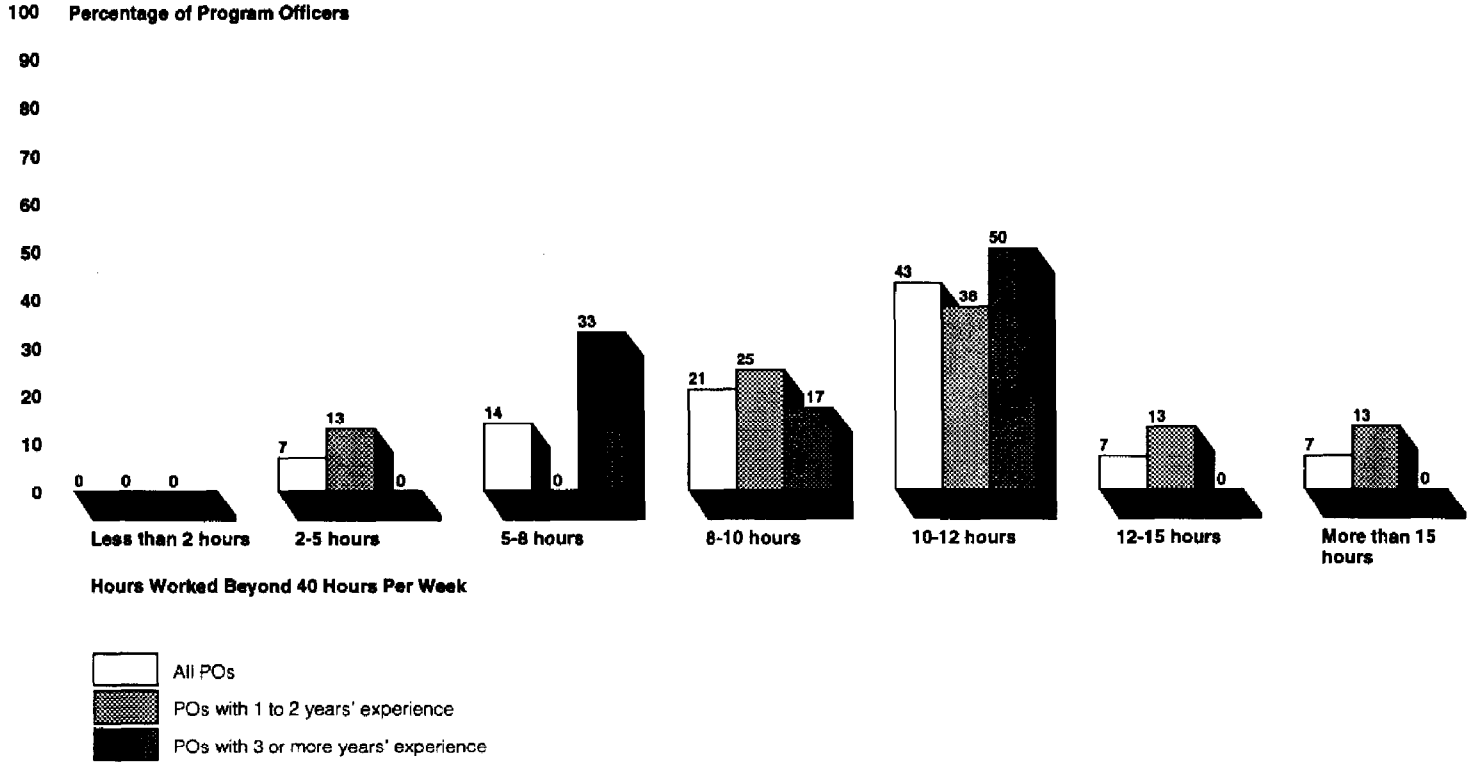
Legend

PO = program officer.

Note: Thirteen program officers responded.

All program officers responding to our questionnaire said that they worked overtime or beyond the standard 40-hour work week to meet their responsibilities. Most program officers (9 of 14, or 64 percent) worked from 8 to 12 hours overtime per week, as shown in figure III.2. This figure also points out that all program officers that worked 12 to 15 or more than 15 hours overtime per week had from 1 to 2 years' experience.

Figure III.2: Weekly Overtime Worked by Program Officers



Legend

PO = program officer.

Notes:

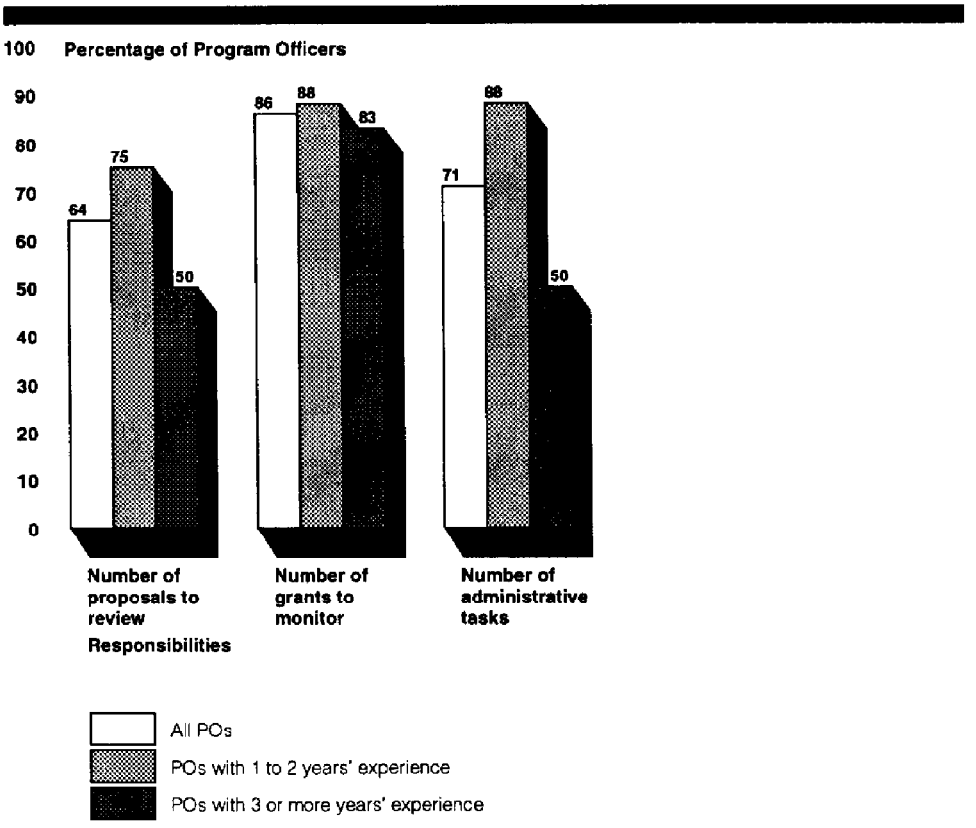
1. Fourteen program officers responded; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience.
2. Some figures do not add to 100 because of rounding.

Concerns With Workload

Most program officers responding to our questionnaire expressed concern about their heavy workload. Sixty-four percent (9 of 14) thought they were assigned too many proposals to review; 12 of 14 (86 percent—1 program officer did not respond) said that they had too many grants to monitor; and 10 of 14 (71 percent) indicated that they had to carry out too many administrative tasks. Program officers with 1 to 2 years' experience were

more likely to view these tasks as excessive, particularly the number of administrative tasks. Figure III.3 illustrates these results in more detail.

Figure III.3: Responsibilities That Program Officers View as Somewhat or Much Too Many



Legend

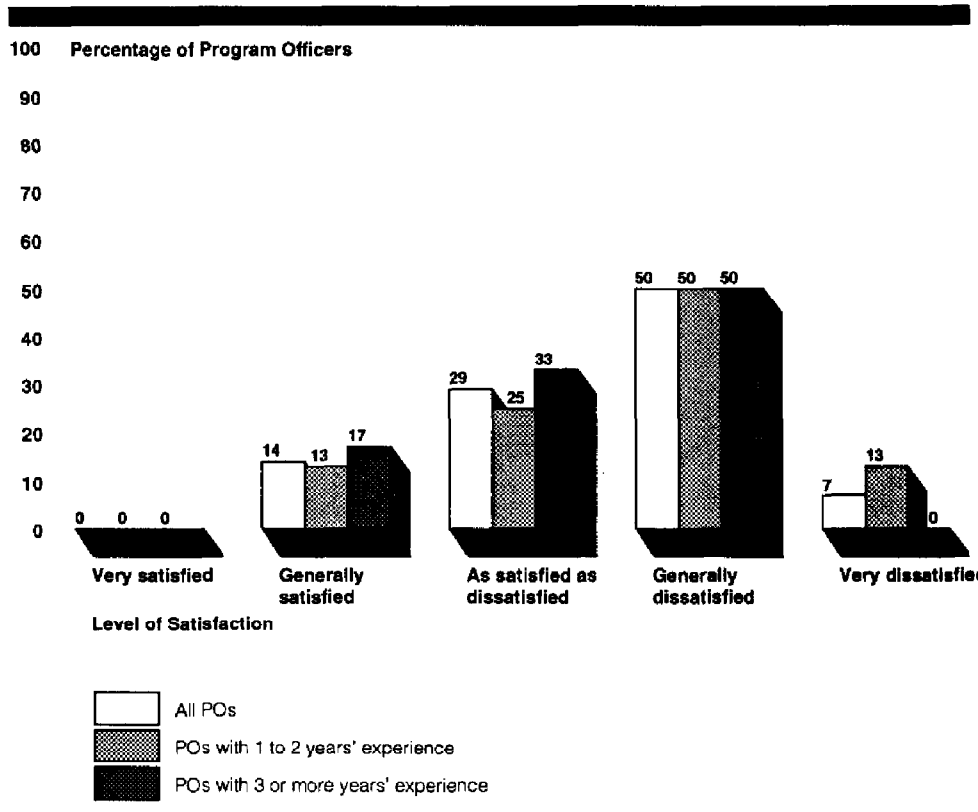
PO = program officer.

Note: Fourteen program officers answered; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience. (One program officer did not respond to the question on the number of grants to monitor.)

We also found that 8 of 14 program officers (57 percent) expressed dissatisfaction with the time available to them (given their typical workload) to communicate with principal investigators to monitor the substantive progress of projects. Figure III.4 depicts these results.

Furthermore, all eight that were dissatisfied conveyed that this limited time available to communicate with principal investigators negatively affected the adequacy of monitoring the project.

Figure III.4: Level of Satisfaction That Program Officers Have With the Time Available to Them to Communicate With Principal Investigators to Monitor Projects



Legend

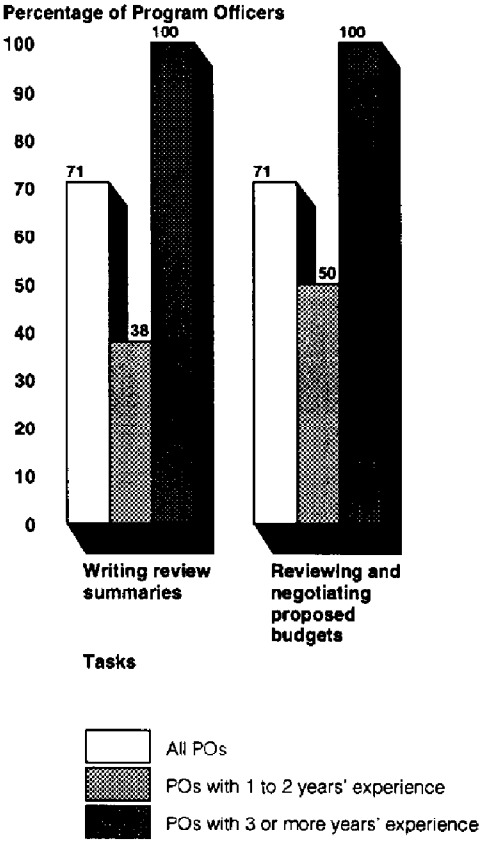
PO = program officer.

Note: Fourteen program officers responded; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience.

While most program officers found their workload excessive, many were less dissatisfied with the time available to them for two tasks: writing review summaries and award recommendations and reviewing and negotiating proposed budgets. For example, 6 of 14 (43 percent) were satisfied, and 4 of 14 (29 percent) were as satisfied as dissatisfied with the

time available to write review summaries and award recommendations; 4 of 14 (29 percent) were satisfied, and 6 of 14 (43 percent) were as satisfied as dissatisfied with the time available for reviewing and negotiating proposed budgets. All program officers with 3 or more years' experience were satisfied or as satisfied as dissatisfied with the time available to conduct both tasks. Figure III.5 illustrates these findings.

Figure III.5: Program Officers Who Were Satisfied or as Satisfied as Dissatisfied With the Time Available for Certain Tasks



Legend

PO = program officer.

Note: Fourteen program officers answered; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience.

Table III.2 provides an overview of how program officers estimate their allocated time among 10 primary responsibilities.[1] The second column from the left depicts what percentage of their time program officers actually spend, on average, on each of these 10 responsibilities. Column 3 highlights what percentage of their time, on average, they would prefer to spend on each task, assuming their workload was neither too heavy nor too light and given the importance each task has in contributing to the success and effective conduct of NSF's precollege science education programs. Finally, column 4—the basis of the differences between columns 2 and 3—shows the magnitude of the increase or decrease that program officers would like to make, on average, to the percentage of the time they spend on each task.

[1]The amounts represent estimates made by the program officers of the portion of their time spent on each task. However, many program officers were concerned about the difficulty of accurately estimating these portions and asked that their answers be regarded as estimates only. They also stated that, while it was difficult to estimate these portions, their estimates of how much more or less time they would like to spend on each task (listed in column 4 of table III.2) were reasonable estimates of the magnitude of their preferred changes in time spent on each task.

Table III.2: Overview of How Program Officers Estimate the Allocation of Their Time Among 10 Principal Responsibilities

Tasks	Portion of time POs spend on task	Portion of time POs would like to spend on task	Magnitude of desired change in time spent on task
Reviewing preproposals	12.5	15.8	26 more time
Reviewing proposals	38.6	26.4	32 less time
Performing administrative tasks	14.6	6.4	56 less time
Monitoring grants (site visits and communicating with PIs)	6.8	13.2	94 more time
Reviewing annual progress reports	5.0	6.2	24 more time
Reviewing summative evaluations	2.5	6.1	144 more time
Other duties (important reports/program announcements)	7.9	7.5	5 less time
Conducting outreach activities	6.4	9.2	44 more time
Formal training and informal mentoring	2.2	2.5	14 more time
Activities to maintain expertise	3.7	6.6	78 more time

Legend

PI = principal investigator.
PO = program officer.

Notes:

1. All amounts are in mean percentages.
2. Portions of time spent do not add to 100 because of rounding.
3. Fourteen program officers' responses are included in column 2 amounts; 12 program officers' responses are included in column 3 amounts because two officers did not respond.

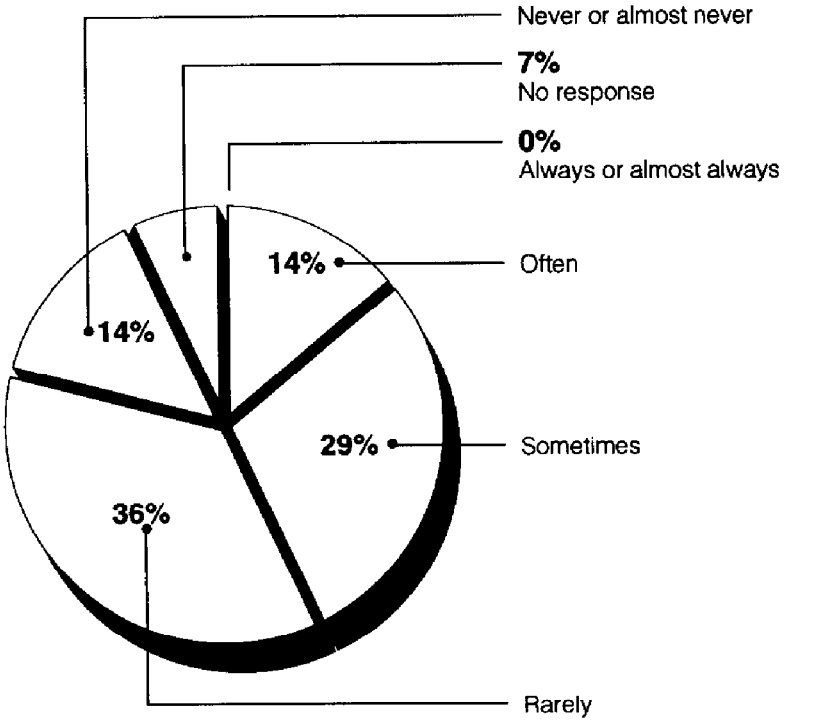
Program officers spend the highest portion of their time reviewing proposals (39 percent of their time), followed by performing administrative tasks (15 percent), and reviewing preproposals (13 percent). They spend the lowest portion of their time in formal training (2 percent), followed by reviewing summative evaluations (3 percent), and attending workshops to maintain their expertise (4 percent). Program officers would prefer a significant decrease in the portion of their time they spend performing administrative tasks and reviewing proposals. (They would like to spend 56 percent less time on administrative tasks and

32 percent less time reviewing proposals than they currently do.) In contrast, program officers indicated they would like a significant increase in the portion of the time they spend (1) reviewing summative evaluations (they would like to spend 144 percent more time than they currently do), (2) monitoring grants (94 percent more time), (3) attending workshops to maintain expertise (78 percent more time), and (4) conducting outreach activities (44 percent more time).

As shown in table III.2, program officers would like to spend significantly more time reviewing summative evaluations. When asked the question, "Given the typical time spent performing summative evaluations of project results (such as evaluating project results and all materials submitted with the final project), how often do you feel NSF determines whether or not project objectives were met?", 7 of 14 (50 percent; one program officer did not respond) answered rarely, never, or almost never. Figure III.6 illustrates the responses provided by all program officers. During our discussions with program officers, some also explained that conducting more reviews of evaluations of projects would help them build a broader knowledge base of what types of projects work and what types do not, which in turn would enable them to make better funding recommendations when reviewing proposals. One program officer cited the lack of this knowledge base as a most serious concern.[2]

[2]According to one program officer, EHR has reemphasized the importance of summative evaluations under the current Assistant Director. As such, at least one division in EHR was planning to include guidelines for evaluation plans in an upcoming program announcement. Furthermore, EHR plans to publish an evaluation handbook for all principal investigators in the near future.

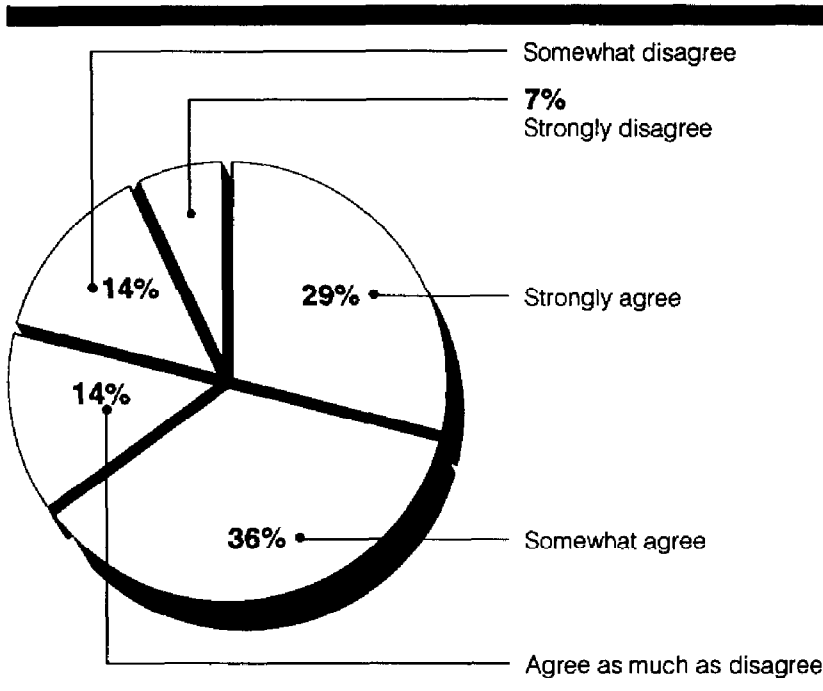
Figure III.6: Extent to Which Program Officers Believe Evaluations Are Used to Determine if Project Objectives Are Met



Note: Thirteen program officers responded.

In addition, as shown in table III.2, program officers would like to spend 78 percent more of their time attending workshops to maintain their expertise. We asked them how much they agreed or disagreed with the following statement: "Due to the limited time available to me to develop subject matter expertise in the field(s) in which I work most closely, I am concerned about maintaining and/or enhancing my knowledge level in this field(s)." Sixty-four percent of the program officers (9 of 14) somewhat or strongly agreed with this statement. Figure III.7 depicts all program officers' responses.

Figure III.7: Extent of Agreement or Disagreement That Workload Causes Concern About Maintaining Expertise



Note: Fourteen program officers responded.

We asked program officers to list all the factors that detract them from spending the time that they would like on some of their primary responsibilities. The factor cited most often was "limited time spent on primary responsibilities due to the heavy workload per program officer," cited by 11 of 14 program officers (one program officer did not respond). "Lack of travel funds for site visits" and "too few program assistants" were also frequently cited as factors. All factors cited are listed in table III.3.

Table III.3: Factors Preventing Program Officers From Spending Desired Time on Certain Tasks

Factors	Number of POs citing factors
Limited time spent on primary responsibilities due to the heavy workload per PO	11
Lack of travel funds for site visits	7
Too few program assistants	5
Lack of capable administrative staff	4
POs required to do too many administrative tasks	4
Resources for professional development are limited	4
NSF's cumbersome mainframe computer/technology deficiencies	3
NSF's nonuser-friendly software	2
Assisting management with nonproject-related tasks	2
Taking phone calls that qualified support staff could answer	1

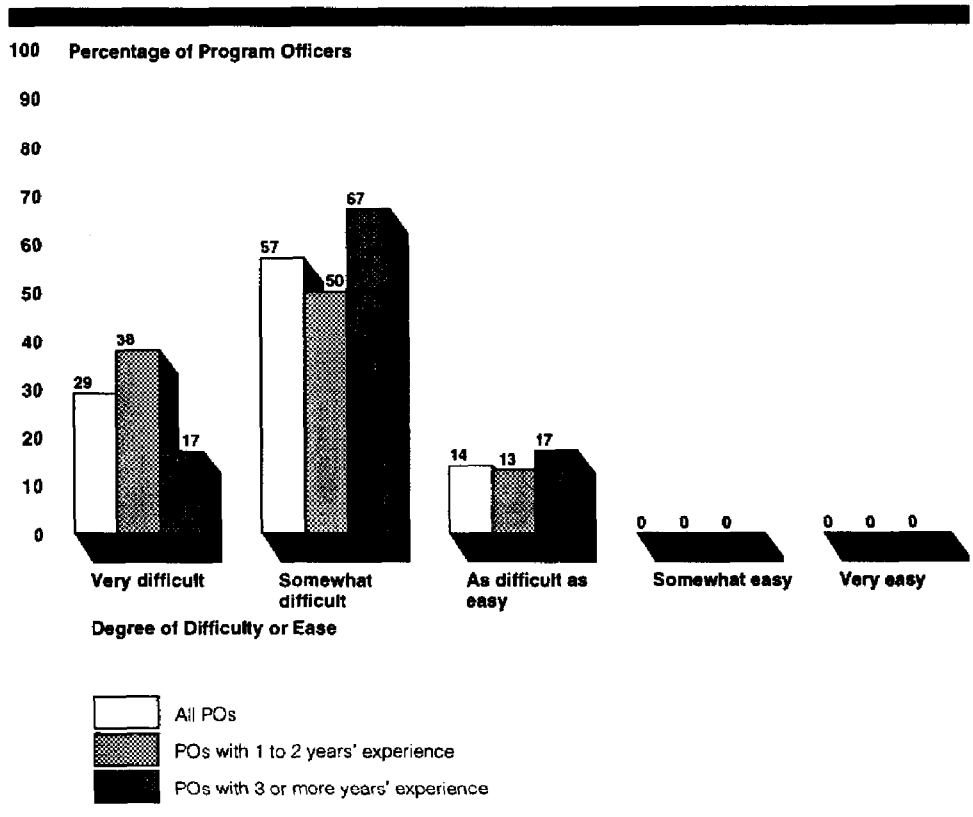
Legend

PO = program officer.

Note: Thirteen program officers responded.

Given their workload constraints, 86 percent of the program officers (12 of 14) indicated that it was difficult or very difficult to stay within the 6-month period allowed to review proposals. No program officers thought it was somewhat or very easy to stay within this period. Program officers with 1 to 2 years' experience found it very difficult to stay within the 6-month period more often, while those with 3 or more years' experience found it somewhat difficult more often. Figure III.8 illustrates these findings.

Figure III.8: Difficulty or Ease in Meeting Standard 6-Month Review Requirement



Legend

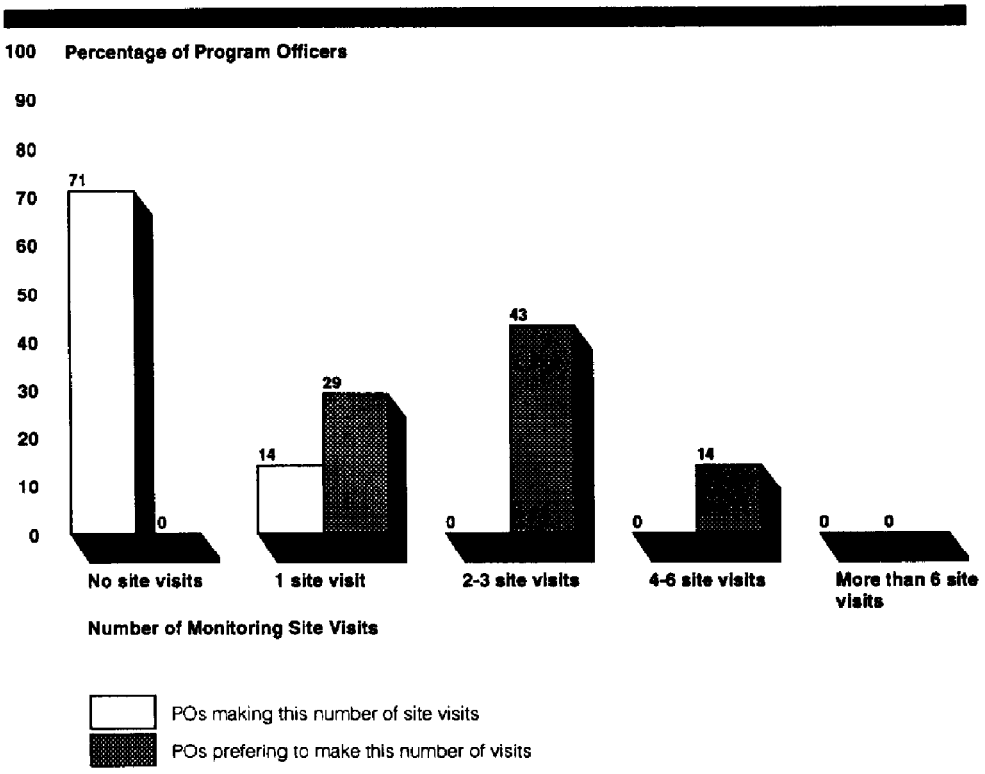
PO = program officer.

Note: Fourteen program officers responded; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience.

Lack of Travel Funds Viewed as Problematic

Program officers were concerned over the limited travel money available to them to conduct site visits to monitor the progress of projects. In most cases, they are making fewer site visits than they would like to make to provide for adequate site monitoring. Figure III.9 compares the number of site visits that program officers typically make with the number they would prefer to make to provide adequate project monitoring. As it shows, 10 of 14 program officers (71 percent; two program officers did not respond) said they typically conduct no site visits.

Figure III.9: Number of Monitoring Site Visits Conducted Compared With the Number That Program Officers Would Like to Conduct



Legend

PO = program officer.

Notes:

1. Twelve program officers responded.
2. Numbers do not add to 100 because two program officers did not respond.

When asked why they could not conduct as many monitoring site visits as they would like, program officers gave two reasons: (1) limited time due to the heavy workload per program officer (cited by 12 of 14 program officers) and (2) lack of travel funds (cited by 10 of 14 program officers). (One program officer did not respond to this question.) One program officer indicated that program officers sometimes plan personal vacations near the projects they are assigned to monitor and visit the sites during these vacations at their own expense.

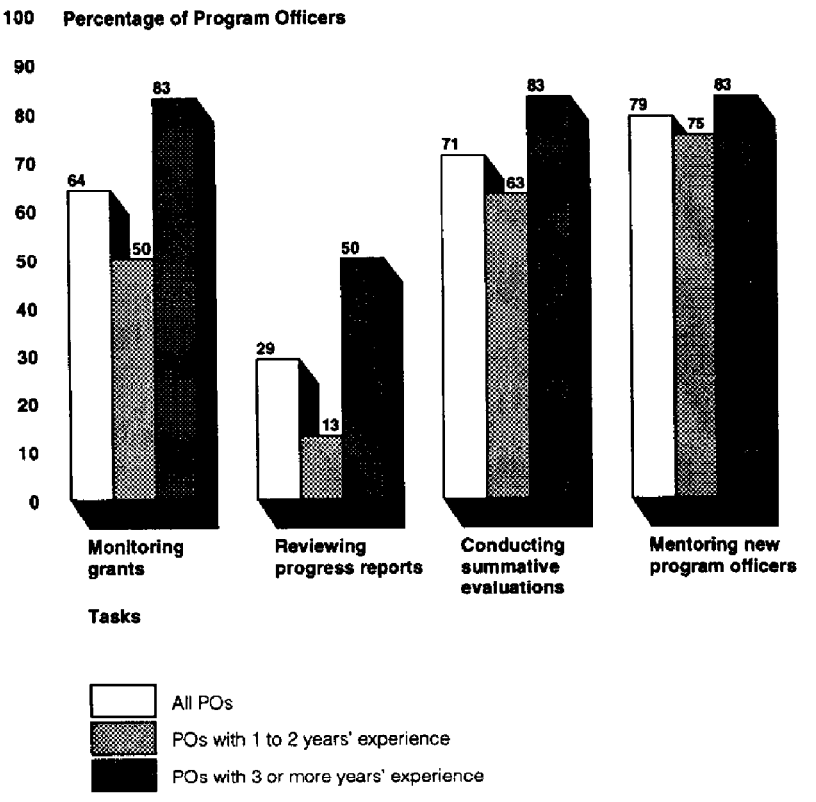
Additionally, program officers cited a lack of travel funds for site visits among their most serious concerns (see table III.1) and among the factors preventing them from spending as much time on certain tasks (including project monitoring) as they would like. (See table III.3.) Nine of 14 (64 percent) of the program officers felt that hiring contractors to conduct site visits does not provide useful information to program officers for monitoring projects.

Program Officer Turnover Also Cited as Concern

Many program officers in EHR fall into one of three categories of nonpermanent employees (1) Visiting Scientists, Engineers, and Educators, (2) Intergovernmental Personnel Act employees, or (3) temporary employees. For example, of the 14 program officers with whom we spoke, 8 held nonpermanent status positions, while 6 held permanent status positions. (We provided our questionnaire only to program officers who have worked for NSF a minimum of 1 year.) The turnover rate for EHR program officers averaged 31.8 percent from 1990 through 1992.

Given these turnover conditions, we asked program officers how much they agreed or disagreed that frequent program officer turnover limits their effectiveness in conducting each of these tasks: monitoring grants, reviewing progress reports to recommend incremental funding for continuing grants, reviewing summative evaluations, and mentoring new program officers. Most program officers agreed that turnover does limit their effectiveness in conducting these tasks; those with 3 or more years' experience with this position most frequently agreed. Program officers, including those with 3 or more years' experience, felt that turnover has less impact on the effectiveness of reviewing progress reports than on the effectiveness of the other tasks. One program officer said that progress reports are not usually reviewed very thoroughly. Figure III.10 characterizes program officers' views on turnover.

Figure III.10: Program Officers That Agreed That Program Officer Turnover Limits the Effectiveness of Certain Tasks



Legend

PO = program officer.

Note: Fourteen program officers answered; 8 had 1 to 2 years' experience; 6 had 3 or more years' experience. (One program officer did not respond to the question on reviewing progress reports. Therefore, for that cluster, seven had 1 to 2 years' experience, and six had 3 or more years' experience.)

Modification of NSF's Peer Review Process

Because of their key role in NSF's peer review process, we asked program officers if they agreed or disagreed that this process needs to be modified to more effectively manage or accommodate the large increase in the proposal workload. Fifty-seven percent (8 of 14) somewhat or strongly disagreed.

Interestingly, most program officers were reluctant to support modification of the peer review process, even though most felt that their workload under the current review process is too heavy (as discussed

earlier in this appendix). When asked to comment on this issue, several were concerned about any mechanism to mange the increased proposal load that would reduce the public's right to an external "peer review" of NSF's proposals—a process that many program officers viewed as the hallmark of NSF's awards process.

We asked those program officers who agreed or agreed as much as disagreed that the review process should be modified how useful or useless various mechanisms would be in achieving this modification. They were generally divided in their views on the usefulness of most mechanisms to accommodate the increased proposal workload. The mechanism receiving the most support was preproposals; those receiving the least support were block grants (deemed as useless by six of six program officers) and limitations in the number of awards made to each institution.

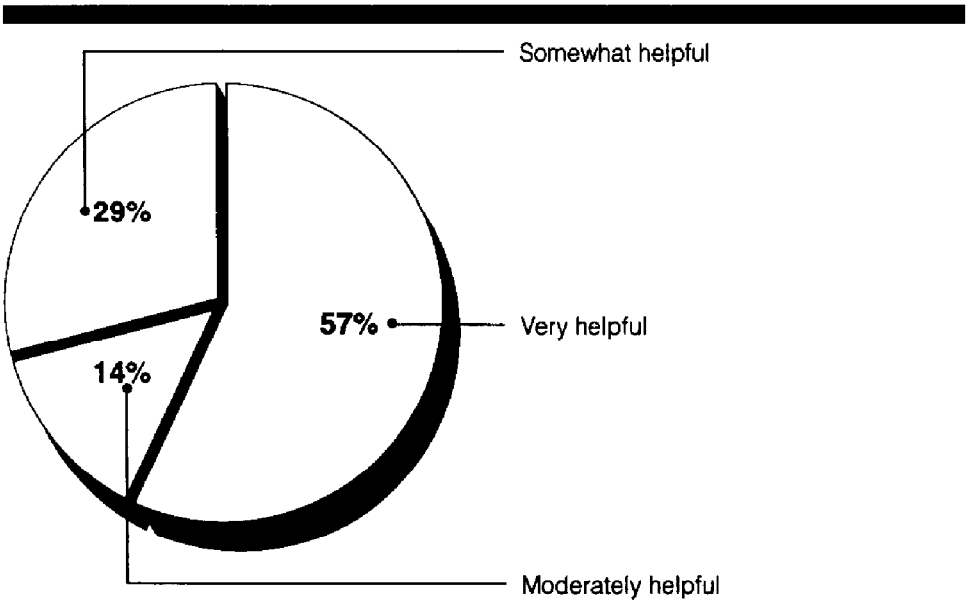
While 64 percent (7 of 11) of the program officers viewed preproposals as very or moderately useful mechanisms to reduce the number of proposals reviewed by EHR as a whole, only 27 percent (3 of 11) viewed preproposals as very or moderately useful in reducing their personal workload. (Three program officers were not familiar with preproposals; thus, the total number of program officers responding to questions concerning preproposals was 11 rather than 14.) Program officers are responsible for reviewing and responding to preproposals along with competitive proposals. As such, they apparently believe that the increase in their workload related to reviewing the preproposals will be the same or greater than the decrease in their workload associated with having fewer competitive proposals to review, but the overall proposal review workload would decrease because fewer proposals would require peer review.

Views on Support Staff and Equipment

Program officers held divided views when asked about the adequacy of the number of support staff available to assist them. Seven of 14 thought the number was adequate, 1 of 14 thought it was as adequate as inadequate, and 6 of 14 viewed it as inadequate. When asked which support staff were too few in number, program officers listed program assistants (mid-level professionals hired or trained to help with the substantive aspects of proposal processing) and other administrative staff, such as secretaries. When asked how well trained their support staff are, 6 of 14 program officers said the staff were well trained, and 8 of 14 said they were not.

All program officers thought that program assistants would be helpful to them in their work. (EHR currently employs a limited number of these program assistants.) Eight of 14 program officers (57 percent) indicated that they would be very helpful. Figure III.11 illustrates these responses.

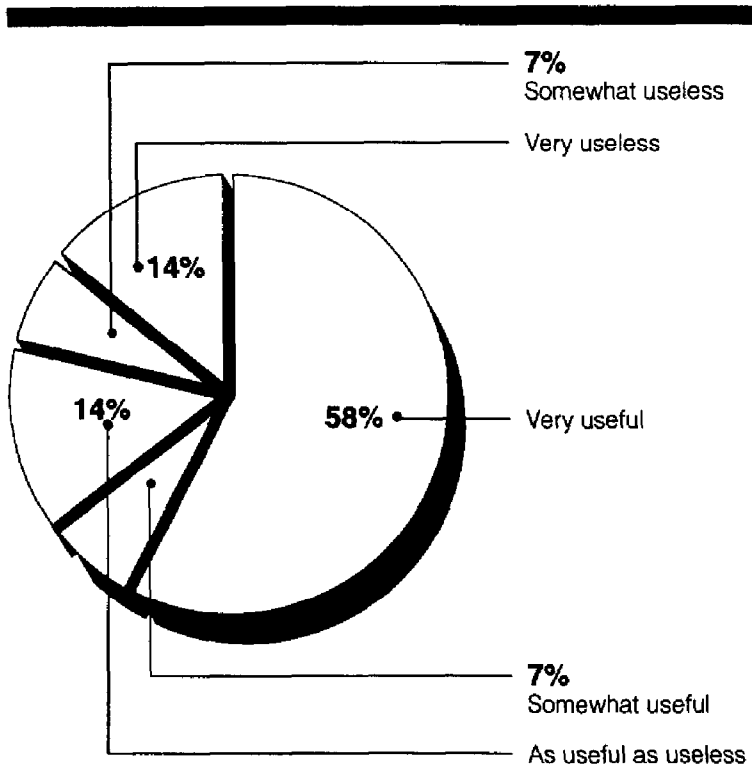
Figure III.11: Perceived Helpfulness of Professional Program Assistants to Program Officers



Note: Fourteen program officers responded.

Additionally, most program officers indicated that support staff trained to coordinate communications with members of the external community regarding the members' science education priorities and needs would be useful, as indicated in figure III.12.

Figure III.12: Perceived Usefulness of Support Staff Trained to Coordinate Communications With External Community



Note: Fourteen program officers responded.

Finally, most program officers thought that they had sufficient technology, such as computers, to carry out their responsibilities: 11 of 14 answered that they did have sufficient technology, while 3 of 14 said they did not. However, three program officers cited NSF's cumbersome mainframe computer or other technology deficiencies, and two cited NSF's nonuser-friendly software among their most serious concerns (see table III.1) and the factors preventing them from spending the time they would like on certain tasks. (See table III.3.) In our discussions with program officers, it was clear that many were concerned about both NSF's mainframe and software capabilities.

Program Officers' Training

Program officers were generally satisfied with NSF's formal training, such as the Program Managers' Seminar and/or computer training; 7 of 14 said that they were very or generally satisfied, 4 of 14 indicated that they were as satisfied as dissatisfied, and 3 of 14 indicated that they were very or generally dissatisfied with this training. Some did express, however, that the timing of the Program Managers' Seminar (best when taken as soon as possible after coming to work for NSF) was not satisfactory because it did not start until several months after they began work. Program officers were less satisfied overall with EHR's informal mentoring program. Five of 14 found the program very or generally adequate, 3 of 14 found it as adequate as inadequate, and 6 of 14 found it very or generally inadequate. Several program officers commented that because the mentoring program was not formalized within divisions or the Directorate, it was not a reliable training mechanism—sometimes new program officers received mentoring, sometimes they did not.

Responses From Program Officers in the Office of Systemic Reform

Most Serious Concerns and Factors Limiting Program Officers' Time

Office of Systemic Reform program officers' most serious concerns related to their principal responsibilities are similar to those of other EHR program officers'. Lack of travel funds for site visits was cited most often as a serious concern, with three of four OSR program officers citing it as being serious. The OSR program officers with whom we spoke told us that inadequate travel funds to conduct monitoring site visits is especially problematic in the Statewide Systemic Initiative program, given the complexity of its goals, the large dollar amounts of the grants, and the longer time periods for which each grant is awarded. The "lack of interaction with or guidance of principal investigators," also cited as a most serious concern by two of four OSR program officers, is a result, in part, of the lack of travel money, as most believe that adequate guidance of principal investigators requires some firsthand project review. Three of four OSR program officers felt that hiring contractors to conduct site visits does not provide useful information to program officers for monitoring projects. The following were other serious concerns listed:

- Lack of communication between program officers and management.
- Too few program assistants.
- Lack of capable administrative staff.
- High turnover among temporary program officers.
- Program officers required to do too many administrative tasks.

When asked to list the factors preventing them from spending as much time as they would like on certain responsibilities, OSR program officers included the following factors:

- Lack of travel funds for site visits.
- Limited time due to heavy workload per program officer.
- Time required to explain program to grantees.

Workload

OSR program officers had some concerns about their workload.[3] For instance, they all work overtime; three work 8 to 12 hours overtime each week. In addition, three of four were dissatisfied with the time available for communicating with principal investigators to monitor the progress of projects. Most OSR program officers (three of four), like other EHR program officers, also viewed the number of administrative tasks they had to carry out as somewhat or much too many.

However, most OSR program officers (three of four) viewed the number of proposals to review and grants to monitor as about right[4]; three of four were also satisfied with the time available to them to write review summaries and award recommendations and to review and negotiate proposed budgets.

Table III.4 provides an overview of how OSR program officers estimate they allocate their time among 10 principal responsibilities.[5] The second

[3]We do not discuss OSR program officers' views on meeting the standard 6-month review requirement or modifying NSF's peer review process because the review period for the SSI program follows a different timetable and is conducted differently from the typical NSF peer review process.

[4]The SSI program's applicant pool is limited to states (and/or commonwealths), and the designated number of initial awards for the program was 26. However, reviewing each proposal and monitoring each grant in the program likely requires more time than typical proposals and grants in EHR because of their complexity and larger scope.

[5]The amounts represent estimates made by the OSR program officers of the portion of their time spent on each task. However, like many other EHR program officers, most OSR program officers voiced concern about the difficulty of accurately estimating these portions and asked that their answers be regarded as estimates only. They also stated that, while it was difficult to estimate these portions, their estimates of how much more or less time they would like to spend on each task (listed in column 4 of table III.4) were reasonable estimates of the magnitude of their preferred changes in the time spent on each task.

column from the left depicts what percentage of their time program officers actually spend, on average, on each of these 10 responsibilities. Column 3 highlights what percentage of their time, on average, they would prefer to spend on each task, assuming their workload was neither too heavy nor too light and given the importance that each task has in contributing to the success and effective conduct of NSF's precollege science education programs. Finally, column 4—the basis of the differences between columns 2 and 3—shows the magnitude of the increase or decrease that program officers would like to make, on average, to the percentage of the time they spend on each task.

As shown in table III.4, OSR's program officers spend the largest portions of their time on (1) other duties, such as helping with important reports or putting together program announcements (20 percent of their time); (2) reviewing proposals (16 percent of their time); and (3) monitoring grants (16 percent of their time).

Table III.4: Overview of How OSR Program Officers Estimate the Allocation of Their Time Among 10 Principal Responsibilities

Tasks	Portion of time OSR's POs spend on task	Portion of time OSR's POs would like to spend on task	Magnitude of desired change in time spent on task
Reviewing preproposals	7.5	8.3	11 more time
Reviewing proposals	16.3	15.0	9 less time
Performing administrative tasks	15.0	7.5	50 less time
Monitoring grants (site visits and communicating with PIs)	16.3	26.3	61 more time
Reviewing annual progress reports	10.0	8.8	12 Less time
Reviewing summative evaluations	2.3	3.8	65 more time
Other duties (important reports/program announcements)	20.0	10.0	50 less time
Conducting outreach activities	4.8	8.8	83 more time
Formal training and informal mentoring	2.3	2.5	9 more time
Activities to maintain expertise	5.8	9.3	60 more time

Legend

PI = principal investigator.
PO = program officer.

Notes:

1. All amounts are in mean percentages.
2. Portions of time spent do not add to 100 because of rounding.
3. Four OSR program officers responded.

Program officers in OSR spend less than half the time that other EHR program officers spend reviewing proposals and more than twice the time that other EHR program officers spend monitoring grants. However, OSR program officers still would like to spend 61 percent more time monitoring grants than they currently spend. Like other EHR program officers, OSR program officers said that limited time due to the heavy workload per program officer (cited by two of four program officers) and the lack of travel funds (cited by all four) prevented them from making the site visits to monitor grants that they would like to make. Table III.5 compares the

number of monitoring site visits that OSR program officers currently make with the number they would prefer to make.

Table III.5: Number of Monitoring Site Visits Conducted by OSR Program Officers Compared With the Number They Would Like to Conduct

Frequency of monitoring site visits conducted	Number of POs making this number of site visits	Number of POs preferring to make this number of site visits
No site visits	0	0
1 site visit	1	0
2-3 site visits	0	1
4-6 site visits	2	0
More than 6 site visits	1	3

Legend

PO = program officer.

Note: Four OSR program officers responded.

OSR program officers spend about the same amount of time on administrative tasks as other EHR program officers (15 percent); both groups would like to decrease this time—desiring, on average, to spend about 50 percent less time. Program officers in OSR would also like to spend 50 percent less time on other duties, such as helping with important reports.

Like other EHR program officers, OSR program officers would like to spend significantly more time in (1) conducting outreach activities (83 percent more time), (2) reviewing summative evaluations (65 percent more time), and (3) attending workshops to maintain expertise (60 percent more time).

We also asked OSR program officers how much they agreed or disagreed with designated statements related to EHR's precollege science education programs in general and program officers' workload and turnover. Most (three of four) did not view EHR's administration of its precollege science education programs as effective. All were concerned about maintaining their expertise, and all agreed that program officers' turnover limits their effectiveness in carrying out their responsibilities. During our conversations, some OSR program officers expressed particular concern about program officers' turnover because SSI grants are made for 5-year periods.

Views on Support Staff, Equipment, and Training

Two of four OSR program officers felt that the number of support staff was inadequate, one of four found the number very adequate, and one did not respond. OSR program officers were more unified in their views regarding how well the support staff were trained; all four indicated they were generally not well trained or not well trained at all.

Like other EHR program officers, OSR program officers felt that program assistants would be helpful to them; all four responded that they would be very helpful. However, OSR program officers were less prone to view support staff trained to coordinate communications with members of the external community regarding the members' science education priorities and needs as useful; three of four said that this would be somewhat or very useless. In our follow-up discussions, some OSR program officers told us that because the SSI program is very complicated and is a high-priority program, questions posed by the external community would best be answered by program officers.

All four OSR program officers indicated that they had sufficient technology to carry out their responsibilities. Unlike other EHR program officers, they did not list technology issues among their main concerns or the factors that prevent them from spending as much time as they would like on certain tasks.

OSR program officers, in contrast to other EHR program officers, were more satisfied with EHR's mentoring program than with NSF's formal training. Two OSR program officers found the mentoring program very or generally adequate, one found it as adequate as inadequate, and one found it generally inadequate. Regarding NSF's formal training, two OSR program officers were generally dissatisfied, one as satisfied as dissatisfied, and one generally satisfied. One, like some other EHR program officers, felt the timing of the Program Managers' Seminar was too late.

Quantitative Resource Indicators

This appendix provides detailed results of our analysis of resource indicators used to assess whether EHR has obtained the resources it needs to administer its science, mathematics, engineering, and technology education programs effectively.

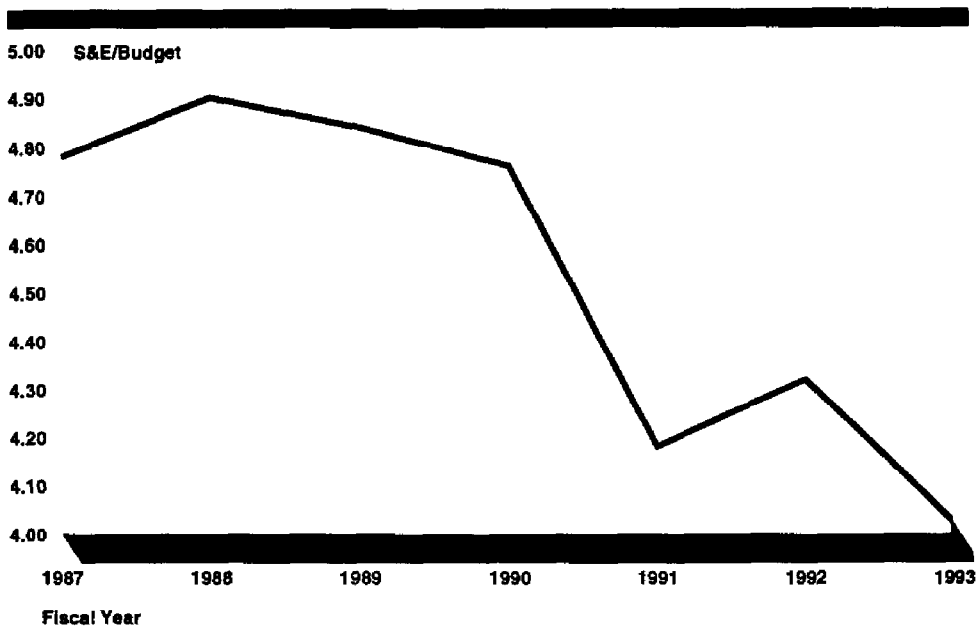
Overhead Indicator

Over the past several years, funds awarded for grants and similar agreements used to advance EHR's SMET education programs has grown considerably—almost doubling for fiscal years 1987-90 and more than doubling for fiscal years 1990-93. Resources used to administer and manage these programs grew at a much slower rate—22 percent adjusted for inflation since fiscal year 1990. A common method that NSF uses to illustrate this condition is to compare its Salaries and Expenses (S&E) appropriation account,[1] with its overall budget to determine an S&E percentage share or overhead rate. EHR officials told us that an overhead rate of 5 percent or less is too low to effectively administer their program responsibilities.

In fiscal year 1985, NSF's overhead rate dropped to below 5 percent and held relatively constant until fiscal year 1990, when it began to decline further. In fiscal year 1990, overhead was about 4.8 percent, and in fiscal year 1993 overhead was about 4 percent—about a 15-percent decline during the preceding 3 fiscal years. Figure IV.1 shows the decline in overhead rates for NSF during fiscal years 1987-93.

[1]The S&E appropriation account includes funds for such items as staff salaries and benefits, travel, rent, equipment, administrative contractual services, supplies, and other operating expenses necessary to support NSF programs.

Figure IV.1: NSF's S&E as a Percentage of Total Budget



Source: GAO's analysis of NSF's data.

To examine how this condition more closely relates to EHR, we used this basic method to determine the share of administrative resources or overhead used directly by each NSF directorate and how it changed during fiscal years 1990-93. The decline experienced for all of NSF was more pronounced for EHR. In fiscal year 1990, administrative charges were about 2.5 percent of EHR's total budget, and in fiscal year 1993 overhead had declined to about 1.4 percent—or about a 42 percent decline since fiscal year 1990.[2] EHR's overhead in fiscal year 1990 was 8.6 percent above the average of all NSF directorates, but in fiscal year 1993, EHR's overhead was 50.3 percent below the average of all directorates.

[2]The share of administrative costs for each directorate does not include costs for personnel benefits. NSF officials were not able to provide us with personnel benefits costs for each directorate because these costs are not tracked separately. We were told to take 19 percent of each directorate's costs for personnel compensation to estimate its costs for personnel benefits. Using this procedure, we determined that (1) EHR's administrative share of its budget in fiscal year 1990 would increase from about 2.5 percent to about 2.9 percent and, in fiscal year 1993, would increase from about 1.4 percent to about 1.7 percent and (2) the percentage decline for fiscal years 1990-93 would remain at about 42 percent.

Table IV.1: Overhead From Fiscal Year 1990 Through Fiscal Year 1993, in Percent

Directorate	FY 1990	FY 1991	FY 1992	FY 1993
EHR	2.46	2.13	1.71	1.43
CISE	2.11	2.04	1.87	1.79
GEO	2.47	2.30	2.37	1.59
MPS	1.41	1.18	1.28	1.26
SBE	N/A	N/A	9.38	9.18
ENG	2.87	2.40	2.80	2.67
BIO	N/A	N/A	2.17	2.17
AVG DIR	2.27	2.01	3.08	2.87

Legend

AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
EHR = Directorate for Education and Human Resources.
ENG = Directorate for Engineering.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
N/A = not applicable.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

Limitations of Overhead Comparisons

Developing indicators from resource data can be an effective tool in assessing the adequacy of administrative resources; however, all such indicators have limitations, and no one indicator should be relied upon with 100-percent certainty to point in the proper direction. This statement is especially true for the S&E or overhead indicator because no magic number exists below which one can then say is too low. New technologies such as personal computers and electronic mail can be used to make business operations more efficient and thus bring about increased productivity with lower overhead charges. Furthermore, other indicators can be used to more directly measure productivity and therefore are better indicators of the adequacy of administrative resources.

Other Key Indicators

To avoid the problems associated with relying only upon overhead comparisons, we identified several key measures of productivity and developed resource indicators to assess both the measures themselves and changes in the measures over time. We also assessed each measure across all NSF directorates to allow comparisons with EHR in order to identify its relative performance or standing among all directorates.

By examining the measures themselves, we were able to determine the extent that the measure changed over time. This was useful to detect trends that may indicate a worsening or improving situation within a particular directorate, which then may suggest a need to realign critical resources. However, since we are operating in an environment of tight or restrictive government resources, changes in resource levels in any one directorate are likely to have an impact on resource levels provided to other directorates. Therefore, we compared performance indicators across all NSF directorates to determine how effective EHR was in using its administrative resources compared with other directorates' resources. This information would be useful in making resource allocation decisions for any realignment process undertaken.

While a number of different indicators exist in addition to the S&E or overhead indicator that may be used to assess the adequacy of administrative resources, the best indicators are those that provide information on outputs or outcomes and are not subject to arbitrary thresholds like the overhead indicator. We identified two such indicators: (1) the processing time for proposals and (2) staff workload.[3]

Processing Time for Proposals

To measure the effectiveness of EHR in using its administrative resources, we used data provided by NSF for the period 1987 to 1992 on the time it takes each directorate to review a proposal and decide whether to recommend the award of a grant. We analyzed the data by (1) calculating changes in processing time over this time period for each directorate and (2) comparing these changes with those of other directorates. As shown in table IV.2, EHR required an average of 176 days to process a typical proposal in 1987 (the shortest amount among all directorates). In 1992, EHR required 212 days to decide whether to recommend the award of a grant—an increase of over 1 month (36 days) since 1987. The increase in processing time in EHR during this period was the greatest increase among all directorates. As also shown in table IV.2, the Directorate for Computer and Information Science and Engineering, in contrast, took 9 fewer days to process a typical proposal over this same period.

[3]We recognize that proposals (or awards) could differ significantly from directorate to directorate in complexity, length, and subject area, thus weakening the results of any such comparisons. However, in our analysis, we could not standardize these differences. Still, our indicators could be useful, since all directorates follow the same basic NSF procedures for reviewing proposals and administering grants. Furthermore, to strengthen the results of any such comparisons, we generated an average NSF directorate that assigns equal weight to each directorate and avoided using direct comparisons such as those that compared EHR with any other specific directorate and instead compared EHR, as well as other directorates, with the average generated—which better provides for any differences between directorates. (See app. V for a more detailed discussion of our methodology.)

Table IV.2: Average Proposal-Processing Time, in Days

Unit	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992
EHR	176	187	184	187	210	212
CISE	223	207	195	187	219	214
GEO	190	189	202	203	196	195
MPS	195	194	185	199	208	205
SBE	207	209	198	200	221	208
ENG	191	192	181	195	201	212
BIO	210	210	208	217	218	231
AVG DIR	199	198	193	198	211	211

Legend

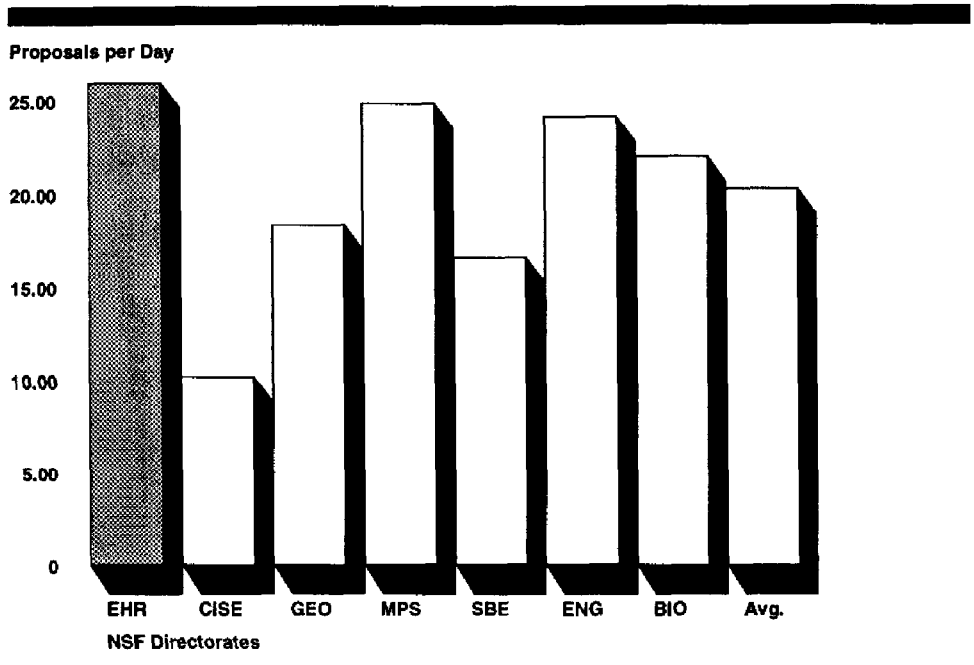
AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
ENG = Directorate for Engineering.
EHR = Directorate for Education and Human Resources.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

However, while EHR had the greatest increase in processing time among all directorates for fiscal years 1987-92, as shown in table IV.2, it took no more time than about the average directorate to process a typical proposal in fiscal year 1992. Also shown in table IV.2, CISE and the Directorate for Biological Sciences (BIO) took longer than average; the Directorate for Geosciences (GEO), Directorate for Mathematical and Physical Sciences, and Directorate for Social, Behavioral, and Economic Sciences took on average less time; and the Directorate for Engineering took the same time as EHR to process a typical proposal. As shown in figure IV.2, by taking into account the number of proposals processed by each directorate, we found that EHR is the most productive directorate in NSF, with a processing rate of 26 proposals per day compared with NSF's average rate of 20.[4] Although, CISE took 9 days fewer to process a proposal for fiscal years 1987-92, it had the lowest productivity-processing rate of all directorates, with a rate of just over 10 proposals per day.

[4]While differences in the complexity and length of proposals between directorates make precise comparisons difficult, EHR officials told us that their proposals require greater administrative resources than those from other directorates. This indicates that EHR's high proposal-processing rate is more significant.

Figure IV.2: Average Number of Proposals Processed Each Day by Each Directorate in Fiscal Year 1992



Legend

Avg. = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
ENG = Directorate for Engineering.
EHR = Directorate for Education and Human Resources.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

Therefore, while EHR took about 20 percent longer in fiscal year 1992 to process an average proposal as it did in fiscal year 1987, it is (1) reviewing more than three times the number of proposals as it did in fiscal year 1987 and (2) processing the most proposals per day compared with all other directorates.

Staff Workload

The staff workload indicator measures changes in the amount of work assigned to an individual employee. Since the primary workload measure

in NSF is the fully reviewed or competitive proposal[5] and program officers are the primary NSF staff responsible for reviewing these proposals and monitoring awards, we compared the total number of competitive proposals reviewed or awarded with the staff available to do the work.[6] We used two classes of available staff. The first type included all staff in each directorate, and the second type included only research staff—an estimate of program officers in a particular directorate.[7]

For fiscal years 1987-92, NSF reviewed about 29 percent more competitive proposals—an increase of 6,660 from the 23,372 reviewed in fiscal year 1987. Also during this period, NSF awarded about 30 percent more grants—an increase of 2,331 from the 7,737 awarded in fiscal year 1987. Furthermore, during this same period, the total number of full-time equivalent employees grew by 35 percent, and the number of program officers grew by an estimated 29 percent.

As shown in table IV.3, each member of EHR's research staff on average, reviewed about 33 competitive proposals in fiscal year 1987—which was the least amount reviewed by any directorate and 38 percent below the average amount reviewed by all research staff. Also shown in table IV.3, EHR's research staff reviewed about 61 proposals in fiscal year 1992—almost double (87 percent) the number of proposals they reviewed in fiscal year 1987—and had the greatest increase in workload experienced in all directorates. However, a comparison of EHR with NSF's other directorates reveals that EHR's research staff reviewed no more than the average number of proposals reviewed by all research staff in fiscal year 1992. We also found similar results by comparing the number of proposals reviewed by total directorate staff. (See table IV.4 for these results.)

[5]Competitive proposals include only those proposals processed through NSF's peer review process. They do not include small increases in funds for existing awards, interagency agreements, or funds to pay for annual increments to existing multiyear awards.

[6]True workload associated with competitive proposals or awards involves its length and complexity, which because of data limitations could not be incorporated into the staff workload indicator.

[7]Because data on the number of program officers were not available, we used available data on scientists and engineers and Intergovernmental Personnel Act employees—which we refer to as research staff—to estimate the number of program officers in each directorate.

Table IV.3: Average Number of Competitive Proposals Reviewed by Each Directorate's Research Staff

Directorates	FY 1987	FY 1992	Percentage of growth
EHR	32.8	61.4	87.0
CISE	42.1	57.6	36.9
GEO	36.2	38.6	6.6
MPS	54.5	69.7	27.9
SBE	N/A	43.4	N/A
ENG	70.4	80.0	13.7
BIO	83.9	90.4	7.7
AVG DIR	53.3	63.0	18.2

Legend

AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
ENG = Directorate for Engineering.
EHR = Directorate for Education and Human Resources.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
N/A = not applicable.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

Table IV.4: Average Number of Competitive Proposals Reviewed by Each Directorate's Staff

Directorates	FY 1987	FY 1992	Percentage of growth
EHR	18.8	35.9	91.4
CISE	20.3	30.0	47.4
GEO	20.6	22.4	8.5
MPS	32.9	38.8	18.0
SBE	N/A	24.8	N/A
ENG	39.8	38.5	-3.2
BIO	43.0	43.3	0.7
AVG DIR	29.2	33.4	14.2

Legend

AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
ENG = Directorate for Engineering.
EHR = Directorate for Education and Human Resources.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
N/A = not applicable.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

We used this same method to analyze the number of competitive proposals awarded by EHR's research staff. As shown in table IV.5, each EHR research staff, on average, monitored almost 12 ongoing grants in fiscal year 1987, which was the least amount monitored by this staff type in any directorate and was about 33 percent below the average amount managed by all research staff. Also, as shown in table IV.5, in fiscal year 1992, EHR's research staff monitored about 45 percent more grants than they did in 1987. This was the greatest increase in workload experienced by all directorates. However, in comparing EHR with NSF's other directorates, we found that EHR's research staff, on average, monitored slightly fewer (19 percent) awards than the average number monitored by all research staff. We also found similar results when comparing grants monitored by total directorate staff. (See table IV.6 for these results.)

Table IV.5: Average Number of Competitive Awards Monitored by Each Directorate's Research Staff

Directorates	FY 1987	FY 1992	Percentage of growth
EHR	11.7	16.9	44.8
CISE	15.2	20.9	37.2
GEO	14.2	16.8	17.9
MPS	22.3	28.3	26.8
SBE	N/A	15.8	N/A
ENG	18.3	22.8	24.8
BIO	22.7	24.6	8.4
AVG DIR	17.4	20.9	19.9

Legend

AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
EHR = Directorate for Education and Human Resources.
ENG = Directorate for Engineering.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
N/A = not applicable.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

Table IV.6: Average Number of Competitive Awards Monitored by Each Directorate's Staff

Directorates	FY 1987	FY 1992	Percentage of growth
EHR	6.7	9.9	48.3
CISE	7.4	10.9	47.8
GEO	8.1	9.7	20.0
MPS	13.5	15.8	17.0
SBE	N/A	9.0	N/A
ENG	10.3	11.0	6.3
BIO	11.6	11.8	1.3
AVG DIR	9.6	11.1	16.2

Legend

AVG DIR = average of the directorates.
BIO = Directorate for Biological Sciences.
CISE = Directorate for Computer and Information Science and Engineering.
EHR = Directorate for Education and Human Resources.
ENG = Directorate for Engineering.
FY = fiscal year.
GEO = Directorate for Geosciences.
MPS = Directorate for Mathematical and Physical Sciences.
N/A = not applicable.
SBE = Directorate for Social, Behavioral, and Economic Sciences.

Source: GAO's analysis of NSF's data.

Therefore, while workload demands as measured by these indicators have increased more in EHR than any other directorate since fiscal year 1987, EHR's workload as measured by the number of competitive proposals reviewed or awarded for each staff type is generally no greater than average for all directorates.

Objectives, Scope, and Methodology

Our objectives were to examine (1) how NSF establishes priorities for its science, mathematics, engineering and technology education programs; (2) how NSF evaluates the results of its SMET education programs and how these evaluations are used in setting future priorities; and (3) whether NSF has obtained the resources it needs to administer the programs effectively. In addition, we were asked to concentrate on precollege SMET education programs.

Although other NSF directorates administer some SMET education programs, we limited our review to the Directorate for Education and Human Resources, which funds the majority of NSF's SMET education programs.

To determine how NSF establishes priorities for its SMET education programs, we interviewed officials involved in the process and reviewed appropriate documents. We interviewed most senior EHR officials including its Assistant Director, Deputy Assistant Director, Senior Staff Associate for Coordination of Cross-directorate Programs, and those officials in charge of each of its six major units (excluding the Director of the Division of Graduate Education and Research Development, as this unit did not have precollege programs). We also reviewed EHR's strategic plan for fiscal years 1991-96, its draft report dated December 1992 on major program plans for fiscal years 1993-2000, minutes of EHR's advisory committee, and other appropriate documents.

To determine the role of the National Science Board in setting SMET education activities, we met with the National Science Board's members and their staff, including the Chairman of the Education and Human Resources Committee and the Board's Executive Officer, attended several Board meetings, and reviewed the Board's and Committee's minutes. We also met with NSF's Acting General Counsel.

To determine how NSF evaluates the results of its educational programs and how these evaluations are used in setting future priorities, we spoke with officials involved in the process and reviewed appropriate documents. We interviewed EHR's Assistant Director; its Director of Research, Evaluations, and Dissemination; and other NSF officials responsible for evaluating or directing EHR's evaluation efforts. In addition, we reviewed a number of evaluation reports, including those from external peer oversight groups—known as Committee of Visitors[1]—and outside

[1]Committee of Visitors' reviews are conducted for each NSF program at 3-year intervals and provide NSF with an assessment of program-level technical and managerial matters pertaining to proposal decisions and program operations.

contractor evaluations of specific programs, and a draft report entitled "Science Education Programs—A Moving Finish Line," dated August 1993, which examined the results of funds invested over the past decade by EHR. We also reviewed NSF's report on evaluations of science and mathematics education programs entitled A Report to the Appropriations Committee of the United States Senate on a Plan for the Evaluation of Science and Mathematics Education Programs of the National Science Foundation, dated April 22, 1991; Pathways to Excellence: A Federal Strategy for Science, Mathematics, Engineering, and Technology Education, prepared by the Committee on Education and Human Resources of the Federal Coordinating Council for Science, Engineering, and Technology and other appropriate documents and reports.

To assess whether NSF has obtained the resources it needs to administer its SMET education programs effectively, we

- interviewed (1) senior EHR officials responsible for managing SMET education activities; (2) Office of Budget, Finance, and Award Management officials (including its Chief Financial Officer) responsible for allocating administrative resources among NSF units; and (3) other knowledgeable officials;
- provided 18 experienced program officers responsible for reviewing proposals and managing grants for EHR's precollege education programs with a questionnaire and met with them to discuss their responses;
- examined 19 Committee of Visitors' reports addressing, among other things, how well EHR's SMET education programs are being administered;
- reviewed 14 precollege grant files documenting EHR's efforts to manage and administer these projects; and
- developed quantitative resource indicators to assess changes in staff's productivity and workload and used the indicators to evaluate not only how effective EHR was in using its administrative resources but how it compared with other directorates.

We contacted senior program officers in four EHR divisions and asked them to provide a list of all program officers under their supervision that work primarily with precollege programs and have at least 1 year of experience with NSF. From the 22 program officers suggested by these managers, we provided a questionnaire to 18 and met with them to discuss their responses. (Three program officers we contacted indicated that their workload was too heavy to meet with us and one was on sick leave.) The responses of these program officers represent their views only; they cannot be generalized to the entire population of EHR's program officers.

Fourteen of the program officers were from divisions that largely award individual principal investigator awards and do not focus extensively on systemic or systemwide change. These include the Division of Elementary, Secondary, and Informal Education; the Division of Human Resource Development; and the Division of Undergraduate Education.[2] The remaining four program officers administer the Statewide Systemic Initiatives program in the Office of Systemic Reform. The SSI program is unique from many other programs within EHR because of the complexity of its goal to effect systemic change in school systems statewide and the longer grant period (5 years) used for SSI awards. As such, the responses of OSR program officers for certain questions differ from those of other EHR program officers. To examine these differences, we analyzed the responses of program officers in each of these two groups separately in appendix III. However, because program officers in OSR generally expressed concerns and suggestions for improvement similar to those of other EHR program officers, we aggregated the responses of the two groups in the letter.

Our approach for conducting the interviews had three parts. First, we pretested the questionnaire to ensure that we were asking appropriate questions and that the questions were expressed clearly. Next, once we were satisfied with the design of the questionnaire, we provided it to each program officer to complete. Last, we met with each program officer individually to discuss any questions we had about their responses. (Three of the 18 program officers were not able to meet with us but did respond to the questionnaire.)

In analyzing the response data, we sometimes looked for patterns of responses by grouping related responses. For example, on questions about the level of satisfaction with the time available for certain tasks, we were more interested in distinguishing whether program officers said that they were "satisfied" or "dissatisfied" than in the distinction between "generally satisfied" and "very satisfied." Consequently, in these cases, we sometimes grouped the latter two responses for analysis. Appendix III includes our analysis of the program officers' responses to the questionnaire.

We also reviewed 19 Committee of Visitors' reports. The reports described results of program reviews conducted by external peer oversight groups convened during fiscal years 1990-92. The majority of these reports were of assessments of the programs done in fiscal year 1991, and over

[2]A few programs in these divisions are major reform efforts similar in scope to the Statewide Systemic Initiative program in OSR, such as the Collaboratives for Excellence in Teacher Preparation program in DUE.

two-thirds of the reviews were for programs having a precollege component.

In addition, we reviewed 14 grant files, each containing all the information necessary to document the review process and to administer the award. We reviewed the files for specific information on the duties and tasks performed by program officers in administering the proposal and for compliance with basic NSF administrative requirements. We selectively chose 14 project files to review on the basis of the following criteria: (1) precollege; (2) continuing grant of 2 or more years; (3) completed or near completion in fiscal year 1992; (4) grant amount over $200,000; (5) non-NSF matching funds; and (6) the likelihood of project materials or other project documents available to review that might indicate progress in meeting the project's stated goals. Not all grants reviewed met all six criteria, but no projects were discarded or replaced for not meeting a majority of our criteria or for any other reason. We used EHR's Directory of Awards for fiscal year 1990—which was the latest one available at the time of selection—to generate a list of grants meeting as many of the criteria as possible. All projects were managed from ESIE: Six projects were in the Teacher Enhancement program, five came from the Instructional Materials Development program, two came from the Informal Science Education program, and one came from the Young Scholars program.

Last, we developed quantitative resource indicators to assess changes in staff productivity and workload. We used the indicators to evaluate how effective EHR was in using its administrative resources for fiscal years 1987-92. In addition, because the indicators included all seven NSF directorates, they were used to evaluate how effective EHR was in using its administrative resources compared with those of other directorates. We recognize that competitive proposals or awards could differ significantly from directorate to directorate in complexity, length, and subject area, thus weakening the results of any such comparisons. However, we could not standardize the data for these differences. Still, since all directorates followed the same basic NSF procedures for reviewing proposals and administering grants, we believe certain comparisons can be an effective indicator of relative performance. Furthermore, to strengthen the results

of any such comparisons, we generated an average NSF directorate[3] and avoided use of direct comparisons such as those that compared EHR with any other specific directorate and instead compared EHR, as well as other directorates, with our average—which better provides for any differences between directorates.

Financial and other data used to generate the indicators came from NSF's management information system, a database maintained by the Office of Budget, Finance, and Award Management. Specifically, the data came from three sources: "NSF Proposal, Award, and Staffing Profiles," "Average Proposal Processing Time for NSF FY 1987-1992," and "NSF Justification of Estimates of Appropriations to the Congress" for fiscal years 1987 through 1994. In addition, data used for analyzing the rate of personnel turnover came from NSF's Personnel Payroll System. Furthermore, because data on the number of program officers were not available, we used available data on scientists and engineers to estimate the number of program officers in each directorate.[4] While we conducted a number of limited reliability checks on the data, we did not conduct a full reliability check on the database. Discrepancies found during our checks were brought to the attention of NSF's budget officials, who reconciled the numbers or explained the discrepancies to the best of their abilities. We did not perform any reliability checks on data from the "NSF Justification of Estimates of Appropriations to the Congress" for fiscal years 1987 through 1994.

[3]We calculated an average directorate by summing individual directorate indicators and dividing the sum by the number of directorates. This method assigns equal weights to each directorate, thereby not favoring one directorate over another. An alternative method to calculate an average directorate is to use the raw data for all the directorates and compute the indicator. For example, applying this procedure to our workload indicator (i.e., the number of proposals reviewed by each program officer) would assign proportionally greater weight to those directorates having the greater number of program officers. This method assumes that all proposals are alike and that any one is as representative of the agency's overall workload as any other. Since we could not adjust the NSF data for proposal differences, we used the method to calculate an average directorate that treats each directorate equally.

[4]Because data on scientists and engineers from NSF's Proposal, Award, and Staffing Profiles documents did not include Intergovernmental Personnel Act employees, we added this staff type to the data and referred to the new total as research staff. However, since the data on scientists and engineers in NSF's personnel payroll system included this type of staff, we did not make any adjustments to the data.

Comments From the National Science Foundation

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

NATIONAL SCIENCE FOUNDATION
4201 WILSON BOULEVARD
ARLINGTON, VIRGINIA 22230

March 30, 1994

nsf

OFFICE OF THE DIRECTOR

Mr. Victor S. Rezendes
Director, Energy and Science Issues
United States
General Accounting Office
Washington, DC 20548

Dear Mr. Rezendes:

Thank you for the opportunity to comment on the draft of GAO/RCED-94-95, "National Science Foundation: Information On the Administration of Science Education Programs." Although we are providing technical notes in an Appendix, there are several areas of concern that I wish to emphasize.

Congressman Boucher requested GAO to examine three specific areas -- priority setting, evaluation of results, and resource availability for program administration. Each of these areas is complex and requires an in-depth understanding of NSF in general and the Directorate for Education and Human Resources (EHR) in particular. Unfortunately, the draft GAO study does not fully demonstrate that understanding.

For example, NSF devotes a substantial amount of time and effort to priority setting for education programs (and all NSF programs, for that matter); it is both a serious and comprehensive undertaking at the Foundation. But the draft report seems to contain contradictory statements on this issue. The report states: "We found that NSF has no established policy procedures for planning or setting priorities for EHR's education program. Instead, EHR's Assistant Director uses an informal process which primarily consists of soliciting advice from a number of groups inside and outside of EHR." (page 5). Yet the report then recites at length a series of regular, comprehensive avenues used by NSF for its priority setting. (Even so, the report excludes mention of the formal Foundation-wide long-range planning procedures.)

See comment 1.

Now on p. 3.

Now on p. 4.

NSF's mechanisms for priority setting are "established" -- they are not "informal". And to state that the " ... Director and the National Science Board (NSB) also provide EHR's Assistant Director some direction on planning and setting priorities for educational programs" (page 6, emphasis added), fails to recognize that the NSB's Committee on Education and Human Resources is not merely a forum for reviewing and approving very large awards and new programs. This committee is actively engaged at each meeting in discussing and debating with the staff extant programs and activities, opportunities for the future, and educational issues at all levels of the education spectrum.

See comment 2.

We are also disappointed with the lack of attention given to evaluation in the report. The plan for evaluating all of NSF's EHR programs received little attention. Furthermore, there is no mention of NSF's leadership in FCCSET activities (it is mentioned as a source in an appendix) on the evaluation of education and human resources programs throughout the federal sector. Nor did the report discuss how these evaluations are or could be used in setting future priorities, a specific issue raised by Mr. Boucher.

See comment 3.

Finally, much of the draft report concerns itself with the resources available for program management. In describing workload issues, the assumption appears to be that all directorates are more or less alike, that one proposal is pretty much equivalent in determining workload as any other, and that monitoring is largely a policing activity. In addition, conclusions about program officer perceptions are based on a very small sample (for which no description of selection criteria is included) *from EHR only*. Yet comparisons are made for workload across the Foundation.

See comment 4.

See comment 5.

We feel those comparisons are not reliable. (See our discussion in the appendix). The bases for generating Tables IV.5 and IV.6 are not given and the data displayed are, to say the least, not very useful. Absence of methodological information makes it difficult to interpret many of the tables. In addition, monitoring of complex projects such as major curriculum development, single investigator research awards, and major facilities support awards are treated as if they were identical; in truth, they are vastly different in scale, scope, and impact.

See comment 6.

See comment 7.

After such a lengthy discussion of workload indicators, we would have hoped that the report would provide some guidance on what is necessary to remedy the situation caused by the gap between resource needs and realities. The only advice provided is that the Director should "...request the National Science Board to study ways to utilize its current administrative resources to more efficiently and effectively manage the NSF review and awards process" (page 25). Since the Director, not the Board, is reponsible for managing the Foundation, a more realistic recommendation might be for the Board to request the Director to conduct such a study.

Now on p. 14.

See comment 8.

We regret that the report is not bolder in its conclusions and recommendations. For example, no discussion is provided on the gap between current funding in the Salaries & Expenses (S&E) account, and the amount that would be needed to most effectively manage EHR and other NSF programs. Instead, we are provided data on how program officers would prefer to allocate their time. No attempt was made to analyze the resource implications of these preferences.

In conclusion, we urge that the report be made more responsive to Mr. Boucher's request. We hope that you will find our comments useful as you further review the draft report. Any questions about this response should be directed to Dr. Daryl Chubin at 703/306-1650. We would, of course, be pleased to review any subsequent draft of the report.

Sincerely,

Neal Lane

Neal Lane
Director

Enclosure

Technical Notes

Basic Technical Flaws

See comment 9.

1. There are roughly 57-62 program officers in EHR who deal with pre-college programs. The findings in the GAO report are based on a survey of 18 program officers: 14 from ESIE, HRD, and DUE, and 4 from OSR. No program officers from RED were interviewed, despite the fact that RTL and AAT both serve pre-college audiences.

See comment 10.

The tables in appendix III are the underlying data from which the conclusions in the text of the report are based. Basic statistical knowledge tells us that the minimum sample one should use is 30, to assure reasonable characteristics of the sample such as normal distribution that permit generalizability to the target population. The sample utilized in the GAO report is about half the desired amount.

See comment 11.

2. Some of the analytical findings are based on the 14 non-OSR program officers, and some are based on all 18. There is no rationale for this discrepancy, when it occurs. Additionally, while there are many references in the text of the report to all 18 program officers, the charts presented in appendix III are based on 14. Thus, it is difficult to compare the written text with the technical appendix.

See comment 12.

3. No discussion is provided regarding how the sample of program officers was selected. Were variables such as length of service at NSF, IPA vs. permanent, divisional representation, funding level of the program, etc., used to stratify the population and then draw a representative sample from these strata? If these considerations were not employed, the sample is highly likely to be biased, and not representative of the population of EHR program officers.

See comment 13.

4. When one is dealing with a very small sample size such as in this report, using percentage data is problematic at best. The tables throughout the report are replete with "findings" where large percentage differences are noted. In fact

Technical Notes 2.

these differences amount to no more than the opinions of very few program officers in many cases.

See comment 14.

5. Performance indicators were "developed" by GAO to measure the impact of limited administrative resources on all NSF directorates since 1987. These performance indicators are minimally defined, at best. What were the operational characteristics? What were the formulas that were used? On what were statistics based?

See comment 15.

6. The indicator discussion is also difficult to interpret because one very basic table is not contained in the report. There is no table which lists i) the total number of program officers per directorate per year, ii) the total number of proposals received per directorate per year, and iii) the total number of awards made per directorate per year.

Specific Page-by-Page Comments

See comment 16.

Now on p. 33.

1. On page 2 there is a reference to most program officers telling GAO that EHR is not effectively administering pre-college programs. This finding comes from Figure III.1 on page 43; it shows responses to a Likert Scale (strongly agree to strongly disagree) item which states: EHR is effectively administering its precollege science education programs. "Most program officers" refers to 3 program officers who strongly disagreed, and 6 who disagreed with the statement, out of the 14 non-OSR program officers. Why were the 4 OSR program officers not included in this finding?

See comment 17.

2. On page 2, one may infer that most program officers cited heavy workload, lack of travel funds, and a high personnel turnover rate as key obstacles to effective administration. Examination of Table III.1 shows that the question asks for most serious concerns related to program officers' principal responsibilities. One could argue whether program officers' concerns related to their principal responsibilities is the same as key obstacles to EHR effectively administering its precollege programs. Nonetheless, only 3 program officers cited heavy workload as a serious concern, 2 cited lack of travel, and only 1 cited turnover.

Technical Notes 3.

These numbers do not substantiate the inference that it was most program officers who had these concerns.

Now on p. 5.
See comment 18.

3. Page 7, footnote: The two temporary evaluation staff are IPAs (hired under the Intergovernmental Personnel Act) not visiting scientists. IPAs can serve for up to four years.

Now on p. 5.
See comment 19.

4. Page 8: The work that the evaluation staff perform in items 1 and 2 at the top of the page were not factored into the workload of program officers in EHR. Among the three evaluation program officers, management is shared for approximately 30 contracts that total close to $15 million. This is in addition to the technical assistance work they provide to the EHR Directorate and the monitoring of a few grants that the evaluation program has awarded.

Now on p. 6.
See comment 20.

5. Page 9: First Full paragraph: Perhaps "awardees" is meant rather than "awards" if so, we do spend more time with them on the effective administration of federal funds, but not generally on how to write proposals. EHR, as other directorates, conduct outreach workshops to provide general advice to our communities on priorities, proposal writing, and the review process. Many EHR awards do require more administrative resources than the average single investigator research award. Since 1990, 11 new programs have been established in EHR, (of which 10 are in whole or in part precollege) most requiring much more complex interactions by the EHR staff with the proposing community. The awards are large, must involve many partners, and involve new performers. This last is particularly true in our systemic reform efforts where we are involving whole states and their governors and legislators, cities and their mayors, and representatives from business, industry, higher education and the public.

Now on pp. 6-7.
See comment 21.

6. Pages 10-11: The clear implication here is that NSF requested travel funds and then deliberately reduced and directed them to other areas. No mention is made of the reductions to the S&E account as a result of Congressional action or the necessity to absorb mandated salary increases within the reduced amount. At the directorate level, the allocations finally received must be reviewed in the context of the pressures on the directorate. Travel, computers, advisory

committee expenses, furniture, etc. must compete for the reduced resources. Requests are estimates, they become actuals only when this process is completed.

Now on p. 9.

See comment 22.

7. Page 14: The conclusions about workload are problematic. On the one hand, Figure III.2 shows that 57 percent of the 14 non-OSR program officers report logging two or more hours of overtime a day. This is a large number if it truly represents what happens on a regular basis. On the other hand, the data of greater interest, namely, the areas in which program officers felt the workload was too heavy, are contaminated by the combination of the categories "somewhat" and "much too many" in one figure. It would be more appropriate to analyze the responses of those who replied "much too many" separate and apart from the "somewhats." It is also of interest that here, when the OSR program officers' responses are combined with the others, workload percentages are lower: 56% of 18 feel they have too many proposals to review, compared to 64% of 14, for example. This is because OSR grants fewer, but much larger, awards.

Now on p. 9.

See comment 23.

Now on p. 41.

8. Page 15: The finding that program officers would like to spend more than double the time they currently spend on summative evaluations comes from Table III.2. Program officers report spending 2.5% of their time on summative evaluations, and would like to spend 6.1%. While this is more than double, it is an increase of only 3.6 percent -- hardly notable, and certainly not "significant", as reported on page 52. The use of ratios of percentages to compute percentage increases and decreases, as in Tables III.2 and III.4 is not appropriate. The ratio ignores the base on which the percentage is built, e.g., an increase from 2.5% to 6.1% is reflected as 144%, (see Table III.2) whereas an increase from 12.5% to 15.8% was only 26%. In fact, in both cases, program officers only wanted to spend about 3% more time in the activity.

Now on p. 10.
See comment 24.

9. Page 16: We assume that "unusual" is meant rather than "usual." at the end of the first full paragraph.

See comment 25.

10. The fact that program officers would like to spend more time on summative evaluations, and that 8 program officers reported that NSF seldom spends enough time performing summative evaluations, does not lead to the conclusion that

Now on p. 9.

summative evaluations are not always conducted to determine whether a project has met its objectives (page 15). In fact, project principal investigators are responsible for their formative and summative evaluations, not program officers. The evaluation work that is conducted by NSF is to determine the effectiveness of programs, not projects.

Now on p. 12.
See comment 26.

11. On page 20, footnote 7, there is a discussion of the process used to compare indicators for EHR to those for the rest of the Foundation. The method used was to compute an average for all of NSF, and compare EHR to that average. This procedure has one major problem, namely, EHR figures are included in the average for all of NSF. A more appropriate method would have been to compute an average for the 6 non-EHR directorates, and use this average as a comparison for EHR. Why is this a problem? When the indicator value for EHR is at one tail of the distribution, either at the low end or the high end, including the EHR value distorts the average, pulling it in the direction of EHR. When the EHR value is low, the average is made lower. When the EHR value is high, the average is made higher. Recomputing, for example, the average overhead for FY93 (Table IV.1) without EHR, yields an NSF average of 3.22, rather than the average of 2.87 that is reported. Comparison of EHR's overhead for FY93 (1.43) to an NSF average of 3.22 rather than 2.87 might change the conclusion one would draw.

Now on p. 13.
See comment 27.

12: Page 22: First paragraph: This paragraph is not supported by the study. Throughout, the report leads to the conclusion of resource inadequacy, then negates that here and returns to "better use of current resources." It asserts that this will ease the heavy workload, free up funds for travel, and decrease program officers turnover. How? There are insufficient funds to hire additional staff. This is controlled both by S&E allocations and available resources NSF-wide to support salaries and benefits. By freeing up funds for travel, does the report imply that we should not buy computers, supplies, etc.? Finally, program staff turnover will not be significantly affected simply by having more funds available. Apparently the study team was unaware of recent IRS rulings which make it a severe financial burden for rotational program staff to serve more than one year.

Technical Notes 6.

Now on p. 30. See comment 28.

13. Page 39: The Division of Undergraduate Education does not hire community college professors as contractors to assist with review analyses. We have had a community college fellows program where community college personnel learn about our programs and procedures and conduct outreach activities and provide feedback to the Foundation on its activities which affect the community college sector. They were specifically prohibited from dealing with review material.

Now on p. 60. See comment 29.

14. Page 74: In Table IV.1, averages for the Foundation are computed by simply summing the individual directorate figures and dividing by the number of directorates for whom there are figures. For example, average overhead for FY90 is computed as follows:

$(2.46 + 2.11 + 2.47 + 1.41 + 2.87)/5 = 2.27$

The problem with this computation is that the individual figures are derived percentages, based on the ratio of a given directorate's administrative costs to the directorate's total budget. Thus, the denominator for each percentage differs, since each directorate has a unique operating budget. The correct way to compute the average overhead would be to use the raw data, e.g., add the dollar values of the administrative costs for each directorate, and then divide this sum by the sum of the total operating budgets for the directorates.

Now on p. 62. See comment 30.

15. Page 78: The information presented in Table IV.2 is based on the assumption that all proposals are keyed into the mainframe database system as soon as they are received by NSF. Is this assumption valid? The table presents average proposal processing time from the time the proposals are entered into the computer.

Now on p. 80. See comment 31.

16. Page 80: There is no indication where the data came from to generate Table IV.2. The report does not contain the number of program officers in each directorate, or the number of proposals that are processed.

Now on p. 63.
See comment 32.

17. Page 81: The workload indicator is flawed in design. It is based on i) only proposals, not proposals and prelims; ii) an estimate of the number of program officers (when exact counts were available); iii) did not consider the complexity of the proposals as a factor; and iv) did not include the ratio of awards to declinations. Examination of declinations when addressing workload is important because the provision of appropriate documentation for declinations often is quite time consuming.

Now on pp. 64-65.
See comment 33.

18. Pages 81-83: Who are the people who comprise the category EHR's research staff? Who are the people who comprise each directorates' staff? Without knowing who they are, and their numbers, it is difficult to assess their contribution to the proposal process.

53.3 - 32.8 = 20.5.

Now on p. 66.
See comment 34.

19. Page 84: How was the average number of grants monitored by each EHR research staff computed (Table IV.5)? Similarly, for each directorate's staff (Table IV.6). The results seem very strange.

The following are GAO's comments on the National Science Foundation's letter dated March 30, 1994. We disagree with NSF that the draft report did not fully demonstrate our understanding of the complex issues that the Chairman of the House Subcommittee on Science asked us to examine. Our overall assessment of NSF's written comments is shown in the letter to this report under the heading "Agency Comments and Our Evaluation." The following contains our detailed responses to NSF's specific comments.

GAO Comments

1. We revised the draft to reflect the fact that the approval process followed by the National Science Board—which we mentioned on page 6 of the draft (now on page 3)—is specified in NSF's Proposal and Award Manual and therefore is an established written process. However, nothing in NSF's written comments leads us to believe that further modification is needed. As described in the report, priority setting is primarily left up to the EHR Assistant Director. He did not provide us with any established (i.e., written) procedures on the process because he said none existed. Furthermore, nothing in NSF's comments disputed the draft report's description of how the EHR Assistant Director goes about setting priorities.

NSF commented that we did not mention its formal Foundation-wide long-range planning procedures. It is true that we do not mention the procedures used to develop the 5-year strategic plan for science and engineering required by 20 U.S.C. 3917. This plan is to be updated on an annual basis and then submitted to two congressional committees by November 30 of each year. However, when we asked for EHR's latest 5-year strategic plan, senior EHR officials told us that because of EHR's recent reorganization, the plan should not be relied upon. We were also told that NSF received permission from the Congress to skip the 1992 update because of EHR's reorganization in June 1991. Finally, when we asked for the 1993 update during our review, a senior EHR official told us that the document was not expected to be finalized and instead would be subject to continuous updating. Therefore, we concluded that, at least during the period of our review, these procedures were not followed and that no mention of this process in the report was justified.

NSF's written comments also mentioned our limited treatment of the National Science Board's Committee on Education and Human Resources in the priority-setting process. To the contrary, we thoroughly investigated the role of the Committee by attending one of its sessions, reviewing the Committee's minutes for the most recent 3 years, and interviewing its Chairman. According to the Chairman, the role of the Committee is to set

broad policy on science education matters. He further stated that the Committee reviews the work of the EHR directorate and gives broad policy direction. He added that the Committee does not get involved in the day-to-day activities of the directorate. Because of the limited, albeit important, role played by the Committee, our discussion of the Committee in the draft report is brief.

2. With regard to NSF's "disappointment with the lack of attention given to evaluation in the report," we believe that we gave this area complete coverage. The draft discussed how NSF's evaluation process evolved from primary reliance on Committee of Visitors' reviews to using contractors to conduct detailed evaluations of the programs. In addition, we devoted a separate appendix (app. I) to listing the status of each program's contractor evaluation. Furthermore, we did not mention NSF's leadership role in the Federal Coordinating Council for Science, Engineering, and Technology's (FCCSET) activities on the evaluation of programs throughout the federal government because our congressional requester did not ask us to examine what NSF or FCCSET (which has been reorganized and renamed the National Science and Technology Council) is doing to evaluate similar programs outside of NSF. Last, NSF expressed concern that the draft did not discuss how the contractors' evaluations are or could be used in setting future priorities. Since only a small number of these programs' evaluations have been completed (i.e., 2 of 30), discussing how these programs are used to set future priorities is premature. However, we added a sentence to the final report citing that EHR plans to use the results of these reviews to assist in setting future priorities.

3. We agree that much of the draft report is directed at assessing the adequacy of the resources available for managing the programs. We believe the issue of whether EHR has received the resources to administer its programs effectively is very important and quite complex. However, we disagree with the comment that, "In describing workload issues, [GAO's] assumption appears to be that all directorates are more or less alike, that one proposal is pretty much equivalent in determining workload as any other, and that monitoring is largely a policing activity." The draft makes no direct or implied assumptions regarding the homogeneity of proposals across NSF's directorates. In fact, page 20 of the draft (now p. 12) carefully explained that significant differences in proposals could take place from directorate to directorate, thus weakening the results of any such comparison. We further stated that such differences could not be standardized in our analysis. Also, in the detailed discussion of our indicators on page 76 of appendix IV of the draft (now on p. 61) and in the

objectives, scope, and methodology section on page 93 of appendix V of the draft (now on p. 72), we again alerted the reader to the lack of homogeneity of proposals. Finally, we have not stated or made any assumptions in the report that monitoring is largely a policing activity and we were not told this by the program officers we interviewed. Although we believe that site visits are important to assist principal investigators in meeting project objectives and to maximize the effectiveness of taxpayers' dollars, the draft pointed out on page 10 (now on pp. 6-7) that NSF's policy does not require site visits to be made.

4. Our analysis of workloads across NSF was not directly connected to our program officer interviews, and we made no link between our conclusions about the program officers' responses and our work on workload comparisons. Furthermore, our interviews with selected program officers were not designed as a statistical sample of all program officers in EHR, and nowhere in the draft did we say that our results from these interviews represent the views of all EHR program officers. Our selection criteria were to interview only those EHR program officers responsible for precollege programs (since our requester asked us to concentrate on these programs) and only those with at least 1 years' NSF experience (since we believe they are in the best position to comment on problems and make suggestions for improvements for these programs). We discussed these criteria with EHR senior program officers who (1) provided us with a list of 22 program officers meeting the criteria and (2) did not express any disagreement with the methodology. We subsequently interviewed all but 4 of the 22 program officers (1 was on sick leave and 3 others were unable to meet with us because of their heavy workloads). In addition, we did not interview an estimated three program officers in EHR's Division of Research, Evaluation, and Dissemination (RED) because, at the time of our selection, we were not aware that RED had any precollege programs. We have added our selection criteria to the report (see app. V) and language, where appropriate throughout the report to clarify that the program officers' responses apply only to those 18 with whom we spoke.

5. We believe our workload comparisons of NSF's directorates are reliable. (See our response No. 14, 15, 26, 29, 30, 32, 33, and 34.) In addition, we stated on pages 80-84 of the draft (now on pp. 63-66) our basis and methodology for generating tables IV.5 and IV.6. To further assist the reader in understanding the results of our analysis, we added to this report our methodology for generating an average directorate (see app. IV, and V) used not only in tables IV.5 and IV.6, but also in four other tables and one figure in appendix IV.

6. We agree that the monitoring of complex projects requires greater administrative resources than the monitoring of small and simple ones. However, our response to comment No. 3 applies to this situation as well. As NSF knows, awards are simply funded proposals. However, to further clarify this fact, we have added "or awards" to the language used throughout the report to alert the reader to the limitation and what we did to strengthen any such comparisons.

7. The National Science Board, under the National Science Foundation Act of 1950, as amended, is responsible for establishing NSF's policy. Since NSF will likely need to make changes beyond the fine tuning of the current system, we believe direct involvement by the National Science Board is needed. Furthermore, our audit work indicated that NSF has had difficulty implementing measures designed to improve efficiency agencywide. (See p. 7 and app. II.) Because of the unique capabilities vested in the National Science Board, we believe it can successfully determine what improvements are needed and have them implemented.

8. We contacted NSF's Office of Budget, Finance, and Awards Management and EHR to specifically ask each if they had done any analysis to identify the amount of additional money that would be needed to most effectively manage EHR and/or other NSF directorates. We were told that no such analysis had been done and no such amount existed. To follow up on NSF's comments that such a "gap" existed, we again asked NSF to describe the "gap" referred to and provide any supporting documentation or analysis. However, in response to this request, we received no estimate, analysis or other proof of the existence of the "gap." Furthermore, as we pointed out on page 10 of the draft (now on p. 6), EHR's Assistant Director told us that EHR has sufficient administrative resources. Finally, our independent review concluded that no such gap existed, but rather that EHR needs to make more effective use of the available resources. Therefore, since no such amount exists, any discussions, conclusions, or recommendations on this topic could not be made.

9. In response to these comments, we asked NSF to provide evidence of the roughly 57 to 62 program officers in EHR that NSF claims deal with precollege programs. However, the response received was incomplete, since NSF did not provide us with all the information requested to fully verify its statement. For example, NSF's response showed that 47 program officers work primarily on precollege programs rather than 57 to 62. Nevertheless, our aim was to interview experienced precollege program

officers, about 72 percent of whom we met with. (See our response No. 4 for further details.)

10. See our response No. 4.

11. All findings in the letter of the report were based on the responses of all 18 program officers. The rationale for separating the 4 OSR program officers from the other 14 program officers was presented in the draft letter on page 14 (now on p. 9) and in appendix V on pages 90 and 91 (now on pp. 70 and 71). Appendix III analyzes the 4 OSR program officers' responses separately from those of the remaining 14 program officers' responses.

12. See our response No. 4.

13. We are aware that using percentage data to characterize response rates can be problematic with a small sample size. That is why we provided the number of program officers associated with each percentage calculation throughout the report. In the vast majority of cases, we provided the number as the primary point of reference, with the associated percentage listed in parentheses. This approach clearly indicates that the percentage reference was not included to mislead the reader. In addition, all charts were accompanied by notes indicating the total number of program officers responding to the question. (See our response No. 4.)

14. On pages 19-21, 75-87, and 93 and 94 of the draft (now on pp. 12-13, 60-68, and 72 and 73) we fully define the performance indicators that we developed. In addition, during our review, we discussed, in detail, these and other proposed indicators with NSF's Chief Financial Officer and his staff, who did not express any concerns with our methodology. (See also our response No. 5.)

15. On page 21 and on pages 75-87 of appendix IV of the draft (now on p. 13 and on pp. 60-68), we did interpret the indicator discussion. Data on the number of program officers per directorate per year, number of proposals received per directorate per year, and number of awards made per directorate per year that we obtained from NSF were not needed to interpret the indicator discussion but could be used to replicate the analysis shown in the tables. However, since we used NSF's data, including such data would serve only to unnecessarily complicate and lengthen the report for others.

16. The finding presented on page 2 of the draft letter (now on p. 2) did not come solely from figure III.1 on page 43 (now on p. 33). This finding applied to all 18 program officers, including the 4 from OSR. (See our response numbers 4 and 11.)

17. On page 2 of the draft letter (now on p. 2), we did state that program officers indicated that their heavy workload, the lack of travel funds, and a high personnel turnover rate are key obstacles to effective administration of EHR's precollege programs. While we believe this table is useful in describing a number of program officers' most serious concerns, our support for this finding did not come solely from table III.1. Rather, this finding came from several questions concerning workload, travel funds, and high turnover as discussed in appendix III.

18. We have revised the draft to indicate that these staff are IPAs (hired under the Intergovernmental Personnel Act) and not visiting scientists.

19. The workload performed by the evaluator staff in items 1 and 2 at the top of page 8 of the draft (now on p. 5) was factored into our workload indicator of EHR's program officers. As stated on page 81 of the draft (now on p. 64), because actual data on program officers were not available, we used available data on scientists and engineers to estimate the number of program officers in each directorate. Furthermore, because some of NSF's data obtained on scientists and engineers excluded Intergovernmental Personnel Act employees—the type of evaluator staff mentioned in NSF's comment letter to us—we added this staff type to the totals for scientists and engineers and referred to the new total as research staff. Therefore, since the employees cited would be included in our estimate of program officers, they were included in our workload indicators of EHR program officers. We have clarified our report to provide more details of this methodology.

20. We have changed "awards" to "awardee" and deleted "to write proposals."

21. The draft report made no direct or implied criticism of NSF's allocation of travel money within the S&E appropriation. In fact, the draft stated on pages 10 and 11 (now on pp. 6 and 7) that (1) travel money used to visit project sites to observe operations first-hand is not required by NSF's Grant Policy Manual and (2) NSF management redirected these funds to other competing demands such as staff salaries within NSF's S&E appropriation. We believe that the merit of paying staff salaries over taking optional

travel is self evident. Furthermore, we did mention reductions to the S&E account as a result of congressional action in footnote 4 on page 11 of the draft (now in footnote 5 on p. 7).

22. The conclusions about workload on page 14 of the draft (now on p. 9) related to both OSR and non-OSR program officers. Figure III.2 did show that 57 percent of the 14 non-OSR program officers report logging two or more hours of overtime a day. We agree that this is a large number, but we have no reason to believe that this number, which was reported by the program officers we interviewed, is not accurate.

We disagree that combining "somewhat" and "much too many" contaminates the workload assessment. We grouped these response categories because they both represented a workload level beyond that perceived as optimal and believe that distinguishing between the two was unnecessary. As explained in appendix V, we used this approach in several places throughout the report.

We agree that the percentage of program officers viewing the number of proposals to review as being too many is smaller when the OSR program officers' responses are included with those of the 14 other program officers. In fact, in our letter, we presented the smaller number that represents all 18 program officers' responses. We are also aware of the differences between OSR's SSI program and other more typical EHR programs, and we discussed these differences in the draft both in the letter and in appendixes III and V.

23. The finding referred to here did not come solely from table III.2. It came from the responses of all 18 program officers. Furthermore, we do not agree that the information presented in tables III.2 and III.4 fails to take into account the base on which the percentage increases and decreases are calculated. The first column of the table shows the base and the last column shows the percentage change, thus providing the reader with complete information on the calculation. In addition, we provided the information in this format because program officers voiced certain concerns. They stated that, while it was difficult to accurately estimate the portion of their time spent on each task, their estimates of how much more or less time they would like to spend on each task were reasonable estimates. We also stated this fact in the draft.

24. We corrected the typo prior to receiving NSF's comments.

25. We recognize that the evaluation work conducted by NSF is to determine the effectiveness of programs and not projects and that principal investigators are responsible for summative evaluations of their projects. However, program officers told us that they should be more involved in (1) making sure that the evaluations of projects are done, (2) reviewing them, and (3) learning from them. As stated in the draft, some told us that they felt strongly that having program officers participate in the project evaluation process (through reviewing summative evaluations) could be an important part of the decision-making process used to make better funding recommendations when reviewing future proposals. We clarified the report to reflect the fact that NSF's program officers do not always have time to determine whether a project has met its objectives.

26. By computing an average consisting of all seven NSF directorates, we generated a standard directorate to compare EHR or any other directorate with. Our goal was to avoid making comparisons of dissimilar objects, and since the nature of proposals could differ significantly from directorate to directorate, using an average directorate that excludes EHR—as suggested by NSF—would magnify any differences between EHR and NSF's other directorates. Consequently, the use of such an average would weaken the relevance of our comparative analysis. Furthermore, using NSF's suggested method would be difficult to implement since comparisons of each of NSF's seven directorates would require seven separate averages and the above criticism would still persist. Finally, for the most current year, EHR happens to fall in the middle of the distribution of our indicators, and as such the distortion problem mentioned does not occur. Therefore, the use of the NSF method would not change our conclusion regarding EHR's workload. (See also our response No. 5.)

27. We disagree that the draft report leads to the conclusion of resource inadequacy. Our audit uncovered conflicting evidence on whether EHR has obtained the resources it needs to administer its education programs effectively. For example, on page 10 of the draft (now on p. 6) we cited that EHR's Assistant Director told us that EHR has obtained sufficient administrative resources, but on draft pages 13-15 (now on pp. 8-10), we gave examples of program officers responsible for precollege programs, whom we interviewed, and cited that they have too many proposals to review, too many grants to monitor, and not enough travel money to make site visits. Similar analysis and examples are cited throughout the report. Therefore, the draft report concluded that we found no strong indication that EHR has not received sufficient resources. We made revisions to the

draft report to better explain that conclusion. The comment on what changes should be made to better use current resources is the reason for our recommended study. Since we found that NSF has been relatively inactive in implementing recommendations made in prior NSF studies to improve operations agencywide, we concluded that the National Science Board is in the best position to identify and implement needed administrative reforms agencywide. Finally, while NSF did not provide us with any analysis supporting additional money that would be needed to most effectively manage EHR and/or other NSF directorates (see our response No. 8), this response indicates a pessimistic view on optimizing available resources, and confirms our assessment that the recommended study should be the responsibility of the National Science Board.

28. We deleted the sentence in the report that refers to this division's use of community college professors as contractors to assist with review analyses.

29. We disagree with NSF's method of calculating averages because it would not result in an average of the directorates or standard directorate whereby each directorate has equal weight. As a result, NSF's computed average would be less representative of each of its directorates. For the example cited by NSF, we averaged each individual directorate's rate to establish a standard rate. In developing this standard, we did not think that the rates of directorates with bigger budgets should have more weight than the rates of those with smaller budgets. There is no reason to believe that budget is more important than any other factor such as availability or use of modern technology. (See also our response No. 26.)

30. We obtained the data shown in table IV.2 on processing time for proposals for each NSF directorate from NSF's Office of Budget, Finance, and Award Management. This office is NSF's office responsible for maintaining such data and determining average processing times for proposals agencywide. We made no changes to the data or the assumptions on which the data were based. Furthermore, the NSF officials who provided us the data did not indicate to us that any assumptions on which the data were based are being questioned. Therefore, since this comment questions the validity of one assumption used by NSF to generate the data provided to us but provides no basis for why the assumption is not valid, we have no reason not to use NSF's data.

31. Assuming that NSF is referring to figure IV.2, and not table IV.2, the information came from the same data that NSF provided us with, which

was referred to in the last comment. On page 93 of the draft (now on p. 73), we cited the specific report used. We worked closely with NSF's budget officials—who provided us with these data—to ensure its accuracy. Furthermore, data on the number of program officers in each directorate would not be needed to calculate an average number of proposals processed each day by each directorate.

32. We discussed the validity of this indicator as well as other indicators with NSF's Chief Financial Officer and his staff. The concerns that NSF now raises were not mentioned during our numerous meetings with these officials. Nevertheless, any such indicators using preliminary proposals could not be developed because complete and reliable data were not available on the number of preliminary proposals reviewed by directorate for the period of our study.

We were also told during our review that data on the exact counts of program officers were not available. However, in response to these comments, we again requested data on the actual number of program officers. The official cited in NSF's written comment letter to us told us that the draft report correctly stated the fact that exact counts of program officers were not available.

As for not considering the complexity of proposals as a factor, we cited on page 81 of the draft (now on p. 64) that the true workload associated with proposals involves the proposal's length and complexity, which because of data limitations could not be incorporated into the staff's workload indicator. Lastly, in response to developing a workload indicator that address the ratio of awards to declinations, we believe the incremental value of adding this indicator to our existing indicators would not be justified.

33. On page 81 of the draft (now on p. 64), we said that because data on the number of program officers were not available, we used available data on scientists and engineers—which we referred to as research staff—to estimate the number of program officers in each directorate. We obtained these data from officials from NSF's Office of Budget, Finance, and Award Management, and we made no changes to these data. During our review, we discussed our use of the data with these officials, who agreed with our usage. (See also our response No. 19.)

34. On page 84 of the draft (now on p. 66), we described our methodology for computing the average number of competitive awards monitored by

each research staff and total staff. We cannot explain why NSF's comment letter stated that the "results seem very strange." During our review, we discussed our approach with NSF's Chief Financial Officer and his staff, and they expressed no concerns to us about that approach. We also used the same method to calculate an average of the directorates as we had used in other related comparisons. Furthermore, the results of this analysis are consistent with the results of our analysis of the number of competitive proposals reviewed by each directorate's research and total staff.

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