

## VIII. VERIFICATION AND VALIDATION (V&V)

The Foundation has both qualitative and quantitative GPRA goals. Its qualitative goals include the three broad strategic outcome goals related to People, Ideas, and Tools and two investment process goals related to implementation of merit review criteria. The outcome goals are presented in a format that requires qualitative assessment of achievement. These assessments are based largely on information included in reports prepared by committees of independent, external experts (e.g. Committees of Visitors and Advisory Committees) who assess the quality of program results based on their collective experience-based norms. Our quantitative goals focus on management activities, with the majority presented in a format that enables quantitative assessment of progress toward goal achievement. Assessment for these goals is based on data collected with NSF's central data systems.

### QUALITY OF REPORTED PERFORMANCE INFORMATION

NSF recognizes the ongoing need to improve data systems for collecting performance information and data, especially that related to facilities. We view the improvement of the quality of data and data systems as an evolutionary process and intend to maintain it as a priority as budget and time allow. Implementing GPRA has enabled NSF to gather information in a structured way and to address issues in a more formal, focused manner than in the past.

In their January 2002 report PricewaterhouseCoopers LLP (PwC) addressed system aspects of NSF data quality for the Awards system, Enterprise Information System, Financial Accounting System, FastLane, Integrated Personnel System, and the Proposal, PI, and Reviewer System. PwC *“reviewed NSF’s information systems to ensure that adequate internal controls are in place to produce reliable data. The techniques presented are based on interviews with NSF managers and staff, rather than a full application review. Pursuant to GAO’s assessment guide, we relied on previously conducted work and on departmental sources to determine whether there were any known problems with the data sources or the data itself that would cast doubt on the credibility of the information. One external report that we referenced was the House Subcommittee on Government Efficiency, Financial Management, and Intergovernmental Relations’ computer security report card, which it released in October 2001. The report card rated NSF with the highest grade (B+) of 24 major federal agencies.”*

In FY 2002, NSF's data quality program has the following objectives:

- Complete the evaluation of data elements with primary focus on data supporting GPRA goals;
- Complete the population of validated data elements into the data dictionary for all GPRA data elements;
- Enhance the functionality of the data dictionary for all NSF-wide information systems to ensure that meta-data describing the data is identified and thoroughly documented;
- Continue to ascertain the causes of the data quality problems and develop systematic methods for correction; and
- Develop and promulgate data quality policies and procedures NSF-wide.

A COV data project initiated in FY 2001 will substantially improve the quality, consistency and availability of data, reports and charts that are used by external NSF committees. These committees, in addition to providing advice to the NSF organization, provide assessments used in NSF's annual GPRA reporting. Currently, each NSF organization produces its own reports

and charts for each of its committees. As a result of this new project, the reports will be generated centrally to reduce costs and improve quality and consistency across NSF. The initial planning for the project begins in FY 2001 with the majority of the implementation to be completed in FY 2002. The project will be completed in FY 2003.

### **DATA V&V ACTIVITIES**

We used a process similar to the one used in FY 2000 to verify and validate selected FY 2001 GPRA performance information. In FY 2000 and FY 2001, we engaged an external third party, PricewaterhouseCoopers LLP, to verify and validate selected GPRA performance results as well as the process through which supporting data was compiled. PwC documented the processes we follow to collect, process, maintain, and report selected performance data. They identified relevant controls and commented on their effectiveness. Based on GAO guidance, they provided an assessment of the validity and verifiability of the data, policies, and procedures we used to report results for the FY 2001 goals. For the outcome goals, PwC confirmed the ratings and interpretations contained in the COV and AC reports. PwC also provided high-level review of NSF's information systems based on GAO standards for application controls. We expect to use a similar process in FY 2002.

In their report (January 2002), PwC concluded "From our review, we determined that NSF has reported on ten of the quantitative goals and all five qualitative goals in a manner such that any errors, should they exist, would not be significant enough to change the reader's interpretation of the Foundation's success in meeting the supporting performance goal. For these goals, NSF relies on sound business processes, system and application controls, and manual checks of system queries to report performance. We believe that these processes are valid and verifiable. For the four goals related to facilities management, we identified significant data limitations, which impaired our ability to verify the processes. However, we believe that NSF's reported outcomes are consistent with the data they collected."

For reporting on goal achievement, all of our outcomes are compiled for programs and activities across the agency. To enable a uniform and systematic organization of reporting information for the strategic outcome goals, we have developed specially designed templates and reporting guidelines for use by committees of external experts (COVs and ACs). These templates and guidelines are reviewed and refined annually. Options for rating NSF are limited to either successful or not successful.

### **TYPES AND SOURCES OF PERFORMANCE DATA AND INFORMATION**

Most of the data that underlie achievement assessments for strategic outcome goals originate outside the agency and are submitted to us through the Project Reporting System, which includes annual and final project reports for all awards. Through this system, performance information/data (compiled by our staff) such as the following are available to program staff, third party evaluators, and other external committees:

- Information on People – student, teacher and faculty participants in NSF activities; demographics of participants; descriptions of student involvement; education and outreach activities under grants; demographics of science and engineering students and workforce; numbers and quality of educational models, products and practices used/developed; number and quality of teachers trained; and student outcomes including enrollments in mathematics and science courses, retention, achievement, and science and mathematics degrees received;

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- Information on Ideas – published and disseminated results, including journal publications, books, software, audio or video products created; contributions within and across disciplines; organizations of participants and collaborators (including collaborations with industry); contributions to other disciplines, infrastructure, and beyond science and engineering; use beyond the research group of specific products, instruments, and equipment resulting from NSF awards; and role of NSF-sponsored activities in stimulating innovation and policy development; and
- Information on Tools – published and disseminated results; new tools and technologies, multidisciplinary databases; software, newly-developed instrumentation, and other inventions; data, samples, specimens, germ lines, and related products of awards placed in shared repositories; facilities construction and upgrade costs and schedules; and operating efficiency of shared-use facilities.

Most of the data supporting management goals can be found in NSF's central systems. These central systems include the Enterprise Information System (EIS); FastLane, with its Performance Reporting System and its Facilities Reporting System; the Online Document System (ODS); the Proposal, PI, and Reviewer System (PARS); the Awards System; the Electronic Jacket; and the Financial Accounting System (FAS). These systems are subject to regular checks for accuracy and reliability.

The Division of Human Resources Management (HRM/OIRM) maintains information related to staff recruitment and staff training, under the guidance of the Chief Information Officer. OEOP databases are also available for reporting purposes.

The qualitative aspects associated with the goals on implementation of both merit review criteria are addressed in reports of external committees (COVs and ACs) and/or staff analyses.

### **Data / Information Limitations**

For outcome goals, the collection of qualitative data during assessment may be influenced by factors such as a lack of long-term data/information to assess the impact of outcomes, the potential for self-reporting bias, the unpredictable nature of discoveries, and the timing of research and education activities. For the quantitative management goals, the assessment may be influenced by factors such as accuracy of data entry into central computer systems, lack of experience in using new reporting systems or modules, or individual non-responsiveness (e.g., self-reporting of diversity information; workplace surveys).

Finally, external expert assessments (presented in COV and AC reports) may lack sufficient justification for ratings or may provide incomplete information. To address this issue NSF is continuing to modify its reporting templates and improve guidance to committees and staff in order to improve the completeness and consistency of the reports. This will aid in compiling qualitative information. Additionally, we have focused on clarifying language in goal and indicator statements.