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ABSTRACT

Statistics concerning employment of scientists were obtained from 59,300 scientists responding to an Engineers Joint Council questionnaire. Findings reported are: (1) the overall unemployment rate was 3 percent for engineers compared to a rate of 5.8 percent for all other workers; (2) considering engineers not having engineering jobs, the unemployment rate was 4.7 percent; (3) unemployment had nearly doubled since March 1970; (4) engineers between 25 and 54 years of age appear to have a more stable employment situation; (5) individuals with doctoral degrees had the lowest unemployment level, followed by those with bachelor and master's degrees; and (6) aerospace, business administration, and industrial engineering have the greatest problems with civil, agricultural, chemical, and mining/geological/petroleum the least. Suggestions for action are: (1) existing government programs should provide assistance to groups outside of the aerospace locations; (2) retraining programs and relocation efforts should be directed toward fields and areas where re-employment prospects are reasonalby high; and (3) more detailed studies should be made. (JG)

ENGINEERING MANPOWER BULLETIN

This is the nineteenth in a series of Bulletins designed for leaders in industry, government, and education whose responsibilities include an awareness of developments affecting engineering and technical manpower. In this issue we present the highlights of the national survey of engineering employment conducted by Engineers Joint Council under contract with the National Science Foundation during the summer of 1971, and interpret some if its results in relation to engineering manpower trends.

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ENGINEERING EMPLOYMENT AND UNEMPLOYMENT, 1971

The National Survey of Engineering Employment

As the economic situation worsened during 1970 and 1971 and overall unemployment rates climbed, interest ran high in what was happening to engineers and scientists caught by layoffs and program cutbacks. The news media were rife with human interest stories leading readers to believe that the bottom had fallen out from under engineering employment, while data from scattered and incomplete sources gave alarming and often conflicting indications of the actual extent of unemployment among engineers. In order to provide reliable statistics on the extent and nature of the employment problem, Engineers Joint Council in December 1970 urged the government to undertake a comprehensive survey of the situation.

Thus in May 1971 the National Science Foundation launched a survey of some 300,000 scientists and commissioned EJC to put together a special mailing list consisting of the combined and unduplicated membership rolls of twenty-three engineering societies that were broadly representative of all major disciplines and specialties in the United States. The societies included are listed in Table 3 on page 6 of this Bulletin. From this list, which included approximately 500,000 names and addresses, a sample consisting of every fifth name was drawn and questionnaires were mailed to the resulting set of 98,000 individuals.

By early August a response rate of 65 percent had been obtained and 59,300 usable questionnaires were prepared for computer analysis. Table 4 on page 6 gives a more complete breakdown of the survey response.

It should be noted that the survey was intended to be representative of engineering society members but not necessarily of the total U.S. engineering population. The mailing list is believed to have included about 40 percent of the self-styled engineers in the nation. In view of the membership standards of the professional societies, the survey respondents constitute a better qualified, more experienced, and more professionally oriented group than engineers as a whole. Although the survey procedures do not permit estimating total numbers of engineers in the U.S. in terms of the various characteristics covered by the questionnaire, the percentage relationships based on such factors as age, specialty, function, degree level etc. are considered significant.

Unemployed Only One Facet of the Problem

On the basis of the 1971 survey the National Science Foundation reported an overall unemployment rate of 3.0 percent for the engineers covered by the survey, compared to a rate for all workers of 5.8 percent during the second quarter of 1971. Using the results of a 1969 census study to make statistical adjustments, NSF further concluded that the unemployment rate for all engineers might have been as high as 3.4 percent. This is because the engineering working force as defined in government statistics includes a substantially higher proportion of people without college degrees than does the EJC list.

However, the employment problems of engineering professionals go considerably beyond the raw unemployment rate. The government statistics count as employed all those doing any kind of work, full-or part-time, engineering or nonengineering, and define the unemployed as those entirely without jobs. For example, a laid-off electronics engineer temporarily driving a taxicab would be considered an employed cab driver in the government statistics, while to most people in the engineering profession he would be a real part of the employment problem. EJC has therefore extracted the detailed data needed to compute an engineering "employment problem" rate that is professionally realistic as well as objective. The "problem" group includes, in addition to the outright unemployed, those who were working part-time in engineering but seeking full-time work, those who were employed in full-time nonengineering positions be-

Distribution of Engineers Unable to Find Full-Time Engineering Employment

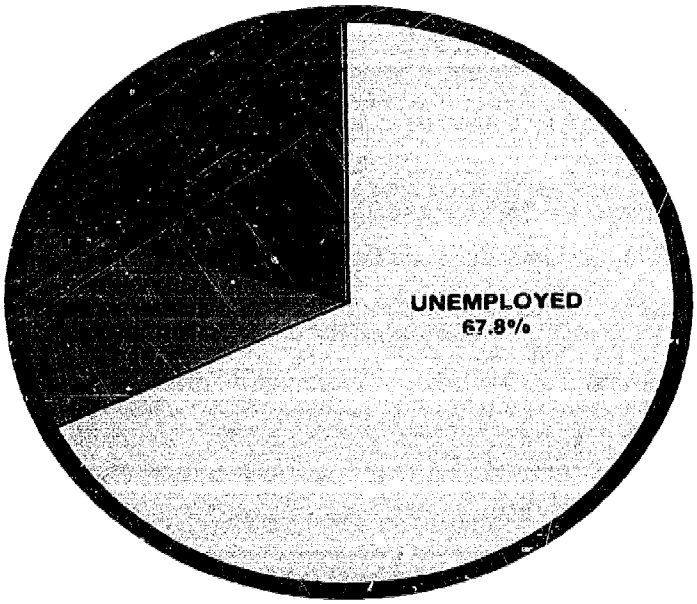


FIGURE 1

cause engineering jobs were not available, and those who were doing part-time nonengineering work but seeking full-time employment in engineering. Similarly, EJC adjusted the data to eliminate those respondents who were working part-time or doing nonengineering work as a matter of preference. This group included people who no longer considered themselves engineers (e.g. patent attorneys, scientists, managers etc.), those who had been "promoted out of engineering" or who preferred other work because of higher pay or better location, and those who gave a variety of other reasons which indicated that they were not away from engineering work because of a lack of jobs, but by their own choice.

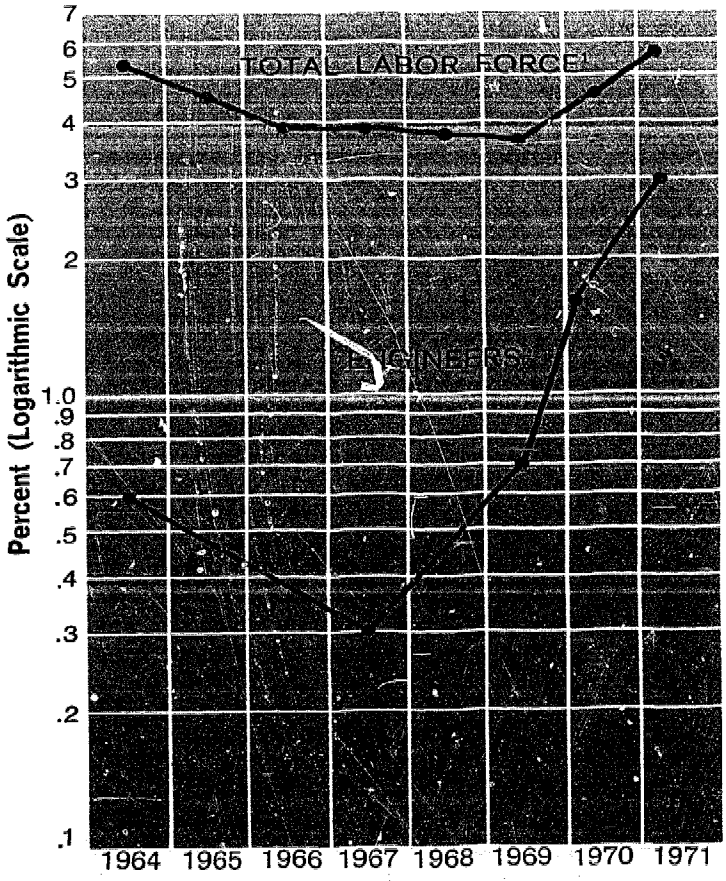
Measured in this way the "employment problem" rate for engineers was 4.7 percent, substantially higher than the unemployment rate computed by the government. Table 1 shows side by side the statistics used in calculating the different rates and indicates how both sets were derived from the same basic data. Figure 1 illustrates the different categories involved in the engineering employment problem. For about every two engineers actually unemployed there was another who was subprofessionally employed as a result of the lack of engineering jobs.

EJC did not attempt to measure the degree to which engineers have had to take salary cuts or shift to work outside of their major field of expertise, nor the extent to which they may be dissatisfied with their jobs. The "employment problem" rate derived from this survey is therefore a conservative measure of the complex employment problems facing the engineering profession today.

Unemployment Up Since 1964

For the group covered by the 1971 survey, unemployment had nearly doubled since March 1970. Previous surveys of similar samples of engineering society members in 1964, 1967, and 1969 showed unemployment rates of less than one percent. (The data for years prior to 1971 do not permit computation of "employment problem" rates.) Figure 2 shows how the rates for engineers have changed compared to all U.S. workers. Although the curve for engineers is lower than the overall U.S. trend, it has risen much more steeply in the last two years. Compared to 1967, while the total national unemployment rate has not even doubled from 3.8 percent to 5.8 percent, that for engineers has gone up by a factor of ten (0.3 percent to 3.0 percent). It is this relative worsening that is now a major cause for concern among engineers and related highly educated professionals.

Unemployment Rates for Engineers and Total Labor Force



[1] Source: U.S. Department of Labor, Monthly Labor Review and Employment and Earnings

[2] Source: National Science Foundation, data from National Engineers Register surveys

FIGURE 2

Engineering Employment and Unemployment Rates as Computed by the National Science Foundation

Employment Status	Number	Percent
Total survey respondents	59,200	
Not employed and not seeking employment	3,500	
In labor force	55,800	100.0
Employed in engineering work	50,400	90.3
Employed in non-engineering work	3,700	6.7
Unemployed and seeking employment	1,700	3.0

Engineering "Employment Problem" Rates as Computed by Engineers Joint Council

Employment Status	Number	Percent
Total survey respondents	59,200	
Not employed and not seeking employment	3,500	
Employed in non-engineering work by choice	3,200	
Employed part-time in engineering by choice	500	
Total in or seeking full-time engineering work	52,000	100.0
Employed full-time in engineering work	49,500	95.3
Not employed full-time in engineering work	2,500	4.7
Employed part-time in engineering, seeking full-time	300	0.6
Employed in non-engineering work, engineering not available	500	0.9
Unemployed and seeking employment	1,700	3.2

TABLE 1

Note: A 28-page report, "*Engineering Employment and Unemployment Data* – 1971" containing detailed data tables from the NSF/EJC 1971 National Survey of Engineering Employment, is available in limited quantity from Engineers Joint Council, Department P, at $5.00 per copy prepaid.

Engineering Employment Problem Rate as a Function of Various Characteristics

Characteristics	Employment Problem Rate, Percent	Unemployment Rate, Percent
Citizenship		
U.S.	4.6	3.2
Non-U.S.	8.1	4.9
Curriculum of Highest Degree		
Civil	2.0	1.3
Agricultural	2.5	1.4
Chemical	2.8	2.1
Mining, Geological, Petroleum	2.9	1.5
Mechanical	3.7	2.6
Other Engineering	4.2	2.7
Metallurgical	4.8	3.1
Engineering Sciences and General	5.1	3.5
Electrical	5.7	3.9
Industrial, Manufacturing, Systems	6.0	3.7
Business Administration	6.3	4.1
Aerospace	7.7	4.9
Professional Registration		
Professional Engineer	3.1	2.0
Engineer in Training	3.8	2.5
Not Registered	5.7	3.9
Type of Employer		
Government	1.6	1.2
Private Industry	4.8	3.6
Education and Non-profit	6.0	2.8
Self-Employed	6.9	1.9
Other and No Report	11.1	6.7
Job Function		
Construction	2.7	2.3
Administration	2.8	2.0
Manager of a Function	3.6	2.5
Engineering, General	3.9	2.9
Sales and Service	4.2	2.7
Teaching	4.3	2.0
Design	4.6	3.6
Planning	4.9	3.3
Development	5.3	3.8
Consulting	5.6	2.5
Research	5.7	3.3
Production	6.0	4.4
Other	6.4	3.9
No Report	10.5	6.9

TABLE 2

Not All Kinds of Engineers Equally Affected

Detailed breakdowns of the survey data offer a revealing insight into the complexity of the engineering employment problem. All too commonly unemployment has been viewed as limited to the aerospace industry. The facts revealed by the survey indicate otherwise. Figures 3-5 present the statistics by age, education, and employment specialty in graphic form, while Table 2 gives the "employment problem" rates in terms of other characteristics.

The statistics in these charts and tables show clearly that employment problems are particularly acute among certain fairly well-defined groups. According to Figure 3, engineers under 24 or over 55 years of age have significantly higher unemployment and problem rates, the reasons for which could be analyzed in detail by a follow-up study of these age groups only. Engineers between 25 and 54 years old, who make up the bulk of the profession, appear to have a more stable employment situation.

Figure 4 shows that eduation is a key factor, with the highest incidence of problems among non-graduates and those whose preparation was in nonengineering curricula. By degree level, those with doctorates had the lowest unemployment level, followed by bachelor's and then master's. Table 2, which includes a more detailed breakdown by curriculum of highest degree, pinpoints aerospace, business administration, and industrial engineering as the fields having the greatest problems; civil, agricultural, chemical, and mining/geological/petroleum the least.

Engineering Unemployment as a Function of Age

FIGURE 3

Engineering Unemployment as a Function of Education

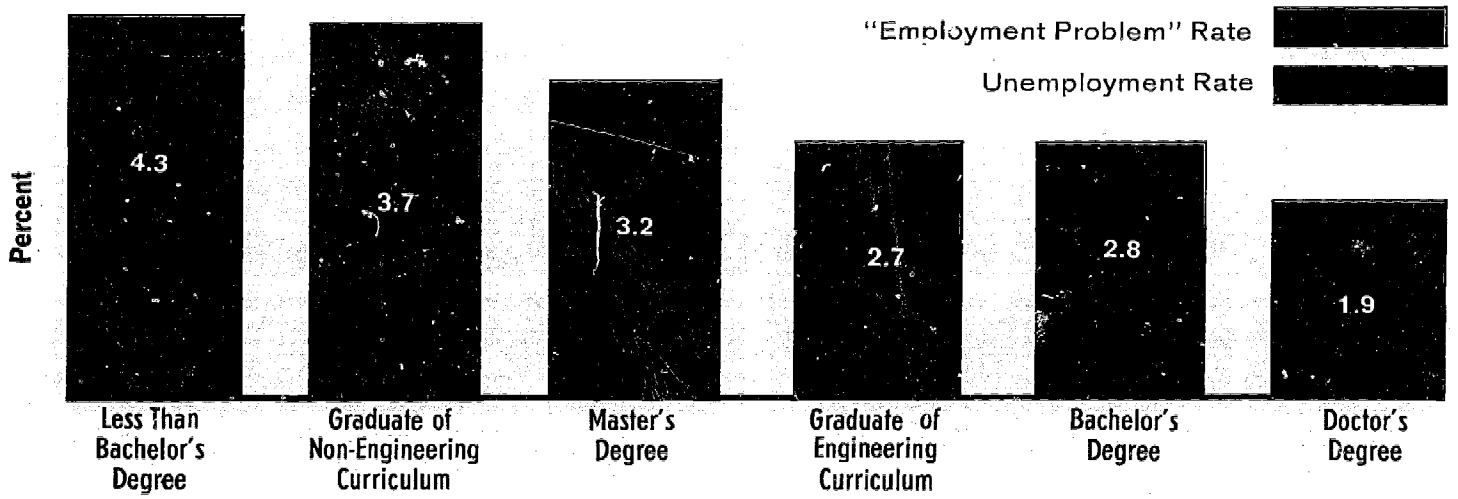


FIGURE 4

Engineering Unemployment as a Function of Employment Specialization

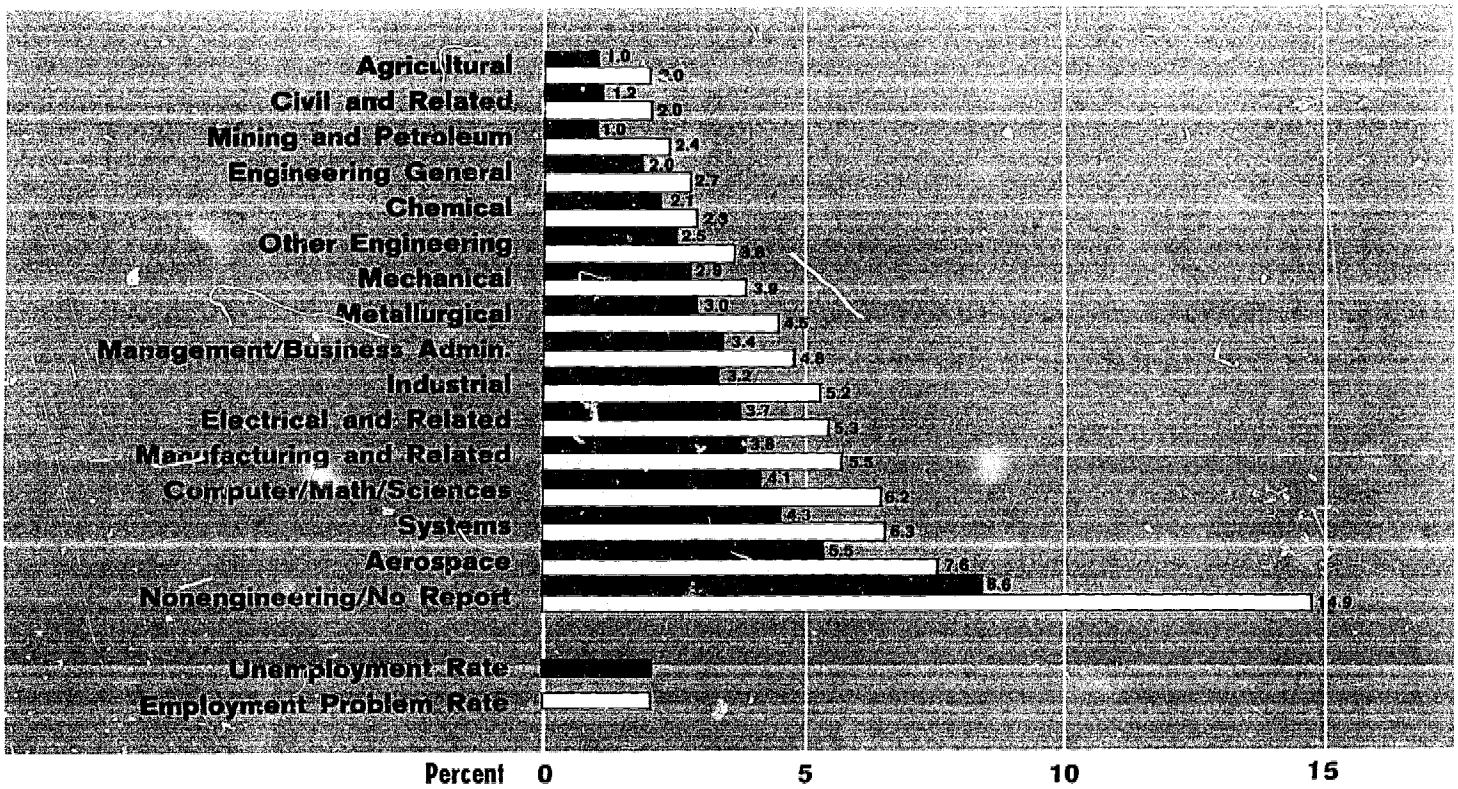


FIGURE 5

Employment in 1970 of Engineers Not Fully Employed in 1971

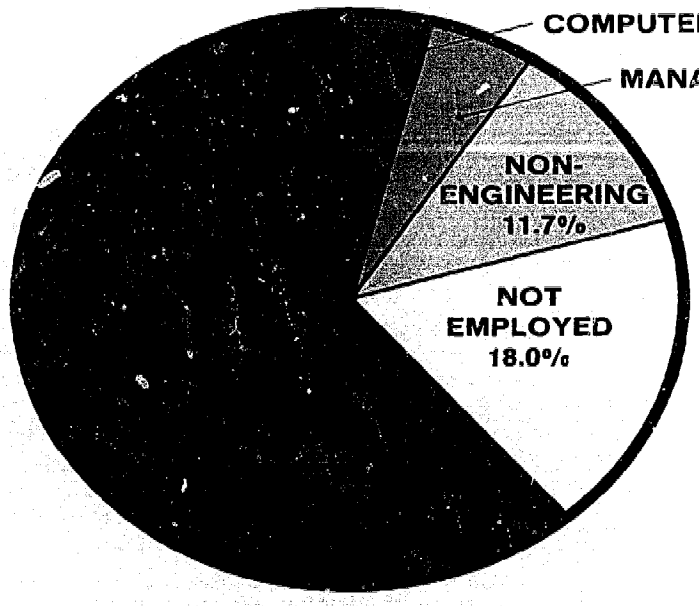


FIGURE 6

Table 2 also shows how such characteristics as citizenship, professional registration, type of employer, and job function are related to the employment problem. Figure 5 gives the unemployment and problem rates as a function of job specialization, and here it is noteworthy that the highest rates of all apply to those in nonengineering specialties or with no specialty reported. It might be speculated that the underlying problem here is technological obsolescence due to prolonged absence from technical engineering work. Further study of this group would be needed to confirm or refute this hypothesis.

A Closer Look at the Unemployed and Underemployed

Figure 6 takes the entire group with employment problems in 1971 and shows what they were doing in March 1970. Although a majority were working in one of the engineering specializations at that time, nearly 40 percent were either not employed or were engaged in nonengineering kinds of work. This finding again seems

to point to technological obsolescence as a major contributor to the problem. Certainly the group that was unemployed in 1970 and is unemployed now deserves careful study. Unfortunately the National Science Foundation was not able to carry out a more detailed analysis of the data for specific problem groups. EJC is currently investigating the feasibility of having such analysis done elsewhere.

What Needs to Be Done?

Several courses of action are indicated by the results of this national survey of engineering employment and unemployment. First, existing government programs should be adjusted to provide assistance to groups outside of the aerospace locations. Assistance to engineers should be concentrated in regions where engineering problems are most severe, both in terms of rates and absolute numbers affected. These locations may not necessarily be the same as those with the highest unemployment rates for the entire labor force. Retraining programs and relocation efforts should be directed toward fields and areas where re-employment prospects are reasonably high, and special employment programs should be tailored to utilize the skills of engineers immediately available. More detailed studies should be made of special groups having particularly severe employment problems, some of which have been pointed out elsewhere in this Bulletin. Finally, provision should be made to follow-up this survey with others on a regular continuing basis, both to measure the success or failure of the government's re-employment programs and to detect new problem areas before they reach crisis proportions.

EJC has proposed the institution of a periodic series of engineering supply and demand surveys at six month or one year intervals, in which the engineering profession and the federal government would act in partnership to gather and evaluate essential manpower information. EJC would use its widespread contacts with industry, education, and engineering professional societies, both members and non-members of the Joint Council, as prime sources of data and expertise to assist the Labor Department in developing meaningful national statistics and indicators. Such a program, EJC believes, offers the best hope of identifying employment problems in time to take corrective action before they become acute. Our ultimate goal should be the development of a capability to predict high-level manpower needs on a national scale far enough in advance to influence the long educational lead time, and a national commitment to avoid wasteful imbalances between demand and supply in such vital occupations as engineers and scientists, whose talents are so clearly needed in solving the major technologically-related problems facing our nation now and in the future.

Engineering Societies Included in the Survey

- American Association of Cost Engineers
- American Institute of Aeronautics and Astronautics
- American Institute of Chemical Engineers
- American Institute of Industrial Engineers
- American Institute of Mining, Metallurgical, and Petroleum Engineers
- American Institute of Plant Engineers
- American Society for Engineering Education
- American Society for Metals
- American Society for Quality Control
- American Society for Testing and Materials
- American Society of Agricultural Engineers
- American Society of Civil Engineers
- American Society of Heating, Refrigerating, and Air Conditioning Engineers
- American Society of Mechanical Engineers
- Institute of Electrical and Electronics Engineers
- Instrument Society of America
- Society for Experimental Stress Analysis
- Society of American Military Engineers
- Society of Automotive Engineers
- Society of Fire Protection Engineers
- Society of Manufacturing Engineers
- Society of Naval Architects and Marine Engineers
- Society of Women Engineers

TABLE 3

Survey Response

Original Mailing	98,004
Total Returns Processed	64,526
Usable Returns	59,339
Bad Address Rejects	2,928
Not Engineers or Unusable	1,903
Deceased	356

TABLE 4