

1997 U.S. INDUSTRIAL R&D PERFORMERS

The National Science Foundation's (NSF's) 1997 Survey of Industrial Research and Development shows that firms¹ spent \$157.5 billion on research and development (R&D) in the United States, 9 percent more than the amount spent during 1996.² Company funding³ continued to increase, as it has each year since 1953, rising from \$121.0 billion in 1996 to \$133.6 billion in 1997, a 10 percent increase. Federal funding of industrial R&D in 1997 was \$23.9 billion—basically unchanged from the 1996 total of \$23.6 billion. After adjusting for inflation, total R&D rose 7 percent, company-funded industrial R&D rose 8 percent, and federally-funded industrial R&D fell 1 percent. Summary statistics from the 1997 and 1996 surveys are presented and compared in table 1.

Increased company funding accounted for most of the growth in the performance of R&D by both manufacturers and firms in nonmanufacturing industries during the period 1988-97. Manufacturing companies increased performance of R&D funded from their own

resources by an average of 6 percent per year—from \$59.4 billion in 1988 to \$101.2 billion in 1997—and nonmanufacturing firms increased their funding by an average of 18 percent per year—from \$7.3 billion to \$32.4 billion. Statistics on company-funded R&D performed during 1996 and 1997 are compared in table 2.

Highlighted in the remainder of this report is the continuing strong support of industrial R&D funded from companies' own resources and the increases in sales and employment reported by R&D-performing firms.

MANUFACTURING R&D: FUNDING SOURCES

As noted above, company funding of industrial R&D continued to rise in 1997 as it has since 1953, when the first annual statistics were compiled by NSF's Survey of Industrial Research and Development. Even after adjusting for inflation, current-year investment exceeded the prior year's investment during 40 of the 45 survey years. Company funding of industrial R&D also continued to far exceed Federal support, which declined by 40 percent in constant dollars since its peak level in 1987. The relationship between the sources of industrial R&D funding is illustrated in figure 1.

Manufacturers dominate in the performance of industrial R&D. They account for about three-quarters of all industrial R&D performed in the United States, a share they have maintained since the early 1990s. Chief among the manufacturers that performed industrial R&D during 1997 *using company funds* were makers of

- motor vehicles (\$13.8 billion);
- office, computing, and accounting machines (\$12.8 billion);
- drugs and medicines (\$11.6 billion);
- electronic components (\$10.8 billion); and
- professional and scientific instruments (\$9.0 billion).

Focusing on recent trends, 1993-97 survey statistics indicate that Federal funding of industrial R&D performed by manufacturers remained in the \$17 to 20 billion range, or \$16 to 19 billion after adjusting for

¹In this report, and in NSF industrial R&D statistics, the terms "firm," "company," and "enterprise" are used interchangeably. "Industry" refers to the activity or group of activities included in the 2- or 3-digit standard industrial classifications (SIC) or groups of SICs used to array statistics resulting from the Survey of Industrial Research and Development. For a list of and more information about these industries and industry groups, see the latest annual report in the survey series, *Research and Development in Industry: 1995-96*, or the forthcoming *Research and Development in Industry: 1997*.

²The survey sample is designed to produce coefficients of variation of 2 percent for industries in which there is a large amount of R&D expenditures and 5 percent for many of the smaller industries. It is unlikely that year-to-year percentage changes larger than the targets are produced by sampling error, but sampling error can exaggerate them somewhat.

³Companies obtain funds for industrial R&D from various sources. In the NSF statistics and for the purposes of this report, these sources are grouped into two categories: company funds and Federal funds. Company-funded R&D, also referred to as "company and other nonfederal" and "company and other" funding, includes funds for industrial R&D performed within company facilities from all sources except the Federal Government. The funds are predominantly the company's own, but also include funds *from* such outside organizations as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments. Funds given *to* other companies, research institutions, universities and colleges, nonprofit organizations, and state governments for R&D not performed within company facilities are measured separately by other NSF surveys.

Table 1. Funds for industrial R&D, by source, industrial sector, character of work, and size of company, in current and constant dollars: 1996 and 1997

Source of funds, industrial sector, character of work, and size of company	Current dollars		Percent change 1996-97	Constant 1992 dollars		Percent change 1996-97
	1996	1997		1996	1997	
	Millions of current dollars			Millions of constant (1992) dollars		
Total industrial R&D	144,667	157,539	8.9	132,080	141,202	6.9
By source and performing sector:						
Company and other non-federal.....	121,015	133,611	10.4	110,486	119,755	8.4
Manufacturing industries.....	91,845	101,202	10.2	83,854	90,707	8.2
Nonmanufacturing industries.....	29,170	32,409	11.1	26,632	29,048	9.1
Federal.....	23,653	23,928	1.2	21,595	21,447	-0.7
Manufacturing industries.....	20,020	19,823	-1.0	18,278	17,767	-2.8
Nonmanufacturing industries.....	3,633	4,105	13.0	3,317	3,679	10.9
By character of work:						
Basic research.....	8,207	10,419	27.0	7,493	9,339	24.6
Applied research.....	29,241	32,642	11.6	26,697	29,257	9.6
Development.....	107,218	114,478	6.8	97,889	102,606	4.8
By size of company:						
Fewer than 500 employees.....	20,249	24,063	18.8	18,487	21,568	16.7
500 to 999 employees.....	4,637	4,966	7.1	4,234	4,451	5.1
1,000 to 4,999 employees.....	18,273	19,590	7.2	16,683	17,558	5.2
5,000 to 9,999 employees.....	11,537	14,266	23.7	10,533	12,787	21.4
10,000 to 24,999 employees.....	20,164	21,510	6.7	18,410	19,279	4.7
25,000 or more employees.....	69,807	73,144	4.8	63,733	65,559	2.9
Company-financed R&D contracted						
to outside organizations.....	5,833	6,000	2.9	5,325	5,378	1.0
Manufacturing industries.....	4,293	4,143	-3.5	3,919	3,713	-5.3
Nonmanufacturing industries.....	1,540	1,857	20.6	1,406	1,664	18.4
Company-financed R&D performed						
outside the United States.....	14,050	13,107	-6.7	12,828	11,748	-8.4
Manufacturing industries.....	11,540	11,743	1.8	10,536	10,525	-0.1
Nonmanufacturing industries.....	2,510	1,364	-45.7	2,292	1,223	-46.7

NOTES: Detail may not add to totals because of rounding. 1992 gross domestic product (GDP) implicit price deflators were used to convert current to constant dollars. The 1996 and 1997 samples were designed to produce coefficients of variation (CV) of 2 percent for industries in which there is a large amount of R&D expenditures and 5 percent for industries in which there is a moderate amount of R&D expenditures. For industries in which there is little expenditure for R&D, the CVs typically are larger. It is unlikely that year-to-year percentage changes larger than the targets were produced by sampling error, but sampling error could have exaggerated them somewhat. In addition to sampling error, year-to-year changes may be influenced by companies with large R&D expenditures that change industry classifications because of payroll composition, mergers, or acquisitions, or companies that change size classifications.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development.

Table 2. Company and other funds¹ for industrial R&D, by manufacturing and nonmanufacturing industry, in current and constant dollars: 1996 and 1997

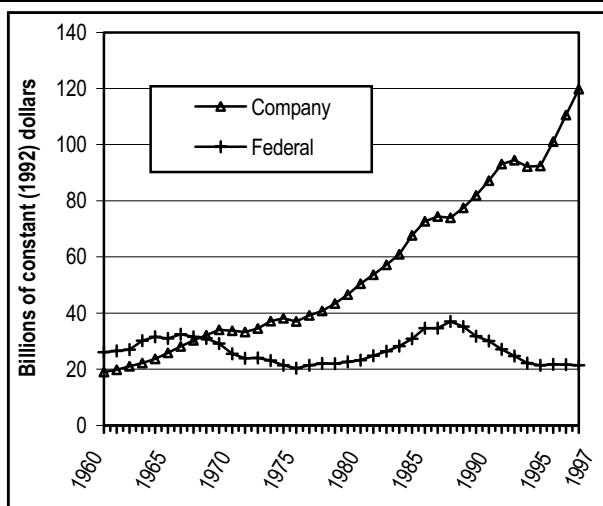
Industry	Current dollars		Percent change 1996-97	Constant 1992 dollars		Percent change 1996-97
	1996	1997		1996	1997	
	Millions of current dollars			Millions of constant (1992) dollars		
Total company-funded¹ industrial R&D.....	121,015	133,611	10.4	110,486	119,755	8.4
Manufacturing industries, total.....	91,845	101,202	10.2	83,854	90,707	8.2
Chemicals and allied products.....	17,520	18,628	6.3	15,996	16,696	4.4
Drugs and medicines.....	9,769	11,586	18.6	8,919	10,385	16.4
Other chemicals.....	7,751	7,042	-9.1	7,077	6,312	-10.8
Machinery.....	13,338	18,393	37.9	12,177	16,486	35.4
Office, computing, and accounting machines.....	8,132	12,787	57.2	7,424	11,461	54.4
Other machinery.....	5,206	5,606	7.7	4,753	5,025	5.7
Electrical equipment.....	20,356	22,747	11.7	18,585	20,388	9.7
Electronic components.....	12,497	10,786	-13.7	11,410	9,667	-15.3
Other electrical equipment.....	7,859	11,961	52.2	7,175	10,721	49.4
Transportation equipment.....	20,535	19,742	-3.9	18,748	17,695	-5.6
Motor vehicles and motor vehicle equipment	14,528	13,758	-5.3	13,264	12,331	-7.0
Other transportation equipment	6,007	5,984	-0.4	5,484	5,363	-2.2
Professional and scientific instruments.....	8,207	8,958	9.2	7,493	8,029	7.2
Scientific and mechanical measuring instruments	3,283	3,719	13.3	2,997	3,333	11.2
Optical, surgical, photographic, and other instruments.....	4,924	5,239	6.4	4,496	4,696	4.5
Other manufacturing industries.....	11,889	12,734	7.1	10,855	11,413	5.1
Nonmanufacturing industries, total	29,170	32,409	11.1	26,632	29,048	9.1
Transportation and utilities	4,492	2,812	-37.4	4,101	2,520	-38.5
Communications	3,970	1,884	-52.5	3,625	1,689	-53.4
Electric, gas, and sanitary services	311	258	-17.0	284	231	-18.6
Other transportation and utilities	211	670	217.5	193	601	211.7
Trade	6,338	7,961	25.6	5,787	7,135	23.3
Finance, insurance, and real estate	1,280	1,500	17.2	1,169	1,344	15.0
Services	15,904	18,594	16.9	14,520	16,666	14.8
Business services.....	10,280	11,560	12.5	9,386	10,361	10.4
Health services	735	679	-7.6	671	609	-9.3
Engineering and management services	4,572	5,909	29.2	4,174	5,296	26.9
Other services	317	446	40.7	289	400	38.1
Other nonmanufacturing industries	1,156	1,542	33.4	1,055	1,382	31.0

¹Company-funded R&D, also referred to as "company and other nonfederal" and "company and other" funding, includes funds for industrial R&D performed within company facilities from all sources except the Federal Government. The funds are predominantly the company's own, but also include funds from such outside organizations as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments. Funds given to other companies, research institutions, universities and colleges, nonprofit organizations, and state governments for R&D not performed within company facilities are measured separately by other NSF surveys.

NOTES: Detail may not add to totals because of rounding. 1992 gross domestic product (GDP) implicit price deflators were used to convert current to constant dollars. The 1996 and 1997 samples were designed to produce coefficients of variation (CV) of 2 percent for industries in which there is a large amount of R&D expenditures and 5 percent for industries in which there is a moderate amount of R&D expenditures. For industries in which there is little expenditure for R&D, the CVs typically are larger. It is unlikely that year-to-year percentage changes larger than the targets were produced by sampling error, but sampling error could have exaggerated them somewhat. In addition to sampling error, year-to-year changes may be influenced by companies with large R&D expenditures that change industry classifications because of payroll composition, mergers, or acquisitions, or companies that change size classifications.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development.

Figure 1. Company and Federal funding of industrial R&D, in constant dollars: 1960-97



NOTES: 1992 gross domestic product (GDP) implicit price deflators were used to convert current to constant dollars. Company-funded R&D includes funds for industrial R&D performed within company facilities from all sources except the Federal Government. The funds are predominantly the company's own, but also include funds from such outside organizations as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development.

inflation. The manufacturers that performed the largest amounts of *federally funded* industrial R&D during 1997 were makers of

- aircraft, missiles, and other transportation equipment (\$12.3 billion);
- professional and scientific instruments (\$4.5 billion); and
- electrical equipment (\$1.8 billion).

NONMANUFACTURING R&D: FUNDING SOURCES

The nonmanufacturing industries that performed the largest amount of R&D paid for with company funds (both their own and those obtained under contract from other firms) during 1997 were

- business services (\$11.6 billion),
- trade (\$8.0 billion),
- engineering and management services (\$5.9 billion), and
- transportation and utilities (\$2.8 billion).

The Federal Government provided \$4.1 billion in support for R&D performed by firms in the nonmanufacturing industries; large portions of this support were expended by the following industries:

- engineering and management services, including R&D and testing labs (\$3.4 billion); and
- business services, including computer-related (\$0.4 billion).

EMPLOYMENT AND SALES

In 1990, R&D-performing firms employed 16.9 million people, 0.7 million of whom were full-time equivalent (FTE) R&D scientists and engineers,⁴ and posted domestic net sales of \$2.7 trillion.⁵ For 1990-94, the annual rates of increase for employment were 0.8 percent; for the number of R&D scientists and engineers, 1.3 percent; and for sales, 7.9 percent. For 1995-97, the annual rates were 1.0, 9.0, and 8.0 percent, respectively. In 1997, employment for R&D-performing companies was 20.2 million, the number of FTE R&D scientists and engineers employed by these firms was 0.9 million, and domestic net sales totaled \$4.6 trillion. These and other employment and sales-related statistics are compared with those from the 1996 survey in table 3.

DEFINITION OF R&D

As used here, R&D is the pursuit of a planned search for new knowledge or understanding of the subject under study. This search may have reference to a specific application (basic research); the acquisition of knowledge or understanding to meet a

⁴“Scientists and engineers” are those employees engaged in scientific or engineering work at a level that requires knowledge, gained either formally or by experience, of engineering or of the physical, biological, mathematical, statistical, or computer sciences equivalent to at least that acquired through completion of a 4-year college program with a major in one of those fields. The statistics in this report show FTE employment of persons employed by the company during the January following the survey year who are assigned full time to R&D, plus a prorated number of employees working part time on R&D.

⁵This figure reflects dollar values for goods sold or services rendered by R&D-performing companies to customers outside the company, including the Federal Government, less such items as returns, allowances, freight, charges, and excise taxes. Domestic intracompany transfers and sales by foreign subsidiaries are excluded, but transfers to foreign subsidiaries and export sales to foreign companies are included.

Table 3. Employment and sales of R&D-performing firms: 1996-97

Employment, sales, industrial sector, and size of company	1996	1997	Percent change 1996-97
	In thousands		
Domestic employment, total¹	18,102	20,221	11.7
Manufacturing industries	11,347	11,700	3.1
Nonmanufacturing industries	6,755	8,521	26.1
Number of FTE R&D scientists and engineers²	833	886	6.4
Manufacturing industries	606	640	5.6
Nonmanufacturing industries	227	246	8.4
Performing company and other nonfederally funded R&D³	711	830	NA
Manufacturing industries.....	506	581	NA
Nonmanufacturing industries.....	205	249	NA
Performing federally funded R&D³	121	122	NA
Manufacturing industries.....	100	102	NA
Nonmanufacturing industries.....	21	20	NA
By size of company²			
Fewer than 500 employees.....	165	177	7.3
500 to 999 employees.....	37	38	2.7
1,000 to 4,999 employees.....	124	132	6.5
5,000 to 9,999 employees.....	61	82	34.4
10,000 to 24,999 employees.....	97	105	8.2
25,000 or more employees.....	349	352	0.9
	Thousands of current dollars		
Cost of R&D per R&D scientist or engineer⁴	\$168	\$171	1.5
Manufacturing industries	180	183	1.7
Nonmanufacturing industries	139	142	2.2
	Billions of current dollars		
Domestic net sales, total	\$4,076	\$4,573	12.2
Manufacturing industries	2,765	3,085	11.6
Nonmanufacturing industries	1,310	1,489	13.7

NA=not available

¹Number of people domestically employed by R&D performing companies in all activities during the pay period that includes the 12th of March, the date most employers use when paying first quarter employment taxes to the Internal Revenue Service.

²Statistics are for January 1996 and January 1997.

³Statistics are for January 1996 and January 1998. Statistics for January 1997 are not available.

⁴All costs associated with the performance of industrial R&D (salaries, wages, and fringe benefits paid to R&D scientists and engineers; materials and supplies used for R&D; depreciation on capital equipment and facilities used for R&D; and any other R&D costs) divided by the number of R&D scientists and engineers employed. To obtain a per person cost of R&D for a given year, the total R&D expenditures of that year are divided by an approximation of the number of full-time-equivalent (FTE) scientists and engineers engaged in the performance of R&D for that year. For accuracy, this approximation is the mean of the numbers of such FTE R&D-performing scientists and engineers as reported in January for the year in question and the subsequent year. For example, the mean of the numbers of FTE R&D scientists and engineers in January 1996 and January 1997 is divided into total 1996 R&D expenditures for a total cost per R&D scientist or engineer in 1996.

NOTES: Detail may not add to totals because of rounding. 1992 gross domestic product (GDP) implicit price deflators were used to convert current to constant dollars. The 1996 and 1997 samples were designed to produce coefficients of variation (CV) of 2 percent for industries in which there is a large amount of R&D expenditures and 5 percent for industries in which there is a moderate amount of R&D expenditures. For industries in which there is little expenditure for R&D, the CVs typically are larger. It is unlikely that year-to-year percentage changes larger than the targets were produced by sampling error, but sampling error could have exaggerated them somewhat. In addition to sampling error, year-to-year changes may be influenced by companies with large R&D expenditures that change industry classifications because of payroll composition, mergers, or acquisitions, or companies that change size classifications.

SOURCE: National Science Foundation/Division of Science Resources Studies, Survey of Industrial Research and Development.

specific, recognized need (applied research); or the application of existing knowledge or understanding toward the improvement of a present product or process (development). In industry, *basic research* is the pursuit of new scientific knowledge or understanding that does not have specific immediate commercial objectives, although it may be in fields of present or potential commercial interest; *applied research* is investigation toward discovering new scientific knowledge that has specific commercial objectives with respect to products, processes, or services; and *development* is the systematic use of the knowledge or understanding gained from research directed toward the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes. The Survey of Industrial Research and Development covers industrial R&D performed by people trained—either formally or by experience—in engineering or in the physical, biological, mathematical, or computer sciences and employed by a publicly or privately owned firm engaged in for-profit activity in the United States.

NOTES ON SURVEY METHODOLOGY AND FUTURE SURVEYS

Research is continually undertaken to improve the validity, strengthen the coverage, and increase the overall relevance of the Survey of Industrial Research and Development, while minimizing the reporting burden on companies selected for the survey. Statistics resulting from the 1997 survey benefit from recent efforts to strengthen statistics for industries that perform the greatest amounts of R&D while lessening coverage of industries that perform little or no R&D. Specifically, a new sampling approach was used for firms in industries that do not conduct significant amounts of R&D. These firms were sampled at much lower rates than in previous surveys. This has shifted more emphasis toward those industries crucial in developing strong, representative estimates of R&D spending. This new sampling approach and its effect on the resulting statistics will be discussed in detail in the annual report, *Research and Development in Industry: 1997* scheduled for publication later this year.

Preparation is under way for conversion to the new North American Industrial Classification System (NAICS) from the Standard Industrial Classification (SIC) system currently used for most establishment-based economic statistics produced by the Federal Government. Statistics in this report as well as all of the statistics produced from the Survey of Industrial Research and Development, a company-based rather than an establishment-based survey, are classified using SIC codes. Plans are being made to publish survey statistics using NAICS beginning with the results from the 1999 survey. For that year, NSF intends to publish some statistics classified by both the SIC and NAICS industry codes. Beginning with the 2000 survey, statistics will be published only with NAICS classifications.

Also under way is research to study the nature of R&D and reporting patterns of firms in the nonmanufacturing industries. This research is being undertaken in an effort to better describe and represent R&D activity in this increasingly important sector.

STATISTICAL REPORTS

This report is the first paper publication of statistics and information from the 1997 Survey of Industrial Research and Development. The annual report, *Research and Development in Industry: 1997*, will contain the full set of 68 tables available from the survey. To provide users with the most timely statistics possible during preparation of the paper publications, a set of early release tables is available from the Internet at <http://www.nsf.gov/sbe/srs> or from the mailing address below. Both the early release tables and the annual report present R&D statistics by industry, size of company, source of funds, and character of R&D. They also provide historical trends in R&D, R&D as a percentage of net sales, R&D contracted to outside organizations and performed outside the United States, sales and total employment of R&D-performing companies, employment and cost of R&D scientists and engineers, and statistics by state. The annual report presents technical information on the survey sample and processing.