DOCUMENT RESUME

ED 062 912 HE 003 002

AUTHOR	Mieremet, Marian; And Others
TITLE	National Patterns of R&D Resources. Funds and Manpower in the United States 1953-1972.
INSTITUTION	National Science Foundation, Washington, D.C.
REPORT NO	NSF-72-300
PUB DATE	71
NOTE	42p.
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (3800-0112; $.50)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Development; *Higher Education; *Research; *Research and Development Centers; Researchers; *Scientific Research; *Scientists

ABSTRACT

This document provides a concise overview of current and historical interrelationships and patterns of national scientific and engineering resources. Major points of the report are: (1) research and development (R&D) expenditures in the U.S. are expected to reach $28.0 billion in 1972; (2) total R&D spending is estimated to rise 4.3% between 1971 and 1972; (3) R&D is expected to account for 2.5% of the estimated 1972 U.S. gross national product; (4) approximately 54% of the national R&D effort is supported with federal funds; (5) the industrial sector is the second largest source of R&D funds, providing 40% of the funds; (6) an estimated 519,000 scientists and engineers were employed in R&D during 1971; (7) more than one-third of the scientists and engineers in the U.S. are engaged in R&D; (8) nearly 40% of the national R&D effort is devoted to research; and (9) universities and colleges are expected to perform more than 55% of the national basic research effort during 1972. (HS)

NATIONAL PATTERNS OF R&D

Funds & Manpower in the United S

National Science

AL PATTERNS OF

R&D RESOURCES

Funds & Manpower in the United States 1953-1972

National Science Foundation—NSF 72-300

NATIONAL PATTERNS OF

R&D RE

Funds & Manpower in the United

National Science

L PATTERNS OF

R&D RESOURCES

unds & Manpower in the United States 1953-1972

National Science Foundation—NSF 72-300

note

This report does not reflect funding levels for research and development proposed to the Congress in the President's budget for fiscal year 1973. Also, data for 1972 are estimated and are discussed only when there has been a significant change over previous years.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 50 cents
Stock Number 3800-0112

FOREWORD

The information presented in this report is based primarily on results from various periodic National Science Foundation surveys on the support and performance of research and development in the United States. The document provides a concise overview of current and historical interrelationships and patterns of national scientific and engineering resources. The R&D funding series begins with 1953, the first year for which survey data are available and extends through 1972 with estimates for this last year. While these analyses are carried out in terms of basic research, applied research, and development, somewhat similar information in terms of major areas of national interest (budget functions) can be found in *An Analysis of Federal R&D Funding by Budget Function, 1960–72* (NSF 71–25). Time series on R&D scientific and engineering manpower employed by each sector, covering the period 1954–71, are also presented.

Research and development experienced rapid growth from the end of World War II through the mid-sixties. This rise was stimulated by increasingly complex defense needs, the highly successful space program, and the demand for new and improved consumer and capital goods. During the latter portion of the sixties, the national R&D effort grew more slowly, primarily reflecting a leveling in Federal Government spending. Although total Federal R&D support remained stable during this period, important shifts in direction—somewhat away from space and defense, and more toward other national goals—took place. Over the same time period, private R&D funding continued to increase at an impressive pace, although at a lower rate than in earlier years. The 1970 and 1971 R&D spending patterns generally followed the trends of the late sixties. For 1972, however, moderate R&D growth, shared by all sectors of the economy, is foreseen.

The report was prepared in the Foundation's Division of Science Resources Studies, under the general direction of Kenneth Sanow, Head, Statistical Surveys and Reports Section.

Charles E. Falk
Director, Division of
Science Resources Studies

December 1971

acknowledgments

This report was prepared under the supervision of Thomas J. Hogan, Study Director, Industry Studies Group. The analysis of the data and the writing of the report were performed by Marian Mieremet, Robert O. Santos, and John R. Chirichiello. Norman Seltzer, Study Director, Scientific Manpower Studies Group, assisted by Joseph Gannon, was responsible for the analysis and statistical materials for the manpower section. Patricia A. Cook assisted in the preparation of the statistical tables and charts.

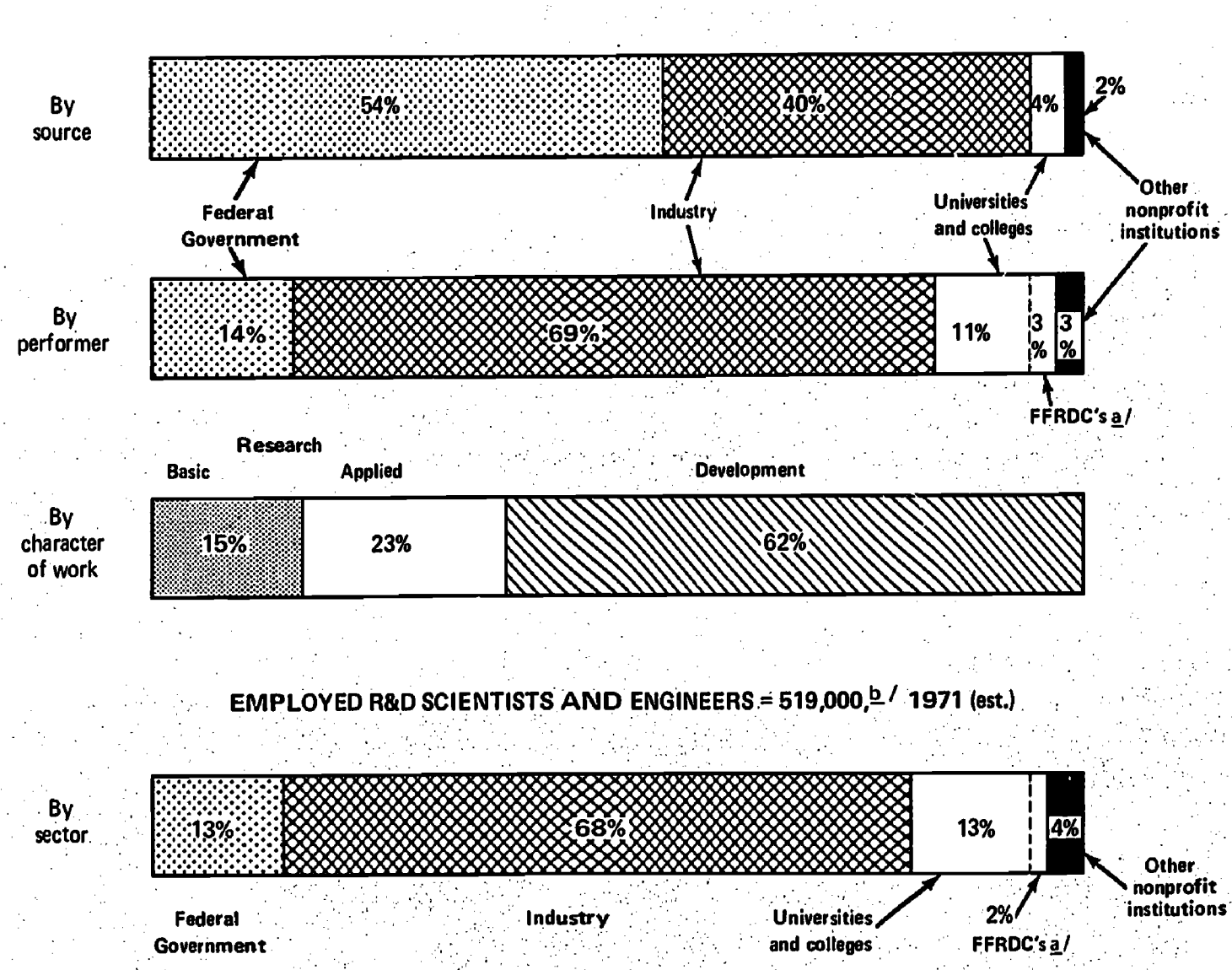
CONTENTS

TEXT TABLES

TEXT TABLES

The national R&D effort

EXPENDITURES FOR R&D = $28 billion, 1972 (est.)



EMPLOYED R&D SCIENTISTS AND ENGINEERS = 519,000, b/ 1971 (est.)

a/ Federally Funded Research and Development Centers administered by universities and colleges.
b/ Full-time equivalents.

Source: National Science Foundation

SUMMARY

- R&D expenditures in the United States are expected to reach $28.0 billion in 1972, up from $26.8 billion in 1971.

- Total R&D spending is estimated to rise 4.3 percent between 1971 and 1972; the 1970–71 increase was only 2.1 percent.

- Research and development is expected to account for 2.5 percent of the estimated 1972 U.S. gross national product (GNP), down from 2.6 percent in 1971. In 1964, the R&D/GNP ratio reached a high of 3.0 percent.

- Approximately 54 percent of the national R&D effort is supported with Federal funds, primarily from the Department of Defense and the National Aeronautics and Space Administration.

- The industrial sector is the second largest source of R&D funds. It is anticipated that companies will provide two-fifths of total U.S. R&D funds in 1972, up steadily from 31 percent in 1964.

- An estimated 519,000 scientists and engineers (full-time-equivalent) were employed in research and development during 1971, 5 percent fewer than in 1970. Nearly 70 percent of these R&D professionals worked for industrial firms.

- More than one-third of the scientists and engineers in the United States are engaged in research and development. This ratio rose steadily during the fifties and early sixties; since 1964 the proportion has declined somewhat.

- Nearly 40 percent of the national R&D effort is devoted to research. For 1972 basic research expenditures are projected at $4.1 billion, with applied research at $6.4 billion. In 1971, $4.0 billion and $6.1 billion, respectively, were spent on these activities.

- Universities and colleges are expected to perform more than 55 percent of the national basic research effort during 1972, up slightly from 1971. Industrial firms are the leading performers of both applied research and development.

R&D funding trends, 1953-72

Average annual rate of growth						
	Current			Constant		
Year	Total	Federal	Non-Federal	Total	Federal	Non-Federal
1953 - 61	13.7	16.3	10.1	11.3	13.9	7.8
1961 - 67	8.4	7.7	9.7	6.3	5.6	7.5
1967 - 72	3.4	1.0	6.8	-1.0	-3.3	2.3

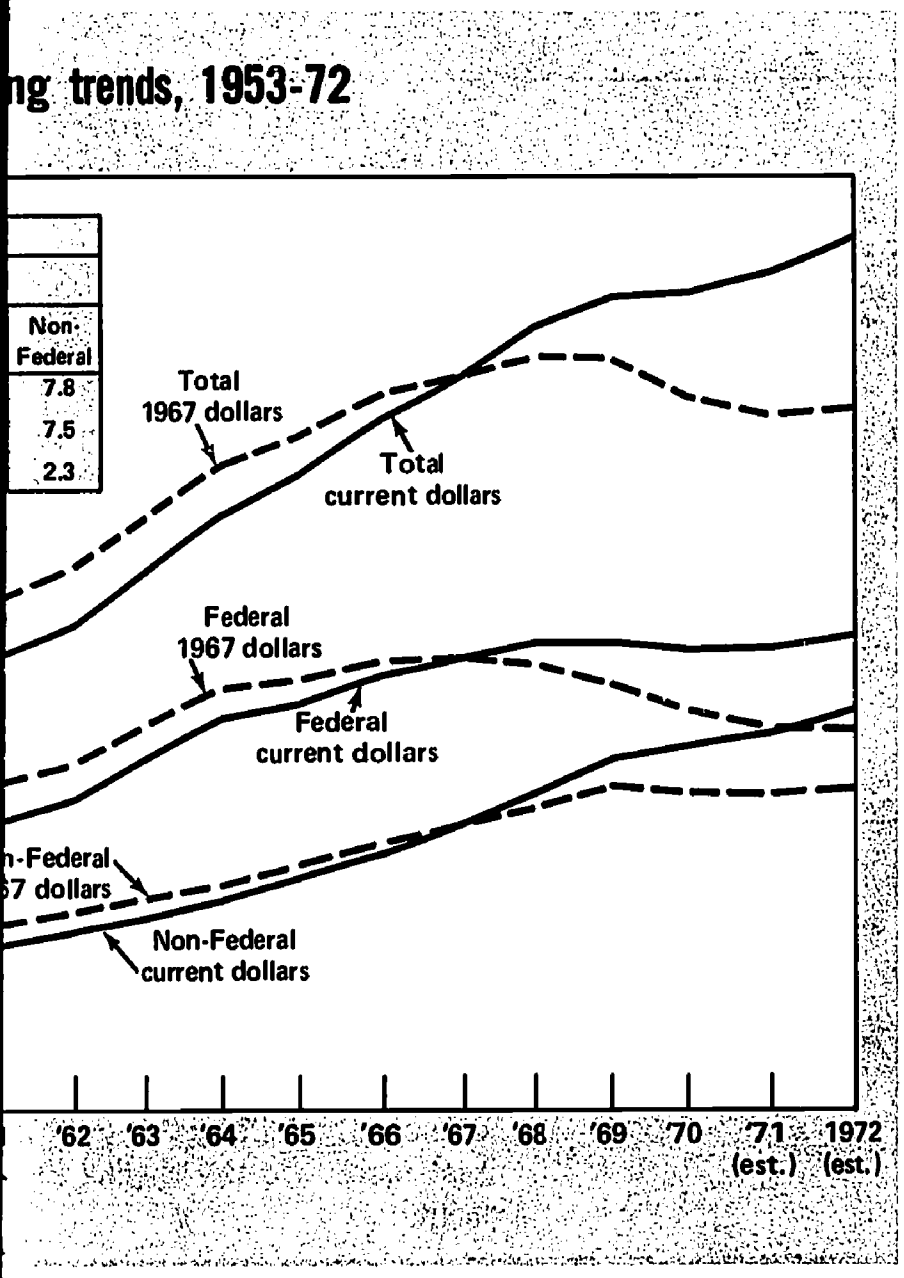
Source: National Science Foundation

R&D

• The
underg
the mi
the ma
that ti
fense
been m
R&D p
industr
caused
ever, t
are exp
1972,
In cons
opment
betwee

NATIONAL R&D TRENDS

ng trends, 1953-72



R&D Funding Patterns

• The support of research and development has undergone a marked change since 1966. Through the mid-sixties, the Federal Government provided the major impetus behind our R&D growth. Since that time, however, decreased emphasis on defense and space research and development has been more than offset by increases in non-Federal R&D programs, particularly those supported by industry funds. The recent economic slowdown has caused a leveling in these funds since 1969. However, total R&D expenditures in the United States are expected to reach a level of $28.0 billion in 1972, 4 percent above the amount spent in 1971. In constant dollars, however, research and development is expected to increase by only 1 percent between the two years.

R&D/OTHER ECONOMIC INDICATORS

• The relationship of R&D expenditures to the GNP affords a comparison of the relative importance of these R&D activities to the economy over time.

• In 1972 total R&D expenditures in the United States are expected to amount to 2.5 percent of the estimated GNP. This ratio is down from 2.6 percent in 1971 and 3.0 percent in 1964, due primarily to a leveling off of Federal R&D funding in recent years.

• As
of R&
and
other
data
State
Fede

• To
the U
that
ble 1
devel
advar

Table 1. R&D spending patterns of selected co

Country	Average annual R&D growth			Tota
	Total R&D	Government	Non-Government	1967
Canada	9%	10%	8%	$ 40
Japan	33	39	30	15
West Germany	16	13	19	35
United States	5	2	11	120

[a] All data are rounded to the nearest $5.

460-050 O - 72 - 2

R&D/OTHER ECONOMIC INDICATORS

• The relationship of R&D expenditures to the GNP affords a comparison of the relative importance of these R&D activities to the economy over time.

• In 1972 total R&D expenditures in the United States are expected to amount to 2.5 percent of the estimated GNP. This ratio is down from 2.6 percent in 1971 and 3.0 percent in 1964, due primarily to a leveling off of Federal R&D funding in recent years.

• As shown in table 1, the average annual rate of R&D growth in the United States between 1967 and 1969 was substantially lower than that of other major R&D performing countries for which data are available. This lower rate in the United States was caused primarily by a leveling off of Federal R&D spending in recent years.

• Total research and development per capita in the United States in 1969 was nearly three times that of other major R&D-performing countries (table 1). When Government support of research and development is removed from these data, the U.S. advantage becomes markedly less.

Table 1. R&D spending patterns of selected countries, by source, 1967–69

Country	Average annual R&D growth			R&D per capita [a]					
	Total R&D	Government	Non-Government	Total R&D		Government		Non-Government	
				1967	1969	1967	1969	1967	1969
Canada	9%	10%	8%	$ 40	$ 45	$20	$25	$20	$20
Japan	33	39	30	15	30	5	10	10	20
West Germany	16	13	19	35	50	15	20	20	30
United States	5	2	11	120	130	70	75	50	55

[a] All data are rounded to the nearest $5.

1972 (est.)

R&D BY SELECTED OBJECTIVE

• In 1972 research and development devoted to space (National Aeronautics and Space Administration (NASA)) and defense (Department of Defense (DOD) and certain Atomic Energy Commission (AEC) programs) is expected to amount to $11.0 billion, 2 percent above the amount spent on these activities in 1971, but 7 percent below the 1968 high of $11.8 billion.

• Other Federal objectives include the civilian type work of the AEC, the health and education programs of the Department of Health, Education, and Welfare (HEW), the basic research programs supported by the National Science Foundation (NSF), and the R&D spending of other Federal agencies. In 1972 it is expected that $4.2 billion will be spent on these programs; this is 6 percent more than in 1971 and 30 percent more than in 1969.

• The remaining $12.8 billion of R&D spending in 1972 will come from non-Federal sources and will include the R&D activities of nonprofit institutions, the basic research programs of universities and colleges, and, in particular, the development programs carried on by industrial firms. In 1971 $12.1 billion was spent on non-Federal programs.

Source: National Science Foundation

IVE

t devoted to
ace Adminis-
ment of De-
rgy Commis-
o amount to
mount spent
ercent below

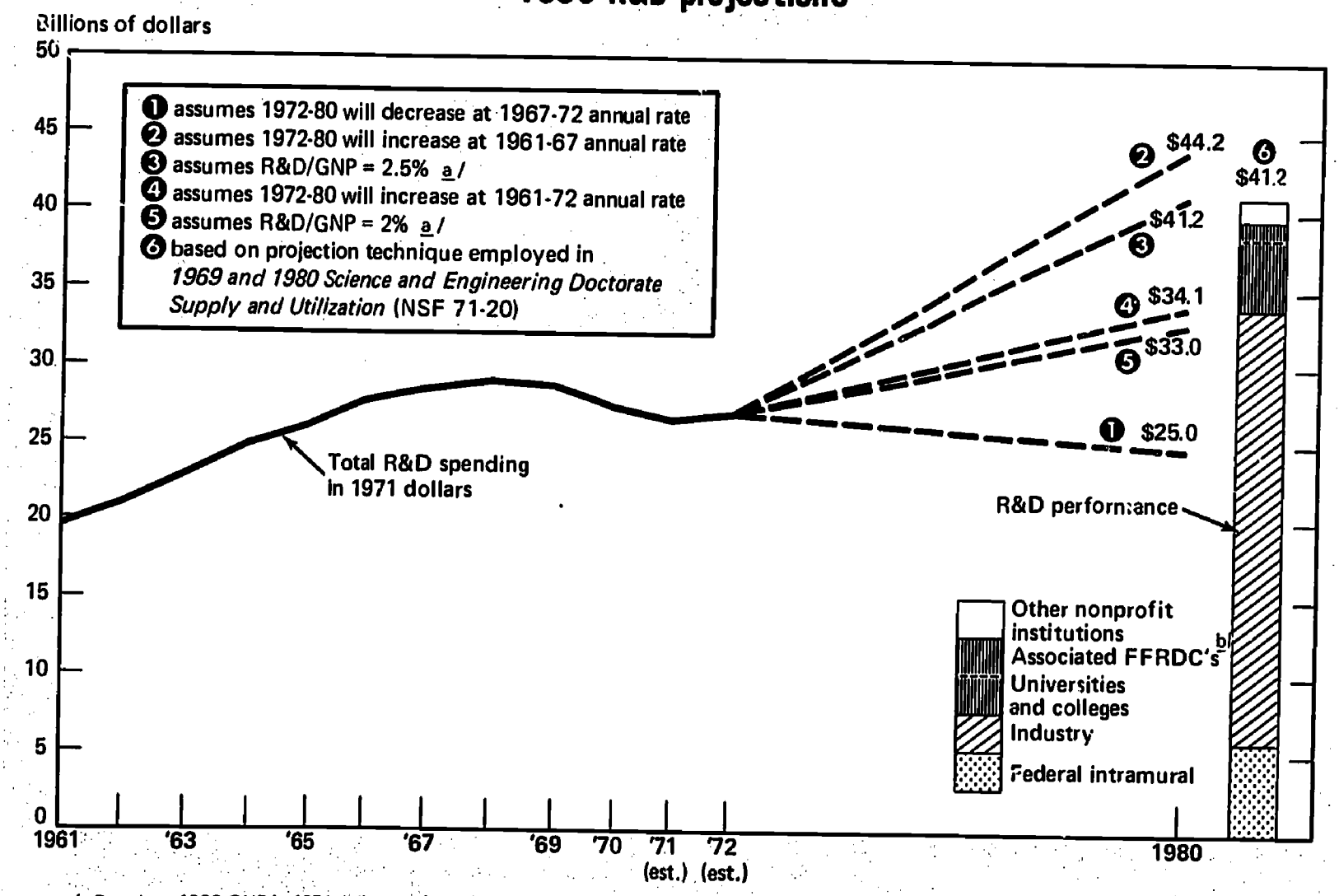
civilian type
ucation pro-
, Education,
ch programs
Foundation
ther Federal
$4.2 billion
is 6 percent
more than in

) spending in
rces and will
institutions,
versities and
lopment pro-
ms. In 1971
al programs.

R&D spending by objective, 1957-72

Source: National Science Foundation

1980 R&D projections

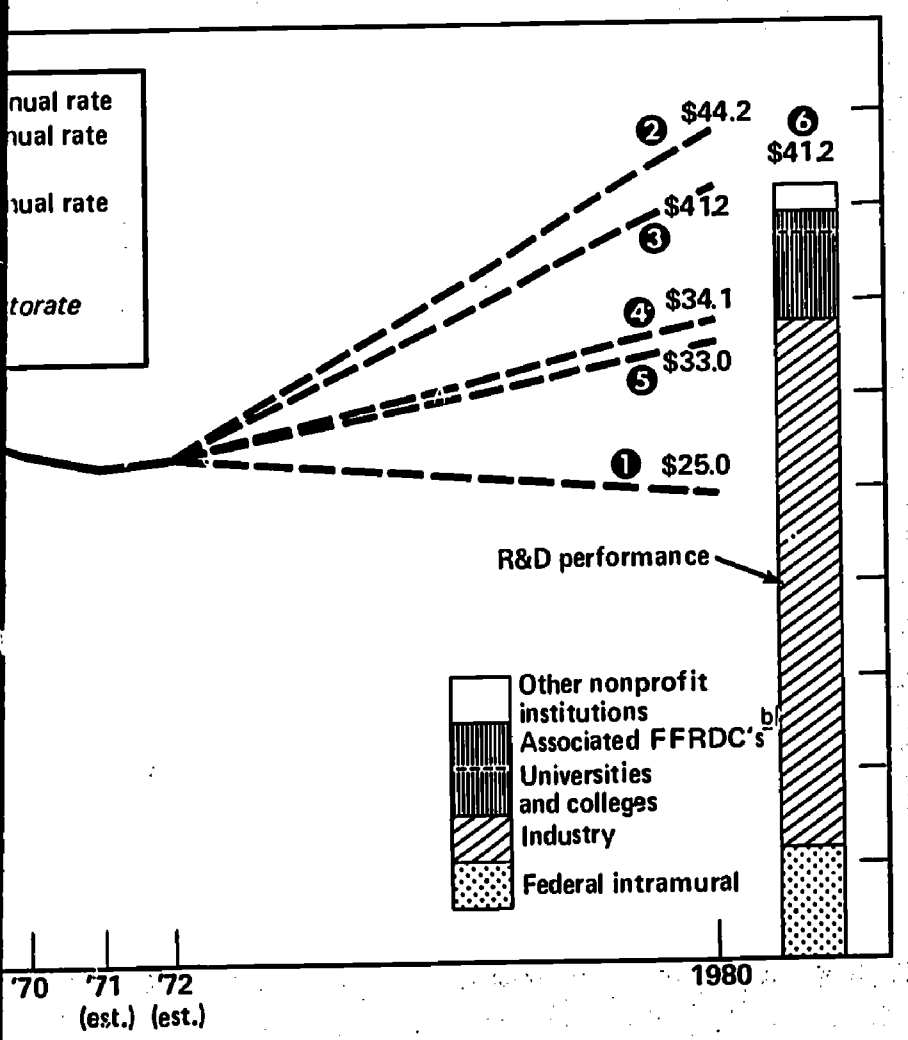


a/ Based on 1980 GNP in 1971 dollars projected at $1.6 trillion.

b/ Federally Funded Research and Development Centers.

Source: National Science Foundation

R&D projections



on.

R&D PROJECTIONS

- Based on several alternative assumptions, the R&D totals of the National Science Foundation can be projected to 1980. The projections for 1980 shown in this report are based on past trends and are not a prediction since the level of R&D activity in 1980 depends on such unknowns as future Government actions, the state of the economy, etc.

- The GNP for the United States, expressed in 1971 dollars, is projected at $1.6 trillion in 1980 (estimated by the Bureau of Labor Statistics). If the GNP approximates this level and the 1980 R&D/GNP ratio were to remain at the 1972 proportion of 2.5 percent, R&D spending in 1980 in 1971 dollars would reach $41.2 billion; if the ratio were to decrease to 2.0 percent, the R&D level would be $33.0 billion.

- If R&D spending were to increase over the period (1972–80) at annual rates equal to those between 1961–67, 1961–72, or 1967–72, the U.S. R&D effort in 1971 dollars would range between $25.0 billion and $44.2 billion in 1980.

- By utilizing the projection technique employed in the report, **1969 and 1980 Science and Engineering Doctorate Supply and Utilization** (NSF 71–20) total R&D spending in 1980, expressed in 1971 dollars, can be shown by performing sector. This is basically achieved by maintaining Federal R&D support as a fixed 1.4 percent of the GNP and basing non-Federal spending on growth trends of previous years.

TRANSFERS OF FUNDS

• The following tables present estimated 1972 data on funds by source and performance for total research and development, as well as basic research, applied research, and development. They permit comparisons of the various sectors of the economy as sources of R&D funds and as performers of research and development.

• Federal agencies are expected to contribute 54 percent of all R&D funds in 1972, over one-half of which will be performed in industry. An additional 26 percent is scheduled for the intramural laboratories of Federal agencies.

• The second largest source of R&D funds is industry which is expected to spend $11.3 billion on these programs in 1972, up from $10.7 billion in 1971.

• Universities and colleges are the largest performers of basic research with a projected $2.3 billion for these activities in 1972, the same as in 1971.

• The industrial sector is the largest performer of both applied research and development. In 1972 industry is expected to perform $18.6 billion on these activities. In 1971, industry spent $17.7 billion on applied research and development.

Table 2. Intersectoral transfers of funds use development, basic research, applied research

RESEARCH AND DEVE
[Millions of doll

Sources of funds	Perfo		
	Federal Govern-ment	Industry [b]	Uni sities colle
Federal Government	4,000	8,050	1,7
Industry	.....	11,150[c]	
Universities and colleges	.....	.....	1,(
Other nonprofit institutions	.....	.....	
Total	4,000	19,200	3,(
Percent distribution, performers	**14.3**	**68.5**	**1(|**

BASIC RESEAR(
[Millions of doll

Sources of funds	Perfor		
	Federal Govern-ment	Industry [b]	Univ sities colleg
Federal Government	675	150	1,3
Industry	.....	435[c]	
Universities and colleges	.....	.....	8
Other nonprofit institutions	.....	.....	1
Total	675	585	2,3
Percent distribution, performers	**16.4**	**14.2**	**56**

[a] All data are estimated from reports by performers.
[b] Expenditures for Federally Funded Research and Development Centers (FFRDC's) administered by both industry and by nonprofit institutions are included in the totals of their respective

se fin qu tra

Table 2. Intersectoral transfers of funds used for performance of research and development, basic research, applied research, and development, 1972 (estimated)

RESEARCH AND DEVELOPMENT[a]

[Millions of dollars]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
Federal Government	4,000	8,050	1,750	775	635	15,210	54.3
Industry	.....	11,150[e]	65	.....	105	11,320	40.4
Universities and colleges	.....	.....	1,060[e]	.....	.....	1,060	3.8
Other nonprofit institutions	.....	.....	175	.....	235[e]	410	1.5
Total	4,000	19,200	3,050	775	975	28,000	
			3,825				
Percent distribution, performers	14.3	68.5	10.9	2.8	3.5		100.0
			13.7				

BASIC RESEARCH [a]

[Millions of dollars]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
Federal Government	675	150	1,355	300	110	2,590	62.9
Industry	.....	435[e]	40	.....	25	500	12.1
Universities and colleges	.....	.....	825[e]	.....	.....	825	20.0
Other nonprofit institutions	.....	.....	115	.....	90[e]	205	5.0
Total	675	585	2,335	300	225	4,120	
			2,635				
Percent distribution, performers	16.4	14.2	56.7	7.3	5.4		100.0
			64.0				

[a] All data are estimated from reports by performers.

[b] Expenditures for Federally Funded Research and Development Centers (FFRDC's) administered by both industry and by nonprofit institutions are included in the totals of their respective sectors. FFRDC's are organizations exclusively or substantially financed by the Federal Government to meet a particular requirement or to provide major facilities for research and training purposes.

Table 2. Intersectoral transfers of funds used for performance of research and development, basic research, applied research, and development, 1972 (estimated)—Con.

APPLIED RESEARCH [a]

[Millions of dollars]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
Federal Government	1,475	1,150	290	225	325	3,465	54.3
Industry	.....	2,500[e]	17	.....	50	2,567	40.2
Universities and colleges	.....	.....	210[e]	.....	.....	210	3.3
Other nonprofit institutions	.....	.....	48	.....	90[e]	138	2.2
Total	1,475	3,650	565	225	465	6,380	
			790				
Percent distribution, performers	**23.1**	**57.2**	**8.9**	**3.5**	**7.3**		**100.00**
			12.4				

DEVELOPMENT [a]

[Millions of dollars]

Sources of funds	Performers					Total	Percent distribution, sources
	Federal Government	Industry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
Federal Government	1,850	6,750	105	250	200	9,155	52.3
Industry	.....	8,215[e]	8	.....	30	8,253	47.2
Universities and colleges	.....	.....	25[c]	.....	.....	25	.1
Other nonprofit institutions	.....	.....	12	.....	55[e]	67	.4
Total	1,850	14,965	150	250	285	17,500	
			400				
Percent distribution, performers	**10.6**	**85.5**	**.9**	**1.4**	**1.6**		**100.0**
			2.3				

[c] Includes agricultural experiment stations.

[d] Federally Funded Research and Development Centers (FFRDC's) administered by individual universities and colleges and by university-consortia.

[e] Includes State and local government funds.

Source: National Science Foundation.

of funds used for performance of research and research, and development, 1972 (estimated)—Con.

PLIED RESEARCH [a]
Millions of dollars]

Performers				Total	Percent distribution, sources
dustry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
1,150	290	225	325	3,465	54.3
2,500[e]	17	.....	50	2,567	40.2
.....	210[e]	.....	.....	210	3.3
.....	48	.....	90[e]	138	2.2
3,650	565	225	465	6,380	
	790				
57.2	8.9	3.5	7.3		100.00
	12.4				

DEVELOPMENT [a]
Millions of dollars]

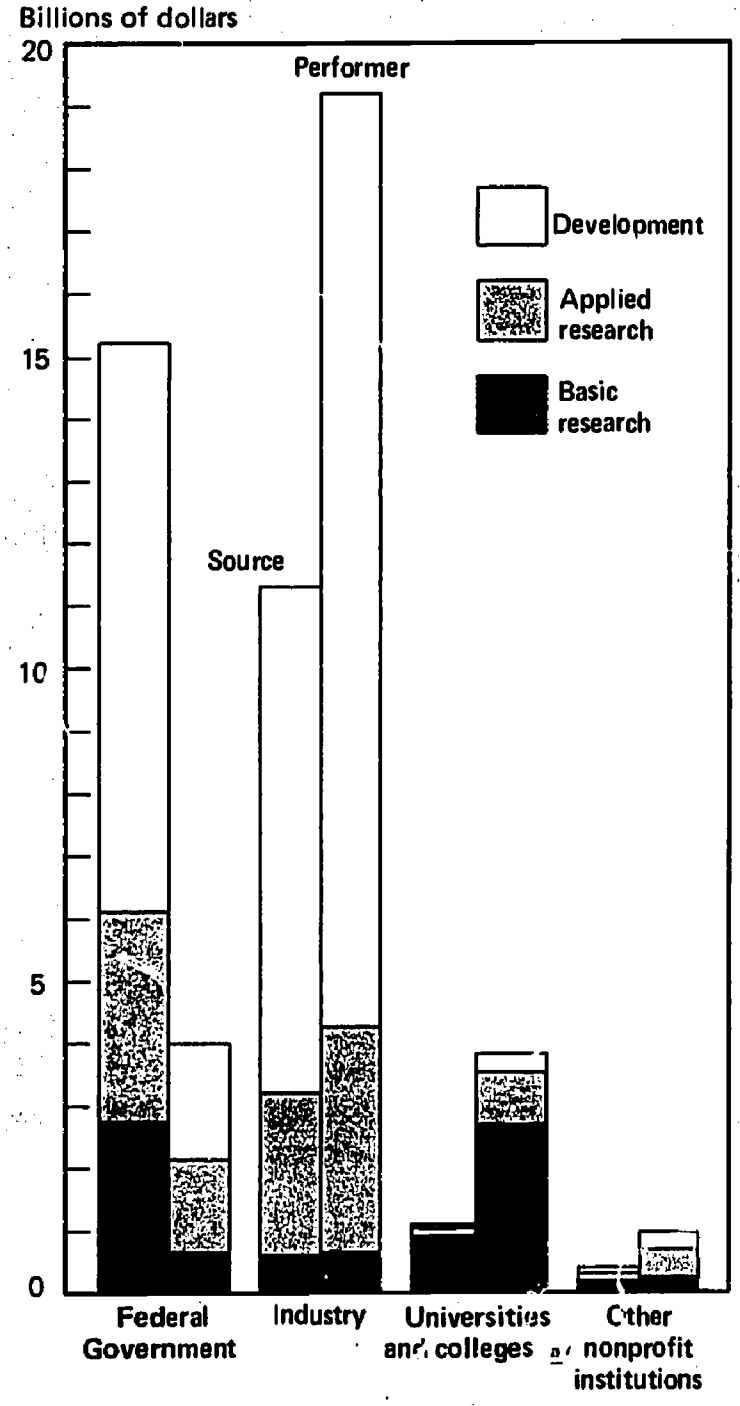
Performers				Total	Percent distribution, sources
ndustry [b]	Universities and colleges [c]	Associated FFRDC's [d]	Other nonprofit institutions [b]		
6,750	105	250	200	9,155	52.3
8,215[e]	8	.....	30	8,253	47.2
.....	25[e]	.....	.....	25	.1
.....	12	.....	55[e]	67	.4
14,965	150	250	285	17,500	
	400				
85.5	.9	1.4	1.6		100.0
	2.3				

RDC's)
nd by

[e] Includes State and local government funds.

Source: National Science Foundation.

Support and performance of R&D in the United States, 1972 (est.)



a/ Federally Funded Research and Development Centers associated with this sector performed $775 million of R&D in 1972.

NOTE: Performer bars include FFRDC's associated with that sector.

Source: National Science Foundation

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS

• Federally Funded Research and Development Centers (FFRDC's) are organizations which undertake R&D activities for the exclusive or almost exclusive use of the Federal Government. They are administered by industrial, nonprofit, or educational institutions, generally on a nonprofit basis.

• In 1971 FFRDC's are expected to perform an estimated $1.5 billion of R&D activities. This represents a 12-percent increase over the 1967 level of $1.3 billion and 35 percent above the 1963 figure of $1.1 billion. Between 1971 and 1972, R&D spending in FFRDC's are expected to increase by 2 percent.

• Over one-half of these 1972 R&D dollars are expected to be spent in university and college-administered FFRDC's. Industry-administered FFRDC's should account for an additional one-third of the R&D spending while those administered by nonprofit institutions are expected to contribute the remaining 17 percent.

R&D performance

a/ Federally Funded Research and Development Centers.

Source: National Science Foundation

AND

velopment
ich under-
almost ex-
They are
or educa-
ofit basis.

erform an
This rep-
967 level
the 1963
nd 1972,
o increase

ars are ex-
ge-admin-
FFRDC's
ird of the
d by non-
ribute the

R&D performance in FFRDC's[a/], 1963-72

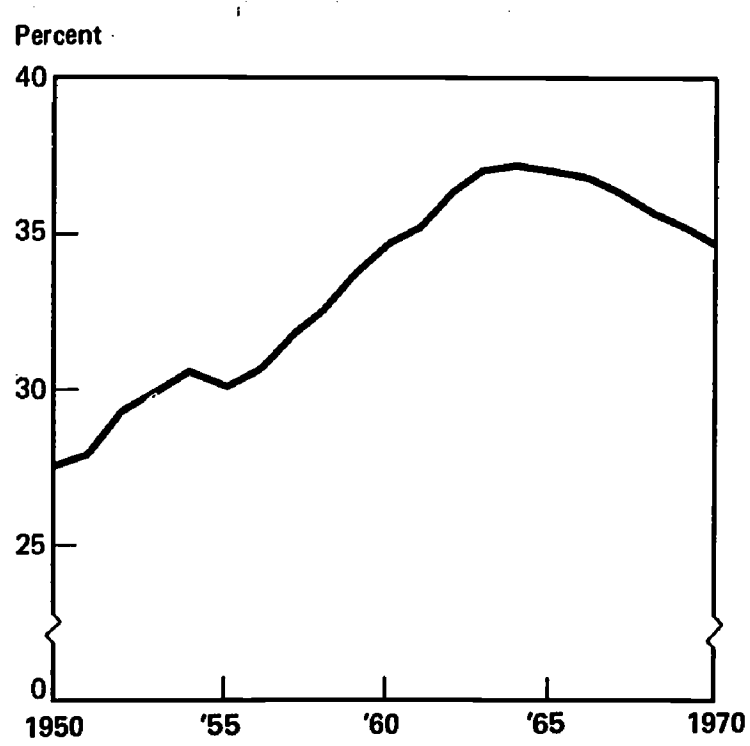
a/ Federally Funded Research and Development Centers.

Source: National Science Foundation

R&D Manpower

• The proportion of all natural scientists and engineers engaged in R&D activities grew steadily from 1950 to 1964 rising from about 27.5 percent to over 37 percent. However, over the years 1965 to 1970 the proportion dropped year by year to about 35 percent.

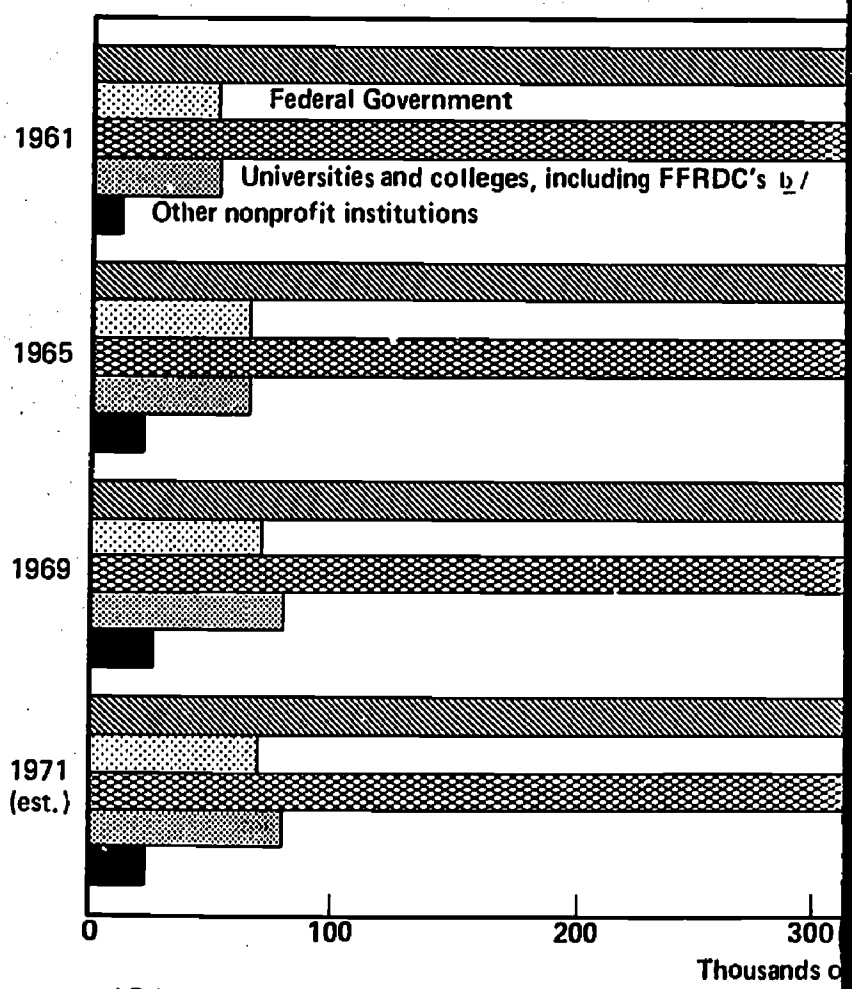
Proportion of all natural scientists and engineers engaged in R&D, 1950-70



Source: National Science Foundation

• The absolute numbers of R&D scientists and engineers increased substantially over the 1950's and 1960's. The full-time-equivalent numbers of these personnel grew by more than 110 percent

FTE[a/] scientists and enginee by sector, selected



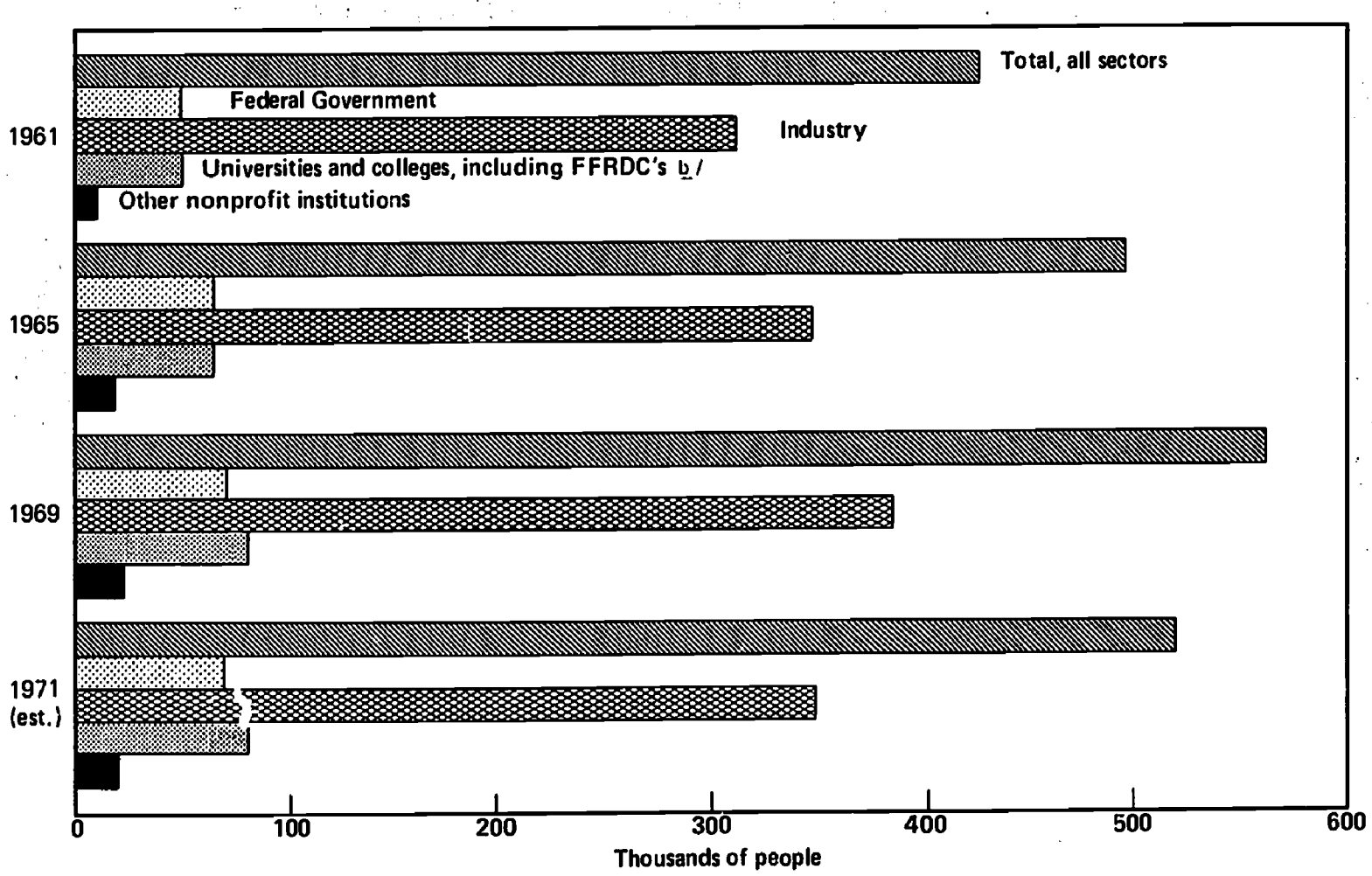
a/ Full-time equivalent.

b/ Federally Funded Research and Development Centers.

Source: National Science Foundation

• The absolute numbers of R&D scientists and engineers increased substantially over the 1950's and 1960's. The full-time-equivalent numbers of these personnel grew by more than 110 percent in the eleven years between 1954 and 1965. Since 1965, the growth has been much slower—only 5 percent in the 5 years 1965 to 1971.

FTE[a/] scientists and engineers employed in R&D, by sector, selected years, 1961-71



a/ Full-time equivalent.

b/ Federally Funded Research and Development Centers.

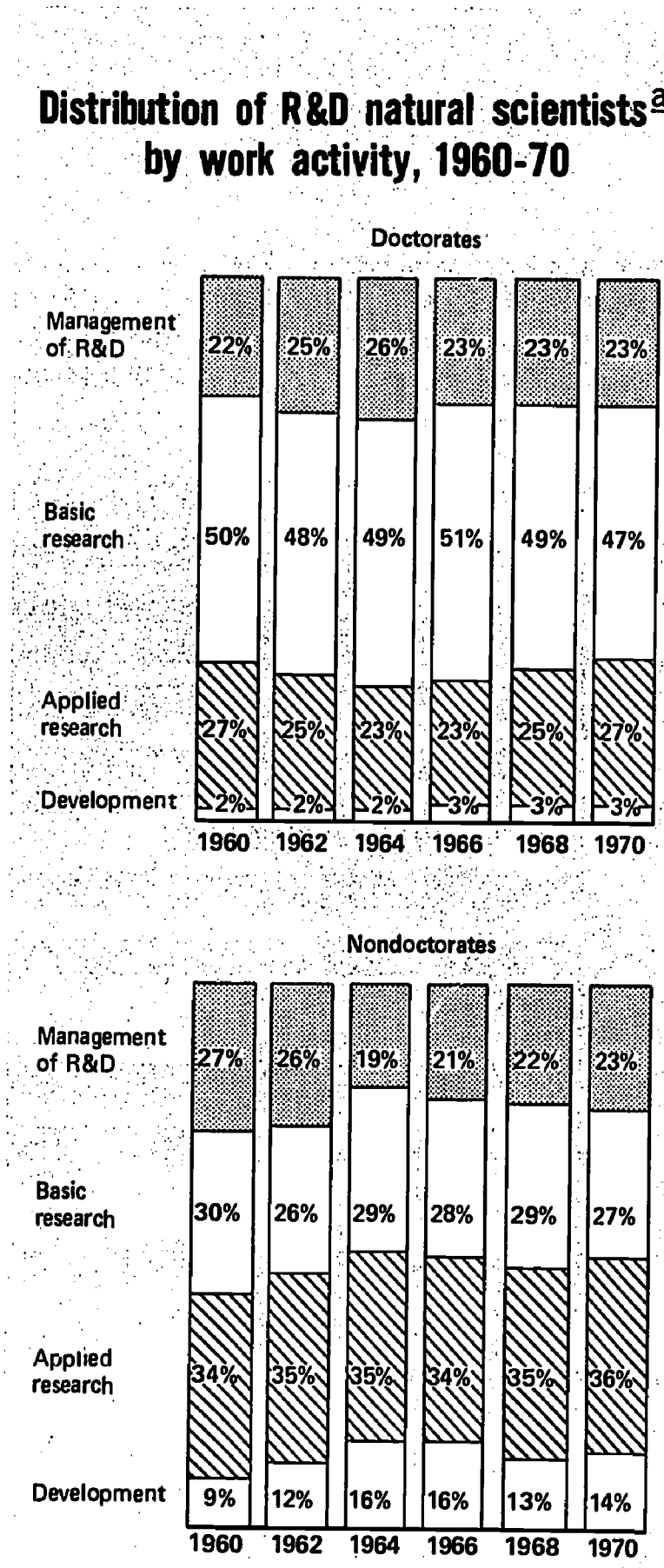
Source: National Science Foundation

• Concurrent with the decline in the proportion of natural scientists and engineers in research and development in recent years, R&D scientists and engineers experienced a higher unemployment rate than other scientists and engineers.[1] In mid-1971, for example, 3.5 percent of all R&D scientists and all R&D engineers were unemployed; while a lesser 1.9 percent of all other scientists and 2.6 percent of all other engineers were unemployed.

• The national average cost per R&D professional (total R&D costs related to FTE employment of scientists and engineers) was $51,700 in 1971 compared to $41,200 in 1965 and $34,200 in 1961. Expressed in constant dollars (1971=100), the comparable ratios are $51,700, $52,600, and $46,300, respectively.

• The distribution of natural R&D scientists (excluding engineers) among the four activities—basic research, applied research, development, and the management of R&D—has changed little over the 1960 decade. This distribution however is different for doctorate and nondoctorate scientists. For example, the proportion of doctorates engaged in basic research varied between 47 and 51 percent while that for nondoctorates ranged between 26 and 30 percent as measured at biennial intervals between 1960 and 1970. These patterns are by no means uniform for the various fields of science. Whereas about three-fifths of the doctorates in physics and biology are in basic research, only a quarter of the agricultural scientists are in this activity. Similarly, only about one-tenth of the nondoctorate mathematicians were in basic research while nearly two-fifths of the nondoctorates in physics and earth scientists were so engaged.

Distribution of R&D natural scientists[a/], by work activity, 1960-70



a/ Excludes engineers.

Source: National Science Foundation

[1] National Science Foundation, Science Resources Studies Highlights, "Unemployment Rates for Scientists, Spring 1971" (NSF 71–26), July 2, 1971 and "Unemployment Rate for Engineers, June–July 1971" (NSF 71–33), September 23, 1971 (Washington, D.C. 20550).

TRENDS IN R&D MANPOWER, BY SECTOR [2]

A look at the employment of R&D scientists and engineers by sector shows 359,300 FTE scientists and engineers in industry in January 1971, a figure 6 percent below the 384,100 in 1970 (table 3). This was the largest decrease in this group since 1957, when comparative data first became available. The next largest decrease occurred between 1969 and 1970, when the total declined 1 percent, from 387,100. Over the pre years the numbers had increased 69 pe 229,400 in 1957.

The major factor in the 1970–71 was the 16-percent decline in R&D sci engineers in the aircraft and missile where the total dropped from 90,600 76,500 in 1971. Also of some importa 1970–71 decline was the 7-percent from 101,500 to 94,300, in the electr

[2] Based on latest detailed data avail for each sector.

Table 3. Full-time-equivalent number of R&D scientists and engi

Industry	1957	1958	1959	1960	1961	1962	1963	1
Total	229,400	243,800	268,400	292,000	312,100	312,000	327,300	34
Chemical and allied products	29,400	31,000	33,500	36,100	37,000	36,500	38,300	3
Petroleum refining and extraction	6,900	7,400	7,700	9,200	9,000	9,100	8,900	
Rubber products	4,700	4,700	4,800	5,300	5,500	5,600	5,800	
Stone, clay, and glass products	(a)	(a)	(a)	(a)	3,600	3,700	3,800	
Primary metals	5,100	5,200	5,700	6,900	6,900	6,000	5,200	
Electrical equipment and communication	42,900	47,900	54,800	72,100	79,200	82,300	85,800	8
Motor vehicles and other transportation equipment	13,600	15,000	16,800	17,800	19,100	20,800	21,100	2
Aircraft and missiles	58,700	58,600	65,900	72,400	78,500	79,400	90,700	9
Professional and scientific instruments	10,200	11,000	12,000	10,000	11,100	9,800	9,400	
Other manufacturing industries	[b]57,900	[b]63,000	[b]67,200	[b]62,100	54,500	50,600	50,100	4
Nonmanufacturing industries					7,500	7,000	8,200	

[a] Data included in the "other manufacturing" group.

[b] For years 1957–60, manufacturing and nonmanufacturing combined—also includes food and kindred products; textiles and apparal; lumber and wood products; paper and allied products; fabricated metal products; and machinery.

Source: National Science Foundation.

460-050 O - 72 - 3

BY SECTOR [2]

R&D scientists 59,300 FTE sci- n January 1971, 100 in 1970 (ta- ase in this group ata first became ase occurred be- total declined 1

available for each

percent, from 387,100. Over the preceding 12 years the numbers had increased 69 percent, from 229,400 in 1957.

The major factor in the 1970–71 decrease was the 16-percent decline in R&D scientists and engineers in the aircraft and missiles industry, where the total dropped from 90,600 in 1970 to 76,500 in 1971. Also of some importance in the 1970–71 decline was the 7-percent decrease, from 101,500 to 94,300, in the electrical equipment and communication industry.

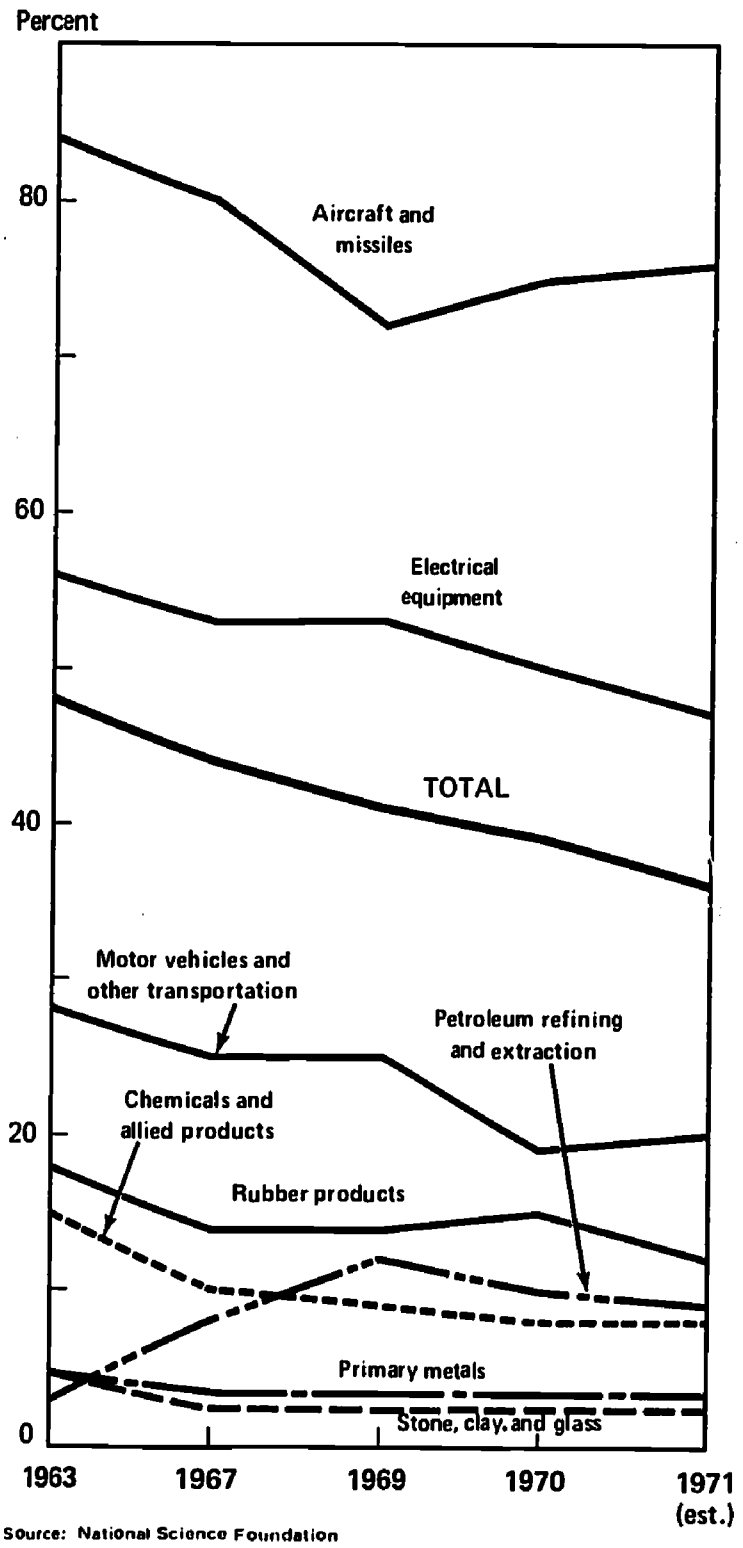
Data available since 1963 on the numbers of R&D scientists and engineers in industry show a trend decline in the proportion whose employment derives from Federal funds, from 48 percent of the total in 1963 to 36 percent in 1971 (table 4). One-third of this decline had already occurred by 1967, when Federal funds supported only 44 percent of the R&D scientists and engineers in industry.

3. Full-time-equivalent number of R&D scientists and engineers, by industry, January 1957–71

57	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
400	243,800	268,400	292,000	312,100	312,000	327,300	340,200	343,600	353,200	367,200	376,700	387,100	384,100	359,300
400	31,000	33,500	36,100	37,000	36,500	38,300	37,800	40,000	40,000	38,700	40,800	42,200	42,100	42,500
900	7,400	7,700	9,200	9,000	9,100	8,900	9,000	9,700	10,200	10,400	11,200	11,900	11,500	10,800
700	4,700	4,800	5,300	5,500	5,600	5,800	6,000	5,800	5,700	5,800	6,100	6,300	6,800	6,600
a)	(a)	(a)	(a)	3,600	3,700	3,800	3,900	4,300	4,200	4,500	5,400	5,500	5,900	5,700
100	5,200	5,700	6,900	6,900	6,000	5,200	5,100	5,500	5,500	5,900	5,900	6,200	6,300	6,200
900	47,900	54,800	72,100	79,200	82,300	85,800	87,700	86,000	90,600	96,000	97,800	100,500	101,500	94,300
600	15,000	16,800	17,800	19,100	20,800	21,100	23,000	23,900	24,600	25,000	24,000	24,700	25,100	24,900
700	58,600	65,900	72,400	78,500	79,400	90,700	99,400	97,400	97,200	98,300	98,700	97,600	90,600	76,500
200	11,000	12,000	10,000	11,100	9,800	9,400	9,700	10,300	11,200	11,400	12,500	13,400	13,400	13,800
				54,500	50,600	50,100	49,100	51,400	52,500	57,600	59,800	64,300	64,900	62,900
900	[b]63,000	[b]67,200	[b]62,100											
				7,500	7,000	8,200	9,600	9,400	11,300	13,600	14,500	14,500	16,000	15,200

roup.
anufacturing combined—also includes food and kindred
wood products; paper and allied products; fabricated

R&D scientists and engineers supported by Federal funds as a proportion of all R&D scientists and engineers in industry, selected years, 1963-71



Source: National Science Foundation

The trend decrease between 1963 and 1971 in the proportion of R&D scientists and engineers supported from Federal funds reflects the pattern found in all industries except petroleum refining and extraction. In this industry the proportion of federally funded R&D employment advanced from 3 percent of all scientists and engineers to 9 percent. In the large electrical equipment and communications industry the proportion of federally

Table 4. Full-time-equivalent number of R&D scien funds, Jan

Industry	1963	1964	19
Total[a]	157,800	165,600	163
Chemical and allied products	5,600	5,500	4
Petroleum refining and extraction	300	(b)	1
Rubber products	1,000	1,100	1
Stone, clay, and glass products	200	200	
Primary metals	200	200	
Electrical equipment and communication	45,300	47,100	48
Motor vehicles and other transportation equipment	6,100	(b)	(
Aircraft and missiles	80,000	87,400	83
Professional and scientific instruments	2,200	2,000	(
Other manufacturing industries	1,000	500	(
Nonmanufacturing industries	5,600	(b)	6

[a] Includes also a small number of scientists and engineers in food and kindred products; textiles and apparel; lumber, wood products, and furniture; paper and allied products; fabricated metal products; machinery; and for several years a small number in other manufacturing industries.

The trend decrease between 1963 and 1971 in the proportion of R&D scientists and engineers supported from Federal funds reflects the pattern found in all industries except petroleum refining and extraction. In this industry the proportion of federally funded R&D employment advanced from 3 percent of all scientists and engineers to 9 percent. In the large electrical equipment and communications industry the proportion of federally funded R&D scientists and engineers dropped from 56 percent of the R&D scientists and engineers in the industry to 47 percent. The aircraft and missiles industry, the other large industry, experienced a comparable decline in the proportion of its R&D scientists and engineers supported by Federal funds, from 84 percent in 1963 to 76 percent in 1971.

Table 4. Full-time-equivalent number of R&D scientists and engineers in industry supported by Federal funds, January 1963–71

Industry	Employment based on Federal funds								
	1963	1964	1965	1966	1967	1968	1969	1970	1971
Total[a]	157,800	165,600	163,200	162,900	161,300	156,800	157,700	148,200	129,600
Chemical and allied products	5,600	5,500	4,400	4,300	3,800	4,200	3,800	3,300	3,300
Petroleum refining and extraction	300	(b)	1,000	1,100	800	1,300	1,500	1,200	1,000
Rubber products	1,000	1,100	1,300	900	800	1,000	900	1,000	800
Stone, clay, and glass products	200	200	100	100	100	200	100	100	100
Primary metals	200	200	200	200	200	200	200	200	200
Electrical equipment and communication	45,300	47,100	48,000	51,600	50,500	50,600	52,800	50,300	44,200
Motor vehicles and other transportation equipment	6,100	(b)	(b)	7,200	6,300	6,500	6,100	4,700	4,900
Aircraft and missiles	80,000	87,400	83,100	79,400	78,600	73,900	70,700	67,800	58,200
Professional and scientific instruments	2,200	2,000	(b)	3,300	2,700	2,400	3,600	3,000	2,300
Other manufacturing industries	1,000	500	(b)	100	(b)	(b)	(b)	(b)	(b)
Nonmanufacturing industries	5,600	(b)	6,700	6,500	8,200	7,600	7,500	8,500	8,200

[a] Includes also a small number of scientists and engineers in food and kindred products; textiles and apparel; lumber, wood products, and furniture; paper and allied products; fabricated metal products; machinery; and for several years a small number in other manufacturing industries.

[b] Not separately available but included in total.

Source: National Science Foundation.

Note: These data have been modified slightly by the National Science Foundation—due to adjustments necessitated by changes in industry classification of a few companies.

The number of scientists and engineers at colleges and universities engaged primarily in research and development increased from 38,800 in 1965 to 46,900 by 1971 (table 5). Life sciences accounted for by far the largest portion of the total, with the 64 percent in 1965 rising to 65 percent by 1971. Other physical sciences and mathematics also increased proportionately over the 6-year period, from 4 and 2 percent of the total, respectively, to 5 and 3 percent. Decreased proportions over the 6-year period occurred in engineering, from 11 to 10 percent; in chemistry and physics, each from 6 to 5 percent; and in the social sciences and psychology combined. from 7 to 6 percent.

The 10,900 R&D scientists and engineers at FFRDC's administered by colleges and universities in 1971 were 2 percent under the 11,100 in 1965 (table 6). Engineering advanced from 44 percent of the total to 46 percent, and mathematics from 9 percent to 10 percent. Conversely, the proportion in the physical sciences declined from 41 percent of the total to 39 percent, and the life sciences proportion declined from 6 percent to 3 percent. The physical science reduction reflected decreased numbers of chemists and other physical scientists; the physicists increased from 22 percent of the science and engineering total to 24 percent.

Table 5. Numbers of scientists and engineers primarily engaged in research and development in universities and colleges, by broad field of specialization, January 1965, 1969, and 1971.

Broad field of specialization	1965	1969	1971
All fields	38,769	45,120	46,941
Engineering	4,153	4,976	4,839
Physical science	5,927	6,970	7,314
Chemistry	2,335	2,685	2,579
Physics	2,132	2,394	2,411
Other	1,460	1,891	2,324
Mathematics	932	1,669	1,446
Life sciences	24,955	28,307	30,433
Social science and psychology[a]	2,802	3,198	2,909

[a] Social science includes economists and sociologists.
Source: National Science Foundation.

Table 6. Numbers of scientists and engineers primarily engaged in research and development in Federally Funded Research and Development Centers, by broad field of specialization, January 1965, 1969, and 1971

Broad field of specialization	1965	1969	1971
Total	11,055	11,004	10,882
Engineering	4,914	4,960	5,034
Physical science	4,563	4,294	4,225
Chemistry	1,409	1,221	1,175
Physics	2,454	2,634	2,589
Other	700	439	461
Mathematics	940	1,085	1,083
Life sciences	656	414	376
Social science and psychology[a]	129	251	164

[a] Social science includes economists and sociologists.
Source: National Science Foundation.

The nonprofit sector employed 21,600 R&D scientists and engineers in 1970, 17 percent above the 18,500 in 1965 (table 7). However, the 1970 total is also 3 percent below the 22,100 in 1967. Life sciences was the largest field of specialization in all years, accounting for 33 percent of the total in 1967, 34 percent in 1970, and 36 percent in 1965. Mathematics decreased even more over the period, from 11 percent of the total to 6 percent. The combined social science and psychology group advanced from 17 percent of the total to 22 percent, and engineering advanced from 20 to 22 percent.

Table 7. Numbers of scientists and engineers primarily engaged in research and development in nonprofit institutions, by broad field of specialization, January 1965, 1967, and 1970

Broad field of specialization	1965	1967	1970
All fields	18,499	22,129	21,556
Engineering	3,745	4,740	4,746
Physical science	2,991	3,571	3,370
Mathematics	2,065	2,172	1,366
Life sciences	6,600	7,338	7,274
Social science and psychology[a]	3,098	4,308	4,800

[a] Social science includes economists and sociologists.
Source: National Science Foundation.

The Federal Government employed about 46,500 R&D scientists and engineers (excluding R&D management for which detailed data are lacking) in October 1969 (table 8). Over one-half —52 percent—were at the Department of Defense. The next largest group was the 16 percent at NASA. In 1967 DOD accounted for 49 percent of the 45,900 R&D scientists and engineers in Federal employ, while NASA accounted for 16 percent.

Table 8. Distribution of R&D scientists and engineers[a] in the Federal Government, October 1967 and 1969

Agency	1967	1969
All agencies	45,909	46,545
Department of Defense	22,717	24,237
Department of Agriculture	4,733	4,803
Department of Health, Education, and Welfare	1,654	1,747
Department of Interior	3,728	3,783
National Aeronautics and Space Administration	7,502	7,607
Department of Commerce	1,731	1,756
Department of Transportation	565	574
All other agencies	3,279	2,038

[a] Excludes management and uniformed military scientists and engineers.
Source: National Science Foundation, based on data of the U. S. Civil Service Commission.

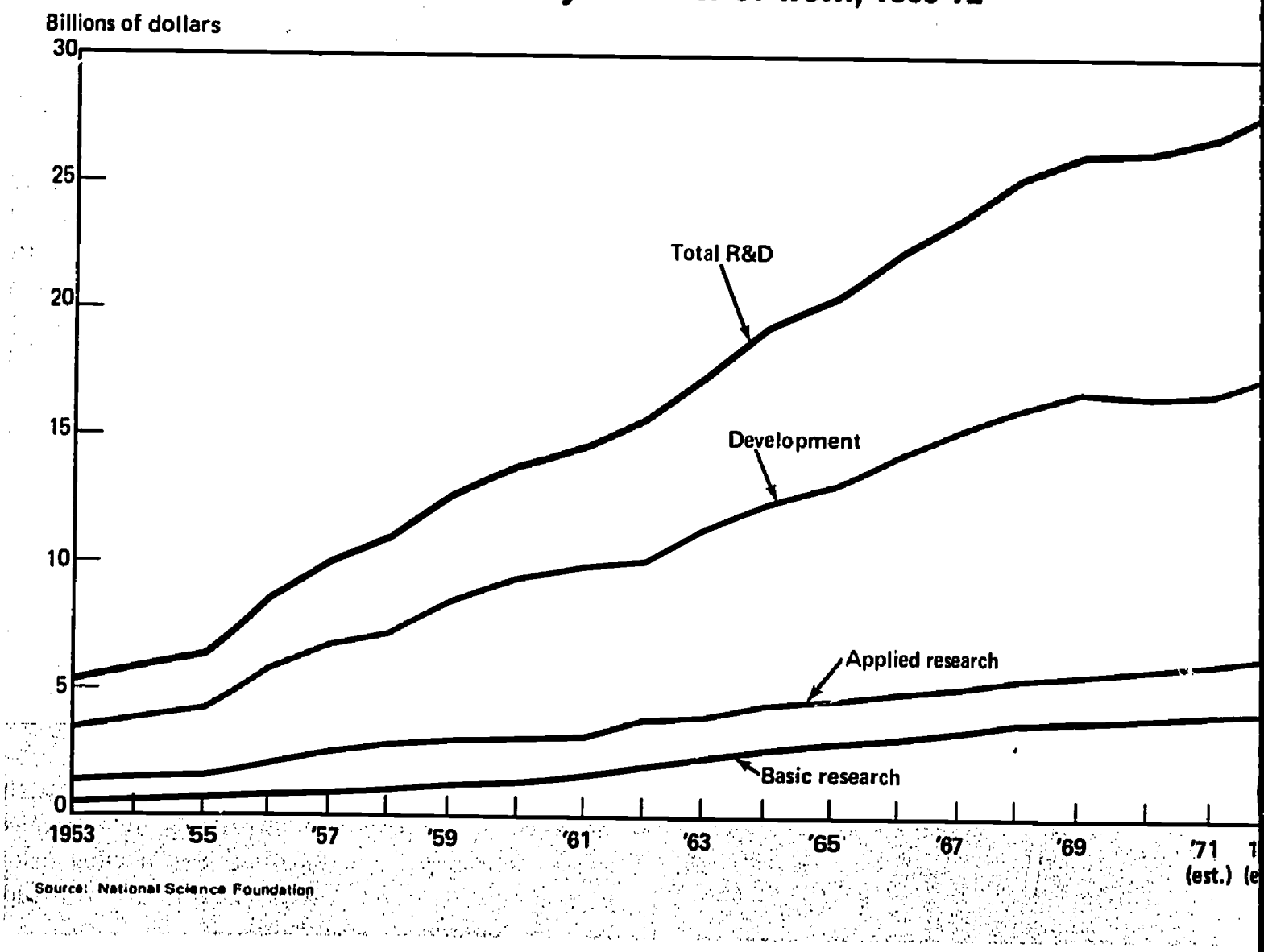
CHARACTER OF R&D WORK

Basic Research

• Basic research performance in the United States is expected to reach $4.1 billion in 1972, a 2-percent increase from 1971. Between 1967 and 1972 basic research shows a rise of 23 percent, compared to 27 percent for applied research only 15 percent for development.

• Basic research accounts for 15 percent of national R&D total in the current period; in its share was 9 percent.

R&D trends by character of work, 1953-72



Source: National Science Foundation

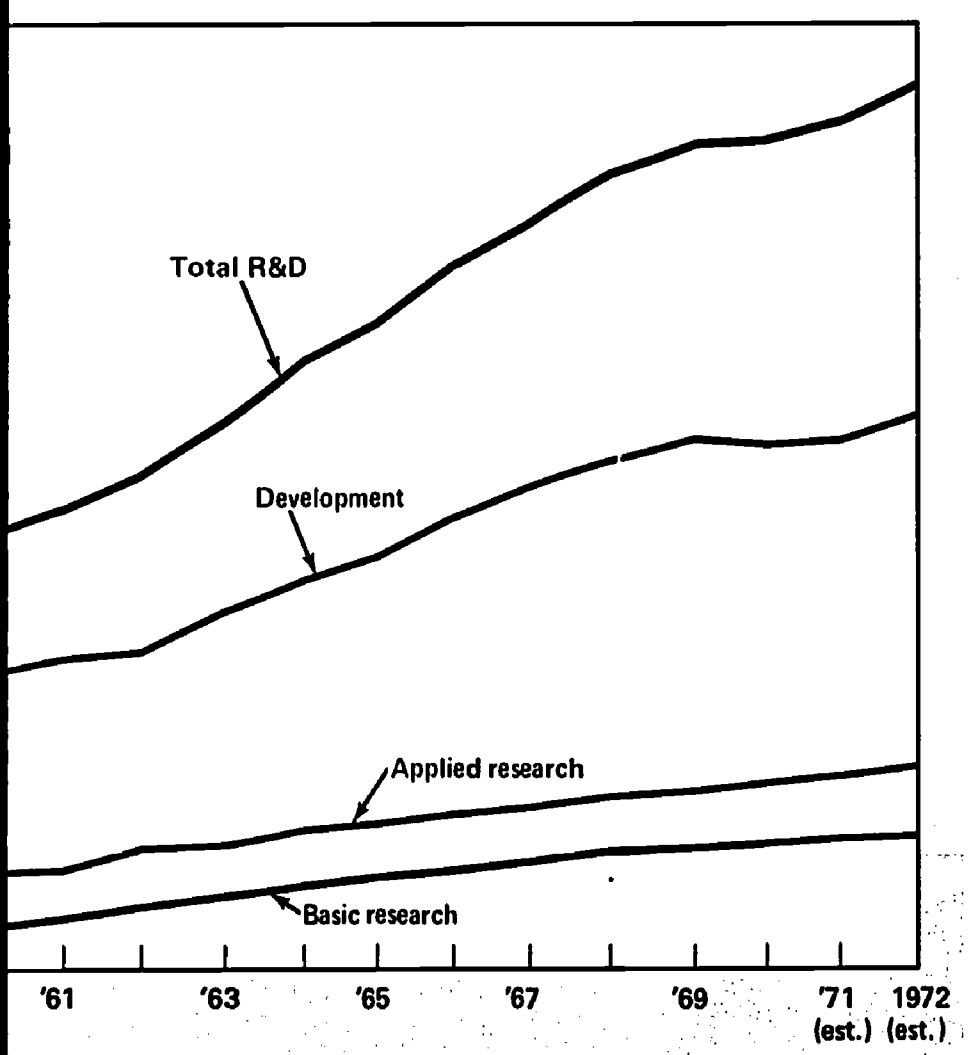
WORK

United
972, a
67 and
ercent,

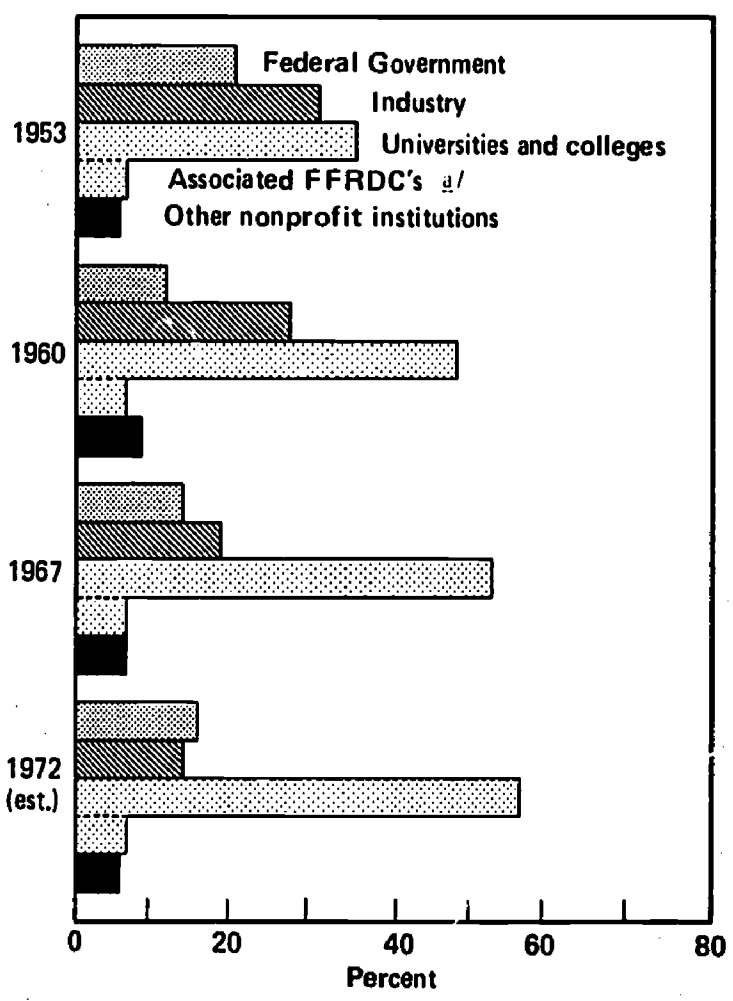
compared to 27 percent for applied research and only 15 percent for development.

- Basic research accounts for 15 percent of the national R&D total in the current period; in 1953 its share was 9 percent.

by character of work, 1953-72



Basic research performance, 1953-72

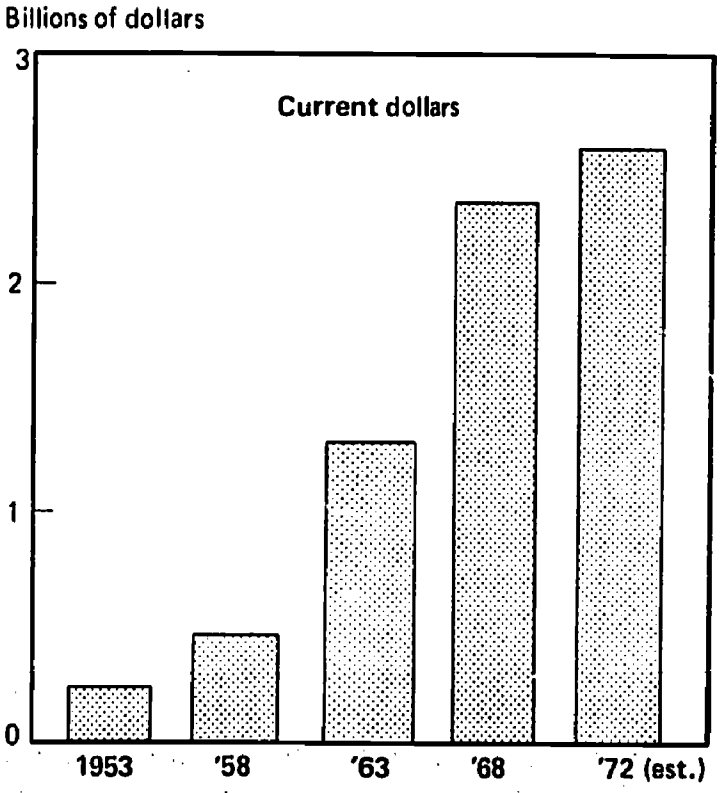


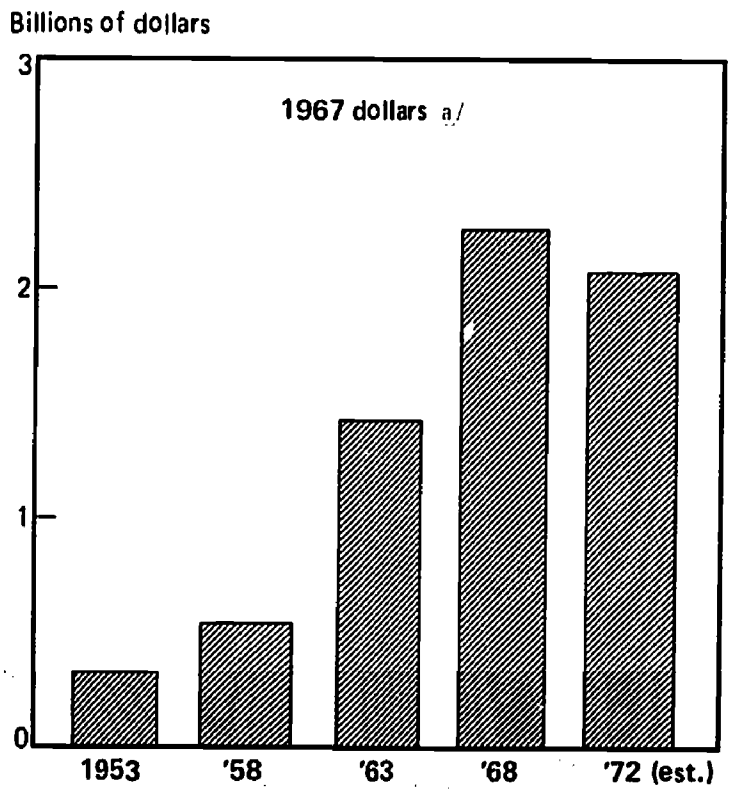
a/ Federally Funded Research and Development Centers.

Source: National Science Foundation

- More than 55 percent of all basic research is performed in universities and colleges. This activity is particularly necessary to high-quality graduate education; the universities and colleges which grant doctorates perform over 95 percent of the sector's basic research.

Federal Government basic research support, 1953-72

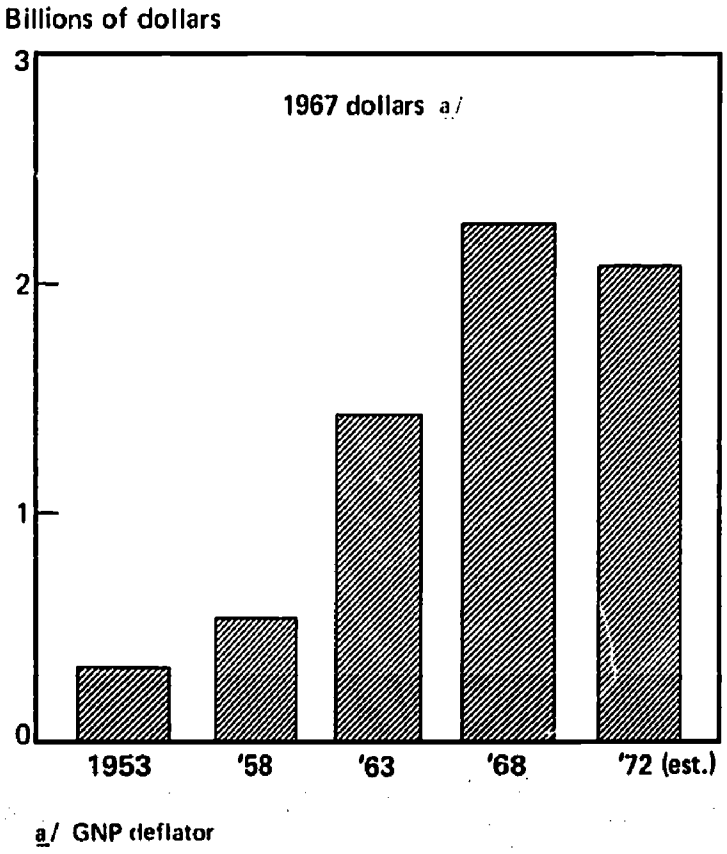




a/ GNP deflator

Source: National Science Foundation

c research support, 1953-72



a/ GNP deflator

- The Federal Government will finance an estimated 63 percent of the Nation's basic research in 1972. While Federal basic research support has increased more than Federal financing of total research and development in recent years (basic research support will be up an average of 2.4 percent between 1968 and 1972, compared to 0.4 percent for total R&D work), in terms of constant dollars there has been an overall 8-percent decrease in Federal basic research funds in the 1968–72 period.

- About nine-tenths of Federal basic research financing comes from DOD, NASA, AEC, HEW, and NSF.

- Universities and colleges are expected to support 20 percent of basic research performance in 1972; industry, 12 percent; and nonprofit institutions, 5 percent.

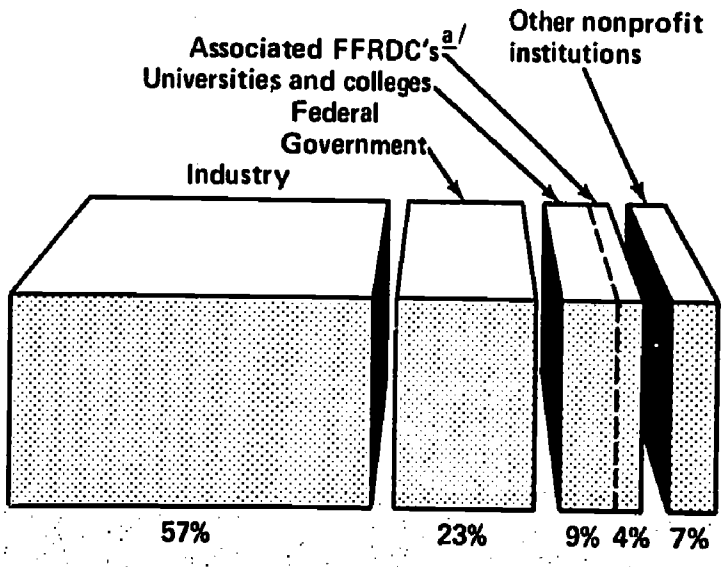
- Although nonprofits' expenditures are relatively small, they are important financers of innovative work and many are national leaders in their fields of R&D performance. Fifty percent of their support is devoted to basic research.

Applied Research

• Funds for applied research are expected to increase to $6.4 billion in 1972, 5 percent above the 1971 amount and 9 percent above the 1970 level.

• The portion of applied research funds in the R&D total has decreased slightly, from 25 percent in 1953 to an anticipated 23 percent in 1972.

Applied research performance, 1972 (est.)



a/ Federally Funded Research and Development Centers.

Source: National Science Foundation

• Industrial firms have accounted for 55–60 percent of all applied research performance in recent years. The profit orientation of industry leads it to devote about 95 percent of its R&D resources to the generally more immediate pay-offs associated with applied research and development. The chemicals, electrical equipment and communication, and aircraft and missiles industries are the leading applied research performers, making up over one-half of the industry total.

• Federal agencies will perform about 23 percent of the Nation's applied research in 1972. Four agencies—DOD, NASA, HEW, and the Department of Agriculture—account for about four-fifths of the Federal work.

• The major share of the national applied research effort is financed by Federal funds at present; this is expected to amount to about 54 percent in 1972. Industry also contributes heavily to the activity, being expected to support an additional 40 percent. The chemicals industry is largest in terms of applied research financing.

• Industrial funding has shown faster growth than Federal support in recent years. Between 1962 and 1967 Federal funding of applied research increased at an average annual rate of 6.2 percent, compared to 5.2 percent for industry. In the 1967–72 period, however, industrial financing rose at 6.3 percent annually while Federal registered 3.9 percent. From 1970 to 1972 Federal support for applied research is expected to increase 4.3 percent annually; industry, 5.2 percent.

ed to in-
nt above
ne 1970

s in the
percent
972.

e,

nprofit
ns

• Industrial firms have accounted for 55–60 percent of all applied research performance in recent years. The profit orientation of industry leads it to devote about 95 percent of its R&D resources to the generally more immediate pay-offs associated with applied research and development. The chemicals, electrical equipment and communication, and aircraft and missiles industries are the leading applied research performers, making up over one-half of the industry total.

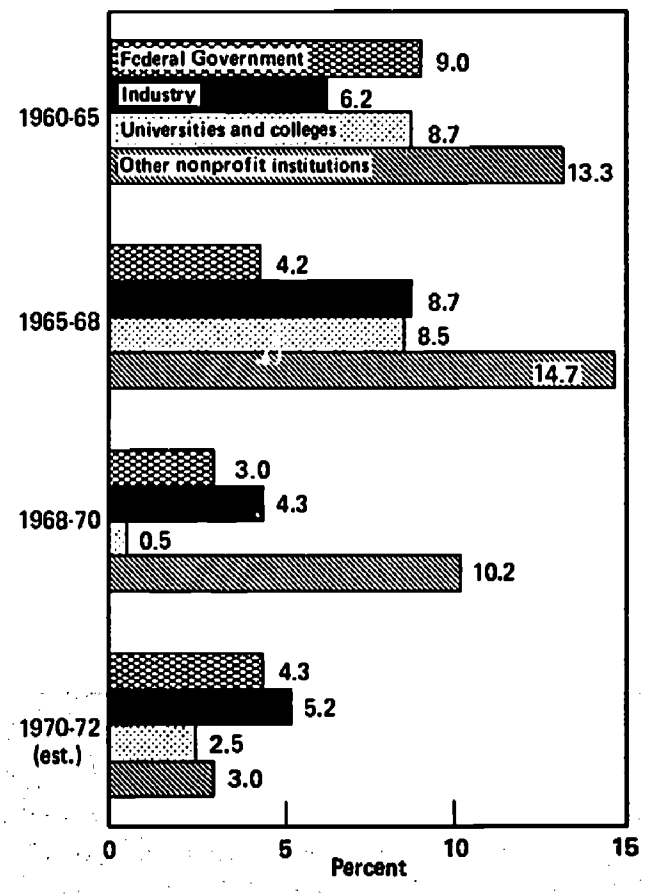
• Federal agencies will perform about 23 percent of the Nation's applied research in 1972. Four agencies—DOD, NASA, HEW, and the Department of Agriculture—account for about four-fifths of the Federal work.

• The major share of the national applied research effort is financed by Federal funds at present; this is expected to amount to about 54 percent in 1972. Industry also contributes heavily to the activity, being expected to support an additional 40 percent. The chemicals industry is largest in terms of applied research financing.

• Industrial funding has shown faster growth than Federal support in recent years. Between 1962 and 1967 Federal funding of applied research increased at an average annual rate of 6.2 percent, compared to 5.2 percent for industry. In the 1967–72 period, however, industrial financing rose at 6.3 percent annually while Federal registered 3.9 percent. From 1970 to 1972 Federal support for applied research is expected to increase 4.3 percent annually; industry, 5.2 percent.

• Virtually all of the nonfederal funding is furnished by the industrial sector, with colleges and universities and other nonprofit institutions supporting less than one percent in 1972.

Average annual rates of growth in sources of applied research funds, 1960-72

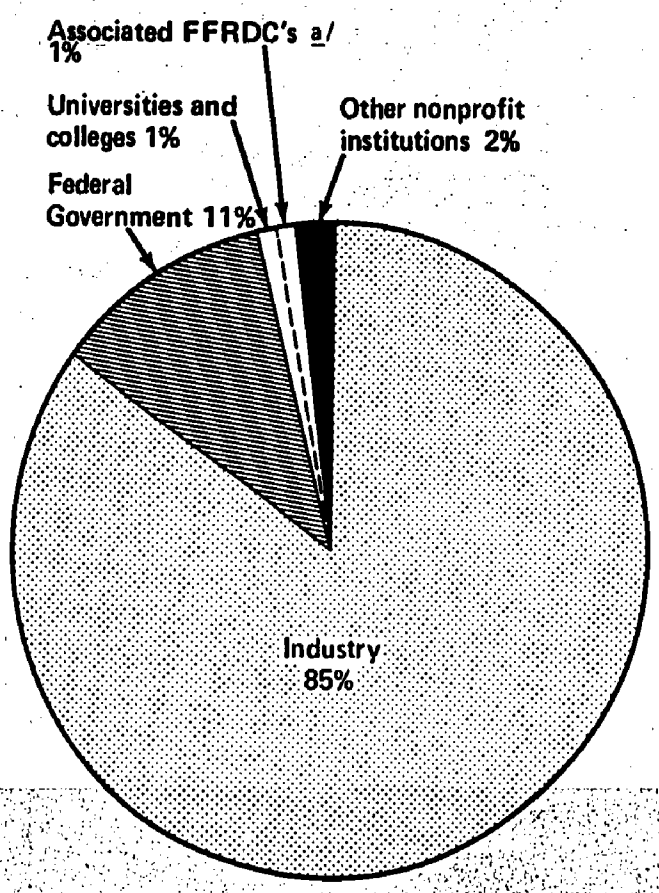


Source: National Science Foundation

Development

• About $17.5 billion is expected to be allocated to development activities in 1972. Development will probably account for 62 percent of total R&D funds, a share that has recently been decreasing.

Development performance, 1972 (est.)



a/ Federally Funded Research and Development Centers.

Source: National Science Foundation

• Industrial firms perform 85 percent of
country's development, devoting about thr
quarters of their total R&D outlays to this activ
The new and improved products and proces
which result range from consumer products
sophisticated defense and space explorat
systems.

• Leading industries in terms of development
aircraft and missiles, and electrical equipm
and communication. Both are heavily involved
Federal contracting for defense and space wo

• The machinery, motor vehicles, and chemic
industries are also major development performe
their programs are primarily company finance

• Federal agencies will account for approximat
11 percent of development performance in 19
This includes funds expended to administer c
tract programs carried on in other sectors. D
makes up about 80 percent of this total. NAS
HEW, and the Departments of Transportation a
Interior also have significant programs.

• The Federal Government currently provides ju
over one-half of the financing for developme
the same share as in the early 1950's, when t
series began. However, from 1957 to 1964 t
Federal portion was in the 67–69 percent ran

• Industrial firms perform 85 percent of the country's development, devoting about three-quarters of their total R&D outlays to this activity. The new and improved products and processes which result range from consumer products to sophisticated defense and space exploration systems.

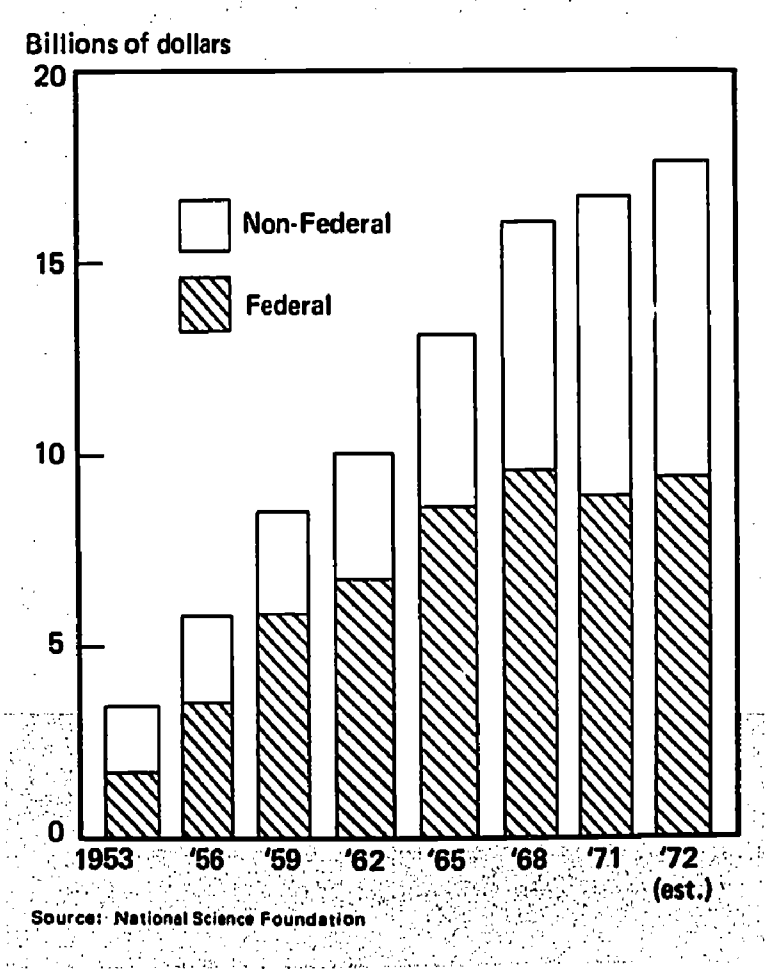
• Leading industries in terms of development are aircraft and missiles, and electrical equipment and communication. Both are heavily involved in Federal contracting for defense and space work.

• The machinery, motor vehicles, and chemicals industries are also major development performers; their programs are primarily company financed.

• Federal agencies will account for approximately 11 percent of development performance in 1972. This includes funds expended to administer contract programs carried on in other sectors. DOD makes up about 80 percent of this total. NASA, HEW, and the Departments of Transportation and Interior also have significant programs.

• The Federal Government currently provides just over one-half of the financing for development, the same share as in the early 1950's, when this series began. However, from 1957 to 1964 the Federal portion was in the 67–69 percent range.

Federal and non-Federal financing of development, 1953-72



Source: National Science Foundation

SELECTED REFERENCES

Executive Office of the President, **Economic Report of the President, February 1971.**

Bureau of the Budget, **Special Analyses—Budget of the United States, Fiscal Year 1972.** Part 3, Analysis R, "Federal Research and Development Programs."

National Science Foundation, **Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1970, 1971, and 1972,** Vol. XX (NSF 71–35).

———. **An Analysis of Federal R&D Funding by Budget Function, 1960–72** (NSF 71–25).

———. **Federal Funds for Academic Science, Fiscal Year 1969** (NSF 71–7).

———. **Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1970** (NSF 71–28).

———. **Research and Development in State Government Agencies, Fiscal Years 1967 and 1968** (NSF 70–22).

———. **Research and Development in Local Governments, Fiscal Years 1968 and 1969** (NSF 71–6).

———. **Resources for Scientific Activities at Universities and Colleges, 1969** (NSF 70–16).

———. **Scientific Activities of Independent Nonprofit Institutions, 1970** (NSF 71–9).

———. **Employment of Scientists and Engineers in the United States, 1950–66** (NSF 68–30).

———. **American Science Manpower, 1970** (NSF 71–45).

———. **Scientific, Technical, and Health Personnel in the Federal Government, 1969** (NSF 70–44).

———. **Research and Development in Industry, 1969** (NSF 71–18).

———. **Science Resources Studies Highlights, "Industrial R&D Spending, 1970"** (NSF 71–39).

———. **Science and Engineering Doctorate Supply and Utilization, 1969 and 1980** (NSF 71–20).

———. **Impact of Changes in Federal Science Funding Patterns on Academic Institutions, 1968–70** (NSF 70–48).

Department of Health, Education, and Welfare, **Research in the Nation's Hospitals, State-Local-Voluntary, 1967.**

Note: Science Resources Studies Highlights available from the National Science Foundation; all other reports available from the Supt. of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

APPENDIX A

Basis for Sectoring

The four-sector division followed by the tional Science Foundation in surveying R&D and personnel and maintaining the time s for expenditures and employment is based o approach that attempts to take account of the legal nature and major functions of orga tions active in financing and performing bas search, applied research, and development. ever, grouping diverse types of organizations discrete sectors requires certain arbitrary ments because of the mixed nature of man ganizations, particularly those in the unive and other nonprofit sectors.

The **Federal sector** is made up of the age of the Federal Government.

The **industry sector** consists of both man turing and nonmanufacturing companies. M facturing is classified in major industry gr ings; and nonmanufacturing, which incl organizations such as those in selected se industries, is treated as a unit. FFRDC's ad istered by industrial firms are also included.

The **universities and colleges sector** is posed of all institutions of higher education, public and private. The term "universities colleges" is used in this report to refer to academic institutions as a group without the a ciated FFRDC's administered by the schools various Federal agencies. The universities colleges comprise the following:

Colleges of liberal arts; schools of arts sciences; professional schools, such as e neering and medical schools, including a ated hospitals; associated research institut and similar organizations, which are inte parts of the universities and colleges; agr tural experiment stations, and associa schools of agriculture.

Basis for Sectoring

The four-sector division followed by the National Science Foundation in surveying R&D funds and personnel and maintaining the time series for expenditures and employment is based on an approach that attempts to take account of both the legal nature and major functions of organizations active in financing and performing basic research, applied research, and development. However, grouping diverse types of organizations into discrete sectors requires certain arbitrary judgments because of the mixed nature of many organizations, particularly those in the university and other nonprofit sectors.

A

The **Federal sector** is made up of the agencies of the Federal Government.

The **industry sector** consists of both manufacturing and nonmanufacturing companies. Manufacturing is classified in major industry groupings; and nonmanufacturing, which includes organizations such as those in selected service industries, is treated as a unit. FFRDC's administered by industrial firms are also included.

The **universities and colleges sector** is composed of all institutions of higher education, both public and private. The term "universities and colleges" is used in this report to refer to the academic institutions as a group without the associated FFRDC's administered by the schools for various Federal agencies. The universities and colleges comprise the following:

> Colleges of liberal arts; schools of arts and sciences; professional schools, such as engineering and medical schools, including affiliated hospitals; associated research institutions, and similar organizations, which are integral parts of the universities and colleges; agricultural experiment stations, and associated schools of agriculture.

Funds used at the universities and attributed to the universities sector as a source consist of several components: (a) State and local government funds separately budgeted for research and development, (b) the direct or indirect costs of R&D performance sponsored by outside organizations that were defrayed in part by universities and colleges in accordance with cost sharing or other arrangements, and (c) unrestricted or general funds which the institutions themselves have been free to allocate for research either through their instructional or departmental budget or through their own separately budgeted research. Funds from the Federal Government, industry, or other nonprofit institutions, which are supplied in the form of grants or contracts for research or development at a university, are credited to the appropriate source in the performance of research and development by universities and colleges. Thus, research contracts from industry are treated as university performance funded by industry as the source, whereas funds given to the institution by industry for general educational purposes and used by the school, at its discretion, for research, are treated as university performance financed with the university's own funds.

Institutions in the **other nonprofit sector** fall into two general groups: (1) organizations that are primarily granting in nature, namely private philanthropic foundations and voluntary health agencies, and (2) public and private organizations that are involved in performing research and development, comprising separately incorporated nonprofit research institutes, professional societies, academies of science, museums, zoological gardens, botanical gardens, arboretums, nonprofit hospitals, and FFRDC's administered by nonprofit organizations.

In this report, both the university and the other nonprofit sectors contain private and public institutions--the latter are closely associated with State or local government. A number of organizations in both sectors, as well as in industry, also receive State and local government funds.

Technical Notes

Revisions of R&D Time Series Since December 1970

1. FUNDS

Federal Government. Data were revised based on the annual survey of R&D activities by Federal agencies covering fiscal years 1970, 1971, and 1972.

Industry. Data were revised for 1969 on the basis of the annual "shuttle" questionnaire that enables respondents to revise the figure reported for the preceding year when they report on the current year. Data for 1970 were obtained from the 1970 industrial R&D survey.

Universities and colleges. Data for 1969–70 were revised in light of new information obtained in the 1971 survey.

Other nonprofit institutions. Data for 1964 to 1969 were based on the 1969 survey and on the basis of detailed information from the National Institutes of Health on voluntary nonprofit hospitals.

Data for 1970 are classified as preliminary because a final report on intramural performance of research and development was available only for the Federal sector at the time of writing. In addition, preliminary data from the 1970 industrial R&D survey and the 1971 universities and colleges survey were available. Estimates for 1971 and 1972 are extensions of the regular time series, taking into account trends shown in **Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1970, 1971, and 1972,** Vol. XX,[1] as well as other related information.

Estimates of R&D performance by State and local government agencies (except at universities and colleges) have not been included in this report because of insufficient survey data.

2. MANPOWER

Data for 1970 were based on surveys of Federal Government personnel as of October 1970, industry as of January 1970 and January 1971, other nonprofit organizations as of January 1970, and universities and colleges as of January 1971, and other related sources.

Concepts and Definitions

Research and development in this report consist of basic and applied research in the sciences (including medical sciences) and in engineering and activities in development, all defined below. In terms of fields, the natural sciences—life, physical, and engineering—as well as the social and psychological sciences are covered in the Federal, universities, and other nonprofit sectors. Industry coverage is limited, at present, to the natural sciences.

Research, which is made up of basic and applied, is systematic, intensive study directed toward fuller scientific knowledge of the subject studied.

Basic research. For three of the sectors—Federal Government, universities and colleges, and other nonprofit institutions—the definition of basic research stresses that it is directed toward increases of knowledge in science with ". . . the primary aim of the investigator . . . a fuller knowledge or understanding of the subject under study, rather than a practical application thereof." To take account of an individual industrial company's commercial goals, the definition for the industry sector is modified to indicate that basic research projects represent "original investigations for the advancement of scientific knowledge . . . which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

Applied research. The core definition in the NSF questionnaire sent to the universities and

[1] National Science Foundation, **Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1970, 1971, and 1972,** Vol. XX (NSF 71–35) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office) 1972.

and colleges) have not been included in this report because of insufficient survey data.

2. MANPOWER

Data for 1970 were based on surveys of Federal Government personnel as of October 1970, industry as of January 1970 and January 1971, other nonprofit organizations as of January 1970, and universities and colleges as of January 1971, and other related sources.

Concepts and Definitions

Research and development in this report consist of basic and applied research in the sciences (including medical sciences) and in engineering and activities in development, all defined below. In terms of fields, the natural sciences—life, physical, and engineering—as well as the social and psychological sciences are covered in the Federal, universities, and other nonprofit sectors. Industry coverage is limited, at present, to the natural sciences.

Research, which is made up of basic and applied, is systematic, intensive study directed toward fuller scientific knowledge of the subject studied.

Basic research. For three of the sectors—Federal Government, universities and colleges, and other nonprofit institutions—the definition of basic research stresses that it is directed toward increases of knowledge in science with ". . . the primary aim of the investigator . . . a fuller knowledge or understanding of the subject under study, rather than a practical application thereof." To take account of an individual industrial company's commercial goals, the definition for the industry sector is modified to indicate that basic research projects represent "original investigations for the advancement of scientific knowledge . . . which do not have specific commercial objectives, although they may be in fields of present or potential interest to the reporting company."

Applied research. The core definition in the NSF questionnaire sent to the universities and colleges is: "**Applied research** is directed toward practical application of knowledge." Here again, the definition for the industry survey takes account of the characteristics of industrial organizations—it covers ". . . research projects which represent investigations directed to discovery of new scientific knowledge and which have specific commercial objectives with respect to either projects or processes." By this definition, applied research in industry differs from basic research chiefly in terms of objectives of the reporting company.

Development. The NSF survey concept of development may be summarized as ". . . the systematic use of scientific knowledge directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes."

Current Operating Costs

Funds used for research and development, reported in this study, refer to current operating costs, consisting of both direct and indirect costs including depreciation, insofar as this information is available to respondents. Capital expenditures are excluded by definition and this is followed in both the industry and other nonprofit sectors. Under the accounting practices of some Federal agencies, particularly the Department of Defense, data on Federal R&D funds, which are available in detail only in terms of obligations rather than expenditures, do not include an allowance for depreciation but do include some obligations for capital items.

Performer-Reporting Basis

In the Foundation's surveys, respondents in all four sectors indicate the amounts they spend on research and development in their own sector and the sources of these funds. The National Science Foundation bases all national totals on data as reported by performers because institutions doing research and development are in the

best position to: (a) indicate how much they spent in the actual conduct of research and development in a given year, (b) classify their work as basic, applied, etc., and (c) identify the sector of the economy in which their financing originated. The use of performer reporting throughout also reduces the possibility of double counting. Because the national time series on Federal funds spent in research and development are based on expenditures reported by organizations which have actually performed the research and development, they differ from the series in the **Federal Funds for Research, Development, and Other Scientific Activities** on agency obligations for research and development to be performed in the non-Federal sectors. Federal agency obligations are used in the series only for intramural performance in agency laboratories where they are treated as the equivalent of expenditures. Expenses of Federal personnel engaged in planning and administering intramural and extramural R&D programs are also included in the intramural performance total.

There have been surveys in all four sectors thus far in the NSF time series for the following years: 1953–54, 1957–58, 1964 and 1966. In general, the Federal Government a have been surveyed every year, bu been possible to maintain the same f the universities and other nonprofit National data for other years are base data on the performance of total r development, basic research, applie and development from the Federal a sectors and on estimates for the un other nonprofit sectors.

Single-Year Designation for National Totals

Data for calendar year 1953 for i nonprofit institutions are combined v intramural and university data for fisca (that is, July 1952 through June 1 R&D funds series. The sector data f following 1953 are grouped accordin annual national totals are based on t

Full-Time-Equivalent (FTE) Num Scientists and Engineers

The concept of the FTE provides denominator for combining the num time employees with an FTE number

ch they spent
and develop-
their work as
fy the sector
ng originated.
oughout also
counting. Be-
Federal funds
are based on
ations which
and develop-
n the Federal
, and Other
ations for re-
ormed in the
y obligations
tramural per-
ere they are
nditures. Ex-
d in planning
ramural R&D
tramural per-

four sectors
the following
nd 1966. In

general, the Federal Government and industry have been surveyed every year, but it has not been possible to maintain the same frequency for the universities and other nonprofit institutions. National data for other years are based on survey data on the performance of total research and development, basic research, applied research, and development from the Federal and industry sectors and on estimates for the university and other nonprofit sectors.

Single-Year Designation for National Totals

Data for calendar year 1953 for industry and nonprofit institutions are combined with Federal intramural and university data for fiscal year 1953 (that is, July 1952 through June 1953) in the R&D funds series. The sector data for the years following 1953 are grouped accordingly and the annual national totals are based on this phasing.

Full-Time-Equivalent (FTE) Number of Scientists and Engineers

The concept of the FTE provides a common denominator for combining the number of full-time employees with an FTE number of part-time employees to achieve a quantitative measure of manpower input. The minimum standard for inclusion of scientists and engineers was the performance of professional scientific or engineering work in research and development, requiring a bachelor's degree, or its equivalent, in science or engineering. In the industry, university, and other nonprofit sectors, both the manpower and expenditures data for each year were obtained in the same surveys; in the Federal sector, data on expenditures and civilian scientists and engineers were reported in different inquiries, and estimates of military scientists and engineers were obtained separately.

Defense-Space Classification

Defense expenditures consist of all R&D spending by DOD and a portion of AEC funds. Space R&D expenditures are those of NASA. The space activities of DOD are included as spending on defense. The space activities of other Federal agencies are not included; it is estimated they account for less than 5 percent of all space R&D spending. This series has been revised to include R&D performance reporting where available.

APPENDIX B

Statistical Tables

Table B–1. Transfers of funds expended annually for performance of research and devel

[Millions of dollars]

Year	Total R&D	Federal Government		Industry [b]			Universities and college			
		Total funds used	Source: Federal Government	Total funds used	Sources: Federal Government	Sources: Industry [d]	Total funds used	Sources: Federal Government	Sources: Industry	Sources: Universities and colleges [d]
1953 ...	5,207	1,010	1,010	3,630	1,430	2,200	[e]334	138	19	151
1954 ...	5,738	1,020	1,020	4,070	[e]1,750	[e]2,320	377	160	22	167
1955 ...	6,279	905	905	4,640	[e]2,180	[e]2,460	[e]409	169	25	185
1956 ...	8,483	1,040	1,040	6,605	3,328	3,277	[e]480	213	29	204
1957 ...	9,912	1,220	1,220	7,731	4,335	3,396	[e]531	229	34	230
1958 ...	10,870	1,374	1,374	8,389	4,759	3,6[illegible]	592	254	39	257
1959 ...	12,540	1,640	1,640	9,618	5,635	3,983	[e]682	306	39	290
1960 ...	13,730	1,726	1,726	10,509	6,081	4,428	[e]825	405	40	328
1961 ...	14,552	1,874	1,874	10,908	6,240	4,668	[e]969	500	40	371
1962 ...	15,665	2,098	2,098	11,464	6,435	5,029	[e]1,143	613	40	424
1963 ...	17,371	2,279	2,279	12,630	7,270	5,360	[e]1,359	760	41	485

pended annually for performance of research and development by sector, distributed by source, 1953–72[a]

[Millions of dollars]

Industry [b]			Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
	Sources			Sources					Source		Sources		
tal nds ed	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
530	1,430	2,200	[e]334	138	19	151	26	121	121	112	60	20	32
070	[e]1,750	[e]2,320	377	160	22	167	28	141	141	[e]130	67	25	38
540	[e]2,180	[e]2,460	[e]409	169	25	185	30	180	180	[e]145	75	28	42
605	3,328	3,277	[e]480	213	29	204	34	194	194	[e]164	84	30	50
731	4,335	3,396	[e]531	229	34	230	38	240	240	190	95	30	65
889	4,759	3,630	592	254	39	257	42	293	293	[e]222	111	31	80
118	5,635	3,983	[e]682	306	39	290	47	338	338	[e]262	140	35	87
009	6,081	4,428	[e]825	405	40	328	52	360	360	[e]310	180	40	90
008	6,240	4,668	[e]969	500	40	371	58	410	410	[e]391	240	41	110
664	6,435	5,029	[e]1,143	613	40	424	66	470	470	[e]490	310	45	135
330	7,270	5,360	[e]1,359	760	41	485	73	530	530	[e]573	380	48	145

Table B–1. Transfers of funds expended annually for performance of research and development by s

[Millions of dollars]

Year	Total R&D	Federal Government		Industry [b]			Universities and colleges				
		Total funds used	Source: Federal Government	Total funds used	Sources: Federal Government	Sources: Industry [d]	Total funds used	Sources: Federal Government	Sources: Industry	Sources: Universities and colleges [d]	Sources: Other nonprofit institutions
1964 ...	19,214	2,838	2,838	13,512	7,720	5,792	1,595	916	41	555	83
1965 ...	20,439	3,093	3,093	14,185	7,740	6,445	[e]1,822	1,073	41	615	93
1966 ...	22,266	3,222	3,222	15,548	8,3?2	7,216	2,085	1,262	42	673	108
1967 ...	23,642	3,395	3,395	16,415	8,395	8,020	[e]2,329	1,409	48	753	119
1968 ...	25,159	3,493	3,493	17,469	8,600	8,869	2,599	1,572	55	841	131
1969 ...	26,179	3,498	3,498	18,321	8,450	9,871	[e]2,705	1,600	60	900	145
1970 ... (prel.)	26,287	3,876	3,876	17,858	7,784	10,074	2,856	1,658	62	970	166
1971 ... (est.)	26,850	3,930	3,930	18,250	7,750	10,500	2,950	1,700	62	1,020	168
1972 ... (est.)	28,000	4,000	4,000	19,200	8,050	11,150	3,050	1,750	65	1,060	175

[a] All data are based on reports by performers.

[b] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of their respective sectors.

[c] FFRDC's administered by individual universities and colleges and by university-consortia.

[d] Includes State and local governme

[e] Estimates derived from related this year or this item was not obta

expended annually for performance of research and development by sector, distributed by source, 1953–72[a]—Cont.

[Millions of dollars]

Industry [b]			Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
	Sources			Sources					Source		Sources		
Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
13,512	7,720	5,792	1,595	916	41	555	83	629	629	640	450	47	143
14,185	7,740	6,445	[e]1,822	1,073	41	615	93	629	629	[e]710	498	53	159
15,548	8,332	7,216	2,085	1,262	42	673	108	630	630	781	546	59	176
16,415	8,395	8,020	[e]2,329	1,409	48	753	119	673	673	[e]830	577	66	187
17,469	8,600	8,869	2,599	1,572	55	841	131	719	719	[e]879	608	73	198
18,321	8,450	9,871	[e]2,705	1,600	60	900	145	725	725	930	640	81	209
17,858	7,784	10,074	2,856	1,658	62	970	166	737	737	[e]960	650	90	220
18,250	7,750	10,500	2,950	1,700	62	1,020	168	760	760	960	630	100	230
19,200	8,050	11,150	3,050	1,750	65	1,060	175	775	775	975	635	105	235

d Development Centers administered by both industry
he totals of their respective sectors.
s and colleges and by university-consortia.

[d] Includes State and local government funds.
[e] Estimates derived from related information because either no sector survey was conducted for this year or this item was not obtained in survey.

Table B–2. Transfers of funds expended annually for performance of basic researc

[Millions of dollars]

Year	Total basic research	Federal Government		Industry [b]			Universities and colleg			
		Total funds used	Source: Federal Government	Total funds used	Sources: Federal Government	Sources: Industry [d]	Total funds used	Sources: Federal Government	Sources: Industry	Sources: Univ sities and c leges
1953 . . .	489	101	101	151	[e]19	[e]132	[e]173	73	12	73
1954 . . .	548	102	102	[e]166	23	143	206	90	14	85
1955 . . .	608	90	90	[e]189	27	162	[e]237	103	16	99
1956 . . .	747	104	104	253	[e]37	[e]216	[e]286	130	18	116
1957 . . .	857	122	122	271	[e]41	[e]230	[e]337	155	21	136
1958 . . .	973	126	126	295	[e]43	[e]252	390	178	24	159
1959 . . .	1,155	173	173	320	[e]72	[e]248	[e]468	226	24	185
1960 . . .	1,326	160	160	376	[e]79	[e]297	[e]576	299	24	215
1961 . . .	1,543	206	206	395	[e]81	[e]314	[e]701	382	25	250
1962 . . .	1,886	251	251	488	143	345	[e]850	481	25	293
1963 . . .	2,196	299	299	522	147	375	[e]1,036	610	25	343

ers of funds expended annually for performance of basic research by sector, distributed by source, 1953–72 [a]

[Millions of dollars]

	Industry [b]			Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
		Sources			Sources					Source		Sources		
	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
1	151	[e]19	[e]132	[e]173	73	12	73	15	33	33	31	8	4	19
2	[e]166	23	143	206	90	14	85	17	39	39	[e]35	11	4	20
0	[e]189	27	162	[e]237	103	16	99	19	49	49	[e]43	17	5	21
4	253	[e]37	[e]216	[e]286	130	18	116	22	51	51	[e]53	23	5	25
2	271	[e]41	[e]230	[e]337	155	21	136	25	65	65	62	25	5	32
6	295	[e]43	[e]252	390	178	24	159	29	78	78	[e]84	35	6	43
8	320	[e]72	[e]248	[e]468	226	24	185	33	92	92	[e]102	46	8	48
0	376	[e]79	[e]297	[e]576	299	24	215	38	97	97	[e]117	58	10	49
6	395	[e]81	[e]314	[e]701	382	25	250	44	115	115	[e]126	57	11	58
1	488	143	345	[e]850	481	25	293	51	136	136	[e]161	80	12	69
9	522	147	375	[e]1,036	610	25	343	58	159	159	[e]180	95	14	71

Table B–2. Transfers of funds expended annually for performance of basic research by sector, distributed

[Millions of dollars]

Year	Total basic research	Federal Government		Industry [b]			Universities and colleges					Asso FFR
		Total funds used	Source: Federal Government	Total funds used	Sources: Federal Government	Sources: Industry [d]	Total funds used	Sources: Federal Government	Sources: Industry	Sources: Universities and colleges [d]	Sources: Other nonprofit institutions	Total funds used
1964 ...	2,559	364	364	549	165	384	1,261	767	25	402	67	191
1965 ...	2,853	424	424	592	186	406	[e]1,419	879	26	445	69	208
1966 ...	3,127	449	449	624	173	451	1,601	1,009	27	494	71	227
1967 ...	3,363	478	478	629	202	427	[e]1,785	1,124	31	551	79	250
1968 ...	3,658	512	512	642	180	462	2,011	1,268	36	621	86	276
1969 ...	3,772	577	577	620	160	460	[e]2,087	1,275	39	678	95	275
1970 ... (prel.)	3,921	658	658	599	150	449	2,185	1,288	40	747	110	269
1971 ... (est.)	4,050	670	670	595	160	435	2,275	1,330	40	793	112	290
1972 ... (est.)	4,120	675	675	585	150	435	2,335	1,355	40	825	115	300

[a] All data are based on reports by performers.

[b] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of their respective sectors.

[c] FFRDC's administered by individual universities and colleges and by university-consortia.

[d] Includes State and local government funds.

[e] Estimates derived from related information this year or this item was not obtained in surve

nnually for performance of basic research by sector, distributed by source, 1953–72 [a]—Cont.

[Millions of dollars]

try [b] Sources		Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
			Sources				Source		Sources			
ral rn- nt	Industry [d]	Total funds used	Federal Govern- ment	Industry	Univer- sities and col- leges [d]	Other non- profit institu- tions	Total funds used	Federal Govern- ment	Total funds used	Federal Govern- ment	Industry	Other non- profit institu- tions [d]
5	384	1,261	767	25	402	67	191	191	194	108	15	71
6	406	[e]1,419	879	26	445	69	208	208	[e]210	120	16	74
3	451	1,601	1,009	27	494	71	227	227	[e]226	132	18	76
2	427	[e]1,785	1,124	31	551	79	250	250	[e]221	125	19	77
0	462	2,011	1,268	36	621	86	276	276	[e]217	118	20	79
0	460	[e]2,087	1,275	39	678	95	275	275	213	111	22	80
0	449	2,185	1,288	40	747	110	269	269	[e]210	105	25	80
0	435	2,275	1,330	40	793	112	290	290	220	110	25	85
0	435	2,335	1,355	40	825	115	300	300	225	110	25	90

rs administered by both industry
spective sectors.
by university-consortia.

[d] Includes State and local government funds.
[e] Estimates derived from related information because either no sector survey was conducted for this year or this item was not obtained in survey.

Table B–3. Transfers of funds expended annually for performance of applied researc

[Millions of dollars]

Year	Total applied research	Federal Government		Industry [b]			Universities and colleges			
			Source		Sources			Sources		
		Total funds used	Federal Government	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]
1953 . . .	1,317	[e]345	345	[e]726	288	438	[e]146	57	6	73
1954 . . .	1,430	[e]349	349	[e]814	32[illegible]	492	154	61	7	76
1955 . . .	1,525	[e]310	310	[e]928	368	560	[e]155	58	8	79
1956 . . .	1,93[illegible]	[e]356	356	1,268	[e]474	[e]794	[e]169	68	9	81
1957 . . .	2,429	[e]417	417	1,670	[e]678	[e]992	[e]169	62	11	85
1958 . . .	2,757	[e]474	474	1,911	[e]774	[e]1,137	175	64	12	88
1959 . . .	2,965	[e]558	558	1,991	[e]813	[e]1,178	[e]186	67	12	95
1960 . . .	3,093	[e]595	595	2,029	[e]833	[e]1,196	[e]215	88	13	102
1961 . . .	3,156	[e]634	634	1,977	[e]812	[e]1,165	[e]233	98	13	110
1962 . . .	3,775	[e]702	702	2,449	1,011	1,438	[e]253	109	13	118
1963 . . .	3,881	730	730	2,457	1,007	1,450	[e]283	128	14	128

nds expended annually for performance of applied research by sector, distributed by source, 1953--72

[Millions of dollars]

Industry [b]			Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
	Sources			Sources					Source		Sources		
tal nds ed	Federal Govern-ment	Industry [d]	Total funds used	Federal Govern-ment	Industry	Univer-sities and col-leges [d]	Other non-profit institu-tions	Total funds used	Federal Govern-ment	Total funds used	Federal Govern-ment	Industry	Other non-profit institu-tions [d]
726	288	438	[e]146	57	6	73	10	44	44	56	36	11	9
814	322	492	154	61	7	76	10	51	51	[e]62	39	13	10
928	368	560	[e]155	58	8	79	10	65	65	[e]67	41	15	11
268	[e]474	[e]794	[e]169	68	9	81	11	71	71	[e]74	43	17	14
570	[e]678	[e]992	[e]169	62	11	85	11	86	86	87	49	17	21
911	[e]774	[e]1,137	175	64	12	88	11	102	102	[e]95	54	17	24
991	[e]813	[e]1,178	[e]186	67	12	95	12	119	119	[e]111	67	18	26
029	[e]833	[e]1,196	[e]215	88	13	102	12	122	122	[e]132	87	19	26
977	[e]812	[e]1,165	[e]233	98	13	110	12	135	135	[e]177	125	19	33
449	1,011	1,438	[e]253	109	13	118	13	155	155	[e]216	150	22	44
557	1,007	1,450	[e]283	128	14	128	13	170	170	[e]241	170	23	48

Table B–3. Transfers of funds expended annually for performance of applied research by sector, distributed by sour

[Millions of dollars]

Year	Total applied research	Federal Government		Industry [b]			Universities and colleges					Associated FFRDC's [c]	
			Source		Sources			Sources					Source
		Total funds used	Federal Government	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government
1964 . . .	4,300	928	928	2,600	1,040	1,560	294	127	14	139	14	202	202
1965 . . .	4,537	1,030	1,030	2,658	1,038	1,620	[e]346	157	13	155	21	204	204
1966 . . .	4,817	1,045	1,045	2,843	1,039	1,804	400	194	13	161	32	207	207
1967 . . .	5,041	1,095	1,095	2,915	1,066	1,849	[e]454	222	15	182	35	219	219
1968 . . .	5,439	1,199	1,199	3,124	1,043	2,081	492	241	16	198	37	231	231
1969 . . .	5,618	1,195	1,195	3,283	1,015	2,268	[e]501	245	16	200	40	210	210
1970 . . . (prel.)	5,833	1,375	1,375	3,275	1,011	2,264	527	266	16	200	45	216	216
1971 . . . (est.)	6,065	1,435	1,435	3,425	1,075	2,350	530	265	16	204	45	220	220
1972 . . . (est.)	6,380	1,475	1,475	3,650	1,150	2,500	565	290	17	210	48	225	225

[a] All data are based on reports by performers.

[b] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of their respective sectors.

[c] FFRDC's administered by individual universities and colleges and by university consortia.

[d] Includes State and local government funds.

[e] Estimates derived from related information because this year or this item was not obtained in survey.

performance of applied research by sector, distributed by source, 1953–72 [a]—Cont.

[Millions of dollars]

ry [d]	Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
		Sources				Source		Sources			
	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
0	294	127	14	139	14	202	202	276	206	22	48
0	[e]346	157	13	155	21	204	204	[e]299	224	25	50
4	400	194	13	161	32	207	207	[e]322	242	27	53
9	[e]454	222	15	182	35	219	219	[e]358	265	31	62
1	492	241	16	198	37	231	231	[e]393	288	35	70
8	[e]501	245	16	200	40	210	210	429	311	39	79
4	527	266	16	200	45	216	216	[e]440	315	40	85
0	530	265	16	204	45	220	220	455	320	45	90
0	565	290	17	210	48	225	225	465	325	50	90

ered by both industry
ctors.
ity-consortia.

[d] Includes State and local government funds.
[e] Estimates derived from related information because either no sector survey was conducted for this year or this item was not obtained in survey.

Table B–4. Transfers of funds expended annually for performance of development by sector, dis

[Millions of dollars]

Year	Total development	Federal Government		Industry [b]			Universities and colleges				
			Source		Sources			Sources			
		Total funds used	Federal Government	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions
1953 ...	3,401	[e]564	564	[e]2,753	1,123	1,630	[e]15	8	1	5	1
1954 ...	3,760	[e]569	569	[e]3,090	1,405	1,685	17	9	1	6	1
1955 ...	4,146	[e]505	505	[e]3,523	[e]1,785	[e]1,738	[e]17	8	1	7	1
1956 ...	5,798	[e]580	580	5,084	[e]2,817	[e]2,267	[e]25	15	2	7	1
1957 ...	6,626	[e]681	681	5,790	[e]3,616	[e]2,174	[e]25	12	2	9	2
1958 ...	7,140	[e]774	774	6,183	[e]3,942	[e]2,241	27	12	3	10	2
1959 ...	8,420	[e]909	909	7,307	[e]4,750	[e]2,557	[e]28	13	3	10	2
1960 ...	9,311	[e]971	971	8,104	[e]5,169	[e]2,935	[e]34	18	3	11	2
1961 ...	9,853	[e]1,034	1,034	8,536	[e]5.347	[e]3,189	[e]35	20	2	11	2
1962 ...	10,004	[e]1,145	1,145	8,527	5,281	3,246	[e]40	23	2	13	2
1963 ...	11,294	1,250	1,250	9,651	6,116	3,535	[e]40	22	2	14	2

pended annually for performance of development by sector, distributed by source, 1953–72 [a]

[Millions of dollars]

Industry [b]		Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
Sources			Sources					Source			Sources	
Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
1,123	1,630	[e]15	8	1	5	1	44	44	25	16	5	4
1,405	1,685	17	9	1	6	1	51	51	[e]33	17	8	8
[e]1,785	[e]1,738	[e]17	8	1	7	1	66	66	[e]35	17	8	10
[e]2,817	[e]2,267	[e]25	15	2	7	1	72	72	[e]37	18	8	11
[e]3,616	[e]2,174	[e]25	12	2	9	2	89	89	41	21	8	12
[e]3,942	[e]2,241	27	12	3	10	2	113	113	[e]43	22	8	13
[e]4,750	[e]2,557	[e]28	13	3	10	2	127	127	[e]49	27	9	13
[e]5,169	[e]2,935	[e]34	18	3	11	2	141	141	[e]61	35	11	15
[e]5,347	[e]3,189	[e]35	20	2	11	2	160	160	[e]88	58	11	19
5,281	3,246	[e]40	23	2	13	2	179	179	[e]113	80	11	22
6,116	3,535	[e]40	22	2	14	2	201	201	[e]152	115	11	26

Table B–4. Transfers of funds expended annually for performance of development by sector, distribute

[Millions of dollars]

Year	Total development	Federal Government		Industry [b]			Universities and colleges					A
			Source		Sources			Sources				
		Total funds used	Federal Government	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used
1964 ...	12,355	1,546	1,546	10,363	6,515	3,848	40	22	2	14	2	236
1965 ...	13,049	1,639	1,639	10,935	6,516	4,419	[e]57	37	2	15	3	217
1966 ...	14,322	1,728	1,728	12,081	7,120	4,961	84	59	2	18	5	196
1967 ...	15,238	1,822	1,822	12,871	7,127	5,744	[e]90	63	2	20	5	204
1968 ...	16,062	1,782	1,782	13,703	7,377	6,326	96	63	3	22	8	212
1969 ...	16,789	1,726	1,726	14,418	7,275	7,143	[e]117	80	5	22	10	240
1970 ... (prel.)	16,533	1,843	1,843	13,984	6,623	7,361	144	104	6	23	11	252
1971 ... (est.)	16,735	1,825	1,825	14,230	6,515	7,715	145	105	6	23	11	250
1972 ... (est.)	17,500	1,850	1,850	14,965	6,750	8,215	150	105	8	25	12	250

[a] All data are based on reports by performers.

[b] Expenditures for Federally Funded Research and Development Centers administered by both industry and by nonprofit institutions are included in the totals of their respective sectors.

[c] FFRDC's administered by individual universities and colleges and by university-consortia.

[d] Includes State and local government funds

[e] Estimates derived from related informat this year or this item was not obtained in s

of funds expended annually for performance of development by sector, distributed by source, 1953–72 [a]—Cont.

[Millions of dollars]

ce	Industry [b]			Universities and colleges					Associated FFRDC's [c]		Other nonprofit institutions [b]			
		Sources			Sources					Source		Sources		
ral rn- nt	Total funds used	Federal Government	Industry [d]	Total funds used	Federal Government	Industry	Universities and colleges [d]	Other nonprofit institutions	Total funds used	Federal Government	Total funds used	Federal Government	Industry	Other nonprofit institutions [d]
6	10,363	6,515	3,848	40	22	2	14	2	236	236	170	136	10	24
9	10,935	6,516	4,419	[e]57	37	2	15	3	217	217	[e]201	154	12	35
8	12,081	7,120	4,961	84	59	2	18	5	196	196	[e]233	172	14	47
2	12,871	7,127	5,744	[e]90	63	2	20	5	204	204	[e]251	187	16	48
2	13,703	7,377	6,326	96	63	3	22	8	212	212	[e]269	202	18	49
5	14,418	7,275	7,143	[e]117	80	5	22	10	240	240	288	218	20	50
3	13,984	6,623	7,361	144	104	6	23	11	252	252	[e]310	230	25	55
5	14,230	6,515	7,715	145	105	6	23	11	250	250	285	200	30	55
0	14,965	6,750	8,215	150	105	8	25	12	250	250	285	200	30	55

nd Development Centers administered by both industry
the totals of their respective sectors.
es and colleges and by university-consortia.

[d] Includes State and local government funds.

[e] Estimates derived from related information because either no sector survey was conducted for this year or this item was not obtained in survey.

Table B–5. Sources of funds, by sector, used for research and development, 1953–72 [a]

[Millions of dollars]

Year	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	5,207	2,759	2,239	151	58
1954	5,738	3,138	2,367	167	66
1955	6,279	3,509	2,513	185	72
1956	8,483	4,859	3,336	204	84
1957	9,912	6,119	3,460	230	103
1958	10,870	6,791	3,700	257	122
1959	12,540	8,059	4,057	290	134
1960	13 730	8,752	4,508	328	142
1961	14,552	9,264	4,749	371	168
1962	15,665	9,926	5,114	424	201
1963	17,371	11,219	5,449	485	218
1964	19,214	12,553	5,880	555	226
1965	20,439	13,033	6,539	615	252
1966	22,266	13,992	7,317	673	284
1967	23,642	14,449	8,134	753	306
1968	25,159	14,992	8,997	841	329
1969	26,179	14,913	10,012	900	354
1970 (prel)	26,287	14,705	10,226	970	386
1971 (est)	26,850	14,770	10,662	1,020	398
1972 (est)	28,000	15,210	11,320	1,060	410

[a] Summary of R&D data in table B–1, by source.

Source: National Science Foundation.

Tab

[a] Su

Sou

sed for research and development,
[a]

llars]

	Industry	Universities and colleges	Other nonprofit institutions
	2,239	151	58
	2,367	167	66
	2,513	185	72
	3,336	204	84
	3,460	230	103
	3,700	257	122
	4,057	290	134
	4,508	328	142
	4,749	371	168
	5,114	424	201
	5,449	485	218
	5,880	555	226
	6,539	615	252
	7,317	673	284
	8,134	753	306
	8,997	841	329
	10,012	900	354
	10,226	970	386
	10,662	1,020	398
	11,320	1,060	410

Table B–6. Sources of funds, by sector, used for basic research, 1953–72 [a]

[Millions of dollars]

Year	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	489	234	148	73	34
1954	548	265	161	85	37
1955	608	286	183	99	40
1956	747	345	239	116	47
1957	857	408	256	136	57
1958	973	460	282	159	72
1959	1,155	609	280	185	81
1960	1,326	693	331	215	87
1961	1,543	841	350	250	102
1962	1,886	1,091	382	293	120
1963	2,196	1,310	414	343	129
1964	2,559	1,595	424	402	138
1965	2,853	1,817	448	445	143
1966	3,127	1,990	496	494	147
1967	3,363	2,179	477	551	156
1968	3,658	2,354	518	621	165
1969	3,772	2,398	521	678	175
1970 (prel)	3,921	2,470	514	747	190
1971 (est)	4,050	2,560	500	793	197
1972 (est)	4,120	2,590	500	825	205

[a] Summary of basic research data in table B–2, by source.

Source: National Science Foundation.

Table B–7. Sources of funds, by sector, used for applied research, 1953–72 [a]

[Millions of dollars]

Year	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	1,317	770	455	73	19
1954	1,430	822	512	76	20
1955	1,525	842	583	79	21
1956	1,938	1,012	820	81	25
1957	2,429	1,292	1,020	85	32
1958	2,757	1,468	1,166	88	35
1959	2,965	1,624	1,208	95	38
1960	3,093	1,725	1,228	102	38
1961	3,156	1,804	1,197	110	45
1962	3,775	2,127	1,473	118	57
1963	3,881	2,205	1,487	128	61
1964	4,300	2,503	1,596	139	62
1965	4,537	2,653	1,658	155	71
1966	4,817	2,727	1,844	161	85
1967	5,041	2,867	1,895	182	97
1968	5,439	3,002	2,132	198	107
1969	5,618	2,976	2,323	200	119
1970 (prel)	5,833	3,183	2,320	200	130
1971 (est)	6,065	3,315	2,411	204	135
1972 (est)	6,380	3,465	2,567	210	138

[a] Summary of applied research data in table B–3, by source.

Source: National Science Foundation.

Table B–8. Sources of funds

Year	Total
1953	3,401
1954	3,760
1955	4,146
1956	5,798
1957	6,626
1958	7,140
1959	8,420
1960	9,311
1961	9,853
1962	10,004
1963	11,294
1964	12,355
1965	13,049
1966	14,322
1967	15,238
1968	16,062
1969	16,789
1970 (prel)	16,533
1971 (est)	16,735
1972 (est)	17,500

[a] Summary of development data in table

Source: National Science Foundation.

or applied research, 1953–72 [a]

ndustry	Universities and colleges	Other nonprofit institutions
455	73	19
512	76	20
583	79	21
820	81	25
1,020	85	32
1,166	88	35
1,208	95	38
1,228	102	38
1,197	110	45
1,473	118	57
1,487	128	61
1,596	139	62
1,658	155	71
1,844	161	85
1,895	182	97
2,132	198	107
2,323	200	119
2,320	200	130
2,411	204	135
2,567	210	138

Table B–8. Sources of funds, by sector, used for development, 1953–72 [a]

[Millions of dollars]

Year	Total	Federal Government	Industry	Universities and colleges	Other nonprofit institutions
1953	3,401	1,755	1,636	5	5
1954	3,760	2,051	1,694	6	9
1955	4,146	2,381	1,747	7	11
1956	5,798	3,502	2,277	7	12
1957	6,626	4,419	2,184	9	14
1958	7,140	4,863	2,252	10	15
1959	8,420	5,826	2,569	10	15
1960	9,311	6,334	2,949	11	17
1961	9,853	6,619	3,202	11	21
1962	10,004	6,708	3,259	13	24
1963	11,294	7,704	3,548	14	28
1964	12,355	8,455	3,860	14	26
1965	13,049	8,563	4,433	15	38
1966	14,322	9,275	4,977	18	52
1967	15,238	9,403	5,762	20	53
1968	16,062	9,636	6,347	22	57
1969	16,789	9,539	7,168	22	60
1970 (prel)	16,533	9,052	7,392	23	66
1971 (est)	16,735	8,895	7,751	23	66
1972 (est)	17,500	9,155	8,253	25	67

[a] Summary of development data in table B–4, by source.

Source: National Science Foundation.

Table B–9. Trends in defense, space and all other R&D outlays, by source, 1953–72

Year	Defense-space outlays as a percent of total R&D			Nondefense-nonspace outlays as a percent of total R&D		
	Total	Defense related	Space related	Total	Non-Federal	Federal
1953	48.3	47.5	0.8	51.7	47.0	4.7
1954	49.1	48.2	0.9	50.9	45.3	5.6
1955	48.4	47.4	1.0	51.6	44.1	7.5
1956	49.5	48.6	0.9	50.5	42.7	7.7
1957	53.2	52.2	1.0	46.8	38.3	8.5
1958	53.0	52.0	1.0	47.0	37.5	9.5
1959	55.8	53.3	2.5	44.2	35.7	8.5
1960	54.7	51.6	3.1	45.3	36.3	9.0
1961	54.7	49.2	5.5	45.3	36.3	9.0
1962	53.7	47.0	6.7	46.3	36.6	9.6
1963	54.3	40.6	13.7	45.7	35.4	10.3
1964	54.6	36.1	18.5	45.4	34.6	10.8
1965	52.7	32.3	20.4	47.3	36.2	11.0
1966	50.9	32.0	18.9	49.1	37.2	11.9
1967	48.3	34.3	14.0	51.7	38.9	12.8
1968	47.1	33.9	13.2	52.9	40.4	12.5
1969	44.7	33.6	11.1	55.3	43.0	12.3
1970 (prel)	43.1	29.2	13.9	56.9	44.1	12.9
1971 (est)	40.3	28.7	11.6	59.7	45.0	14.7
1972 (est)	39.4	29.0	10.4	60.6	45.7	14.9

Source: National Science Foundation.

Table B–10. Full-time-equivalent (FTE) scientists and engineers employed in research and development, by sector, selected years [a]

[In thousands]

Sector	1954	1958	1961	1965	1968	1969	1970 [b]	1971 [b]
Total	236.8	354.7	425.2	496.5	550.6	559.4	544.6	519.4
Federal Government [c]	37.4	46.1	50.6	64.2	68.3	70.3	69.8	68.5
Industry [d,e]	164.1	256.1	312.0	348.4	381.9	385.8	372.3	350.0
Universities and colleges, total	25.0	36.5	42.4	53.4	66.0	68.3	68.5	68.4
Scientists and engineers	20.3	29.2	33.6	40.4	49.0	50.4	50.3	49.8
Graduate students [f]	4.7	7.3	8.8	13.0	17.0	17.9	18.2	18.6
Associated FFRDC's, total	5.0	8.1	9.1	11.1	11.2	11.6	11.5	11.5
Scientists and engineers	4.9	7.9	8.8	10.7	10.7	11.1	11.0	11.0
Graduate students [f]	.1	.2	.3	.4	.4	.5	.5	.5
Other nonprofit institutions [d]	5.3	7.9	11.1	19.4	23.2	23.4	22.5	21.0

[a] Number of full-time employees plus the FTE of part-time employees.

[b] Estimate.

[c] Includes both civilian and military service personnel; military scientists and engineers in Department of Defense were estimated at 7,000 in 1954, 8,400 in 1958, 9,200 in 1961, 12,000 in 1965, 13,000 in 1968, and 14,000 in 1969 and 1970, and 12,500 in 1971.

[d] Includes professional R&D personnel employed at FFRDC's administered by organizations in the sector.

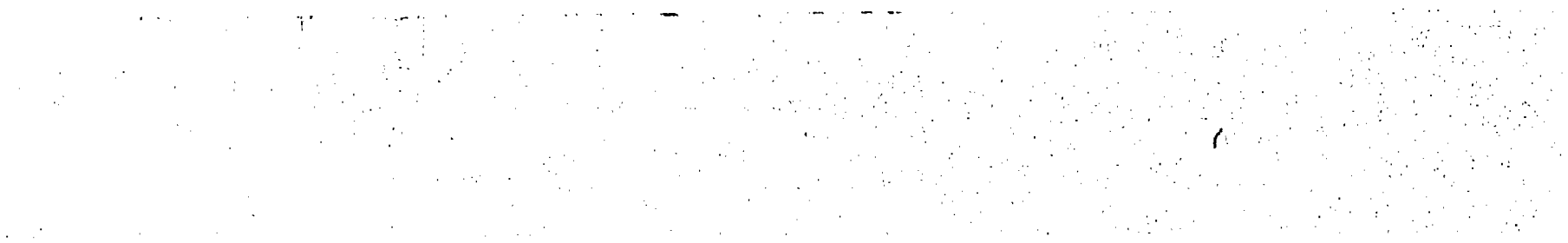
[e] Excludes social scientists.

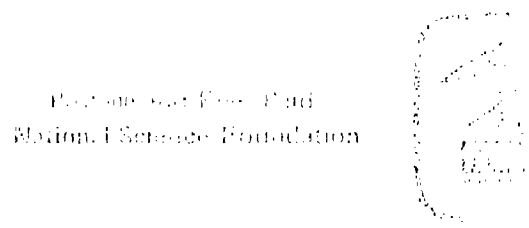
[f] Numbers of FTE graduate students receiving stipends and engaged in research and development.

Note: Excludes scientists and engineers employed in State and local government agencies.

Source: National Science Foundation.

U. S. GOVERNMENT PRINTING OFFICE : 1972 O - 460-050





ERIC CLEARING HOUSE ON 20573
HIGHER EDUCATION
ONE DUPONT CIRCLE-SUITE 630
WASHINGTON DC 20036