NATIONAL SCIENCE FOUNDATION

Case Study

Strategic Planning at The National Science Foundation

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The experience of NSF exemplifies both the difficulty and benefits of the process of consensus building and articulating the ultimate goals and implementation strategies for an organization of 1200-1300 people, even when the implicit goals of the organization had previously been considered widely shared.

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Case Study on NSF's Strategic Planning

History/Context

NSF is an independent federal agency created by the National Science Foundation Act of 1950 (P.L. 81-507). Its aim is to promote and advance scientific and engineering progress in the United States. The idea of such a foundation was an outgrowth of the important contributions made by science and technology during World War II. From those first days, NSF has had a unique place in the Federal government: It is responsible for the overall health of science and engineering across all disciplines. In contrast, other federal agencies support research focused on specific missions, such as health or defense. The Foundation is also committed to ensuring the Nation's supply of scientists, engineers, and science educators.

NSF funds research and education in science and engineering through grants, contracts, and cooperative agreements to more that 2,000 colleges, universities, and other research institutions in all parts of the United States.

NSF receives about 53, 000 requests for funding (both new and renewal projects) each year and makes about 20,000 awards. These typically are awarded to universities, colleges, academic consortia, nonprofit institutions, and small businesses. The agency operates no laboratories itself but does support National Research Centers, certain oceanographic vessels, and Antarctic research stations. The Foundation also supports cooperative research between universities and industry and U.S. participation in international scientific efforts.

The Foundation is led by a presidentially appointed director and a National Science Board composed of 24 outstanding scientists, engineers, and educators from universities, colleges, industries, and other organizations involved in research and education.

NSF is structured much like a university, with grants-making divisions for the various disciplines and fields of science and engineering and science education. NSF also uses a formal management process to coordinate research in strategic areas that cross traditional disciplinary boundaries. The Foundation is helped by advisors from the scientific and engineering community and from industry who

serve on formal committees or as *ad hoc* reviews of proposals. This advisory system, which focuses on both program direction and specific proposals, involves more than 59,000 scientists and engineers a year.

Long Range Planning

NSF has always done long-range planning, as part of the budget cycle, preparatory to developing the budget for a particular year. Divisions and Directorates consider scientific
opportunities, issues and constraints confronting them, as well as national needs and trends, with the object of articulating priorities and formulating new initiatives. The long range planning process typically starts internally, and bottom-up. The resulting ideas are filtered by top NSF management and structured by staff for consideration by the National Science Board at its yearly Long Range Planning meeting. NSB provides guidance on priorities and initiatives. NSF's management then negotiates with OMB on the budget request for the next year. Goals have been largely implicit.

The annual planning cycle has been punctuated periodically by more focused long range planning that included elements of strategic planning for the agency.

Shift to Strategic Planning

The current strategic plan was developed and written over the period of January to October, 1994. The impetus for the effort came from the confluence of many forces in the prior few years. The Government Performance and Results Act (GPRA) had been passed, and the National Performance Review (NPR) begun. Congressional Committees were pressing NSF to be more precise about how, and to what national benefit, we planned to use our appropriated funds. NSF had lived through radical cuts in its science education function in the early years of the Reagan administration, and a subsequent swift regrowth in the late eighties. Rather than simply recreating what had existed before, with whatever vestigial remnants of the past it might have incorporated, it was clear that forward-looking "strategic thinking" was what was needed. That experience engendered the notion that the Foundation as a whole could benefit from such an activity.

In early 1992, Director Walter Massey recommended and the National Science Board established the (external) National Science Board Commission on the Future of the National

Science Foundation. The Commission was charged to think, and to stimulate thinking, about long range strategies for the Foundation. In its report [1], the Commission articulated NSF's dual goals: "One is to support first-rate research at many points on the frontiers of knowledge, identified and defined by the best researchers. The second is a balanced allocation of resources in strategic research areas in response to scientific opportunities to meet national goals."[2] It emphasized the importance of merit review, the encouragement of interdisciplinary work, intersectoral and international collaboration, the important link between research and education, and "common sense metrics". In short, it established a basis for NSF's 1994 strategic plan, and also echoed a thrust of GPRA.

Following the work of the Commission, in the spring of 1993, Director Massey asked a number of Task Groups within NSF to make recommendations for implementing some of the Commission's ideas. The new Director Neal Lane (whose tenure began in the fall of 1993) shared his predecessor's interest in a strategic approach to planning, and wanted to take advantage of the work done under Massey. One of Dr. Massey's task forces (working on the issue of accountability) had determined that the largest payoff for improving accountability would come from NSF's establishing goal setting and progress reporting processes, and from improving the quality and availability of information relating to the impact of NSF funding on the conduct of research and education.

Thus, the development of the strategic plan was undertaken to satisfy multiple purposes, including tying NSF goals to the Administration's national science and technology goals. NSF is represented on the President's National Science and Technology Council, which sponsored a Forum on Science in the National Interest in early 1994. NSF was thus party to the discussions that led to a presidential statement *Science in the National Interest*, August 1994, and the NSF strategic plan reflects the influence of those discussions. NSF's strategic plan was developed with the knowledge that GPRA had been enacted, but without specific effort to meet GPRA requirements.

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[1] *A Foundation for the 21st Century: A Progressive Framework for the National Science Foundation,*
Report of the National Science Board Commission on the Future of the National Science Foundation, November 20, 1992, NSB 92-196.

[2] op. cit. p.5.

Strategic Planning Process

There were three stages in the development of NSF's current strategic plan, in the sense that major inputs came first from the NSF staff, then NSF Advisory Committees, and finally the National Science Board. But all these groups kept track of the process; and all were considering planning issues simultaneously.

The first, largely internal, stage consisted of the work of two groups. A mid-level staff group from all across the Foundation called the Strategic Planning Working Group started the drafting. They reported to an *Ad Hoc* Committee on Strategic Program Planning, consisting primarily of the Assistant Directors, who worked with the Advisory Committees and the National Science Board, circulating drafts to them. A fairly complete plan was developed by NSF staff, through iterative discussion and drafting. Rather than top-down or bottom-up, the evolution of the document was interactive, although what it was to contain - vision, core values, goals, a set of principles to guide NSF investment strategy - was set out by the Director in a memorandum to the Ad Hoc Committee. The memo is in Attachment 1.

In the second stage, the draft was discussed with Advisory Committees to the various directorates of the Foundation. These groups include a variety of stakeholders, such as academic researchers, industrial representatives, and people from other Federal agencies. At that time, the Chairs of those committees guided a lot of rewriting and refocusing.

At the start of the process, mechanisms for the later involvement of the National Science Board were established. Director Lane and the Chair of the NSB set up a Board Task Force to follow the process and work with NSF staff. In the third stage of the plan's development, the Board task force guided further redrafting. The Board's input on policy issues is reflected in the final version. For instance, initial emphasis on "strategic areas" of research - a topic that had generated lively discussion in the Washington science community - was placed in the broader contexts of world leadership and service to society with the Board's influence. They stressed broader goals and objectives. The Board also found the international dimensions of science underemphasized, and helped remedy that.

As the planning process was begun, in January 1994, a schedule for many regional forums across the country was

sketched out, to discuss the planning process and other issues with the scientific community and others. As the process developed, however, this schedule proved unrealistic and overly ambitious. NSF therefore relied on the Advisory Committees and the National Science Board to provide inputs from NSF's stakeholders. Congressional committees and OMB have not yet been actively involved in the planning process. (To the extent that the plan is embodied in the budget and public testimony, it has been implicitly imparted. It also formed the conceptual framework for National Performance Review planning with OMB and the Office of Science and Technology Policy in the White House.)

The challenges faced in the strategic planning process were mainly predictable human ones. Many staff members were not convinced that the resulting document, containing fairly abstract goals and strategies, would improve NSF's operation in any way. Because of that skepticism, normal "group-writing" frustrations may have been magnified; they were certainly present.

Strategic Plan Summary

NSF's mission is set out by Congress in the enabling legislation: NSF is to promote the progress of science and engineering, and thus the national welfare. The strategic plan[3] articulates three interrelated long-range goals for accomplishing this mission:

1 Enable the US to uphold a position of world leadership in all aspects of science, mathematics, and engineering
1 Promote the discovery, integration, dissemination, and employment of new knowledge in service to society
1 Achieve excellence in US science, mathematics, engineering and technology education at all levels.

The plan enumerates four core strategies for achieving the goals:

1 develop intellectual capital
1 strengthen the physical infrastructure
1 integrate research and education
1 promote partnerships.

The first two strategies reflect the fact that a world-class research and education infrastructure, comprising both human

[3] *NSF in a Changing World: The National Science Foundation's Strategic Plan* , NSF 95-24, 1995. Executive Summary included in Attachment A6.

and physical resources, is a *sine qua non* for upholding world leadership. The third strategy, integrating research and education, strives to better take advantage of a special characteristic of the research enterprise in the US: the extent to which it is embedded in institutions of higher education.

Finally, NSF recognizes that it cannot reach its goals without the activity of many different kinds of partners. The plan discusses who NSF's partners are. It also describes the set of core values with which NSF operates.

Subsequent to the publishing of the Strategic Plan, approaches to linking its goals and strategies with performance goals and indicators have been sought. Under one approach, the achievement of a strategic goal would require NSF to implement all or some of its four core strategies. For instance, a performance plan for implementing the core strategy of developing intellectual capital to meet the strategic goal of enabling the United States to uphold a position of world leadership in all aspects of science, mathematics and engineering would require NSF to set performance goals for each of our three key program functions: research projects, facilities, and education and training.

Use and Impact of Strategic Planning

Over time, the planning process built consensus among those directly involved. The resulting text now guides testimony, speeches, and budget submissions. The concepts that were developed helped NSF address the questions of the National Performance Review Phase II, which dealt with the core functions of the agency, and what it should be doing. NSF could test its functions and processes against the goals and strategies it had articulated the year before. The document also provides a framework for developing performance assessment to comply with GPRA, and for structuring performance information. NSF's FY97 budget submission presented accomplishments organized by strategic goal and core strategy.

The plan is independent of organizational structures, and thus led to no reorganization or other major formal changes. In some areas, it has clearly led to changes in the activities of NSF managers, staff, contractors, and grantees (examples below.) In others, such changes will depend on more detailed, visible implementation plans. In still others, core activities and behaviors require little change.

1 The plan provides a conceptual framework in which NSF activities can be described; thus aligning, to some degree, concepts of what NSF is doing. For instance, the thrust of integrating research and education is clearly visible in NSF activities. The new

> ”Recognition Awards for the Integration of Research and Education“ will make awards that recognize up to ten research-intensive universities that have shown leadership, innovation, and achievement in their efforts to integrate research and education (specifically college freshmen through Ph.D.) throughout their organizations. Also, the Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that supports junior faculty within the context of their overall career development. It combines in a single program the support of quality research and education in the broadest sense. The program emphasizes the importance the Foundation places on the development of full and integrated academic careers that include both research and education.

1 Units, particularly those that have some responsibilities across NSF (e.g., the Division of International Programs), are explicitly seeking to describe the way their activities are serving Foundation goals.

1 The National Science Board has formed an NSB/Staff Task Force on Merit Review to examine the Board’s generic review criteria for the selection of research proposals (adopted in 1981). This reexamination is being undertaken in the light of the Strategic Plan’s new long-range goals and core strategies, as well as NSF’s expanded portfolio. (A staff task group on review criteria, formed by the Deputy Director in the fall of 1995, found that the NSB criteria are unevenly applied by reviewers and NSF staff in the proposal selection process.)

1 The articulated goals and strategies permeate the ongoing search for ways of communicating to outsiders what NSF accomplishes.

1 Ways of measuring progress toward the goals are still being worked on (see Next Steps, below.)

> When in 1992 the Congress and the National Science Board Commission talked of science in service to society (using various other words), parts of the scientific community strenuously objected, thinking such an emphasis would put fundamental research in danger. It is probable that the set of planning activities from 1992 to 1994 helped reduce that trepidation.

Costs

There have been large costs in staff time and frustration,

and perhaps cynicism. Staff members are largely focused at an immediate, local level. Developing a strategy for NSF as a whole was difficult for them. It was very disconcerting for an agency based upon science and engineering to have little or no actual science or engineering in its strategic plan, as opposed to what some thought mere rhetorical generalities. On the other hand, some people within NSF think the plan is *too* focused on science and engineering to communicate well with the general public, one intended function of the document.

The second phase of NPR, the efforts to balance the Federal budget, and the shutdowns associated with the FY 1996 appropriations have all contributed to delaying and diffusing efforts for more detailed, visible implementation of the plan. This contributes to the view of many that the plan has little influence on their actions. Others would argue that the
plan has made NSF's staff subliminally aware of how the science we promote can be of service to society.

Political costs have not been obvious; perhaps they will be more evident when the
implementation of the plan affects resource allocations more directly.

Lessons learned

Consensus on the basic concepts is relatively easy to obtain; that was achieved by March, 1994. But consensus on points of implementation, presentation, and wording is much more difficult; this took until October, and agreement was still not complete. As planning gets closer to actual operations, and thus to matters of "turf ", it becomes much harder to get people to sign on. This is largely because different people read the same words to mean different things. It remains to be seen whether setting out a hierarchy of goals, resulting objectives and performance indicators *appropriate* to the functions assessed will help allay people's fears on this.

NSF considers it important to focus on what will help it to manage better. Long range planning helps the Foundation decide where opportunities for investment are, but may omit or leave implicit what the agency is ultimately trying to accomplish. The National Science Foundation has a tradition of fairly decentralized, autonomous operation. The framework provided by the strategic plan is intended to let that operation remain autonomous, while increasing the

agency’s focus on common goals.

Next Steps

The immediate next step is to supplement NSF’s strategic plan so that it complies with the requirements of GPRA. This does not mean changing the substance of the goals and strategies, but adding elements such as the set of external factors that influence the agency’s ability to meet its goals. Sharpening the goals and strategies so they yield assessable performance goals will also be important.

More generally, what follows from this experience is that if the planning process is to have its desired effect, NSF senior management need to do a better job of explaining to program officers how to incorporate the strategic plan into their programmatic decisions. Though the senior management has absorbed the concepts in the strategic plan, program officers tend to think the half-life of strategic plans is short. They understand their own jobs in a longer time-frame. Questions remain as to how the strategic plan should inform NSF’s central process: choosing among competing proposals those that will be funded.

No doubt NSF will learn more about these questions as we go along. The Foundation is planning to seek OMB approval to use the ”alternative " descriptive (non-quantitative) form for statement of some of its performance goals as permitted under GPRA. The
alternative form would describe what NSF would be doing if it were "minimally effective", and what it would be doing if it were "successful". These descriptions will be in terms of our strategic goals and core strategies. To make this determination, we would assemble independent assessment panels to judge our progress toward the articulated goals, based on the best available data and other information. The panels would assess broad aggregates of the Foundation’s activities, using the framework provided by the strategic plan, covering all NSF’s research and educational activities, most likely in a rotation of panels over a period of several years. The panels would be expected to use the strategic plan’s goals, with derived appropriate objectives and results information, to guide their expert assessments, and their reports to the Director. (A more extended discussion of these issues can be found in NSF’s companion Case Study on the Development and Use of Outcome Information by NSF.) When they do this, all concerned should learn a lot about how the strategic plan relates to NSF operations.