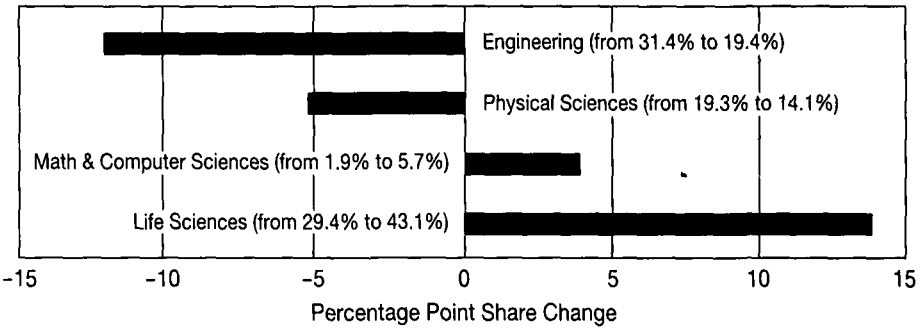
NSF Study Shows Dramatic Shift in Shares of Federal Scientific Research Support

According to a U.S. National Science Foundation (NSF) Issue Brief, the end of the Cold War and new national priorities were major contributors to dramatic shifts in the field mix, or "market share," of federal support for science and engineering (S&E) research between 1970 and 1997. The Issue Brief, "How Has the Field Mix of Federal Research Funding Changed Over the Past Three Decades?" was produced by the NSF's Division of Science Resources Studies (SRS). According to the report, the share of federal S&E research funding for the life sciences increased nearly by half—from 29.4% of the total mix to 43.1%—while engineering's share of federal research support dropped by nearly two-fifths, from 31.4–19.4%, between 1970 and 1997 (see figure).

Issue Brief author Alan Rapoport said, "A declining Department of Defense budget in the post-Cold War period led to fears of declining support for engineering and the physical sciences. Recent increases in the budgets of the NIH have stirred anxiety about funding imbalances between the life sciences and other fields."

According to the brief, "All engineering fields except metallurgy and materials had declining shares, with the largest losses in electrical and mechanical engineering." While the broad category of engineering lost 12.0 percentage points, metallurgy and materials increased its share by 0.1 percentage point within the three decades, with most of the increase occurring in the 1980s (0.5 percentage point; an increase of 0.4 percentage point shows during the 1990s). The study found that most of engineering's share decline had occurred by the end of the 1980s. The mathematical and computer sciences' (pri-



Changes in field shares of total federal research funding: 1970-1997. Extracted from Figure 1 of the National Science Foundation Issue Brief, "How Has the Field Mix of Federal Research Funding Changed Over the Past Three Decades?"

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marily the latter) "market share" tripled, from 1.9–5.7%, while the physical sciences saw significant drops in their share, mostly during the 1990s.

SRS data are available on the web: www.nsf.gov/sbe/srs/stats.htm. The Issue Brief is available at www.nsf.gov/sbe/srs/issuebrf/ib99328.htm.

Report Confirms Ability to Assess Soundness of Long-Term Federal Research Programs

The effectiveness of federally funded research programs—both basic and applied—can be assessed meaningfully on an annual basis as required by law, according to a report from the Committee on Science, Engineering, and Public Policy, a joint committee of the National Academies of Sciences and Engineering and the Institute of Medicine. The report said that different criteria should be used for different types of research to ensure that assessments fairly gauge progress.

During the course of its study, the committee heard two conflicting viewpoints on approaches to measuring basic research. One held that it is possible to measure research annually and provide quantitative measures of the useful outcomes of both basic and applied research. The other viewpoint was that given the long-range nature of basic research, no sensible way exists to respond to the annual measurement requirement. Therefore, some agencies may resort to using measures that seem to respond to federal law—such as a list of the agency's top 100 discoveries of the preceding year—but are actually meaningless.

Committee chair Phillip A. Griffiths, director, Institute for Advanced Study, Princeton, said, "We concluded that both basic and applied research can be evaluated meaningfully on a regular basis. But it is important that agencies evaluate their research programs using measurements that match the character of the research." Differences in character will lead to differences in the appropriate time scale for measurement, in what is measurable and what is not, and in the expertise needed by those who contribute to the measurement process, the committee reported.

Basic research involves theoretical or experimental investigation to advance scientific knowledge, without immediate practical application as a direct objective. The committee said that government agencies can regularly assess the progress of basic research in terms of quality and relevance to agency goals and intended users. Applied research uses knowledge gained through theoretical or experimental investigation to make things or create situations that will serve a practical purpose. Programs in applied research usually include a series of milestones to be reached by particular times, and a description of the intended outcomes as well as their significance to society. Progress toward these milestones can be measured annually, the committee found.

The committee reported that the most effective means of evaluating federally funded research programs is expert review, which should be used to assess both basic and applied research. The committee outlined three forms of expert review and their applications: quality review, relevance review, and benchmarking.

To assess quality, peer review should be used, the committee said. Peer reviewers should include scientists at agency, university, and industrial laboratories who have participated in and who best understand federally funded research programs. However, peer review as it currently takes place in most federal agencies varies greatly and should be analyzed and modified as necessary. Relevance review and international benchmarking also are needed.

Relevance review draws on not only the views of experts in the field, but also potential users and experts in related fields, to evaluate the relevance of the research to an agency's mission. Benchmarking reviews use panels of experts from the United States and elsewhere to judge the international leadership status of the United States in a program.

In conducting its study, the committee reviewed and assessed the strategic and performance plans of 10 federal agencies—the U.S. departments of Agriculture, Defense, Energy, and Transportation as well as the National Institutes of Health (NIH), the National Science Foundation (NSF), the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency, the National Institute of Standards and Technology, and the National Oceanic and Atmospheric Administration. Over the course of the 12-month study, workshops were held to gather information, including industry methods to evaluate research performance.

All federal agencies are mandated by law, under the Government Performance and Results Act, to set goals and use performance measures to encourage greater efficiency, effectiveness, and accountability. The Act requires that agencies write strategic plans with annual performance targets and produce an annual report that demonstrates whether these targets are met. The first performance reports are due in March 2000.

Copies of the report, *Evaluating Federal Research Programs: Research and the Government Performance and Results Act*, are available through the National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20055; 202-334-3313 or 1-800-624-6242. The cost of the report is $18.00 plus shipping charges of $4.00 for the first copy and $.50 for each additional copy. More information about the report and the committee's work is available at http://www2.nas.edu/cosepup. □

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