ENGINEER SHORTAGE: MYTH VS. REALITY

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Introduction

During the last few years, reports about shortages of engineers have been frequent, and many observers have expressed concern that shortages may intensify. A closer inspection of the facts, however, indicates that recent shortages have been slight, or limited to particular specialities. In fact, according to the latest projections by the Bureau of Labor Statistics (BLS), there should be an overall balance between supply and demand throughout the 1980's.

This article explains why there is good reason not to believe in the widely publicized "engineer shortage." In addition, it describes the employment outlook for engineers in the United States and in Alaska, and identifies and explains the problems which do exist, and why some of those problems are unavoidable.

Is There a National Shortage? *1/*

One of the major reasons there have been so many conflicting reports about shortages of engineers is the fact that "shortage" has been defined in different ways by different people. In traditional economic terms, a shortage means that sufficient workers are not available and willing to work at the existing wage. Therefore, although the lengthy training period may cause delays in supply adjustments, raising wages should eliminate the shortage.

Unfortunately, there is no direct measurement of shortage since data collection programs do not gather information about job vacancies. However, related information about salaries, unemployment, transfers out of the occupation, and surveys of employers can assist in evaluating the market for engineers.

Salaries are a good indicator of market conditions since shortages are unlikely to occur without some bidding up of salaries. Table 1 shows the average starting salary of engineers relative to the average starting salaries of five other professional occupations—accountants, auditors, attorneys, buyers, and chemists. Note that beginning engineers have earned slightly more in recent years (in relation to other professionals) than they did during either the mid 1970's, which was a period of moderate demand, or in the early 1960's, which was a period of high demand. In contrast, Table 2 shows the average salary for experienced engineers relative to the average salary for experienced workers in the same five professional occupations. Clearly, some of the edge which new engineers have over other professions

Table 1. Starting salaries of engineers relative to starting salaries of other professional occupations and average salaries of all college-educated men, 1963-82

Year	Ratio of engineers' starting salaries to: Average starting salaries of 5 professional occupations	Men 18 years and over with 4 or more years of college
1963	—	.751
1964	—	.747
1965	—	—
1966	1.128	.696
1967	1.124	.753
1968	1.132	.738
1969	1.098	.728
1970	1.088	.753
1971	1.073	.758
1972	1.062	.718
1973	1.060	.695
1974	1.081	.737
1975	1.075	.716
1976	1.107	.717
1977	1.107	.693
1978	1.136	.703
1979	1.167	.702
1980	1.184	.740
1981	1.211	.771
1982	1.193	—

Source: Bureau of Labor Statistics.

Table 2. Salaries of experienced engineers relative to salaries of experienced professionals and college-educated men, 1963-82

Year	Ratio of experienced engineers' salaries to: Experienced workers in 5 professional occupations	Men 18 years and over with 4 or more years of college
1963	—	1.141
1964	—	1.120
1965	—	—
1966	1.205	1.056
1967	1.194	1.115
1968	1.191	1.072
1969	1.140	1.046
1970	1.132	1.084
1971	1.130	1.103
1972	1.123	1.063
1973	1.127	1.056
1974	1.112	1.111
1975	1.110	1.077
1976	1.113	1.069
1977	1.117	1.047
1978	1.112	1.059
1979	1.139	1.051
1980	1.122	1.085
1981	1.117	1.113
1982	1.123	—

Source: Bureau of Labor Statistics.

is lost as they remain in the occupation. This is consistent with the fact that new graduates have been in short supply since the late 1970's whi experienced engineers have not.

Unemployment of engineers is another indicator of supply, since a decrease in unemployment would be expected during a shortage. Table 3 shows the unemployment rate for engineers from 1963-1982. Note that the recent rates of 1.2-2.4% are consistent with a slight shortage but not a severe one.

The frequency with which people leave an occupation can also indicate a shortage. For instance, if engineers are in short supply, one would expect employers to try to retain employees, thus reducing the rate at which engineers leave the field. BLS reports that 4.4% of all engineers left their field during 1980. While this rate is considerably lower than the 8.9% rate for all occupations, it is only slightly lower than the 5.1% rate for all professional and technical workers. Such a transfer rate may be consistent

Table 3. Engineers' unemployment rates, 1962-83

Year	Rate
1963	1.2%
1964	1.5
1965	1.1
1966	0.7
1967	0.7
1968	0.7
1969	0.8
1970	2.2
1971	2.9
1972	1.9
1973	1.0
1974	1.4
1975	2.6
1976	2.0
1977	1.3
1978	1.2
1979	1.2
1980	1.3
1981	1.5
1982	2.4

Note: The standard error of the 1982 rate is 4.4%. Other years' standard errors may vary slightly.
Source: Bureau of Labor Statistics.

with moderate shortages, but not with critical shortages. BLS data are not available for other time periods. However, National Science Foundation data indicate that the turnover rate was similiar from 1968-1972 (4.3%) and 1972-1978 (3.7%), both periods of reasonably good supply.

Another way to judge market conditions is simply to ask employers whether or not there is a shortage. The National Science Foundation surveyed 225 firms in October 1981. Although they found probable shortages in computer, electrical, electronic, and petroleum engineering; a rough balance in industrial, chemical, and mechanical engineering; and a probable surplus in civil engineering, there was disagreement over what constitutes an adequate supply. Many employers reported a shortage because they had been forced to offer higher salaries than planned, or to hire graduates with a lower class rank than desired. Of all those reporting a shortage, only 3% said they had reduced production or research and development as a result. The National Science Foundation repeated the survey in August 1982, and found that employers reported fewer shortages than in the previous year.

Table 4
Engineering Degrees Awarded in Alaska

	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
UAA†										
School of Engineering										
MS Arctic Engineer									2	2
Civil Engineer							2	3	2	2
Engineer Management						2	5	14	5	6
Science Management							3			
Environmental Quality Engineer							1		1	
Environmental Quality Science								1		1
Total (1974-1978)	n/a	4	5	8	9					
UAF†										
School of Engineering										
BS Civil Engineer	19	13	12	12	17	17	15	16	17	17
Electrical Engineer	5	6	5	4	5	2	5	11	10	15
Mechanical Engineer	1	5	5	2	4	2	5	5	9	18
MS Arctic Engineer		1 PhD				1			1	4
Civil Engineer	4	1	1	3		1	2	5	3	1
Electrical Engineer	1			1						
Engineer Management		1				2	2	1		2
Science Management		1				2	2	1		2
Environmental Health Engineer	1	1	1							
Environmental Quality Engineer	3	3	3	3			2	1	2	6
Mechanical Engineer	1									
School of Mineral Industry										
BS Geological Engineer	2	3	1	1	2	3	7	5	4	3
Mining Engineer	1	3	3	3	3	6	2	3	5	1
Petroleum Engineer									3	8
MS Mineral Preparation Engineer	1	2		1		2	1		1	
Mining Engineer					1		1	1		2
Petroleum Engineer										1
UAJ†										
BS Engineer Management	n/a			2	1	2		4**	1	
Total										
BS	28	28	24	22	31	30	32	38	50	64
MS	11	15	8	18	11	12	21	31	18	29
PhD		1								

†Source: Office of Institutional Planning, University of Alaska, Statewide System of Higher Education. Except 1982-83 data from UAA Office of Institutional Studies, and UAJ Office of Administration and Records.

††Source: UAF, Office of Institutional Studies and Testing.

* First year of program.
** Program discontinued.

National Employment Outlook *2/*

Two separate sets of projections are needed in order to forecast a future labor market: projections of demand and projections of supply. Studies which focus on only one side of this relationship may well reach inaccurate conclusions. In addition, care must be taken to recognize methodological biases and to avoid making extrapolations based on invalid assumptions. For instance, many of the reports which caused alarm by predicting severe shortages of engineers contained errors of this sort. One of the most widely publicized was the American Electronic Association's "Technical Employment Projections of Professionals and Paraprofessionals." This report was also one of the most widely criticized. It focused primarily on demand, and overstated future requirements because of biases inherent in its methodology.

In contrast, BLS has projected that requirements for engineers will be in rough balance with supply, on average, for the rest of the 1980's. BLS has projected that there will be 120,000 to 136,000 openings annually throughout the 1980's, depending on the rate of growth. Three-fourths of these openings are expected to be the result of replacement needs. Actual growth is expected to be 2.5-3.2% a year—a rate which is faster than the average projected for all occupations, but slower than the 4.7% annual growth achieved over the 1976-1981 period. These projections are based on several assumptions, including enough growth in the economy to reduce unemployment, increased productivity, and increased defense expenditures.

The picture is not complete, however, without evaluating the supply side. The National Center for Education Statistics has projected that an average of 74,000 bachelor's degrees in engineering and engineering technology will be awarded annually between 1980 and 1990. If entry rates observed during the 1970's continue, roughly 60,000 new engineering graduates will seek engineering jobs each year. Since employers have a preference for recent graduates, virtually all of them can be expected to find work. As a result, between 44% and 50% of the projected 120,000 to 136,000 job openings during the 1980's could be filled by those graduates.

This might indicate a potential shortage; however, during 1980 only about 44% of those who entered engineering were recent engineering graduates. Most other entrants were transfers from other occupations, although some were recent science and mathematics graduates, immigrant engineers, or persons over 55 who had not worked the previous year. Therefore, if the supply of new engineering graduates maintains current levels and if roughly the same percentage seek engineering jobs as did in the 1970's, no major imbalances will occur.

Is There an Alaskan Shortage?

Unfortunately, information about whether a shortage of engineers exists in Alaska is even harder to pin down than it is at the national level. No data have been compiled on unemployment or turnover rates, and limited salary information does not span enough years to identify trends or relationships. However, a casual survey of the student placement offices at the University of Alaska, Anchorage and the University of Alaska, Fairbanks indicates that graduates have had little difficulty finding work. Similar discussions with the deans of all three engineering schools support this conclusion.

Alaskan Employment Outlook

The current distribution of Alaskan engineers among industries, fields, and geographic areas is illustrated in three pie charts. Current distribution is important because future distribution is expected to follow the same general pattern. Consequently, the fact that particular specialities, areas, and industries dominate the overall picture is very important.

Rough estimates by the Alaska Department of Labor indicate that about 80-100 job openings will occur each year through 1988 as a result of industry growth. This prediction is based on the conservative assumption that current industry trends will continue. Assuming the BLS estimate tha only one-fourth of the job openings for engineers will be due to growt. holds true in Alaska, the total number of job openings each year should be between 320 and 400.

To evaluate the future supply of engineers it is necessary to look at the training programs which are available today. There are currently three engineering training programs in Alaska: the University of Alaska, Anchorage (UAA), School of Engineering; the University of Alaska, Fairbanks (UAF), School of Engineering; and the University of Alaska, Fairbanks, School of Mineral Industry. All three programs offer graduate and undergraduate training. However, the UAA undergraduate program is still quite young, and limited to civil engineering.

Table 4 lists the number of degrees awarded in each major at each school in Alaska. Only bachelor degree recipients should be used to estimate the supply of newly trained engineers because most graduate engineering students in Alaska continue to work while attending school, and consequently, are not entering the labor force. If the 80% national entrance rate holds true in Alaska, and if 90% of them stay in Alaska to work (as they did between 1973 and 1978) 2/, then the 64 graduates in 1982-1983 should have resulted in about 47 individuals entering engineering positions in Alaska. This means that less than one-fifth of the job openings for engineers in Alaska were filled by recent Alaskan graduates. This proportion is very low, even taking into account the fact that recent engineering graduates accounted for only 44% of those who entered engineering nationwide in 1980. The supply in Alaska is improving, however. The number of bachelor degrees awarded has grown consistently in recent years, and all three programs report that enrollment has jumped significantly in the pas' year or two. Continuing increases in the number of degrees awarded ai expected.

PROBLEMS IN THE DEMAND/SUPPLY EQUILIBRIUM

Unavoidable Short Term Imbalances

Although BLS has projected an overall balance through the decade, imbalances over short periods of time and among specialties are inevitable. Demand for engineers depends on a wide variety of factors, including technological developments, the general economic condition of the country, and public willingness to support defense, space, and public works projects. All of these factors fluctuate, some of them quickly and dramatically.

The minimum time required to train an individual as an engineer is four

years. Alternative sources of supply, such as transfers from other fields, make adjustments possible, but there are limits to how quickly supply can be increased or decreased. In addition, in situations where new technology is significantly different from the old, some employers prefer to hire recent graduates rather than to re-train their older employees. Consequently, cyclical student enrollments tend to trail industry needs by four or five years.

Obsolescence Among Engineers

Obsolescence is a valid concern among engineers. However, there are factors which increase the risk, as well as ways of minimizing the danger. Engineers who are particularly susceptible to obsolescence include those who work in fields where technology is changing rapidly or where demand fluctuates drastically, as well as those who allow themselves to become overly specialized in a narrow area of technology. The risk of obsolescence can be minimized by choosing an industry, an employer, and a job function where changes occur more slowly. Most jobs in Alaska fall into this category. Some individuals sidestep the problem altogether by moving out of engineering into fields where their experience is more important than their technical expertise, such as management, administration, or sales. Continuing education is, of course, vital; especially for engineers who specialize in areas of rapidly changing technology.

Public Sector Salaries

Whenever a shortage of engineers exists, rising salaries should, over time, cause supply to rise to meet demand. Although this causes only minor difficulties for most private sector employers, it causes major problems for many public sector employers who often do not have the flexibility to raise engineers' salaries without raising the salaries of all other employees. This creates a class of employers who routinely have difficulty attracting and retaining engineers. Primary employers of this sort are universities, governmental agencies and the military. However, this is probably less of a problem in Alaska than in most of the country, since wages in the public sector more nearly match those in the private sector.

Engineering Faculty Shortage

Because colleges and universities often have inflexible salary schedules and scarce or obsolete laboratory equipment, they often find it difficult to attract and retain qualified faculty. According to the National Science Foundation, about 10% of engineering faculty jobs were vacant in the fall of 1980. Although BLS has predicted that the number of degree recipients would only have to remain at the 1981 level for supply and demand to be in rough balance through the 1980's, a faculty shortage such as this has the potential to cause either a decline in the quality of engineering education, or a decrease in the number of graduates.

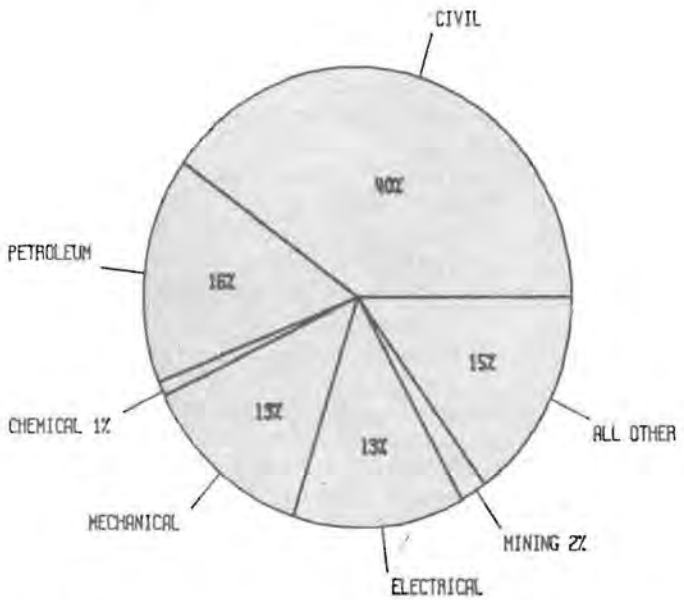
Summary

The publicized engineer shortage crisis has not occurred, and it is not expected to occur. There is clearly a strong demand for engineers. The employment outlook for engineers in the 1980's is good, both in the United States and in Alaska. Unfortunately, short term imbalances are unavoidable, and the required training period will cause an inevitable lag in supply. Cause for concern over the quality of engineer training programs has occurred because of the difficulty attracting and retaining qualified faculty, and the fact that laboratory equipment is scarce or obsolete at many universities. For individuals who wish to remain working as engineers, continuing education is absolutely vital. For those who do not, opportunities exist in management, administration, and sales.

1/ Condensed from "Occupational Outlook Quarterly"; U.S. Department of Labor, BLS, Summer 1983.

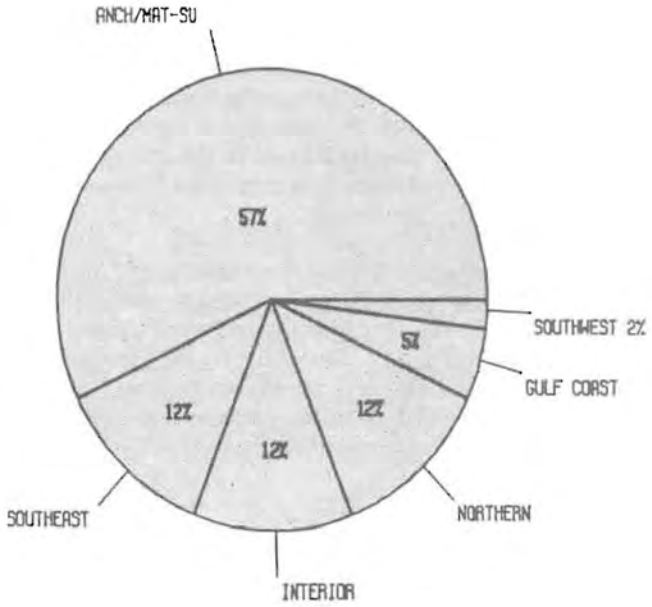
2/ 'Recommendations Regarding the Future Development and Organization of University of Alaska Engineering Programs,' Alaska Commission on Post Secondary Education, March 1979.

Distribution of Alaska Engineers by Field
1983



Source: Alaska Department of Labor, Research and Analysis, Occupational Employment Statistics.

Distribution of Alaska Engineers by Geographic Area
1983



Distribution of Alaska Engineers by Industry
1983