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ABSTRACT

Data regarding supervisory responsibility of engineers are analyzed and implications of these analyses are considered. The data indicated that a majority of engineers were employed as managers or supervisors. The data also indicated that those engineers with no supervisory responsibility declines from 38 percent in the 25-30 year old group to 12 percent among 40-45 year olds. Based on the large number of engineers who move into management responsibilities, there is a need for increased opportunity for appropriate educational experiences; most apparently need such work between the ages of 30 and 45. (RH)

ENGINEERING MANPOWER BULLETIN

This is the twenty-fifth in a series of Bulletins designed for leaders in industry, government, and education whose responsibilities include an awareness of engineering and technical manpower. In this issue we present some data and analysis bearing on the relationship between technical and managerial work in the career development of engineers.

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Engineering Manpower Commission of
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THE ENGINEER AS A MANAGER

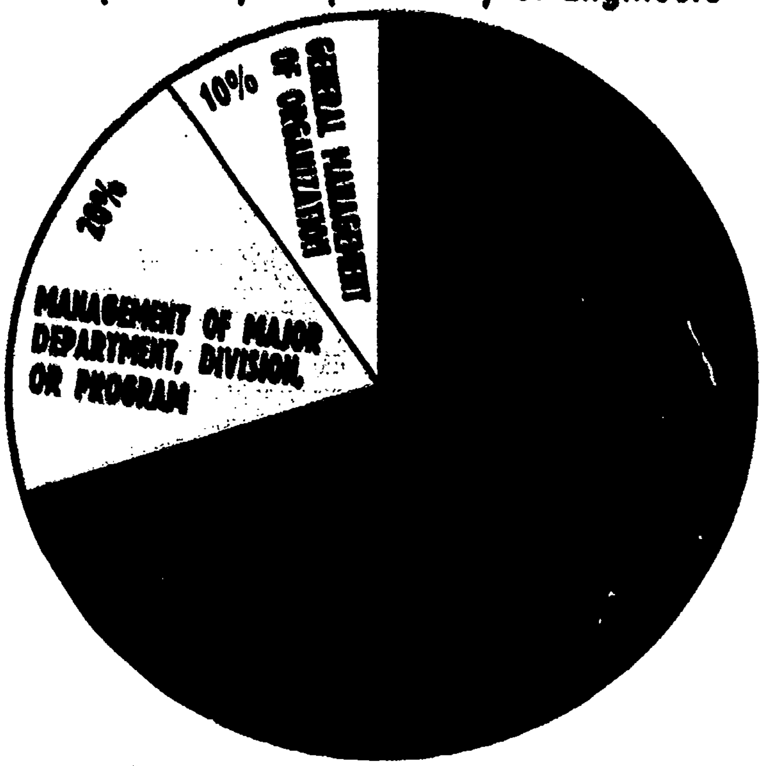
ENGINEER OR MANAGER?

Engineers appear to be somewhat divided in their approach to the function of management as it relates to their professional development. On the one hand are those who view managerial jobs as the preferred path of advancement. Others look upon managers as people who have "dropped out" of the engineering profession. Most engineers recognize that their work involves both technical and managerial or administrative elements in varying proportions, and that it is often difficult to separate the two elements in the overall performance of their job. Most engineers also tend to prefer one element over the other, and when the proportions become unbalanced they begin to feel dissatisfied or frustrated. Manpower studies have devoted surprisingly little attention to the relationship between the technical and managerial aspects of engineering work. The purpose of this Bulletin is to pull together and try to interpret the scattered data bearing on the subject.

Dual Professionalism. Engineers generally think of themselves as professionals on the basis of their rigorous education and special responsibility to their employers or clients. Many executives, especially those who have graduated from business school programs at an advanced level, consider themselves professionals in the field of management. What, then, is the professional status of the engineer who has moved into a managerial position, or whose duties have come to include important managerial as well as technical elements?

The question is not merely academic. Many engineers really wrestle with it every time they are asked to give their occupation. For them it is a problem of professional identity. The question is also important in interpreting and using national manpower data. Census returns, employment and unemployment statistics, and most government manpower studies treat engineers and managers as separate occupational groups. The person who considers himself an engineer by profession but who reports his occupation as an administrator or manager will be counted as a manager, not as an engineer.

Supervisory Responsibility of Engineers

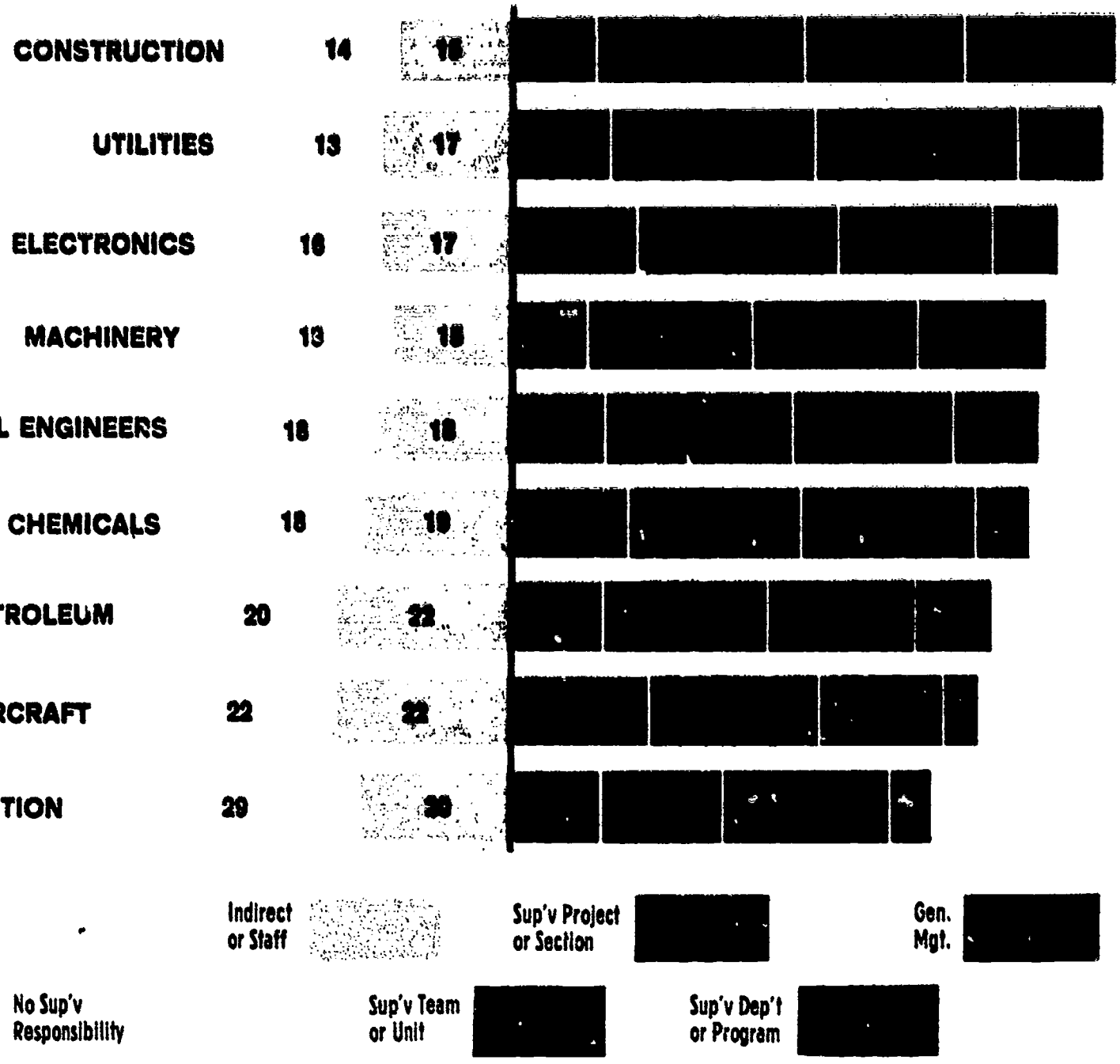


Source: National Engineers Register, 1969

FIGURE 1

Newly-released figures from a 1972 post-censal study conducted by the National Science Foundation show that over 480,000 people with college degrees in engineering were reported under other occupational categories in the last census. Managers and administrators made up a large part of this group. In earlier surveys of engineering society members conducted by Engineers Joint Council, 21 percent of the respondents selected managment or administration when asked to indicate their single most important work function. It is therefore apparent that a large number of the nation's engineering graduates have difficulty in deciding whether they are engineers or managers when they are forced to choose between the two categories.

Supervisory Responsibility as a Function of Product or Service



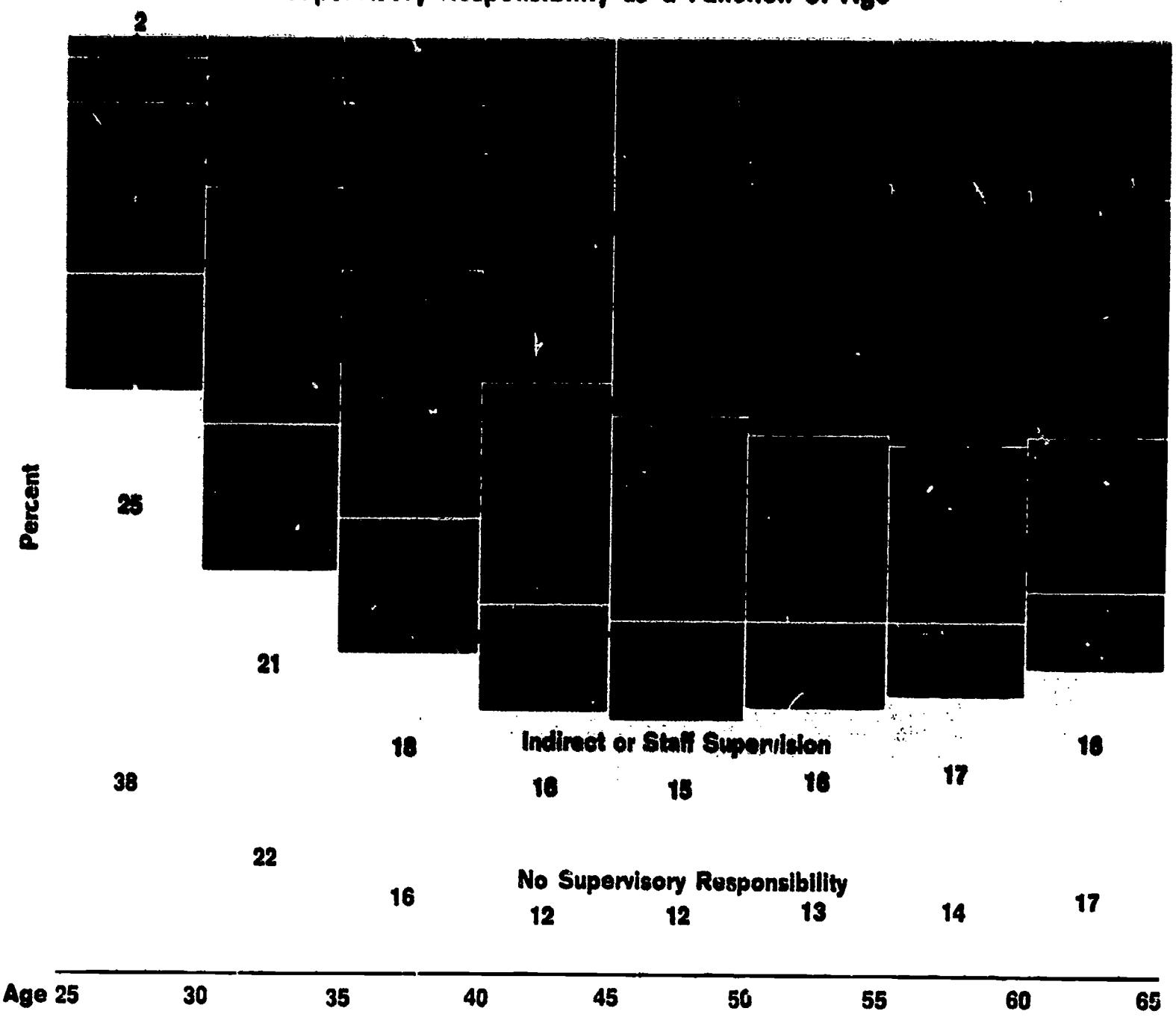
Source: National Engineers Register, 1969

FIGURE 2

A Closer Look. One of the objectives of the last National Engineers Register survey, conducted in 1969, was to look in greater detail at the management function. To avoid the problem caused by trying to make people categorize themselves as either engineers or managers, the questionnaire was redesigned and respondents were asked to specify the level of supervision they exercised over others, in addition to the functional area in which they were employed. The results, as shown in Figure 1 for all survey respondents combined, indicate that a majority of engineers were actually engaged in some kind of management or supervision of other people ranging from team leadership to general management of an organization.

Since publication of these initial findings, EJC has obtained cross-tabulations showing how supervisory responsibility varies as a function of other characteristics. Generally speaking, there are no dramatic differences in the distribution of supervisory responsibility by level of formal education. The percentages of bachelor's, master's, and doctor's degree engineers in the various supervisory categories are very similar. There are more noticeable differences in the distribution from industry to industry as shown in Figure 2, which is broken down into selected product or service areas. Similar differences appear when the various engineering curricula are looked at separately, with civil engineers generally resembling the construction industry, chemical engineers the chemical industry, aerospace engineers the aircraft industry, etc. as might be expected. Although the pattern shifts gradually from industry to industry, the differences between categories at opposite ends of the chart, such as construc-

Supervisory Responsibility as a Function of Age



Source: National Engineers Register, 1969

FIGURE 3

tion compared to aircraft, are quite striking. Construction employs the smallest percentage of engineers in nonsupervisory positions and has the highest percentage in general managment, while aerospace uses a high percentage in nonsupervisory and team leader positions. Education is a special category because engineering teachers and researchers in colleges and universities generally work independently. Even so, half of them have some supervisory or managerial responsibilities, as disclosed by the survey.

Managerial Responsibilities as a Function of Age. When the data are broken down according to age groups, a significant relationship becomes apparent. The progression of the average engineer up the management ladder is clearly evident in Figure 3. The young engineer in the 25-30 year age bracket has duties that are largely technical. A majority have no supervisory responsibilities at all or exercise staff functions that require only indirect supervision over the work of others. About a third have supervisory responsibilities, but mostly at the team or project level. As the age level increases, managerial duties expand rapidly. The percentage of engineers with no supervisory responsibility decreases steadily from 38 percent in the 25-30 year old group to 12 percent among 40-45 year olds, then increases slightly with advancing age. Similarly, the proportion of those with only staff responsibilities drops from 25 percent to 15 percent, and levels off after age 40.

In the supervisory categories, the percentage of team or unit leaders is highest in the 30-35 year age group. The proportion of project supervisors peaks at 35-40 years, while that of department heads is highest from 45

to 60. The percentage of engineers in general management increases steadily from 2 percent at the start to 17 percent at retirement age. By the time engineers are 40, the statistics show that two-thirds or more will have taken on managerial or supervisory duties of an increasingly responsible nature.

Some Implications. If management is an inherent part of the work of so many engineers, that fact should receive greater recognition in the education and career development of members of the profession. The typical undergraduate curriculum in engineering is almost entirely technical in nature, and most engineering students are oriented toward technical duties. Such a preparation is adequate for the first few years out of college, but not for the long run career requirements of a majority of engineers. Although more and more engineers are returning to school for advanced courses in business administration, only about two percent of all engineers held MBA degrees in 1969. The disparity between the formal education of engineers for management and the extent to which they actually become involved in it is apparent.

Not only do engineers need more education in the arts and techniques of management, but they must be made more aware of the ways in which their duties will change during their professional careers. The gradual transition from technical to managerial responsibilities is something that more engineers should recognize as a normal pattern of career development. Too many engineers today are educationally and psychologically unprepared to make the shift, and seem to feel that they are abandoning their profession when they move out of strictly technical work. Young engineers should be helped to recognize that the current job structure, especially in industry, does not provide openings for all those who would like to stay in purely technical and nonsupervisory positions throughout their careers. Since this job pattern has developed over a long period of time in response to employers' needs, and is now traditional in many organizations, it is unlikely to be altered radically in the near future. Even where companies have stressed the "dual ladder" concept of advancement along parallel technical and managerial routes, the technical side has tended to offer fewer opportunities than the managerial. This is a fact of life which engineers should be prepared to face.

A partial solution might lie in a continuing education approach by which engineers moving into supervisory and managerial positions could take short courses in appropriate skills such as personnel administration, budgeting, accounting, communications, etc. Employers should recognize the need for this additional formal education and provide the opportunity to obtain it as a normal part of the engineer's professional development. The timing and specific nature of the courses to be taken should, of course, be determined by the needs of each individual, but most engineers apparently need them between the ages of 30 and 45.

More fundamentally, the distinction between engineering and science lies in engineering's emphasis on the *application* of science and technology to meet human needs. Such needs are becoming increasingly complex, and in meeting them engineers must not only develop plans and designs, but also see that projects are carried through to successful conclusion. Although many technical assignments can still be handled by a single person working alone, modern engineering projects of major consequence involve huge amounts of money and material and require that the efforts of many people be coordinated to achieve completion. The engineer who aspires to a position of responsibility for a major technological project or activity cannot avoid the managerial duties that are inherent in such a position. Since both the technical and the managerial aspects are essential to the overall engineering job, there is no logical reason why one should be considered less "professional" than the other.

It appears to be both normal and appropriate for a majority of engineers to encounter managerial responsibilities at some stage in their careers, and for the proportion of managerial duties to increase as the scope of the job increases. Not all engineers need become managers and not all engineers will, but those who do are no less members of the engineering profession than those who do not.