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ABSTRACT

Presented is a review of the results of a 1976 survey of 50,000 scientists and engineers made with the intent of measuring changes occurring in the science and engineering (S/E) labor force since 1970. Highlights include: less than 2% of the sample were working on a part-time basis and less than 4% were engaged full-time in non-S/E work. Of the part-time workers, three-fourths preferred part-time work and were not looking for full-time work; only 10% of those holding non-S/E positions did so because of the nonavailability of S/E positions. Two percent of the sample was unemployed and over one-third of the sample stated they received nonformal training each year. (SL)

SCIENCE RESOURCES STUDIES HIGHLIGHTS

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National Sample of Scientists and Engineers: Changes in Employment, 1972-74 and 1974-76

In 1972 the National Science Foundation and the Bureau of the Census developed a sample of 50,000 scientists and engineers who represented the individuals working in science and engineering at the time of the 1970 Census of Population. This sample (The National Sample) was surveyed in 1974 and in 1976 with the intent of measuring changes in the 1970 science and engineering (S/E) labor force. This report presents selected topics from the 1976 survey. All data presented here refer only to the National Sample which in 1976 represented approximately 1 million scientists and engineers and was slightly less than one-half of the estimated total of scientists and engineers in the country.

Impact Highlights

UTILIZATION

- Part-time and nonscience/nonengineering (non-S/E) employment are often regarded as elements of the underemployment problem of scientists and engineers. Less than 2 percent of the National Sample labor force were working on a part-time basis and less than 4 percent were engaged full time in non-S/E work. Furthermore, of those working part-time, around three-fourths preferred part-time employment and were not seeking full-time employment. Only 10 percent of those holding non-S/E positions did so because an S/E position was not available. From these data it can be concluded that:
  - (a) There are so few scientists and engineers in part-time and non-S/E positions that they do not constitute a significant reserve of unused talent.
  - (b) Scientists and engineers are generally in part-time and non-S/E positions on a voluntary basis.
  - (c) As a consequence of the small size of the part-time labor force, those scientists and engineers outside the labor force who might be interested in engaging in professional work on a part-time basis are likely to encounter difficulty in locating such positions. This may be especially significant in terms of expanded utilization of women scientists and engineers.

UNEMPLOYMENT

- The unemployment rate for the National Sample fell from about 2 percent in 1972 to close to 1 percent in 1974 and then returned to the 2-percent level in 1976. The decline between 1972 and 1974 followed by the increase between 1974 and 1976 was consistent with the overall unemployment pattern in the United States during this period. Women scientists and engineers reported unemployment rates of approximately 3 percent in 1972 and 1974 and 4 percent in 1976 as contrasted with about 2 percent, 1 percent, and 2 percent, respectively, for men.

QUALITY/EDUCATION

- There is a propensity on the part of scientists and engineers in the National Sample to maintain or upgrade their technical competence, thereby enhancing the quality of their activities. Over one-third of the National Sample received nonformal training in every year, 1972-75. These nonformal training activities were principally "on-the-job-training" or "courses at employer's training facility." The prevalence of "on-the-job-training" and "courses at employer's training facility" should be taken into consideration in formulating any future continuing education program directed to scientists and engineers.

Other Highlights

- Although there was mobility during the period 1972-76, about 73 percent of the National Sample who were in science and engineering in 1972 were still in science and engineering in 1976. Of those who left science and engineering between 1972 and 1974, 38 percent (56,000) had returned by 1976.
- About 60 percent of the National Sample was employed by business and industry in 1976 and managerial activities were the most often reported primary work activity of the group. This is not surprising since the median age for the National Sample is 44 years.
- Business and industry reflected the largest proportional (10 percent) increase between 1974 and 1976 among all types of employers with compensating decreases being experienced by State and local governments and nonprofit organizations.

(Prepared in the Manpower Characteristics Studies Group, Division of Science Resources Studies.)

Status of the National Sample in 1976

The National Sample represents 1,400,000 individuals who were scientists and engineers in 1972. In 1976 data were collected from a sample representing 1,028,000 individuals; this is slightly less than one-half of the Nation's scientists and engineers and does not include scientists and engineers who entered the work force since 1970. The 4-year period 1972-76 showed marked mobility into and out of science and engineering. Over one-third of the National Sample had either left science and engineering (16 percent), or were nonrespondents(18 percent) sometime between 1972 and 1976. By 1976, one in five of this group reported that they were working in science or engineering (chart 1).

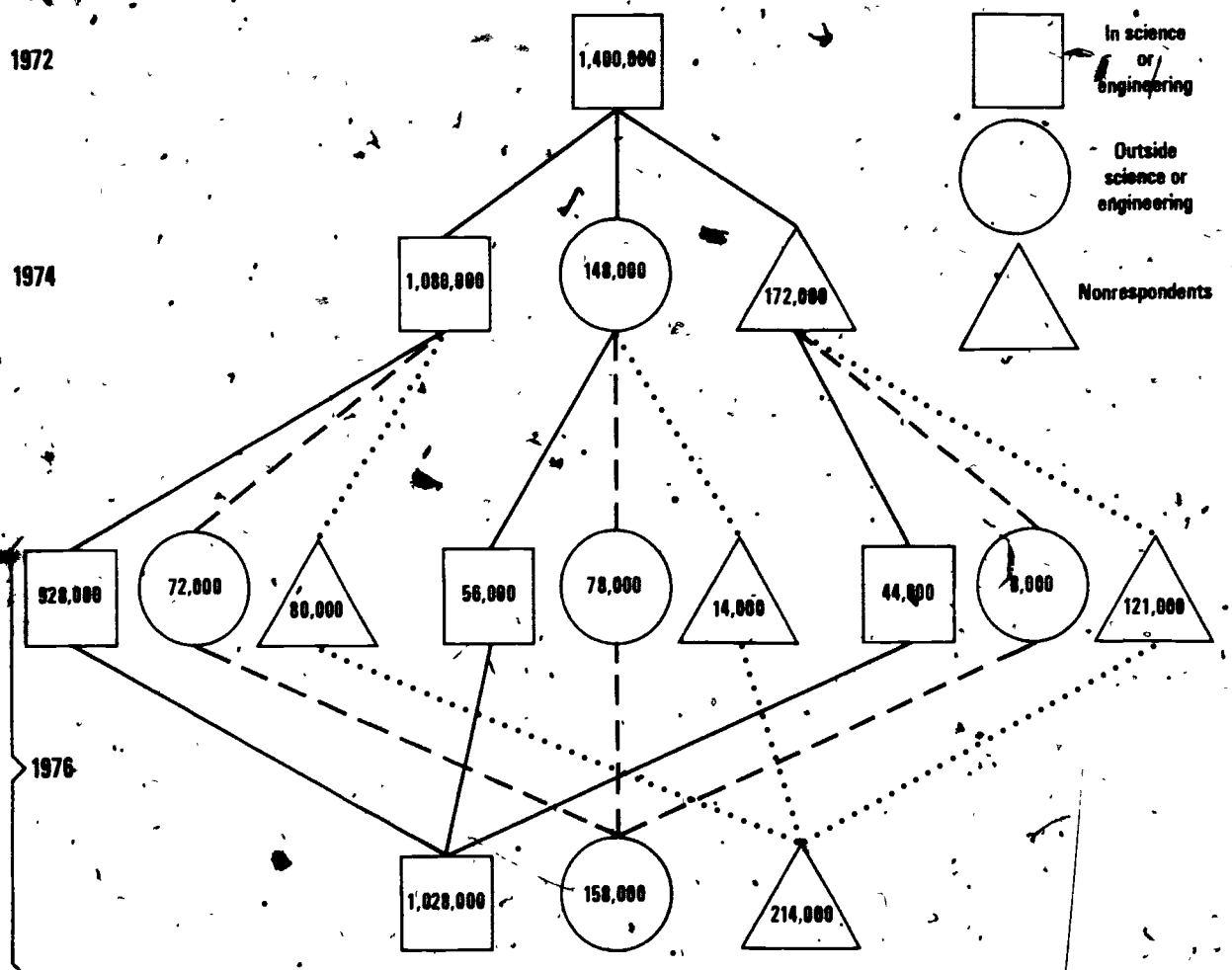
The median age of the National Sample in 1976 was 44 years, 6 years over the estimated median age of the total S/E population in 1976. Only 5 percent of the National Sample were women while minorities constituted only 4 percent of the group. In younger groups these proportions are much higher; in 1976 the graduates of the 1975 and 1974 classes reported about 20 percent of those employed in science and engineering as women and 7 percent as members of minority groups.

S/E Labor Force

Scientists and engineers in the National Sample have reported a labor force participation rate of over 95 percent for each of the survey years, 1972, 1974, and 1976. For the last 2 survey years about 96 percent of the employed scientists and engineers were in positions directly related to science or engineering (table 1). Of those engaged in non-S/E employment only 1 in 10 individuals reported the unavailability of S/E employment. Thus, the most prevalent reasons for employment in non-S/E positions were personal decisions made by the individual.

While there is great interest currently in the implication of part-time employment, particularly among

Chart 1. Changes in the 1970 science/engineering labor force: 1972-74 and 1974-76



NOTE: Detail may not add to total because of rounding.
SOURCE: National Science Foundation

Table 1—Employment status of the 1970 science/engineering labor force: 1972, 1974, and 1976

Employment status	1972	1974	1976
Total	1,400,000	1,400,000	1,400,000
S/E's (National Sample)	1,400,000	1,080,000	1,028,000
S/E labor force	1,338,000	1,024,000	959,000
Employed	1,312,000	1,013,000	941,000
In S/E	1,056,000	977,000	902,000
Full-time	NA	958,000	886,000
Part-time	NA	19,000	16,000
In non-S/E	256,000	36,000	39,000
Full-time	NA	34,000	37,000
Part-time	NA	2,000	2,000
Unemployed, seeking employment	26,000	11,000	18,000
Outside labor force	62,000	55,000	69,000
Outside S/E	—	148,000	158,000
Nonresponse	—	172,000	214,000

[1] Represents the same individuals as in 1972
NA Not available
Note Detail may no add to total because of rounding
Source National Science Foundation

women and students, the National Sample reported only 2 percent (19,000) of its employed working on a part-time basis. This finding is not surprising considering that the National Sample represents a mature, professionally well-established male-dominated group Furthermore, over three-fourths of those employed part-time chose such employment. Since they are so few in number, their non-S/E potential as an S/E manpower resource is limited.

Unemployment

The general pattern of unemployment in the United States showed a decline between 1972 and 1974 and an increase between 1974 and 1976. The National Sample followed this pattern; the unemployment rate fell from 1.9 percent (±0.2 percent)[1] to 1.1 percent (±0.1 percent) between 1972 and 1974 and rose to 1.9 percent (±0.2 percent) again by 1976. Women although accounting for only 6 percent of the National Sample, experienced much higher unemployment rates during the same period—2.7 percent (±0.6 percent), 2.8 percent (±0.8 percent) and 4.0 percent (±1.4 percent), respectively, for each of the survey years (table 2). With minor exceptions unemployment rates within various fields followed the general pattern of unemployment.

[1] Sampling errors are reported at the 95-percent level of confidence

Table 2.—Unemployment rates of the 1970 science/engineering labor force by sex: 1972, 1974, and 1976

Sex	1972	1974	1976
Total	1.9	1.1	1.9
Men	1.9	1.0	1.8
Women	2.7	2.8	4.0

Source National Science Foundation

Just as the increase in the National Sample unemployment rate reflected the recent climb in unemployment for the Nation as a whole between 1974 and 1976, other employment data series somewhat similar to the National Sample showed the same general trend in this time period. The Bureau of Labor Statistics' Male Professional and Technical Workers series reported a rise in unemployment from 1.8 percent to 2.7 percent and its Male Household Head (25 years of age and older) series climbed from 2.9 percent to 5.3 percent between 1974 and 1976.[2]

Additional Training

Although the National Sample represents an aging population, there is continued participation in training programs—both formal and nonformal. Thus, the proportion of doctorate-holders climbed 4 percentage points between 1972 and 1976 while the proportion of scientists and engineers obtaining nonformal training remained relatively high (over 35 percent) for each of the years 1972 through 1975. The established S/E community seems to feel that human capital does depreciate and is taking advantage of opportunities to maintain and improve its level of competence.

"On-the-job-training" and "courses at employer's training facility" were the two most frequent types of supplementary training cited by respondents; each was listed by about 17 percent of the National Sample in all 4 years. Thus, there is evidence that National Sample scientists and engineers as a group are maintaining their technical competency.

Primary Work Activity

As might be expected with a maturing group, there has been a noticeable shift into managerial activities. During the period 1974-76 the proportion of individuals so engaged increased by 4 percentage points. This shift was pervasive; all fields reflected increases in managerial or administrative positions during the period with the greatest increase occurring among computer specialists who reported a gain of 6 percentage points. The finding suggests that this relatively young field presents the greatest opportunity, among scientists and engineers, for advancing into managerial positions.

The increase in managerial positions was offset by declines in basic research, production and inspection, and consulting activities, while applied research increased very slightly and the proportion in teaching and development activities remained stable (table 3).

Type of Employer

Business and industry continued to be the largest source of employment accounting for about 60 percent of those employed in the National Sample during the

[2] U.S. Department of Labor, Bureau of Labor Statistics *Employment and Earnings* 20-8 Feb 1974 and 22 9, Mar 1976 (Washington, D C.)

Table 3.—1970 science/engineering labor force by primary work activity: 1974 and 1976

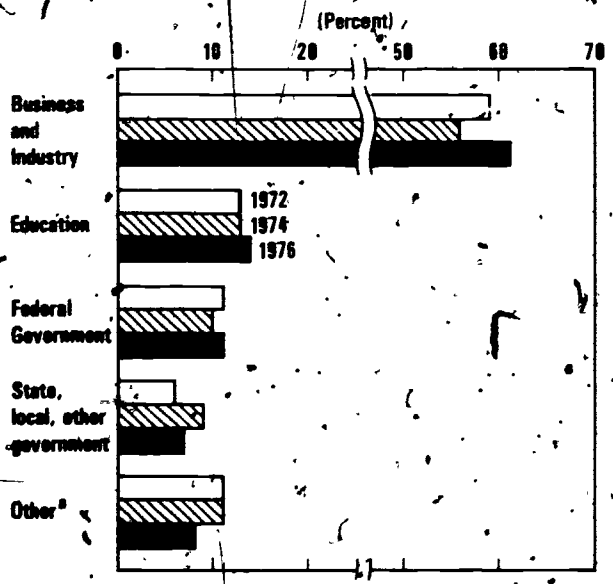
(Percent distribution)

Primary work activity	1974	1976
Total	100	100
Research and development	30	29
Basic research	4	3
Applied research	5	6
Development and design	20	20
Management or administration	27	31
Of R&D	10	12
Of other than R&D	17	19
Teaching	8	8
Production and inspection	13	12
Consulting	7	5
Other	13	11
Not reported	2	4

Source: National Science Foundation

period 1972-76. The proportion employed by educational institutions, the second largest employer, displayed little variability (13-14 percent) over the 4-year period, perhaps reflecting the tenured status of the middle-aged group of scientists and engineers. In general, other employers maintained stable proportions of scientists and engineers employed during the time span 1972-76, although the proportion of individuals employed by local and other governments displayed more variation than other employment sectors (chart 2).

Chart 2. 1970 science/engineering labor force by type of employer: 1972, 1974, and 1976



*Includes nonprofit organizations and hospital/clinic.

SOURCE: National Science Foundation

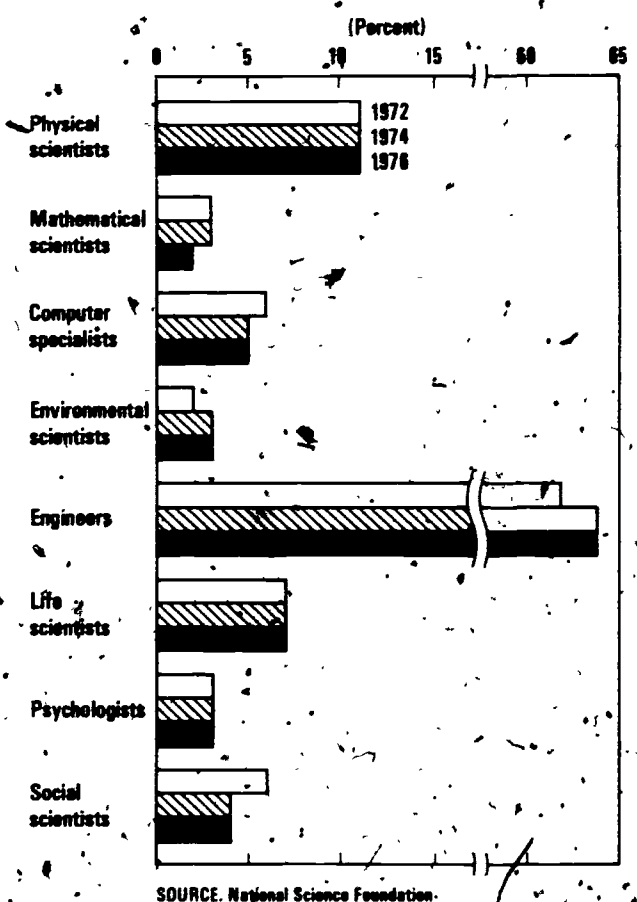
The increase in employment in business and industry between 1974 and 1976 was reflected in all major fields of science and engineering, with the proportion of physical scientists, computer specialists, and environmental scientists increasing about 10 percentage points between the 2 years. In these fields one-half or more of all employed scientists and engineers were affiliated with business and industry in 1976.

Although educational institutions acounted for only 14 percent of the total number of employed scientists and engineers in the National Sample, this sector continued to provide employment to almost one-half the mathematical, life and social scientists, and psychologists in 1976.

Field

Only small changes occurred in the distribution of scientists and engineers by field in the years 1972, 1974, and 1976; the largest change was reflected in engineering which grew by 2 percentage points over the period 1972-76 (chart 3).

Chart 3. 1970 science/engineering labor force by field: 1972, 1974, and 1976



SOURCE: National Science Foundation

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Women

As noted earlier, unemployment rates for women were substantially higher than those for men in the National Sample in all 3 survey years However, the proportion of women leaving the labor force for reasons other than retirement, e.g., family and household responsibilities, back-to-school, etc , declined between 1974 and 1976 This phenomenon suggests that employment of women in the National Sample may be undergoing changes Although women are still experiencing more difficulties than men finding jobs, some employment characteristics are beginning to approximate those of men in this particular maturing professional population

TECHNICAL NOTES

A sample of 150,000 individuals was selected and surveyed in 1972 from those reported by the 1970 Census to be in science and engineering and in related occupations The screening criteria designed to designate a scientist or engineer resulted in an identified list of 50,000 scientists and engineers to be retained for future biennial surveys the first of which took place in 1974 Details of the sampling procedures used, response rates and errors associated with the procedures used were presented in the following publication *Characteristics of the National Sample of Scientists and Engineers 1974* (NSF 75-333)

The following 1970 Census occupations were included in the survey

Engineers
- Aeronautical and astronautical engineers
- Chemical engineers
- Civil engineers
- Electrical and electronic engineers
- Industrial engineers
- Mechanical engineers
- Metallurgical and materials engineers
- Mining and petroleum engineers
- Sales engineers
- Engineers, not elsewhere classified (n e c) and engineering teachers

Mathematical specialists
- Actuaries and statisticians
- Mathematicians and mathematics teachers

Life scientists
- Agricultural scientists and teachers
- Foresters and conservationists
- Biological scientists and teachers[1]

Physical scientists
- Atmospheric and marine scientists and geologists and teachers[1]
- Chemists and chemistry teachers[1]
- Physicists and physics teachers[1]

Social scientists
- Economists and economics teachers[1]
- Psychologists and psychology teachers[1]
- Other social scientists and teachers

Computer specialists
- Computer programmers
- Computer systems analysts
- Computer specialists, n e c

Operations and system researchers and analysts

Engineering and science technicians
- Agricultural, biological, and chemical technicians, except health
- Draftsmen
- Electrical and electronic engineering technicians
- Industrial and mechanical engineering technicians
- Surveyors
- Mathematical technicians, and science and engineering technicians, n e c

Other related occupations
- Personnel and labor relations workers
- Health specialties teachers[1]
- Trade, industrial and technical teachers[1]
- Miscellaneous teachers[1]
- Teachers, subject not specified[1]
- Technicians, not elsewhere classified
- Research workers, not specified
- School administrators, college[2]
- Managers and administrators, n e c[2]

[1] Excludes teachers below the college or university level
[2] Excludes persons who reported in the 1970 Census having completed less than 4 years of college