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ABSTRACT

This document reports results of a review of estimated 1977 federal research and development (R&D) funding and requested 1978 federal R&D funding. Highlights include: 1978 estimated R&D total is $26.3 billion, an increase of 7.6% over 1977; average annual R&D growth rate for the period 1974-78 has risen to 10.9% compared to 1.5% for the period 1968-74. Department of Defense (DOD), Energy Research and Development Administration (ERDA), National Aeronautics and Space Administration (NASA), and Department of Health, Education, and Welfare (HEW) represent 89% of the growth in R&D funding during the period 1974-78. Basic research funding for 1978 is estimated at $3.0 billion; applied research funding for 1978 is estimated at $6.5 billion, a record high. (SL)

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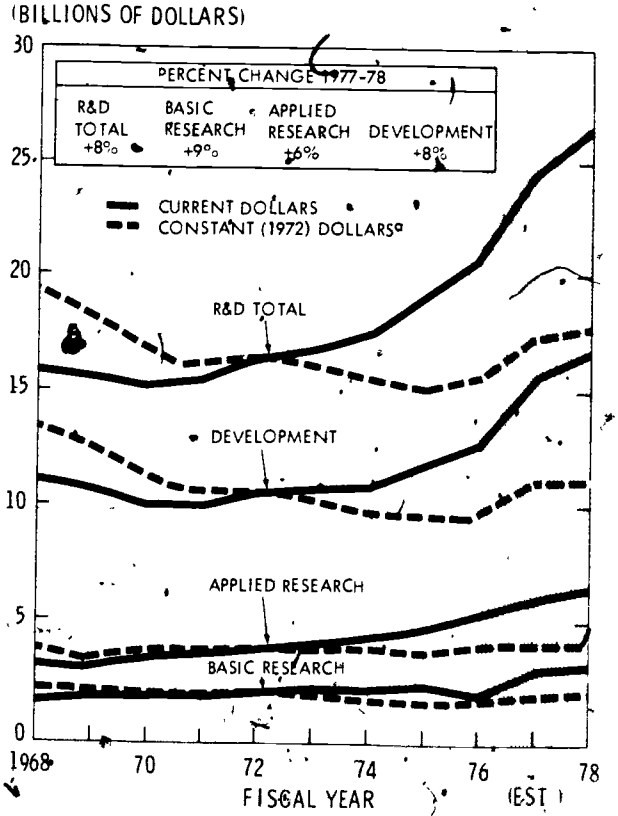
Federal R&D Funding Shows Strong Recent Rise But Little Real Growth in FY 1978

The following data are taken from Federal Funds for Research, Development, and Other Scientific Activities, Volume XXVI, to be published later. Data reflect estimates for 1977 and requested amounts for 1978 as shown in the President's budget to Congress. The survey on which the report is based was conducted in the second quarter of fiscal year 1977, shortly after the budget message for 1978. Final legislative and executive decisions will change, by varying degrees, the amounts shown below.

- Federal R&D programs (plant excluded) make up an estimated total of $26.3 billion for fiscal year 1978, an increase of 7.6 percent over the previous year. A small real increase is indicated, assuming an inflation rate of 6 percent for the economy as a whole.
- The share of the Federal R&D and R&D plant total in the controllable portion of the overall Federal budget has fallen only slightly—from 14.7 percent in 1968 to an estimated 13.8 percent in 1978—evidence that agency emphasis on research and development has been substantially unchanged in the past decade.
- In the 1974-78 period Federal R&D funding has risen significantly—at an average annual growth rate of 10.9 percent—compared with 1.5 percent in the 1968-74 period. In constant dollars the recent growth rate is 3.4 percent versus an average annual rate of decline of 3.1 percent for the earlier period.
- Most growth between 1974 and 1978 (89 percent) is represented by four agencies. The Department of Defense (DOD), the Energy Research and Development Administration (ERDA), the National Aeronautics and Space Administration (NASA), and the Department of Health, Education, and Welfare (HEW). DOD and ERDA account for 71 percent.
- Basic research is an estimated $3.0 billion in the President's 1978 budget. Although it represents a budget high, the figure is still 3 percent below the 1968 basic research total in constant dollars.
- The recent growth of DOD, NASA, and ERDA programs has reversed a decline in development funding. Such funding fell after 1968 but has risen yearly since 1971 and is now at a record high of $16.8 billion. Between 1968 and 1978, however, a decline of 16 percent in real terms is indicated.
- Applied research is the only character-of-work component to reflect real growth from 1968 to 1978—a 14-percent rise. The $6.5 billion total in 1978 is a record high.

Federal R&D obligations by character of work: FY 1968-78



[a]Based on GNP implicit price deflator with estimates for fiscal years 1977 and 1978

SOURCE: National Science Foundation

(Prepared in the Government Studies Group, Division of Science Resources Studies)

- Three-fourths of the Federal R&D total—$19.8 billion—is expected to be obligated in the form of grants and contracts to extramural performers in 1978. The remaining one-fourth—$6.5 billion—is expected to cover work by Federal personnel.

Share of Budget

Between 1968 and 1977 the share of R&D and R&D plant outlays in the total Federal budget dropped steadily—from 9.5 percent to an estimated 5.4 percent. The estimated share in 1978 will rise to 5.6 percent.

A comparison between the R&D component of the budget and the relatively controllable budget total shows only a small decline in the R&D ratio between 1968 and 1978—from 14.7 percent to an estimated 13.8 percent. The controllable portion of the budget, of which R&D programs are a part, is subject only to annual authorization and appropriation actions as distinct from the uncontrollable area where the growth of fixed cost and open-ended programs[1] cannot be regulated except by changes in existing substantive law. R&D and R&D plant outlays as a share of controllable budget outlays have fluctuated fairly narrowly in the 1968-78 period, a sign that research and development play an integral part in mission responsibilities.

Character of Work

In 1978 the shares of the character-of-work components within the Federal R&D total are estimated at 11 percent for basic research, 25 percent for applied research, and 64 percent for development. In the past decade almost no change has been shown in the basic research share, but applied research has increased from 20 percent to 25 percent and development has declined from 69 percent to 64 percent. The shift is largely the result of the faster growth of programs related to national problems other than those in defense and space where programs are heavily development-oriented.

The basic research total of $3.0 billion for 1978 is 9 percent higher than the 1977 estimate, reflecting a Presidential policy decision for 3-percent real growth in the basic research effort. Despite the fact that this is the highest figure ever budgeted for basic research, it is still 3 percent lower than the 1968 total in constant dollars. HEW and NSF together account for almost one-half of basic research support in 1978, HEW making up one-fourth and NSF more than one-fifth.

Applied research is expected to grow 6 percent to $6.5 billion in 1978, another record high. No growth in real terms over 1977 is indicated, however. During the past decade real growth of 14 percent is shown. Chief agency sponsors of applied research in 1978 are DOD and HEW, each with more than one-fourth of the total, and NASA with one-sixth.

[1] Social security medical insurance, veterans benefits, public assistance, interest and miscellaneous other programs. See Office of Management and Budget, *The Budget of the United States Government, Fiscal Year 1978* table 16 (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), pp. 420-21.

Development funding will rise 8 percent in 1978 to an estimated $16.8 billion, somewhat ahead of anticipated inflation. But a drop of 16 percent in constant dollars is shown for the 1968-78 decade. Some correlation may exist between the decline in industry employment of R&D scientists and engineers in 1970-75 and lower real Federal support to development, which is mostly industry-performed. Recent increases in development funding by DOD, NASA, and ERDA may reverse this trend.

R&D Program Changes

In 1978 the rise in total Federal R&D funding, as shown in the budget, is almost $1.9 billion. The three leading R&D support agencies—DOD, ERDA, and NASA—together are expected to contribute more than 9 out of every 10 dollars of this increase.

DOD In 1978 the Department of Defense plans for an 8-percent rise of $936 million, which represents slightly more than one-half of the increase for Federal R&D funding as a whole. DOD will provide an estimated 46 percent of total Federal R&D obligations in 1978.

Greatest increases within DOD are represented by Navy programs, which rise 10 percent as a group. Major increases are planned for the F-18 air combat fighter and the Tomahawk sea-launched cruise missile programs. The LAMPS helicopter and V/STOL aircraft programs are also scheduled for higher support, while the Trident missile system will reflect a substantial drop as development enters the final stages. Air Force programs show the next largest gain (8 percent) with the increase in strategic weapons funding resulting from accelerated development of the M-X intercontinental ballistic missile and the air-launched cruise missile, and in tactical weapons from the ground-launched cruise missile, the advanced medium air-to-air missile, and the close support missile system. Funding for the F-16 air combat fighter is scheduled to decline as development advances. Development funds are included for the B-1 bomber, procurement of which has since been discontinued by the President while development is scheduled to go forward. The Army displays a 6-percent gain, placing emphasis on weapons for tactical forces—the XM-1 tank, the SAM-D Patriot missile, the Hellfire heliborne missile, the advanced forward air defense system, and the general support rocket system.

ERDA The R&D programs of ERDA are expected to grow by 15 percent, or $533 million, in 1978, accounting for between one-fourth and one-third of the total increase in Federal R&D obligations. This rise will make ERDA the second largest R&D support agency, with a 16-percent share of the Federal R&D total.

The principal mission of ERDA is to develop and foster economical and effective energy sources and uses, and 80 percent of the ERDA budget for research and development in 1978 is devoted to energy and energy-related programs. Another 20 percent is directed to weapons R&D and naval reactor development.

Federal obligations for research and development by agency: fiscal years 1976-78

[Dollars in millions]

Agency	Actual 1976	Estimates 1977	Estimates 1978
Total	$20 759	$24 465	$26 317
Department of Defense	9 655	11 172	12.108
Energy Research and Development Administration	2 499	3.610	4.143
National Aeronautics and Space Administration	3.447	3.610	3.848
Department of Health, Education and Welfare	2.546	2.959	3.009
National Science Foundation	609	686	758
Department of Agriculture	462	525	574
Department of Transportation	295	407	398
Department of the Interior	314	348	361
Environmental Protection Agency	259	361	311
Department of Commerce	229	247	239
Other agencies	444	538	568

Source: National Science Foundation

Direct nuclear energy programs make up 34 percent of the ERDA total, and among these the liquid metal fast breeder reactor (LMFBR), the largest, is scheduled for a decline in obligations. Other nuclear programs show substantial increases in 1978 including fuel cycle R&D, laser and magnetic fusion, nuclear research and applications, and uranium-enrichment process development.

On the direct nonnuclear side (30 percent of the ERDA total) coal utilization, the largest program, is scheduled for a decrease. A 9-percent increase is planned in solar energy, and a 138-percent increase in end-use conservation.

Another 16 percent of the ERDA R&D total in 1978 is devoted to supporting R&D activities in high-energy physics, basic energy sciences, and nuclear physics, and in environmental and health areas that are affected by energy production and use.

NASA The R&D programs of NASA reflect a $238 million gain, or 7 percent over 1977. In 1978 NASA will account for 15 percent of all Federal R&D obligations.

The space shuttle, which makes up an estimated 35 percent of the entire NASA R&D budget in 1978, shows little increase in funding because it is in a fairly advanced stage of development. However, another spaceflight program, space transportation system (STS) operations capability development, is scheduled for the largest dollar increase of any NASA program, more than quadrupling to $81 million in 1978. The next largest increase is for a space sciences program area, physics and astronomy; within this area a leading program is the 2.4-meter space telescope to be launched by the shuttle in 1983. Aeronautics and research and technology, another broad area, is expected to grow 12 percent. The space applications area reveals variation in the direction of programs, with earth resources detection and monitoring scheduled for a 45-percent increase while ocean condition monitoring and forecasting programs are down. Space research and technology is expected to expand by 12 percent.

HEW In 1978 R&D support shows a $50 million increase, the small size of which is partly due to a high obligational carryover to 1977, resulting from a Presidential veto of the 1976 HEW appropriation that was later overridden by the Congress midway in the fiscal year. HEW will still account for an estimated 11-percent share of the Federal R&D total in 1978.

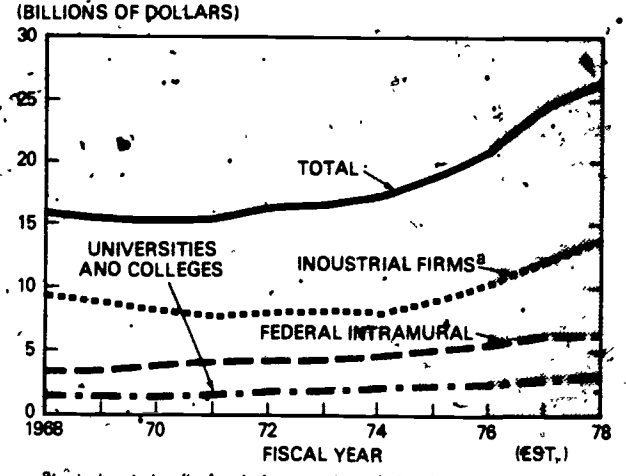
Three-quarters of the R&D effort within HEW is accounted for by the National Institutes of Health for biomedical research. Institute programs showing greatest relative growth in 1978 are general medical sciences, allergy and infectious diseases, aging, and environmental health sciences. The Alcohol, Drug Abuse, and Mental Health Administration, which represents 5 percent of the HEW R&D total, is expected to receive the same level of funding in 1978 as in 1977. The National Institute of Education reflects a 21-percent increase.

NSF The 10-percent growth of NSF in 1978 is the second largest relative gain next to that of ERDA. NSF is expected to maintain its 3-percent share of all Federal R&D obligations, covering research project support among all the sciences disciplines, research applied to national needs, and science education development and research.

USDA The 9-percent increase for the Department of Agriculture (USDA) includes a special effort directed to competitive grants in research related to food production. More than one-half of the R&D effort of USDA is represented by the Agricultural Research Service, and more than one-fourth by the Cooperative State Research Service.

Other agencies The next four agencies in size of R&D support in the 1978 budget—the Departments of

Trends in Federal R&D obligations by major performer



[a]Includes federally funded research and development centers (FFROC's) administered by this sector.

SOURCE: National Science Foundation

Transportation (DOT) and the Interior, the Environmental Protection Agency (EPA) and the Department of Commerce—reflect little change from their 1977 funding levels. The chief change is a 14-percent decrease for EPA, which actually reflects a large carryover of unobligated funds into 1977.

Performers

In 1978 an estimated $19.8 billion, or 75 percent of the Federal R&D total, is planned for support of extramural performance. The remaining $6.5 billion, or 25 percent, is scheduled for support of intramural performance or work done by Federal personnel.

The proportion represented by industrial firms is expected to rise in the current (1976-78) budget period, continuing the trend begun in 1975 after 6 years of decline. Industrial firms (including FFRDC's)[2] will account for an estimated 53 percent of the total in 1978, compared with 51 percent in 1977. Universities and colleges will represent an estimated 12 percent, nearly identical to the 1977 share, and direct work by Federal agencies is scheduled to drop 1 percentage point to 25 percent of the 1978 total. The growth of industrial performance in the current period reflects program expansion by DOD, NASA, and ERDA.

Federal R&D support to universities and colleges has risen almost continually from $1.5 billion in 1968 to an anticipated $3.1 billion in 1978 (the only drop occurring in 1970). A different picture is revealed, however, when totals are converted into constant dollars. Growth has fluctuated unevenly, but in the current period real support is rising—an estimated 9 percent between 1976 and 1978. Following the pattern of recent years, HEW continues to account for an estimated 50 percent of all Federal funding to universities and colleges in 1978. NSF will account for 18 percent and DOD for 10 percent.

[2] Federally funded research and development centers

Fields of Science

The life sciences, which have been the most heavily funded area since 1972, are again the leading field for Federal research support, with 33 percent of total Federal research obligations in 1978. They are chiefly supported by HEW—mainly through NIH, for health-related research. Engineering remains the second largest support field with a share of 30 percent in 1978. DOD and NASA obligate most of the funds for work in this area.

The physical sciences (astronomy, chemistry, physics) are expected to account for 17 percent of the Federal research effort in 1978. Major agencies funding this field are ERDA, DOD, NASA, and NSF. Growth in the current period is chiefly influenced by ERDA.

The environmental sciences are scheduled to account for 10 percent of the total research effort in 1978; these are primarily funded by NASA, DOD, NSF, and Interior.

The social sciences, with HEW, USDA, and NSF as the major sources of support, will represent an estimated 5 percent of the Federal research total.

Federal obligations for research by field of science: fiscal years 1976-78

(Dollars in millions)

Field of science	Actual 1976	Estimate 1977	Estimate 1978
Total	$7,873	$8,853	$9,490
Life sciences	2,646	2,983	3,105
Engineering	2,378	2,602	2,811
Physical sciences	1,221	1,406	1,570
Environmental sciences	770	852	925
Social sciences	390	457	482
Mathematics and computer sciences	153	166	184
Psychology	140	164	178
Other sciences	175	224	235

Note: Detail may not add to totals because of rounding.
Source: National Science Foundation