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ABSTRACT

A survey of the employment and demand for scientists and engineers in industrial research laboratories was made among all companies belonging to the Industrial Research Institute and a number of other organizations early in 1972. A questionnaire was used to analyze such aspects as reliability of future estimates, employment trends, personnel movement patterns for 1971, degree of success in personnel movements, availability and qualification of applicants, employee transfer, executive development, fringe benefits, and conditions of employment. Data analyses of 86 replies showed the evidence of personnel movements into areas of rapid payoff. Personnel reductions were not large, and, by 1973, most industry groups expected to expand again. A shift of emphasis back toward longer-range research activities and a stable working situation in laboratories were marked. Continuing liberalization of benefits was anticipated for the future, but at a gradual pace. Project leadership ability was needed, and managerial skill was likely to be found among experienced personnel. Besides 32 statistical tables, a sample questionnaire and instructions for entering data are included. (CC)

Utilization of and Demand for

ENGINEERS AND SCIENTISTS IN INDUSTRIAL RESEARCH

Report of a Survey

Conducted by the

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Engineering Manpower Commission
of
Engineers Joint Council,
and
Scientific Manpower Commission

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tables. These generally tabulate the answers to the questions as provided by the respondents. In addition to showing the actual numbers in each category, these tables indicate the "not givens," i.e. the number of blanks or uninterpretable replies. Where data do not appear in the appendix tables, either the computer was not programmed to produce them, technical problems were encountered that made the data unreliable, or all significant information is already included in the main tables. Specifically, no analysis was done on Form III or on Additional Question 3. Also, problems were encountered in processing the year of degree in Forms II and IIa such that no usable data were obtained. Except for the foregoing cautionary notes, the results of the survey contain much that is interesting and illuminating about the place of engineers and scientists in industrial research.

Reliability of Future Estimates.

Respondents to this survey were asked to check the degree to which they considered their future projections were firm or reliable. The wording of the questions and the answers are tabulated in Table 2.

Overall, respondents may be characterized as being fairly uncertain about the future but willing to use their best judgment in estimating future needs. Answers about the potential supply and utilization of technical personnel were largely based on the assumption that current experience would continue to apply in the near future; and future employment practices were predicted on the basis of educated guesses rather than planned changes. Generally, respondents who were most uncertain about the future tended not to give estimates of employment beyond 1972. The results of this survey reflected careful thinking on the part of all respondents as well as a healthy realization that plans will be subject to alteration because of unpredictable changes in the economic and manpower situation. To the extent that answers were based on guesses, these can be accepted as highly educated guesses by people whose qualifications to make them are unsurpassed by any other group that could be assembled.

Overall Employment and Future Trends.

The survey generally reflected the severe cutbacks in R&D employment experienced in 1971 and 1972. Professional employment as of 1-1-72 was down in all industry groups by an average of 5 percent from the previous January, and projected employment for 1-1-73 was below 1971 levels in all groups except food. By 1974, however, all groups but petroleum expected to have recovered, and substantial increases were envisioned by 1977. Employment indices for each group, based on 1971=1000, are shown in Table 3. (Actual data on which the year-to-year comparisons were based are given in Appendix Tables 1 and 2.)

The laboratories in the food industry showed the least amount of dip and the fastest and strongest prospective growth. Paper producers declined the most in 1972 and 1973 but then indicated a strong recovery. The petroleum laboratories declined only moderately but lagged behind all other groups after 1974. The mechanical, chemical, and electrical groups all followed patterns that were close to the median.

In terms of technical field, the engineering disciplines were slightly better off than the sciences. Of the major fields, physics appeared to have the poorest prospects, taking until 1977 to recover to its 1971 employment level. Electrical engineering showed the deepest dip in 1972 but was expected to recover more quickly than physics. Chemical engineering also appeared to have better prospects than chemistry. The largest rate of growth by 1977 was indicated in mathematics, biology, geology, and "other" science and engineering, but the number of positions actually involved was much smaller than in the more general-purpose disciplines that make up the bulk of R&D employment.

The breakdown by degree level shows that PhD holders were in a noticeably stronger position than their BS-MS counterparts, and that engineers had better prospects than scientists at both levels. The strong showing of PhD engineers was particularly noteworthy, with growth taking place even during 1971-72. Apparently the reduction in number of hires was offset to some extent by a greater emphasis on the quality of the people hired, with R&D managers generally planning to upgrade the average educational level of their employees despite temporary cutbacks in the size of their organizations.

As a general conclusion, industrial research employment was expected to bottom out in 1972, recover quite strongly through 1973, and continue to grow steadily thereafter. (As of early 1973 there were indications that a strong recovery in the hiring of engineers was already in process.) It should be noted, however, that company plans and expectations have undoubtedly changed since the survey was conducted, and will be subject to further change in the future.

ENGINEERS AND SCIENTISTS IN INDUSTRIAL RESEARCH

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ENGINEERS AND SCIENTISTS IN INDUSTRIAL RESEARCH

Introduction

Early in 1972 the Industrial Research Institute, Engineering Manpower Commission of Engineers Joint Council, and Scientific Manpower Commission conducted a survey of the employment and future demand for engineers and scientists in industrial research laboratories. Questionnaires were sent to all companies belonging to the Industrial Research Institute and to a small number of other organizations. A copy of the questionnaire is included in the Appendix. Replies were received from 91 respondents, and 86 of these were included in the data analysis on which this report is based. (The remaining questionnaires either were incomplete, were received too late, or did not fit any of the categories into which the analysis was divided.) A list of the respondents and the industry groups in which they were classified appears in Table 1.

The chemical group accounted for nearly half of the data received, while 8 to 13 returns were received from each of the food, paper, petroleum, mechanical, and electrical groups. Approximately 11,200 professional employees (as of 1-1-72) were represented by the data. Because not all respondents answered every question, the analysis treats each question independently, using the number of replies to that question as a base for statistics. Percentages in general are based on the total number of responsive replies to each section, with "not givens" excluded from the statistics.

In interpreting the results of some questions, the reader may be tempted to make comparisons with the answers to other questions. Such comparisons should be made with great caution and should be tempered by the reader's knowledge of conditions in the particular group being studied. For example, it might be useful to compare the distribution of personnel movements (hires, transfers, promotions) as measured in one part of the survey with the distribution of professional employees as measured in another part, but this comparison would not be statistically valid. In the first place, the questions asked and categories used were probably not the same in the two parts. (This was necessary to keep the questionnaire to a manageable size.) Secondly, the set of respondents that provided answers was probably not the same in the case of each question. Consequently it is impossible to determine whether differences in distributions from one question to another are due to significant factors within the group being investigated, or are merely due to technicalities in the way the survey was conducted and analyzed.

The reader will also find that the text does not discuss all of the relationships that might be inferred from the statistics presented in the tables, but merely singles out a few highlights. This is because the author does not pretend to be sufficiently knowledgable in the internal operations of research laboratories to be able to explain why certain relationships exist. For example, the statistics show a relatively high concentration of non-degree people in the personnel movements within the paper companies represented by the survey respondents, and a low percentage of PhD's in the mechanical group. (Table 7.) These results could have been caused by inherent differences between the industries or simply by the peculiarities of the companies that responded. Only someone intimately familiar with the industry would be in a position to judge whether these statistics were truly significant.

Another caution results from the size of the sample, which varies widely depending on the characteristic being measured. As a very general observation, the number of geologists employed turned out to be extremely small, as did the number of people engaged in the role of marketing. In both cases it is probable that the general nature of the work done by industrial research organizations tends to exclude these groups. Statistics for these and other small populations are omitted from some of the tables. Where given, they should be interpreted with caution. There can be no assurance that any of the groups described in the survey data are actually representative of industrial research as a whole. In fact, the great variability in responses, even among companies with apparently similar products, makes it unlikely that any company could be found whose manpower characteristics could be accepted as "typical" of a particular industry. There are also undoubtedly minor errors in the data introduced during the interpreting and keypunching process. For all these reasons, undue significance should not be placed on small percentage differences in the characteristics of different groups.

In order to enable the reader to investigate details that were not brought out in the text or the tables, most of the actual survey data are given in raw form in the appendix

TABLE 1

RESPONDENTS TO I.R.I.-E.M.C.-S.M.C. DEMAND SURVEY, 1972

Group A - Food Products

American Maize-Products Co.	Hunt-Wesson Foods, Inc.
Carnation Company	Nabisco, Inc.
CPC International	Philip Morris U.S.A.
General Foods Corp.	Swift & Co.
Gerber Products	

Group B - Paper

Crown Zellerbach Corp.	Mead Corporation
Kimberly-Clark Corp.	St. Regis Paper Company
MacMillan Bloedel Ltd.	J.P. Stevens & Co. Inc.
Marathon Division	Union Camp Corp.

Group C - Chemicals

Air Products and Chemicals	International Flavors & Fragrances
American Can Company	Koppers Company, Inc.
Armstrong Cork Company	P.R. Mallory & Co.
Ashland Oil, Inc.	Morton-Norwich Products
BASF Wyandotte Corp.	National Starch & Chemical
Cabot Corporation (partial)	Olin Corporation
Colgate-Palmolive Co.	PPG Industries, Inc.
Consolidation Coal	Pfizer, Inc.
Diamond Shamrock Corp.	Richardson-Merrell
E.I. du Pont de Nemours & Co.	Rohm and Haas Co.
Ferro Corporation	Sandoz-Wander, Inc.
General Tire & Rubber Co.	Stauffer Chemical Co.
The B.F. Goodrich Company	Sterling Drug
Goodyear Tire & Rubber	Sun Chemical Corp. (5 locations)
W.R. Grace & Co., Inc.	Tennessee Eastman Co.
Hercules Incorporated	U.S. Borax & Chemical
Inmont Corporation	U.S. Gypsum
Interpace Corp.	Warner-Lambert Company

Group E - Petroleum

Atlantic Richfield Co.	Standard Oil Co. (Indiana)
Chevron Research Co.	Sun Oil Company
Cities Service Co.	Union Oil Co. of California
Pennzoil United, Inc.	Phillips Petroleum Co.

Group F - Mechanical Products

Allegheny Ludlum Steel	Carrier Corporation
American Metal Climax	Moore Business Forms, Inc.
Beloit Corporation	National Steel
Bethlehem Steel Corp.	Reynolds Metals Company
Borg-Warner Corp.	The Timken Company
Cabot Corp. (partial)	USM Corporation

Group I - Electrical Products

Allis-Chalmers Corporation	GTE Laboratories
American Optical	Honeywell, Inc.
Bendix Corporation	North American Philips
Cabot Corp. (partial)	RCA
Cutler-Hammer, Inc.	Sperry Rand Corp.
The Foxboro Company	Unidentified
General Electric Co.	

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TABLE 2

ANSWERS TO RELIABILITY QUESTIONS*

INDUSTRY GROUP	List 1: 1	List 1: 2	List 1: 3	List 1: 4	List 2: 1	List 2: 2	List 2: 3	List 2: 4	List 3: [illegible]	List 3: 2	List 3: 3	List 3: 4
FOOD	1	3	4	1	1	2	5	1	1	4	3	1
PAPER	0	1	6	1	0	5	3	0	0	5	3	1
CHEM.	6	12	12	6	6	10	16	4	3	20	8	5
PETROL.	0	6	2	0	0	4	3	1	1	6	1	0
MECH.	1	4	3	2	0	1	7	2	4	4	0	2
ELEC.	1	9	0	3	1	2	8	2	3	7	1	2
UNCLASS.	0	0	1	1	0	0	1	1	0	2	0	0
TOTAL	9	35	28	14	8	24	43	11	12	48	16	10

* See below for wording of the questions in the three lists.

LIST 1

1. Future requirements (next five years) for professional people in our industrial research activities have been estimated. Barring unforeseen circumstances, we believe we are fairly clear about the number of qualifications and likely assignment of additional, future professional personnel.

2. Future requirements for the number and level of professional personnel in our industrial research activities have been estimated. However, we are less clear about the qualifications and assignments associated with these future positions. For the purpose of this questionnaire we have used our best judgment.

3. Present circumstances do not permit good estimates of future funding and program emphasis. Consequently, we are only able to guess for the purpose of this questionnaire at our future requirements for professional personnel.

4. Present circumstances preclude an attempt to estimate future requirements. Accordingly, we have not provided estimates where consideration of such future requirements would be involved.

LIST 2

1. We have been in a position to consider and attempt to anticipate the changing supply and demand (including qualifications) of technical personnel and, accordingly, to modify our expectations of how we expect to utilize the various specialities and levels and kinds of education and experience.

2. We have reviewed information on the changing supply and demand of technical personnel and considered some of the potential implications to us. However, we have not yet reformulated our guidelines. Therefore, for the purposes of this questionnaire, we have only guessed at the consequences of these changes.

3. We have reviewed information on the changing supply and demand of technical personnel and considered some of the potential implications to us. However, we have not yet reformulated our guidelines. Therefore, for the purposes of this questionnaire, we have assumed that our <u>current</u> experience will apply to the future.

4. Present circumstances preclude an attempt to estimate changes in the potential supply and utilization of technical personnel. Entries on the questionnaire which relate to such estimates have been left blank.

LIST 3

1. We have had an opportunity to consider the more important factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits. As a result we are anticipating changes which our answers to this questionnaire reflect.

2. Although we have reviewed some of the factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits, we have not anticipated changes. Therefore, our answers to this questionnaire are only guesses which have been made solely for the purposes of this questionnaire.

3. Although we have reviewed some of the factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits, we have not anticipated changes. Therefore, our answers to this questionnaire anticipate none.

4. Present circumstances preclude an attempt to estimate changes in these practices and benefits. Entries on the questionnaire which relate to such estimates have been left blank.

TABLE 3

INDEX OF PROJECTED CHANGE IN EMPLOYMENT OF R&D PROFESSIONALS
1971 - 1977
(1971 = 1000)

Industry Group	No. of Respondents	1-1-71	1-1-72	1-1-73	1-1-74	1-1-77
			Employment as of Date Indicated			
Food	9	1000	985	1020	1096	1285
Paper	8	1000	903	919	1018	1189
Chemicals	36	1000	957	988	1049	1188
Petroleum	8	1000	976	973	991	1054
Mechanical	12	1000	969	986	1052	1230
Electrical	13	1000	974	981	1054	1142
All Respondents	86	1000	964	983	1041	1164
Technical Field						
Biology		1000	961	1005	1156	1312
Chemistry		1000	952	958	1005	1125
Geology		1000	1021	990	1083	1268
Mathematics		1000	1034	1130	1239	1472
Physics		1000	954	931	960	1006
Other Science		1000	987	1038	1141	1302
All Science		1000	959	972	1033	1156
Chem. Eng.		1000	970	1012	1068	1177
Elec. Eng.		1000	938	969	1036	1126
Mech. Eng.		1000	981	1017	1050	1193
Other Eng.		1000	1034	1054	1131	1299
All Eng.		1000	975	1010	1066	1188
Degree Level						
BS-MS All		1000	958	970	1019	1130
BS-MS Sci.		1000	955	960	1011	1123
BS-MS Eng.		1000	963	986	1030	1140
PhD All		1000	975	1012	1092	1237
PhD Sci		1000	965	990	1063	1202
PhD Eng.		1000	1023	1112	1218	1390

Note: All respondents did not provide data for all years. Statistics are based on year-to-year comparison of those who provided data for both years, which number varied from 82 to 67 depending on the years being compared.

Distribution of Professionals in Industrial Research

The six industry groups surveyed each had a substantially different "mix" of professional employees, as shown in Table 4. (Actual data for this section are in Appendix Table 3. Chemists and chemical engineers were the predominant discipline in the chemical, food, petroleum, and paper groups and were well represented even in the mechanical and electrical groups. Geologists and mathematicians were a minor factor throughout, and biologists were significant

TABLE 4

PERCENT DISTRIBUTION OF PROFESSIONALS 1-1-72
BY INDUSTRY GROUP

POSITION LEVEL	Food	Paper	Chem.	Petrol.	Mech.	Elec.	All Indust.
1-2	52	56	55	56	50	46	53
3	32	24	25	25	34	29	27
4-5	16	19	20	19	16	25	20
TOTAL	100	100	100	100	100	100	100
ALL SCIENTISTS							
1-2	52	50	56	54	56	46	54
3	32	28	24	25	31	32	26
4-5	16	21	20	20	13	22	20
TOTAL	100	100	100	100	100	100	100
ALL ENGINEERS							
1-2	55	64	49	58	47	46	52
3	30	19	30	24	35	26	28
4-5	16	17	21	18	18	27	21
TOTAL	100	100	100	100	100	100	100
TECHNICAL FIELD							
BIOL.	7	1	11	*	*	*	6
CHEM.	48	44	64	48	15	17	47
GEOL.	0	0	*	2	*	*	*
MATH.	*	2	*	*	2	5	2
PHYS.	*	3	2	2	6	22	6
OTH. SCI.	23	5	6	2	7	7	7
ALL. SCI.	79	55	84	55	31	51	68
CHEM. E.	15	18	12	34	11	2	15
ELEC. E.	*	4	*	*	6	29	6
MECH E.	2	18	2	8	18	12	7
OTHER E.	3	6	2	2	35	6	5
ALL E.	21	45	16	45	69	49	32
TOTAL	100	100	100	100	100	100	100
DEGREE LEVEL							
B-M	84	69	65	62	84	58	67
D	16	31	35	38	16	42	33
TOTAL	100	100	100	100	100	100	100
% PHD-SCIENCE	19	44	39	48	11	57	39
% PHD-ENGRG.	5	14	14	25	18	26	20

*Less than 1%

only in the chemical and food industries. Physicists and electrical engineers made up a minor percentage everywhere except in the electrical group, but mechanical engineers played a substantial role in the mechanical, paper, and electrical industry groups. The food laboratories employed a large group of "other" scientists, probably nutritionists and medical scientists. The largest percentage of "other" engineers was in the mechanical industry group. In view of the large number of metals producers in this group of respondents, it is probable that metallurgical engineers are heavily represented here.

It is interesting to note that on one extreme the chemical group consisted of 84 percent scientists to 16 percent engineers, while in the mechanical group the proportions were 69 percent engineers to 31 percent scientists.

The various industry groups tended to be quite alike in terms of distribution by position level. The overall proportions were 53 percent in levels 1 & 2, 27 percent in level 3, and 20 percent in levels 4 & 5, and no industry group differed widely from this pattern. However, there appeared to be more variation in terms of degree level, and this was particularly noticeable when scientists were compared with engineers. Overall, the food and mechanical groups had the lowest proportion of doctorates, 16 percent, while the electrical group was highest with 42 percent. Among all scientists the ratio was 39 percent PhD's to 61 percent bachelor's and master's, but among engineers it was 20 percent to 80 percent. In the mechanical industry group the percentage of doctorates among all scientists was lower than that for engineers, the only group in which this was so. The proportion of PhD's among scientists ranged from only 11 percent in the mechanical group to 57 percent in the electrical industry, while that for engineers varied from 5 percent in the food laboratories to 26 percent in the electrical group.

Table 5 gives the distribution by technical field and position level. As with the industry groups, there was little variation among the technical fields in terms of position level. This tends to indicate that the opportunity for advancement is essentially the same for all disciplines.

TABLE 5

PERCENT DISTRIBUTION OF PROFESSIONALS 1-1-72
BY TECHNICAL FIELD

POSITION LEVEL	Biol.	Chem.	Geol.	Math.	Phys.	Oth. Sci.	All Sci.	Chem. Eng.	Elec. Eng.	Mech. Eng.	Other Eng.	All Eng.	All Fields
1-2	61	54	53	61	48	51	54	52	51	53	49	52	53
3	19	27	33	25	35	22	26	28	24	26	32	28	27
4-5	20	19	14	14	17	27	20	20	25	21	19	21	20
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

One other distribution of interest is the variation of position level as a function of degree level, as shown in Table 6. Of the BS-MS group, 61 percent were in levels 1 & 2, 25 percent in level 3, and 15 percent in levels 4 & 5. Among PhD's, however, the percentages were 38, 31, and 31 respectively. This concentration of the higher educated in the higher position levels is an obvious indication of the importance of an advanced degree in research work.

TABLE 6

PERCENT DISTRIBUTION OF PROFESSIONALS 1-1-72
BY HIGHEST COLLEGE DEGREE

POSITION LEVEL	Bachelor & Master	Doctor
1-2	61	38
3	25	31
4-5	15	31
TOTAL	100	100

Personnel Movement Patterns for 1971.

A study of personnel movements (hires, transfers, and promotions) during the year reveals, for the group of respondents as a whole, that engineers were involved to a somewhat greater extent than scientists. For example, the proportion of the engineers among the personnel moved was 38 percent, whereas engineers made up only 32 percent of the professional employees on the payroll as of the end of the year. Scientists, who constituted 68 percent of the total employees, were involved in 62 percent of the 1971 personnel movements. Although these differences are not great, the pattern was consistent in all industry groups except food companies, where scientists provided a proportionally greater share of the movements during the year. (These findings are also consistent with the more rapid recovery in engineering employment noted by college placement officials.) In terms of degree level, the proportions were nearly the same for the year's movements as for the employed population. Thus there was no evidence of reduced opportunity for PhD's in these statistics.

There were substantial differences among the different industry groups in terms of the source, role, and type of project involved in the transactions made during 1971. For all laboratories combined, colleges were the source of 29 percent of the people moved, but even more, 33 percent, came from within the R&D organization itself and 13 percent were transferred from other areas within the company. Another 22 percent were hired from outside sources. The numbers of displaced aerospace personnel, veterans, and former college faculty members were too small to reveal any useful information about these groups. Of the separate industry groups, the paper companies derived the smallest percentage from college and made three-fourths of all movements within the company. The petroleum labs obtained very few experienced people from outside sources, while for the food group outside hires were the largest personnel source and there were only a few transfers from elsewhere in the company.

Types of projects also varied widely. The food, petroleum, and mechanical groups concentrated on product improvement, the paper companies on technical service, the chemical laboratories on research for new knowledge, and the electrical group on major developments. Complete data on the breakdowns by industry group, including characteristics not discussed above, will be found in Table 7

TABLE 7

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS BY INDUSTRY GROUP

LEVEL OF DEGREE	Food	Paper	Chem.	Petrol.	Mech.	Elec.	All Indust.
BS	52	44	38	39	54	32	40
MS	24	21	19	16	30	31	22
PhD	24	26	41	40	9	37	35
Non-Deg.	1	10	3	4	7	0	2
TOTAL	100	100	100	100	100	100	100
TECHNICAL FIELD							
BIOL.	6	0	12	0	0	2	6
CHEM.	47	41	54	25	7	14	38
GEOL.	0	0	*	3	4	*	*
MATH.	1	3	2	1	2	9	3
PHYS.	*	0	*	2	7	13	3
OTH. SCI.	26	3	9	3	7	4	10
ALL SCI.	82	46	78	33	26	41	62
CHEM. E.	11	21	14	55	4	4	18
ELEC. E.	*	0	*	1	13	30	6
MECH. E.	2	13	5	8	17	19	8
OTHER E.	4	21	3	4	39	7	6
ALL E.	18	54	22	67	74	59	38
TOTAL	100	100	100	100	100	100	100

TABLE 7 (continued)

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS
BY INDUSTRY GROUPS

	Food	Paper	Chem.	Petrol.	Mech.	Elec.	Indust.
POSITION LEVEL							
1	26	14	25	29	32	20	25
2	49	22	34	34	30	32	36
3T	8	27	16	16	11	25	16
4T	*	8	7	10	0	8	6
5T	*	5	*	0	2	2	1
3A	8	11	7	4	16	6	[illegible]
4A	4	5	7	5	7	[illegible]	[illegible]
5A	3	8	3	3	2	[illegible]	3
6	0	0	0	0	0	0	0
TOTAL	100	100	100	100	100	100	100
TYPE PROJECT							
GEN RES.	6	10	28	19	15	14	18
EXPL. RES.	9	3	11	5	2	15	10
MAJ. DEV.	8	10	21	4	15	41	19
PROD. IMP.	44	18	21	42	48	16	29
TECH. SERV.	27	38	12	26	13	4	17
GEN.	2	18	4	1	2	10	5
OTHER	4	3	3	2	4	1	3
TOTAL	100	100	100	100	100	100	100
ROLE							
TECH. PROJ.	44	35	63	42	50	77	57
TECH. STAFF	26	10	16	24	15	8	17
MKTG.	*	0	0	*	2	*	*
PROJ. LDR.	22	29	11	21	20	9	15
MGR.	8	26	8	10	13	5	8
OTHER	1	0	1	4	0	1	2
TOTAL	100	100	100	100	100	100	100
SOURCE							
COLLEGE	34	9	28	25	22	34	29
OUTSIDE	37	15	21	6	13	25	22
WITHIN R&D	22	45	34	15	46	15	33
WITHIN CO.	4	30	13	12	20	21	13
ALL OTHER**	3	0	4	1	0	4	3
TOTAL	100	100	100	100	100	100	100
PREVIOUS POSITION LVL							
0	37	19	29	27	27	38	31
1	34	16	20	13	16	8	19
2	21	25	23	34	31	24	25
3T	3	16	11	11	16	17	11
4T, 5T	*	0	3	2	4	3	3
3A	2	12	[illegible]	5	0	4	5
4A	3	9	4	6	7	5	5
5A	0	3	1	2	0	3	1
6	0	0	0	0	0	0	0
TOTAL	100	100	100	100	100	100	100

*Less than 1%

**Includes Aerospace, Armed Forces, Teaching, and Other. Each of these separate sources was less than 1% in practically all industry groups.

A breakdown by highest degree, Table 8, shows a fairly even distribution in terms of role and source (except for non-graduates, who did not come directly from college) but wide differences in position level, type of project, and technical field. Bachelor's degree holders tended to be concentrated at levels 1 and 2 and in product improvement projects. The master's degree holders went mostly into level 2 positions, also in product improvement projects. The PhD's, however, were more likely to be in levels 2 or 3T and in research or major development projects. Among technical fields, the master's degrees were slightly more concentrated in engineering while the doctor's were largely in science, especially chemistry.

TABLE 8

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS
BY HIGHEST COLLEGE DEGREE

TECHNICAL FIELD	Bachelor	Master	Doctor	Non-Grad.	All Degrees
BIOL.	5	4	8	4	6
CHEM.	37	24	48	52	38
GEOL.	0	1	2	0	*
MATH.	3	5	2	4	3
PHYS.	3	5	3	0	3
OTHER SCI.	9	10	11	11	10
ALL SCI.	58	49	73	70	62
CHEM. E.	19	23	15	0	18
ELEC. E.	6	11	4	0	6
MECH. E.	11	10	4	7	8
OTHER E.	6	7	4	22	6
ALL E.	42	51	27	30	38
TOTAL	100	100	100	100	100
ROLE					
TECH PROJ.	58	54	58	61	57
TECH. STAFF	23	16	11	18	17
MKT.	*	0	*	0	*
PROJ. LDR.	10	18	20	7	15
MGR.	7	10	10	7	9
OTHER	2	1	1	7	2
TOTAL	100	100	100	100	100
POSITION LEVEL					
1	44	19	4	54	25
2	30	41	40	23	36
3T	10	14	25	12	16
4T	4	4	10	0	6
5T	*	*	2	0	1
3A	5	9	8	0	7
4A	4	8	7	8	6
5A	2	4	4	4	3
TOTAL	100	100	100	100	100

TABLE 8 (continued)

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS
BY HIGHEST COLLEGE DEGREE

TYPE PROJECT	Bachelor	Master	Doctor	Non-Grad.	All Degrees
GEN. RES.	13	17	26	7	18
EXPL. RES.	4	6	20	11	10
MAJ. DEV.	16	19	22	18	19
PROD. IMP.	37	33	18	32	29
TECH. SERV.	22	19	9	18	17
GEN.	6	5	4	4	5
OTHER	4	2	1	11	3
TOTAL	100	100	100	100	100
SOURCE					
COLLEGE	27	27	34	0	29
OUTSIDE	24	23	19	11	22
WITHIN R&D	29	33	33	78	33
WITHIN CO.	16	15	10	11	13
AERO.	1	*	0	0	*
ARM. FORCE	1	*	*	0	*
TEACHING	*	*	2	0	*
OTHER	*	0	*	0	*
TOTAL	100	100	100	100	100
PREVIOUS POSITION LEVEL					
0	33	27	33	25	31
1	31	15	5	32	19
2	19	31	27	39	25
3T	8	9	16	0	11
4T	2	1	4	0	2
5T	*	*	0	0	*
3A	2	7	8	4	5
4A	4	6	6	0	5
5A	*	3	1	0	1
TOTAL	100	100	100	100	100

* Less than 1%

Table 9 shows how the different technical fields differed as to project and role. (The differences in terms of position level and source were much less noteworthy and are not shown here.) Engineers generally were concentrated in major development and product improvement projects, while scientists were more likely to be in general or exploratory research, except for mathematicians who were strong in the technical service area. In terms of role the differences were less pronounced, but engineers were somewhat more likely to hold technical project or managerial positions.

TABLE 9

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS BY TECHNICAL FIELD

TYPE OF PROJECT	BIOL.	CHEM.	GEOL.	MATH.	PHYS.	OTHER SCI.	ALL SCI.	CHEM. ENG.	ELEC. ENG.	MECH. ENG.	OTHER ENG.	ALL ENG.	ALL FIELDS
GEN. RES.	47	20	80	3	32	16	22	13	17	8	12	12	18
EXPL. RES.	12	15	0	0	16	9	13	5	4	3	9	5	10
MAJ. DEV.	15	15	10	26	21	11	16	15	40	33	17	23	19
PROD. IMP.	8	24	0	23	16	41	25	42	22	35	38	36	29
TECH. SERV.	11	19	0	49	5	15	18	21	7	5	14	14	17
GEN.	3	4	10	0	11	4	4	3	7	9	6	5	5
OTHER	5	2	0	0	0	4	2	2	3	7	5	3	3
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100
ROLE													
TECH. PROJ.	59	55	50	44	73	54	56	52	71	66	59	59	57
TECH. STAFF	17	21	0	38	14	19	20	16	14	7	6	12	17
MKT.	0	0	0	0	0	*	*	*	0	0	3	*	*
PROJ. LDR.	16	15	30	15	8	15	15	18	4	15	20	16	15
MGR.	6	7	20	3	5	10	7	11	10	10	8	10	8
OTHER	1	1	0	0	0	2	1	1	1	2	5	2	2
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100

*Less than 1%

The different types of projects are examined separately in Table 10, in terms of roles, sources, position levels, and highest degrees. Note the distinctively different set of roles in the technical service and general categories as compared to the similarity of the other four, and the concentration of PhD's in exploratory research. There were also variations in the position levels filled in the different types of projects. Major development and exploratory research took noticeably fewer people at the lowest entry level, and the two research categories drew heavily on technical personnel at levels 3,4, and 5. Most of the top administrative positions were in the general category, as would be expected.

TABLE 10

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS BY TYPE OF PROJECT

ROLE	Gen. Res.	Expl. Res.	Major Devel.	Prod. Impr.	Tech. Serv.	General
TECH. PROJ.	66	74	76	65	6	48
TECH. STAFF	14	9	1	4	72	0
PROJ. LDR.	13	14	16	19	16	6
MGR.	6	3	5	11	4	36
TOTAL #	100	100	100	100	100	100
SOURCE						
COLLEGE	22	46	33	24	30	31
OUTSIDE	24	12	18	22	28	10
WITHIN R&D	40	25	21	40	31	33
WITHIN CO.	9	14	23	10	10	25
TOTAL #	100	100	100	100	100	100
POSITION LEVEL						
1	25	17	13	31	32	27
2	30	39	46	33	36	24
3T	21	26	17	13	12	10
4-5T	10	12	8	5	6	4
3A	8	3	8	7	8	4
4-5A	8	4	7	11	6	31
TOTAL	100	100	100	100	100	100
HIGHEST DEGREE						
BS	28	16	34	51	53	48
MS	21	13	22	24	25	21
PHD	49	69	41	22	19	29
TOTAL	100	100	100	100	100	100

Minor categories included in total but not listed separately.

Table 11 looks at the principal roles in terms of source, position level, and highest degree. The differences between technical project and staff people on the one hand and project leaders and managers on the other are quite pronounced. The first two roles tended to be filled by people hired directly from college at levels 1 and 2, while the others were filled by promoting from within at higher position levels. Technical project roles appeared to require more PhDs, whereas technical staff roles used mostly people with bachelor's degrees. Project leaders and managers were more likely to hold doctorates, but substantial numbers of people with lower degrees also moved into these roles.

TABLE 11

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS BY ROLE

SOURCE	Tech. Proj.	Tech. Staff	Proj. Leader	Mana-ger
COLLEGE	35	35	15	4
OUTSIDE	22	30	17	11
WITHIN R&D	25	24	54	61
WITHIN CO.	13	8	13	24
TOTAL #	100	100	100	100
POSITION LEVEL				
1	31	38	4	0
2	43	43	21	0
3T	19	9	21	3
4-5T	5	4	16	6
3A	1	3	26	18
4-5A	*	3	12	72
TOTAL	100	100	100	100
HIGHEST DEGREE				
BS	41	54	27	32
MS	21	21	26	26
PHD	36	22	46	40
TOTAL	100	100	100	100

*Less than 1%

Minor categories included in total but not listed separately.

Finally, Table 12 examines the four major sources according to position level, role, and type of project. The most interesting column is the one dealing with college graduates, as this gives an indication of the kind of work new graduates are likely to encounter. Although new hires from college tended to fill largely technical project and staff roles at levels 1 and 2, they were widely distributed by type of project. Outside hires generally came in at level 2 to fill technical project or staff roles in product improvement, technical service, or general research projects. Promotions from within were used to fill upper level positions, with project leaders tending to come more from within the R&D organization than from elsewhere within the company.

These tables by no means exhaust the cross-tabulations that can be made from the basic questionnaire data but they do cover the most interesting comparisons. Other cross-tabulations can be constructed as desired from the raw data in Appendix Tables 4 through 10.

TABLE 12

PERCENT DISTRIBUTION OF 1971 PERSONNEL MOVEMENTS
BY SOURCE OF HIRE

POSITION LEVEL	College	Outside Hire	Within R&D	Within Co.
1	43	23	17	12
2	41	46	24	33
3T	10	17	20	20
4-5T	*	4	11	16
3A	4	2	15	4
4-5A	2	8	14	16
TOTAL	100	100	100	100
ROLE				
TECH. PROJ.	69	57	43	53
TECH. STAFF	21	24	13	11
PROJ. LDR.	8	12	26	15
MGR.	1	4	16	16
TOTAL	100	100	100	100
TYPE OF PROJECT				
GEN. RES.	14	21	23	12
EXPL. RES.	16	6	8	10
MAJ. DEV.	20	15	11	30
PROD. IMPR.	25	30	36	22
TECH. SERV.	17	22	16	13
GENERAL	5	2	5	9
TOTAL	100	100	100	100

*Less than 1%

Availability and Qualifications of Applicants.

Respondents were asked to check their subjective assessment of the availability of personnel from various sources to fill positions at various organizational levels, and also of the extent to which applicants were qualified as to technical ability, project leadership, managerial skill, and adaptability. Each answer was given equal weight, as it appeared that the organizations involved were relatively homogeneous in terms of size and function. The results for all industry groups combined are shown in Table 13. (Raw data are in Appendix Table 12.)

In general, respondents saw no lack of new college graduates except at the associate degree level where 27 percent reported a shortage and only 19 percent perceived a surplus. The greatest surplus appeared to exist at the PhD level. The relative shortage of technicians was also noted among experienced personnel from outside sources, and there was sone indication that technical people at levels 4 and 5 were not easy to find everywhere. Within research organizations themselves, however, there appeared to be no surplus of experienced personnel, and a rather high percentage of the respondents actually felt that there were shortages. Judging by the answers to other parts of this question, it appears that management views this as a lack of requisite skills or characteristics on the part of their employees and not simply a shortage of people.

The technical ability of new graduates was rated generally good, with greater ability at the higher degree levels as would be expected. Although between 16 and 21 percent of the respondents felt that new graduates were only fair in technical ability, experienced personnel were generally rated even lower, expecially those hired from outside the organization. This tends to support the observation frequently made by personnel managers that job applicants were plentiful during the 1970-72 period of relatively high unemployment but that well-qualified people were still not easy to find.

In terms of project leadership and managerial skill, employers tended to give higher ratings to the advanced degree people, but overall the ratings were only fair. Outside applicants generally were rated better than inexperienced graduates in project leadership ability, while in-house personnel did relatively poorly. In terms of managerial skill, people within the organization received the best evaluation. Interestingly enough, these people were rated noticeably higher in managerial skill than in project leadership ability, whereas new graduates and outside hires were more likely to be rated higher in project leadership than in management skills. However, these findings are not consistent in all categories and may reflect the fact that people in an organization are closely observed whereas outside applicants must be judged on a more superficial basis. It is evident that project leadership ability is seen as rather scarce at all levels within research organizations, while managerial skill is somewhat easier to come by within the organization.

The adaptability of new graduates was rated good to fair, but here advanced education reduced the percentage in the good column, implying that the additional education was considered narrowing. Among experienced personnel, higher ratings in adaptability went to those within the organization than outside it, except at the two lowest position levels.

These findings, representing a summary of the opinions of about 86 industrial research laboratory managers, should probably be taken only as indications of perceived strengths and weaknesses in the manpower supply as it appeared in early 1972. Overall, project leadership appears to be the quality that is most difficult to find and also (judging by the response to other parts of the questionnaire) one that is in highest demand.

TABLE 13

EVALUATION OF AVAILABILITY AND QUALIFICATION OF APPLICANTS, PERCENT OF REPL *

1 Source	2 Level	3 Availability of Applicants			Qualifications of Applicants: 4 Technical Ability			5 Project Leadership			6 Managerial Skill			7 Adaptability		
		Shortage	Adequate	Surplus	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
New Graduates	AAS	27	55	19	66	31	3	22	50	28	17	28	56	62	32	5
	BS	5	28	67	79	21	0	15	63	22	14	54	31	58	35	6
	MS	6	35	59	84	16	0	32	60	9	14	64	22	56	39	5
	PhD	4	17	79	84	16	0	48	46	6	21	62	17	52	41	7
Experienced Personnel Outside Hire	Technician	25	48	27	63	35	2	20	64	16	20	35	45	66	34	0
	Levels 1-2	1	41	57	58	41	1	32	55	13	14	51	35	61	38	2
	Level 3	9	43	49	44	53	3	40	52	8	31	56	12	48	49	3
	Levels 4-5 T	18	45	36	60	33	7	53	38	9	45	34	20	48	44	8
	Levels 4-5 A	9	53	38	66	26	8	20	51	29	60	35	5	53	38	9
Experienced Personnel Available Within Organization	Technician	31	60	9	63	37	0	22	20	58	21	63	15	56	34	10
	Levels 1-2	31	64	5	70	30	0	15	27	58	33	56	10	62	29	10
	Level 3	36	61	4	76	19	4	12	63	25	45	51	4	61	29	10
	Levels 4-5 T	41	55	4	77	20	3	17	64	19	56	40	4	50	46	4
	Levels 4-5 A	34	64	3	66	30	5	15	65	20	62	30	8	74	24	2

* Answers in each section add up horizontally to 100%.

Degree of Success in Personnel Movements.

In order to see how successful various types of movements had been, data were collected on 2,418 personnel transactions during the period 1969-1971. Data were not complete for about 300 of these, but the remaining 2,100 provided a base for a thorough analysis of success as a function of each of the other parameters measured. The complete results are reported in Table 14, and the raw data in Appendix Table 11. (Note that this analysis covers selected kinds of movements within a three-year period, whereas Tables 7-12 are based on a one-year period only.)

TABLE 14

DEGREE OF SUCCESS AS A FUNCTION OF OTHER CHARACTERISTICS

DEGREE OF SUCCESS, %

CHARACTERISTIC	UNSAT.	BELOW EXPECT.	SAT.	ABOVE EXPECT.	TOTAL	SIZE OF GROUP (n)
ALL PERSONNEL	3	4	75	17	100	2117
INDUSTRY GROUP						
FOOD	3	2	82	13	100	357
PAPER	5	5	77	14	100	111
CHEM.	2	4	78	16	100	810
PETROL.	2	6	71	21	100	272
MECH.	4	5	73	18	100	193
ELEC.	6	6	67	20	100	374
						2117
TECHNICAL FIELD						
BIOL.	*	2	81	17	100	124
CHEM.	2	4	80	13	100	846
GEOL. #	0	0	29	71	100	14
MATH.	7	9	66	18	100	67
PHYS.	6	6	68	19	100	94
OTH. SCI.	6	3	74	17	100	218
ALL SCI.	3	4	77	15	100	1363
CHEM.E.	3	5	77	15	100	311
ELEC. E.	3	4	68	25	100	118
MECH.E.	6	5	64	25	100	173
OTHER E.	3	5	72	20	100	149
ALL E.	4	5	72	20	100	751
						2114
HIGHEST DEGREE						
BS	4	6	78	13	100	887
MS	4	4	77	15	100	473
PhD	2	3	70	25	100	689
NON-DEG.	6	2	84	8	100	49
						2098
SOURCE						
COLLEGE	3	4	81	11	100	621
OUTSIDE	4	4	76	16	100	580
WITHIN R&D	*	4	71	24	100	547
WITHIN CO.	8	7	69	16	100	235
AERO.	9	0	78	12	100	32
ARM. FORCE.	7	4	70	19	100	27
TEACHING	0	6	71	23	100	48
OTHER	5	0	71	23	100	21
						2111

TABLE 14 (continued)

DEGREE OF SUCCESS AS A FUNCTION OF OTHER CHARACTERISTICS

DEGREE OF SUCCESS, %

CHARACTERISTIC	UNSAT.	BELOW EXPECT.	SAT.	ABOVE EXPECT.	TOTAL	SIZE OF GROUP (n)
TYPE PROJECT						
GEN. RES.	2	5	73	20	100	380
EXPL. RES.	3	4	79	15	100	236
MAJ. DEV.	4	2	73	21	100	365
PROD. IMP.	4	4	77	15	100	608
TECH.	3	8	75	13	100	338
GEN.	5	*	71	23	100	135
OTHER	0	3	32	15	100	39
						2101
ROLE						
TECH. PROJ.	4	5	79	13	100	1242
TECH. STAFF	4	8	76	12	100	325
MKT. #	0	0	100	0	100	11
PROJ. LDR.	1	4	66	29	100	294
MGR.	2	0	62	36	100	205
OTHER	0	0	86	14	100	28
						2105
POSITION LEVEL						
1	4	5	82	9	100	590
2	4	5	77	14	100	673
3T	3	4	73	20	100	331
4T	5	8	66	21	100	108
5T	0	5	67	29	100	21
3A	*	5	69	25	100	162
4A	2	0	74	25	100	125
5A	2	0	55	44	100	62
6#	0	0	20	80	100	5
						2077
PREVIOUS POSITION LEVEL						
0	3	5	81	12	100	596
1	3	3	81	12	100	430
2	4	5	70	21	100	478
3T	4	6	65	24	100	233
4T	2	8	60	30	100	53
5T#	0	0	38	62	100	8
3A	2	4	75	20	100	107
4A	2	4	72	22	100	82
5A	4	4	65	26	100	23
6#	0	0	25	75	100	4
						2014

Statistics for these groups should be interpreted with particular caution because of the small numbers of individuals involved.

* Less than 1%

In general, respondents appeared to have been quite satisfied with the outcome of their hires, promotions, and transfers. Overall, only 3 percent were judged unsatisfactory and 4 percent below expectations, while 17 percent were rated as above expectations and 75 percent were considered satisfactory. The differences among industry groups were small, but the electrical and paper groups had the highest percentages in the less-than-satisfactory categories. On the other hand, the electrical and petroleum groups had higher proportions above expectations.

Among the various technical fields, mathematics, physics, and mechanical engineering showed the most unsatisfactory and below expectations results, but also had more than an average percentage above expectations. The engineers generally tended to perform above expectations more frequently than the scientists. Chemists, the largest field, had the lowest percentage above expectations but close to the highest rated satisfactory.

The analysis by degree level shows a clear progression toward greater success as a function of increased education. There were more above expectations and fewer less-than-satisfactory at the PhD level than in any other educational group. The non-degree people, however, tended to be largely satisfactory with only 8 percent either above or below that rating.

Position level is presumably directly related to the difficulty of the work and the responsibility involved. The analysis using position level as the independent variable shows that success tended to increase along with the level of the job, especially on the administrative side, except that level 4 on the technical side showed the highest percentages below satisfactory.

Looking at roles, the data show a very high degree of success among those selected to be managers and project leaders. Finally, broken down by source, they show that those promoted or transferred from within the organization itself had the best record of success, while those brought in from elsewhere in the company had 15 percent lower than satisfactory. All in all, the findings point toward weakness in technical ability on the part of engineers selected to fill high-level technical positions as the most important cause of failure in personnel transactions.

One object of the study was to examine the utilization of people displaced from the aerospace and defense industries, separated from the armed forces, or hired from teaching positions in colleges or universities. A rather surprising finding was the small number of people obtained from these sources, both in 1971 alone and in the 1969-71 period. The actual numbers reported (with 1971 totals in parentheses) were: aerospace & defense, 33 (7); armed forces, 30 (10); college faculty, 51 (11). The results for these groups show that faculty members did very well in filling industrial research jobs, aerospace personnel tended to perform satisfactorily with relatively few above expectations and with a fairly large number clearly unsatisfactory, while armed forces veterans were a little more likely to be less than satisfactory, at least initially. This, of course, is not too surprising in the case of scientists and engineers whose military service probably involved little technical work comparable to that done in industrial research organizations.

A final group of transfers deserves special attention, namely those from an administrative to a technical position. Although there were only 56 such movements in the entire survey, their degree of success seems to have been noticeably lower than that for all personnel transactions combined and particularly so when compared to all movements from levels 3A, 4A, and 5A to other positions. All of the administrative to technical shifts came from this group. As indicated in Table 15, 16 percent of the A to T transfers were less than satisfactory, in contrast to 6 percent for the entire 3-4-5A group. By difference, those movements from levels 3-4-5A that were not to technical positions had only about 2 percent lack of success. While too much significance should not be read into these statistics, they do seem to confirm the conventional wisdom which says that it is easier to shift from technical to administrative work than back in the other direction.

TABLE 15
SUCCESS OF ADMINISTRATIVE TO TECHNICAL TRANSFERS

	Unsat.	Below Expect.	Satis-Factory	Above Expect.	Number of Cases
3-4-5A to T	4%	12%	73%	11%	56
All Transactions	3	5	75	17	2117
All 3-4-5A	2	4	73	21	212
3-4-5A to Other	2	*	72	25	156

* Less than 1%

Advantages of Different Kinds of Experience.

In connection with positions to be filled during 1972, respondents were asked to check various kinds of experience that would be advantageous. Generally speaking, technical experience was seen as advantageous to over three-fourths of the positions, while nearly one fifth of the jobs did not depend on any of the kinds of experience listed. Corporate staff, aerospace/defense, military, and teaching experience were considered advantageous in relatively few of the prospective positions, except for some specialized cases in the paper and electrical groups as indicated in Table 16.

Only ten percent of the new openings were viewed as particularly suitable for surplus supervisory and management personnel, who were assumed to be in plentiful supply at the time the survey was made. An exception appeared to be the paper industry, where 37 percent of the jobs could have been filled by such individuals.

TABLE 16
EXPERIENCE ADVANTAGEOUS IN FILLING 1972 OPENINGS

ADVANTAGEOUS EXPERIENCE	INDUSTRY GROUP: FOOD	PAPER	CHEM.	PETROL.	MECH.	ELEC.	ALL
TECHNICAL	88%	89%	78%	50%	93%	77%	77%
ADMINISTRATIVE	10	14	11	13	15	5	10
CORPORATE STAFF OR OPERATIONS	3	17	10	4	10	3	7
AERO/DEFENSE	0	0	3	0	0	16	5
MILITARY	0	0	0	0	2	0	*
UNIV. TEACHING	0	20	1	10	0	2	3
NONE INDICATED	12	0	16	43	5	22	19
SURPLUS R&D ADMINISTRATORS	0	37	15	4	7	4	10
NUMBER OF POSITIONS	59	35	226	70	40	129	559

Note: Percentages will not add up to 100 because two or more kinds of experience were applicable to the same job in many instances.
* Less than 1%

Organizational Policies and Strategies.

This part of the survey sought to ascertain the extent to which various policies or practices were followed by industrial research organizations. The answers for all respondents combined are given in Table 17.

The three practices listed that appear to be most widely followed are the use of technical personnel as high-level internal consultants, the infusion of "new blood into laboratories at entry levels, and the use of "task forces" to push specific projects through development. About half of the respondents reported that they frequently brought "new blood" into their

TABLE 17

EXTENT TO WHICH RESPONDENTS USE VARIOUS ORGANIZATIONAL POLICIES OR STRATEGIES

POLICY	Percent of Replies*			
	Not Done	Rarely Done	Frequently Done	General Practice
Recent (up to 5 years) graduate re-vists his own university to discuss relevance & utility of his education to present industry position	38	51	8	2
"Task forces" to push specific projects through development to commerical production	5	31	50	14
Special training to make R&D personnel more cognizant of economic factors	13	41	35	12
Use of technical personnel as high-level internal consultants	1	15	56	28
"Sensitivity training" or similar programs in interpersonal relations	42	41	14	2
Rotation of R&D personnel to other functions as a deliberate effort to stimulate the organization	19	65	10	6
Rotation of R&D personnel to other functions to broaden and develop the individual	19	60	19	2
Deliberately bring "new blood" into industrial research laboratory from outside the company at entry levels	8	20	42	30
Deliberately bring "new blood" into industrial research laboratory from outside the company at levels above the entry level	3	47	44	6
Utilize industrial research to recruit and train technical people for positions in corporate staff and operations	16	49	30	5

* Percentages add up horizontally to 100%

organizations above the entry level, and that they gave their personnel special training in economic factors. About a third used research as a training ground for corporate staff and operations positions. Other strategies were used little or not at all, although two - having recent graduates visit their alma mater as a feedback mechanism, and rotating personnel to other functions to broaden and develop the individual - would appear to be helpful in overcoming some of the deficiences that respondents attributed to their employees in that part of this survey dealing with the availability and qualifications of applicants.

Attrition, Transfer, and Executive Development.

Respondents were asked to indicate the percentage of their entry-level personnel who would normally be expected to transfer to other kinds of activity after one, two, or five years. The averages of their answers are given in Table 18. There were a few extreme estimates in most categories, but generally the replies clustered quite closely around the mean values. Attrition in the sense of leaving the organization averaged out at about three percent per year. Few of the respondents expected to transfer employees to operations or corporate staff until they had had at least two years of service in research.

There appears to be little participation of laboratory personnel in executive development programs. One respondent explained this by pointing out that these programs were normally directed toward marketing or administrative personnel rather than to the kind of technical employees most prevalent in the research organization. However, there is some inconsistency between this finding and the previous indication that a third of the organizations used R&D to train employees for corporate staff and operations jobs. A probable interpretation is that such a practice is followed, but not many people are involved in it.

TABLE 18

EXPECTED SHIFTING OF NEWLY HIRED PERSONNEL
AFTER ONE TO FIVE YEARS

KIND OF SHIFT	PERCENT SHIFTED*		
	After 1 Year	After 2 Years	After 5 Years
Transferred to operations, or corporate staff	0.5%	3.9%	9.8%
Left organization	3.1	7.7	15.2
Identified as having potential for management and given special assignments as part of an executive development program	0.6	2.7	7.1

*Percentages are the mean of all responses to each part of the question

Fringe Benefits and Conditions of Employment.

The question about fringe benefits asked both the extent to which they were currently available and the amount of change that respondents anticipated in the next five years. The answers are presented in Table 19. Paid vacations, vested pension rights, reimbursement for educational expenses, and time off with pay for professional meetings, are practically universally available "to all who qualify," a qualification that was not explored in any greater depth except in the case of paid vacations and vesting, both of which will be discussed more extensively below.

TABLE 19

AVAILABILITY OF FRINGE BENEFITS

1 Benefit or Condition	Extent to Which Available Now				Change in 5 Years		
	2 None	3 Exceptional Cases Only	4 Available to All Who Qualify	5 Other (Specify Below)	6 Same or Less	7 More	8 Much More
Reimbursement for educational expenses incurred on own time	0	2	98		62	37	1
Company pays both salary and educational expenses	17	34	49		75	24	1
Company sponsored continuing education courses in-house or on-campus	26	23	51		44	52	4
Time off with pay for professional meetings and activities	0	1	99		79	20	1
Time off allowed for outside consulting	74	22	4		94	4	1
Paid vacation after 1 year of service - indicate number of weeks in Columns 5 & 6, respectively	0	0	100		78	15	7
Sabbatical	76	22	1		84	16	0
Vested pension rights - indicate minimum years in Columns 5 & 6, respectively	1	0	99		58	40	1
Portable pension plan	95	2	2		55	39	6
Profit sharing, bonus plan, or stock option plan	12	25	63		58	42	0
Patent rights to inventor	72	18	10		92	6	3
Pay for overtime work	48	21	32		93	7	0
Collective bargaining unit	94	0	6		93	7	0
Time off with pay for social or public service work	33	46	22		67	32	1

Note: Answers in each section add up horizontally to 100%.

Portability of pensions exists in only a very small number of laboratories. Other seldom-available benefits are time off for outside consulting (a common practice in universities but understandably frowned upon by industry), sabbaticals, and patent rights to inventors. Profit sharing and similar plans appear to be quite common, and about half of the organizations offer educational assistance beyond reimbursement of expenses incurred on the employee's own time. Pay for overtime work and time off for public service work seem to be fairly prevalent. In all of these instances, however, the availability of the benefits may be quite restricted by the definitions of those who qualify for them.

With regard to the future, respondents generally did not expect to see a major change in any benefits over the next five years, but quite a few anticipated some change in the direction of greater liberality. Those respondents who mentioned a specific figure for this change specified amounts that were already in effect in a substantial number of companies. Company-sponsored education, profit sharing, portable pensions, more educational assistance, and more time off for public service work appeared most likely to receive increased corporate blessing, while the door will probably remain shut for outside consulting, patent rights, and the extension of overtime pay.

Collective bargaining is rare at present and was not expected to become more prevalent, but in this instance, of course, the decision will lie with professional employees themselves rather than with management. It is perhaps significant that the managers who answered this questionnaire did not seem to relate the liberalization of benefits to a growth of collective bargaining. They also did not expect to provide much more paid time off for professional activities, but the growing involvement of professional societies with conditions of employment could become a factor influencing more rapid change in several of the benefit areas listed.

One benefit that was not listed in the questionnaire - payment for unused sick leave at time of retirement - was mentioned by a respondent as likely to be adopted in the near future.

The question on paid vacations asked respondents to specify the number of weeks given after one year's service. Practically all of the replies gave two weeks, with a handful saying three and one six, which seems questionable. Several of those who envisioned a liberalization in vacation policies gave three weeks as a future possibility.

In the case of vested pension rights, the situation was more complicated, with five different kinds of plans reported. The most common plan was vesting after a set number of years of employment, which was reported by 76 percent of the respondents. Not quite half of these gave 10 years as the minimum period, and about as many gave 15 years. There were scattered replies above and below these numbers.

The next most common type of plan, reported by 9 percent, was a combination of minimum age and minimum length of service, ranging from 40 years of age and 10 of service to 55 years of age and 10 years of service. One plan used "points" instead of years of service, each point probably representing one month. Two plans of this type also provided for vesting after 15 and 25 years respectively regardless of age.

A third type of plan, reported in 8 percent of the replies, provided vesting when age plus service totaled a prescribed number of years, varying from 50 to 65. One of these plans also allowed vesting after 20 years regardless of age. Plans of the second or third type were reported in all industry groups.

A fourth variant appeared to be most prevalent in the petroleum industry. This kind of plan offered partial vesting (50 percent at 5, 10, or 15 years) followed by full vesting after an additional 5 or 10 years of service. Only four laboratories mentioned this type, however.

The fifth kind of plan, vesting at a fixed age (48), was reported by only one company.

Because of the abbreviated nature of the questionnaire, it is possible that all respondents did not explain their plans in the same detail, but the above examples probably represent the range of vesting plans in use in industry. Note, however, that almost none include portability of the pension if the employee moves to a different company.

Trends in Personnel Utilization.

Respondents were asked to indicate how they expected the utilization of personnel in different types of projects to change between 1972 and 1977, and to what extent they thought the use of PhD's would change. The results are given in Table 20.

While it is difficult to quantify the replies to this question, it can be seen that respondents expected a higher proportion of their employees to be engaged in exploratory research and major developments and a smaller proportion in product improvement in 1977. Practically no change was anticipated in the general research and technical service areas. (Note: in Table 20, the data are presented in terms of the number of respondents who indicate percentages within ten-point ranges. Thus, 68 replies out of 87 gave percentages between 0 and 9 for the general research category in 1972, and 65 out of 83 reported the same range for 1977.)

Respondents expected to use more doctorates by 1977 in all types of projects except technical service, where a slight decrease can be inferred from the replies. The greatest increases were forecast in major development, exploratory research, and general research projects respectively, while little overall change was envisioned in product improvement.

TABLE 20

PERSONNEL UTILIZATION

PERCENTAGE ENGAGED IN TYPE OF PROJECT, 1972

TYPE PROJECT	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOT.	N.G.
Gen. Res.	68	11	3	2	2	0	1	0	0	0	87	0
Expl. Res.	39	28	10	5	1	2	0	1	1	0	87	0
Maj. Dev.	17	21	21	13	10	1	1	1	1	1	87	0
Prod. Imp.	5	8	12	7	17	22	7	9	0	0	87	0
Tech. Svc.	25	28	23	8	3	0	0	0	0	0	87	0

PERCENTAGE ENGAGED IN TYPE OF PROJECT, 1977

TYPE PROJECT	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	TOT.	N.G.
Gen. Res.	65	10	4	2	1	0	0	1	0	0	83	4
Expl. Res.	27	37	10	5	2	0	1	0	0	1	83	4
Maj. Dev	10	17	19	19	8	5	3	1	0	1	83	4
Prod. Imp.	8	5	18	16	14	16	4	5	1	0	83	4
Tech. Svc.	25	29	20	9	0	0	0	0	0	0	83	4

CHANGE IN UTILIZATION OF DOCTORATES, 1972-1977

TYPE PROJECT	Much Less	Less	About Same	More	Much More	Total	N.G.
Gen. Res.	0	1	65	16	2	84	3
Expl. Res.	0	2	52	28	2	84	3
Maj. Dev.	0	6	47	31	0	84	3
Prod. Imp.	1	7	66	10	0	84	3
Tech. Svc.	2	10	63	9	0	84	3

Summary.

The overall picture presented by the survey results is one of retrenchment in the size of industrial research laboratories during 1971 and 1972, with evidence of personnel movements into areas of rapid payoff, such as product improvement projects. Personnel reductions were not large, and probably did not greatly exceed normal attrition levels. By 1973, however, most industry groups expected to be expanding again, with 1971 levels of employment reached or exceeded by January 1974. Laboratory directors also appeared to anticipate a shift of emphasis back toward longer-range research activities as their organizations resumed their former growth.

Generally speaking, the laboratories appear to offer a stable working situation, with low attrition, equitable opportunities for advancement, and a readiness to shift personnel when program emphasis changes. Although executive development programs are available, relatively few research personnel seem to be involved in them. New blood is introduced into the labs by the steady input of people from colleges to entry-level positions and to a lesser extent by bringing in experienced technical people at middle levels. Administrative jobs tend to be filled from within.

Fringe benefits appear to be generally available at sufficiently generous levels that laboratory managers do not see or expect any significant union activity on the part of professionals. A continuing liberalization of benefits is anticipated for the future, but at a gradual pace.

Managers appeared to be somewhat dissatisfied with the technical ability of their scientists and engineers, but this should probably be interpreted as a lack of readiness for advancement rather than as incompetence at current job levels. The incidence of unsatisfactory performance was low in all technical fields and at all position levels. Project leadership ability appeared to be highly sought after but not in plentiful supply, while managerial skill was most likely to be found among experienced personnel already working in the organization.

APPENDIX TABLE 1

SUMMARY DATA FROM FORM I BY INDUSTRY GROUP

Group	Year to Year 1-1-71	1-1-72	Year to Year 1-1-72	1-1-73	1-1-73	Year to Year 1-1-74	1-1-77
FOOD	1172	1155	681	705	482	518	607
PAPER	606	547	547	557	510	565	660
CHEMICALS	5018	4802	4126	4262	4262	4524	5123
PETROLEUM	2092	2041	1828	1824	1824	1856	1975
MECHANICAL	841	815	815	829	772	824	963
ELECTRICAL	1895	1846	1679	1691	1691	1816	1968
TOTAL	11624	11206	9676	9868	9541	10103	11296

APPENDIX TABLE 2

SUMMARY DATA FROM FORM I BY TECHNICAL FIELD & DEGREE LEVEL

		1971 to 1972				1972 to 1973				1973 to 1974				1974 to 1977			
Field	Level	1971	1972	Change	%	1972	1973	Change	%	1973	1974	Change	%	1974	1977	Change	%
BIOLOGY	B-M	414	394	-20	-5.0	334	344	10	3.0	341	370	29	8.5	370	419	49	13.3
	D	231	226	-5	-2.2	198	212	14	7.1	198	250	52	25.4	249	284	35	14.1
	B-M-D	645	620	-25	-4.0	532	556	24	4.5	539	620	81	15.0	619	703	84	13.6
CHEMISTRY	B-M	3358	3174	-184	-5.6	2589	2594	5	.2	2479	2589	110	4.4	2587	2852	265	10.3
	D	2209	2126	-183	-8.3	1913	1938	25	1.3	1910	2014	104	5.4	2014	2298	284	14.1
	B-M-D	5567	5300	-267	-4.8	4502	4532	30	.7	4389	4603	214	4.9	4601	5150	549	11.9
GEOLOGY	B-M	21	21	-	-	12	10	-2	-20.0	10	11	1	11.0	11	13	2	18.2
	D	27	28	1	3.7	21	22	1	4.5	22	24	2	9.1	24	28	4	16.7
	B-M-D	48	49	1	2.1	33	32	-1	-3.3	32	35	3	9.1	35	41	6	17.1
MATHE - MATICS	B-M	140	147	7	5.0	135	144	9	6.6	141	151	10	7.1	151	172	21	13.9
	D	34	33	-1	-3.0	28	34	6	21.4	34	41	7	20.4	41	56	15	36.6
	B-M-D	174	180	6	3.4	163	178	15	9.2	175	192	17	9.7	192	228	36	18.8
PHYSICS	B-M	301	285	-16	-5.3	264	249	-15	-6.0	244	252	8	3.3	252	275	23	9.1
	D	347	333	-14	-4.1	323	324	1	.3	324	334	10	3.3	334	339	5	1.5
	B-M-D	648	618	-30	-4.5	587	573	-14	-2.4	568	586	18	3.3	586	614	28	4.8
OTHER SCIENCE	B-M	577	574	-3	-0.5	443	454	11	-2.3	425	463	38	9.0	462	527	65	14.1
	D	254	246	-8	-3.0	218	241	23	10.9	234	262	28	10.7	262	299	37	14.1
	B-M-D	831	820	-11	-1.4	661	695	34	5.0	659	725	66	10.1	724	826	102	14.1
ALL SCIENCE	B-M	4811	4595	-216	-4.6	3777	3795	18	.05	3640	3836	196	5.40	3833	4528	425	11.1
	D	3102	2992	-110	-3.6	2701	2771	70	.26	2722	2925	203	7.46	2924	3304	380	13.0
	B-M-D	7913	7587	-326	-4.1	6478	6566	88	.14	6362	6761	399	6.26	6757	7562	805	11.9
CHEMICAL ENGINEERING	B-M	1366	1312	-54	-4.0	1092	1124	32	2.9	1049	1108	59	.56	1107	1211	104	9.4
	D	352	354	2	.6	318	348	30	9.5	345	363	18	5.2	363	409	46	12.7
	B-M-D	1718	1666	-52	-3.0	1410	1472	62	4.4	1394	1471	77	.55	1470	1620	150	10.2
ELECTRICAL ENGINEERING	B-M	532	500	-32	-6.2	441	450	9	2.0	436	459	23	5.2	459	492	33	7.2
	D	181	169	-12	-7.0	145	155	10	6.9	154	172	18	11.7	172	194	22	12.8
	B-M-D	713	669	-44	-6.3	586	605	19	3.2	590	631	41	7.0	631	686	55	8.7
MECHANICAL ENGINEERING	B-M	683	658	-25	-3.8	627	644	17	2.7	607	615	8	1.3	615	702	87	14.1
	D	63	74	11	17.5	68	76	8	11.8	71	85	14	19.5	85	94	9	10.6
	B-M-D	746	732	-14	-1.9	695	720	25	3.6	678	700	22	3.3	700	796	96	13.7
OTHER ENGINEERING	B-M	419	422	3	.7	394	395	1	.3	389	410	21	5.4	410	461	51	12.4
	D	113	128	15	13.3	123	132	9	7.3	132	149	17	12.9	149	181	32	21.5
	B-M-D	532	550	18	3.4	517	527	10	2.0	521	559	38	7.3	559	642	83	14.9
ALL ENGINEERING	B-M	3002	2892	-110	-3.8	2554	2613	59	2.32	2481	2592	111	4.45	2591	2868	275	10.6
	D	709	725	16	2.3	654	711	57	8.73	702	769	67	9.50	769	878	109	14.2
	B-M-D	3711	3617	-94	-2.6	3208	3324	116	3.66	3183	3361	178	5.6	3360	3744	384	11.4
ALL SCIENCE & ENGINEERING	B-M	7813	7487	-326	-4.2	6331	6408	77	1.22	6121	6428	306	5.0	6424	7124	700	10.9
	D	3811	3717	-94	-2.5	3355	3482	127	3.79	3424	3694	270	8.0	3693	4182	489	13.2
	B-M-D	11624	11204	-420	-3.6	9686	9890	204	2.10	9545	10122	577	6.05	10117	11306	118	11.7

APPENDIX TABLE 3

DATA FROM FORM I BY INDUSTRY GROUP, FIELD, POSITION LEVEL & DEGREE LEVEL

EMPLOYMENT AS OF 1-1-72

TECHNICAL FIELD OF WORK SPECIALTY	POSITION LEVEL	Food Degree Level			Paper Degree Level			Chemicals Degree Level			Petroleum Degree Level			Mechanical Degree Level			Electrical Degree Level			All Combined Degree Level		
		B-M	D	BM+D	B-M	D	BM+D	B-M	D	BM+D	B-M	D	BM+D	B-M	D	BM+D	B-M	D	BM+D	B-M	D	BM+D
B	1	37	8	45	2	1	3	256	60	316	9	2	11	1	0	1	2	1	3	307	72	379
B	2	15	9	24	0	2	2	40	49	89	2	0	2	0	0	0	0	3	3	57	61	118
B	3	4	3	7	0	2	2	26	84	110	0	0	0	0	0	0	0	4	4	30	93	123
B	4	56	20	76	2	5	7	322	193	515	11	2	13	1	0	1	2	8	10	394	226	620
C	1	264	21	285	78	41	119	1216	492	1708	327	201	528	58	4	62	91	61	152	2034	820	2854
C	2	147	42	189	33	38	71	426	371	797	112	139	251	27	10	37	21	62	83	766	662	1428
C	3	47	36	83	21	31	52	228	341	569	57	143	200	6	4	10	15	89	104	374	644	1018
C	4	458	99	557	132	110	242	1870	1204	3074	496	483	979	91	18	109	127	212	539	3174	2126	5300
G	1	0	0	0	0	0	0	6	0	6	9	10	19	1	0	1	0	0	0	16	10	26
G	2	0	0	0	0	0	0	0	2	2	2	11	13	0	0	0	0	1	1	2	14	16
G	3	0	0	0	0	0	0	0	1	1	1	3	4	2	0	2	0	0	0	3	4	7
G	4	0	0	0	0	0	0	6	3	9	12	24	36	3	0	3	0	1	1	21	28	49
M	1	5	0	5	7	0	7	22	1	23	10	2	12	7	0	7	45	10	55	96	13	109
M	2	4	0	4	1	0	1	6	3	9	4	0	4	4	0	4	13	10	23	32	13	45
M	3	1	0	1	1	0	1	3	2	5	1	1	2	1	0	1	12	4	16	19	7	26
M	4	10	0	10	9	0	9	31	6	37	15	3	18	12	0	12	70	24	94	147	33	180
P	1	3	1	4	3	2	5	46	22	68	7	13	20	25	0	25	88	88	176	172	126	298
P	2	4	1	5	2	3	5	7	6	13	1	1	2	9	2	11	44	137	181	67	150	217
P	3	0	1	1	3	2	5	9	8	17	4	5	9	7	0	7	23	41	64	46	57	103
P	4	7	3	10	8	7	15	62	36	98	12	19	31	41	2	43	155	266	421	285	333	618
S	1	126	10	136	12	6	18	135	11	146	24	3	27	26	0	26	49	18	67	372	48	420
S	2	55	19	74	4	3	7	28	15	43	8	3	11	13	2	15	16	16	32	124	58	182
S	3	34	20	54	3	1	4	24	89	113	3	5	8	6	3	9	8	22	30	78	140	218
S	4	215	49	264	19	10	29	187	115	302	35	11	46	45	5	50	73	56	129	574	246	820
TS	1	435	40	475	102	50	152	1681	586	2267	386	231	617	118	4	122	275	178	453	2997	1089	4086
TS	2	225	71	296	40	46	86	507	446	953	129	154	283	53	14	67	94	229	323	1048	958	2006
TS	3	86	60	146	28	36	64	290	525	815	66	157	223	22	7	29	58	160	218	550	945	1495
TS	4	746	171	917	170	132	302	2478	1557	4035	581	542	1123	193	25	218	427	567	994	4595	2992	7587
CE	1	94	2	96	39	15	54	250	28	278	261	137	398	33	2	35	7	5	12	684	189	873
CE	2	50	3	53	17	8	25	143	28	171	123	43	166	26	4	30	9	8	17	368	94	462
CE	3	24	2	26	13	4	17	105	27	132	102	30	132	7	4	11	9	4	13	260	71	331
CE	4	168	7	175	69	27	96	498	83	581	486	210	696	66	10	76	25	17	42	1312	354	1666
EE	1	2	0	2	14	0	14	9	1	10	10	0	10	21	3	24	212	70	282	268	74	342
EE	2	0	0	0	2	1	3	4	1	5	4	0	4	12	2	14	107	29	136	129	33	162
EE	3	1	0	1	1	2	3	3	0	3	0	0	0	1	1	2	97	59	156	103	62	165
EE	4	3	0	3	17	3	20	16	2	18	14	0	14	34	6	40	416	158	574	500	169	669
ME	1	7	0	7	66	2	68	46	5	51	85	4	89	69	1	70	90	11	101	363	23	386
ME	2	9	0	9	12	1	13	25	3	28	37	0	37	33	5	38	54	14	68	170	23	193
ME	3	8	0	8	16	0	16	13	1	14	28	4	32	19	5	24	41	18	59	125	28	153
ME	4	24	0	24	94	3	97	84	9	93	150	8	158	121	11	132	185	43	228	658	74	732
E	1	24	1	25	19	1	20	35	2	37	23	10	33	94	12	106	41	6	47	236	32	268
E	2	8	1	9	5	1	6	16	11	27	11	2	13	61	31	92	22	8	30	123	54	177
E	3	0	2	2	6	0	6	9	2	11	2	2	4	32	18	50	14	18	32	63	42	105
E	4	32	4	36	30	2	32	60	15	75	36	14	50	187	61	248	77	32	109	422	128	550
TE	1	127	3	130	138	18	156	340	36	376	379	151	530	217	18	235	350	92	442	1551	318	1869
TE	2	67	4	71	36	11	47	188	43	231	175	45	220	132	42	174	192	59	251	792	204	996
TE	3	83	4	37	36	6	42	130	30	160	132	36	168	59	28	87	161	99	260	551	203	754
TE	4	227	11	238	210	35	245	658	109	767	686	232	918	408	88	496	703	250	953	2894	725	3619
ALL	1	562	43	605	240	68	308	2021	622	2643	765	382	1147	335	22	357	625	270	895	4548	1407	5955
ALL	2	292	75	367	76	57	133	695	489	1184	304	199	503	185	56	241	286	288	574	1840	1162	3002
ALL	3	119	64	183	64	42	106	420	555	975	198	193	391	81	35	116	219	259	478	1101	1148	2249
ALL	4	973	182	1155	380	167	547	3136	1666	4802	1267	774	2041	601	113	714	1130	817	1947	7489	3717	11206

APPENDIX TABLE 4

DATA FROM FORM II BY INDUSTRY GROUP

LEVEL OF DEGREE	Food	Paper	Chem.	Petrol.	Mech.	Elec.	All Indust.
BS	112	17	164	73	25	64	455
MS	51	8	82	30	14	62	247
PhD	52	10	180	75	4	74	395
Non-Deg.	2	4	11	8	3	0	28
TOTAL	217	39	437	186	46	200	1125
Not Given	0	0	7	0	0	0	7
TECHNICAL FIELD							
BIOL.	14	0	52	0	0	3	69
CHEM.	103	16	238	45	3	27	432
GEOL.	0	0	2	5	2	1	10
MATH.	3	1	11	2	1	17	35
PHYS.	2	0	4	3	3	26	38
OTH. SCI.	56	1	40	6	3	8	114
ALL SCI.	178	18	347	61	12	82	698
CHEM. E.	24	8	61	101	2	7	203
ELEC. E.	2	0	2	2	6	60	72
MECH. E.	5	5	21	14	8	38	91
OTHER E.	8	8	12	7	18	13	66
ALL E.	39	21	96	124	34	118	432
TOTAL	217	39	443	185	46	200	1130
Not Given	0	0	1	1	0	0	2
POSITION LEVEL							
1	56	5	110	54	14	41	280
2	106	8	146	63	13	64	400
3T	18	10	68	29	5	50	180
4T	1	3	29	18	0	16	67
5T	1	2	3	0	1	5	12
3A	18	4	30	7	7	11	77
4A	9	2	32	10	3	8	64
5A	7	3	15	5	1	5	36
6	0	0	0	0	0	0	0
TOTAL	216	37	433	186	44	200	1116
Not Given	1	2	11	0	2	0	16
TYPE PROJECT							
GEN. RES.	12	4	117	35	7	28	203
EXPL. RES.	20	1	47	10	1	30	109
MAJ. DEV.	17	4	89	7	7	82	206
PROD. IMP.	96	7	87	79	22	32	323
TECH. SERV.	58	15	50	49	6	7	185
GEN.	5	7	18	2	1	19	52
OTHER	9	1	11	4	2	2	29
TOTAL	217	39	419	186	46	200	1107
Not Given	0	0	25	0	0	0	25

APPENDIX TABLE 4 (continued)

FORM II - INDUSTRY GROUP

ROLE	Food	Paper	Chem.	Petrol.	Mech.	Elec.	All Indust.
TECH. PROJ.	94	11	279	77	23	153	637
TECH. STAFF	51	3	73	44	7	16	194
MKTG.	2	0	0	1	1	1	5
PROJ. LDR.	48	9	50	38	9	17	171
MGR.	18	8	36	18	6	9	95
OTHER	3	0	6	7	0	2	18
TOTAL	216	31	444	185	46	198	1120
Not Given	1	8	0	1	0	2	12
SOURCE							
COLLEGE	73	3	119	46	10	69	320
OUTSIDE	80	5	89	11	6	51	242
WITHIN R&D	48	15	147	105	21	30	366
WITHIN CO.	8	10	58	22	9	42	149
AERO.	2	0	1	0	0	4	7
ARM. FORCES	0	0	8	1	0	1	10
TEACHING	3	0	6	0	0	2	11
OTHER	2	0	2	1	0	1	6
TOTAL	216	33	430	186	46	200	1111
Not Given	1	6	2	0	0	0	21
PREVIOUS POSITION LVL							
0	78	6	117	51	12	75	339
1	72	5	82	24	7	15	205
2	44	8	92	63	14	48	269
3T	6	5	44	20	7	34	116
4T	1	0	13	4	1	5	24
5T	0	0	1	0	1	1	3
3A	4	4	34	9	0	7	58
4A	7	3	17	12	3	9	51
5A	0	1	6	3	0	5	15
6	0	0	0	0	0	0	0
TOTAL	212	32	406	186	45	199	1080
Not Given	5	7	38	0	1	1	52

APPENDIX TABLE 5

DATA FROM FORM II BY HIGHEST COLLEGE DEGREE

TECHNICAL FIELD	Bachelor	Master	Doctor	Non-Grad.	All Degrees	Not Given
BIOL.	24	9	30	1	64	5
CHEM.	168	60	189	14	431	1
GEOL.	0	3	7	0	10	0
MATH.	15	12	7	1	35	0
PHYS.	14	12	12	0	38	0
OTH. SCI.	43	25	43	3	114	0
ALL SCI.	264	121	288	19	692	6
CHEM. E.	87	57	58	0	202	1
ELEC. E.	27	28	17	0	72	0
MECH. E.	51	24	14	2	91	0
OTHER E.	26	17	17	6	66	0
ALL E.	191	126	106	8	431	1
TOTAL	455	247	394	27	1123	7
Not Given	0	0	1	1	2	9
ROLE						
TECH. PROJ.	260	132	226	17	635	2
TECH. STAFF	103	40	41	5	189	5
MKT.	3	0	2	0	5	0
PROJ. LDR.	47	44	78	2	171	0
MGR.	30	25	38	2	95	0
OTHER	8	3	5	2	18	0
TOTAL	451	244	390	28	1113	7
Not Given	4	3	5	0	12	19
POSITION LEVEL						
1	198	47	15	14	274	6
2	135	100	158	6	399	1
3T	44	34	99	3	180	0
4T	18	9	40	0	67	0
5T	4	2	6	0	12	0
3A	23	23	31	0	77	0
4A	17	19	26	2	64	0
5A	9	10	16	1	36	0
6	0	0	0	0	0	0
TOTAL	448	244	391	26	1109	7
Not Given	7	3	4	2	16	23

APPENDIX TABLE 5 (continued)

FORM II - HIGHEST COLLEGE DEGREE

TYPE PROJECT	Bachelor	Master	Doctor	Non-Grad.	All Degrees	Not Given
GEN. RES.	56	42	98	2	198	5
EXPL. RES.	17	14	75	3	109	0
MAJ. DEV.	70	46	85	5	206	0
PROD. IMP.	165	79	70	9	323	0
TECH. SERV.	97	46	35	5	183	2
GEN.	25	11	15	1	52	0
OTHER	16	5	5	3	29	0
TOTAL	446	243	383	28	1100	7
Not Given	9	4	12	0	25	32
SOURCE						
COLLEGE	120	65	133	0	318	2
OUTSIDE	107	56	75	3	241	1
WITHIN R&D	130	80	131	21	362	4
WITHIN CO.	69	37	40	3	149	0
AERO.	6	1	0	0	7	0
ARM. FORCES	6	1	3	0	10	0
TEACHING	1	2	8	0	11	0
OTHER	3	0	3	0	6	0
TOTAL	442	242	393	27	1104	7
Not Given	13	5	2	1	21	28
PREVIOUS POSTITION LVL						
0	146	63	121	7	337	2
1	136	36	19	9	200	5
2	84	74	100	11	269	0
3T	34	22	60	0	116	0
4T	8	3	13	0	24	0
5T	2	1	0	0	3	0
3A	11	17	29	1	58	0
4A	16	14	21	0	51	0
5A	3	7	5	0	15	0
6	0	0	0	0	0	0
TOTAL	440	237	368	28	1073	7
Not Given	15	10	27	7	52	59

APPENDIX TABLE 6

DATA FROM FORM II BY TECHNICAL FIELD

TYPE PROJECT	BIOL.	CHEM.	GEOL.	MATH.	PHYS.	OTHER SCI.	ALL SCI.	CHEM. ENGR.	ELEC. ENGR.	MECH. ENGR.	OTHER ENGR.	ALL ENGR.	ALL FIELDS	NOT GIVEN
GEN. RES.	31	81	8	1	12	18	151	25	12	7	8	52	203	0
EXPL. RES.	8	63	0	0	6	10	87	10	3	3	6	22	109	0
MAJ. DEV.	10	64	1	9	8	13	105	30	29	30	11	100	205	1
PROD. IMP.	5	101	0	8	6	47	167	83	16	32	25	156	323	0
TECH. SERV.	7	80	0	17	2	17	123	42	5	5	9	61	184	1
GEN.	2	18	1	0	4	4	29	6	5	8	4	23	52	0
OTHER	3	7	0	0	0	5	15	3	2	6	3	14	29	0
TOTAL	66	414	10	35	38	114	677	199	72	91	66	428	1105	2
Not Given	3	18	0	0	0	0	21	4	0	0	0	4	25	27
ROLE														
TECH. PROJ.	41	233	5	15	27	61	382	104	51	60	39	254	636	1
TECH. STAFF	12	90	0	13	5	21	141	32	10	6	4	52	193	1
MKT.	0	0	0	0	0	1	1	2	0	0	2	4	5	0
PROJ. LDR.	11	65	3	5	3	17	104	37	3	14	13	67	171	0
MGR.	4	31	2	1	2	11	51	23	7	9	5	44	95	0
OTHER	1	6	0	0	0	2	9	3	1	2	3	9	18	0
TOTAL	69	425	10	34	37	113	688	201	72	91	66	430	1118	2
Not Given	0	7	0	1	1	1	10	2	0	0	0	2	12	14
POSITION LEVEL														
1	25	109	1	8	7	25	175	53	16	21	14	104	279	1
2	21	163	1	13	11	42	251	68	26	30	24	148	399	1
3T	7	60	3	3	6	19	98	35	16	19	12	82	180	0
4T	4	29	0	3	5	6	47	13	3	4	0	20	67	0
5T	1	4	0	0	3	1	9	0	1	1	1	3	12	0
3A	2	31	4	3	4	7	51	7	2	11	6	26	77	0
4A	6	16	1	0	0	8	31	21	4	4	4	33	64	0
5A	2	14	0	2	2	6	26	4	3	0	3	10	36	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	68	426	10	32	38	114	688	201	71	90	64	426	1114	2
Not Given	1	6	0	3	0	0	10	2	1	1	2	6	16	18

APPENDIX TABLE 6 (continued)

FORM II - TECHNICAL FIELD

SOURCE	BIOL.	CHEM.	GEOL.	MATH.	PHYS.	OTHER SCI.	ALL SCI.	CHEM. ENGR.	ELEC. ENGR.	MECH. ENGR.	OTHER ENGR.	ALL ENGR.	ALL FIELDS	NOT GIVEN
COLLEGE	17	121	2	11	4	34	189	52	27	29	22	130	319	1
OUTSIDE	19	87	1	11	8	42	168	33	22	11	8	74	242	0
WITHIN R&D	26	157	6	9	17	23	238	76	7	26	18	127	365	1
WITHIN CO.	3	43	1	2	8	8	65	33	16	19	16	84	149	0
AERO.	0	1	0	1	0	0	2	0	0	3	2	5	7	0
ARM. FORCES	0	7	0	0	0	0	7	2	0	1	0	3	10	0
TEACHING	2	3	0	1	1	1	8	1	0	2	0	3	11	0
OTHER	2	2	0	0	0	1	5	1	0	0	0	1	6	0
TOTAL	69	421	10	35	38	109	682	198	72	91	66	427	1109	2
Not Given	0	11	0	0	0	5	16	5	0	0	0	5	21	23

PREVIOUS POSITION LEVEL	BIOL.	CHEM.	GEOL.	MATH.	PHYS.	OTHER SCI.	ALL SCI.	CHEM. ENGR.	ELEC. ENGR.	MECH. ENGR.	OTHER ENGR.	ALL ENGR.	ALL FIELDS	NOT GIVEN
0	20	131	2	11	4	37	205	61	27	28	18	134	339	0
1	22	84	0	7	6	27	146	29	4	17	8	58	204	1
2	5	96	3	9	9	22	144	51	22	28	24	125	269	0
3T	7	47	4	3	8	8	77	19	7	7	6	39	116	0
4T	1	6	0	1	2	3	13	7	1	3	0	11	24	0
5T	1	0	0	0	1	1	3	0	0	0	0	0	3	0
3A	5	22	1	1	4	4	37	14	1	2	4	21	58	0
4A	3	13	0	1	2	6	25	15	7	1	3	26	51	0
5A	0	4	0	1	2	1	8	3	2	1	1	7	15	0
TOTAL	64	403	10	34	38	109	658	199	71	87	64	421	1079	1
Not Given	5	29	0	1	0	5	40	4	1	4	2	11	51	53

APPENDIX TABLE 7

DATA FROM FORM II BY POSITION LEVEL

TYPE PROJECT	1	2	3T	4T	5T	3A	4A	5A	6	All Lev.	Not Given
GEN. RES.	50	59	42	18	1	15	9	6	0	200	3
EXPL. RES.	19	43	28	10	3	4	0	2	0	109	0
MAJ. DEV.	27	94	35	13	4	16	11	3	0	203	3
PROD. IMPR.	100	106	42	17	0	21	25	9	0	320	3
TECH. SERV.	58	66	22	8	3	14	6	4	0	181	4
GEN.	14	12	5	1	1	2	7	9	0	51	1
OTHER	6	11	2	0	0	1	4	3	0	27	2
TOTAL	274	391	176	67	12	73	62	36	0	1091	16
Not Given	6	9	4	0	0	4	2	0	0	25	41

ROLE	1	2	3T	4T	5T	3A	4A	5A	6	All Lev.	Not Given
TECH. PROJ.	196	272	117	29	5	7	3	0	0	629	8
TECH. STAFF	73	81	17	8	0	6	4	1	0	190	4
MKT.	0	2	0	1	0	0	2	0	0	5	0
PROJ. LDR.	7	35	36	24	3	44	20	1	0	170	1
MGR.	0	0	3	3	3	17	33	34	0	93	2
OTHER	2	7	3	0	0	3	2	0	0	17	1
TOTAL	278	397	176	65	11	77	64	36	0	1104	16
Not Given	2	3	4	2	1	0	0	0	0	12	28

SOURCE	1	2	3T	4T	5T	3A	4A	5A	6	All Lev.	Not Given
COLLEGE	134	129	31	3	0	11	2	4	0	314	6
OUTSIDE	54	109	41	8	2	5	14	6	0	239	3
WITHIN R&D	60	87	72	32	7	54	31	18	0	361	5
WITHIN CO.	17	48	29	20	3	6	16	8	0	147	2
AERO.	2	2	1	2	0	0	0	0	0	7	0
ARM. FORCES	6	3	0	0	0	1	0	0	0	10	0
TEACHING	2	4	4	1	0	0	0	0	0	11	0
OTHER	3	3	0	0	0	0	0	0	0	6	0
TOTAL	278	[illegible]	178	66	12	77	63	36	0	1095	16
Not Given	2	15	2	1	0	0	1	0	0	21	37

PREVIOUS POSITION LEVEL	1	2	3T	4T	5T	3A	4A	5A	6	All Lev.	Not Given
0	162	118	35	2	0	6	3	5	0	331	8
1	107	91	0	1	0	5	0	0	0	204	1
2	5	160	62	1	0	37	2	0	0	267	2
3T	0	4	56	31	1	16	7	1	0	116	0
4T	0	0	0	16	3	0	2	2	0	23	1
5T	0	0	0	0	2	0	0	1	0	3	0
3A	0	4	11	5	0	11	26	1	0	58	0
4A	0	2	3	5	2	0	21	18	0	51	0
5A	0	0	1	2	4	0	1	7	0	15	0
6	0	0	0	0	0	0	0	0	0	0	0
TOTAL	274	379	168	63	12	75	62	35	0	1068	12
Not Given	6	21	12	4	0	2	2	1	0	48	64

APPENDIX TABLE 8

DATA FROM FORM II BY TYPE OF PROJECT

ROLE	Gen. Res.	Expl. Res.	Major Devel.	Prod. Impr.	Tech. Serv.	General	Other	All Proj.	Not Given
TECH. PROJ.	134	81	156	208	11	24	7	621	16
TECH. STAFF	28	10	3	14	130	0	5	190	4
MKT.	0	0	2	2	1	0	0	5	0
PROJ. LDR.	27	15	32	61	29	3	2	169	2
MGR.	12	3	11	34	8	18	7	93	2
OTHER	1	0	0	2	1	5	8	17	1
TOTAL	202	109	204	321	180	50	29	1095	25
Not Given	1	0	2	2	5	2	0	12	37
SOURCE									
COLLEGE	45	50	64	78	54	16	7	314	6
OUTSIDE	48	13	35	71	52	5	9	233	9
WITHIN R&D	81	27	41	130	56	17	5	357	9
WITHIN CO.	18	15	44	33	19	13	6	148	1
AERO.	0	1	3	3	0	0	0	7	0
ARM. FORCES	4	0	4	1	1	0	0	10	0
TEACHING	2	3	1	3	1	0	1	11	0
OTHER	4	0	0	2	0	0	0	6	0
TOTAL	202	109	192	321	183	51	28	1086	25
Not Given	1	0	14	2	2	1	1	21	46
PREVIOUS POSITION LEVEL									
0	52	55	59	88	49	17	11	331	8
1	33	10	16	78	55	4	4	200	5
2	54	17	54	76	47	11	9	268	1
3T	35	17	22	25	8	3	0	110	6
4T	5	1	6	6	2	1	3	24	0
5T	0	1	1	0	0	1	0	3	0
3A	11	4	11	16	9	3	1	55	3
4A	3	1	9	17	8	10	1	49	2
5A	3	2	3	3	3	1	0	15	0
TOTAL	196	108	181	309	181	51	29	1055	25
Not Given	7	1	25	14	4	1	0	52	77

APPENDIX TABLE 9

DATA FROM FORM II BY ROLE

SOURCE	Tech. Proj.	Tech. Staff	Mar-keting	Proj. Leader	Mana-ger	Other	All Roles	Not Given
COLLEGE	221	68	0	26	4	1	320	0
OUTSIDE	138	58	2	29	10	4	241	1
WITHIN R&D	157	47	1	93	58	7	363	3
WITHIN CO.	78	16	2	22	23	6	147	2
AERO.	7	0	0	0	0	0	7	0
ARM. FORCES	7	3	0	0	0	0	10	0
TEACHING	9	1	0	1	0	0	11	0
OTHER	6	0	0	0	0	0	6	0
TOTAL	623	193	5	171	95	18	1105	6
Not Given	14	1	0	0	0	0	15	27

PREVIOUS POSITION LEVEL	Tech. Proj.	Tech. Staff	Mar-keting	Proj. Leader	Mana-ger	Other	All Roles	Not Given
0	246	62	0	20	8	3	339	0
1	119	63	2	17	2	1	204	1
2	151	45	1	48	15	8	268	1
3T	54	13	1	40	6	1	115	1
4T	10	1	0	6	6	1	24	0
5T	0	0	0	0	3	0	3	0
3A	13	6	0	25	9	3	56	2
4A	4	2	1	8	34	1	50	1
5A	6	1	0	1	7	0	15	0
TOTAL	603	193	5	165	90	18	1074	6
Not Given	34	1	0	6	5	0	46	58

APPENDIX TABLE 10

DATA FROM FORM II BY SOURCE OF HIRE

PREVIOUS POSITION LEVEL	College	Outside Hire	Within R&D	Within Co.	Other	All Sources	Not Given
0	267	9	30	4	14	324	15
1	16	87	66	25	11	205	0
2	14	68	137	44	6	269	0
3T	2	36	55	22	1	116	0
4T	0	4	7	11	2	24	0
5T	0	1	1	1	0	3	0
3A	1	13	34	10	0	58	0
4A	0	7	24	20	0	51	0
5A	0	2	7	6	0	15	0
TOTAL	300	227	361	143	34	1065	15
Not Given	20	15	5	6	0	46	67

APPENDIX TABLE 11

DATA FROM FORMS II & IIA BY DEGREE OF SUCCESS

CHARACTERISTIC	Unsat.	Below Expect.	Sat.	Above Expect.	All Degrees	Not Obs.	Not Given
INDUSTRY GROUP							
FOOD	11	8	293	45	357	1	0
PAPER	5	5	85	16	111	6	6
CHEM.	16	33	629	132	810	29	93
PETROL.	6	16	194	56	272	10	1
MECH.	8	10	141	34	193	4	0
ELEC.	24	22	252	76	374	39	112
TOTAL	70	94	1594	359	2117	89	212
TECHNICAL FIELD							
BIOL.	1	2	100	21	124	3	4
CHEM.	18	37	681	110	846	23	82
GEOL.	0	0	4	10	14	3	0
MATH.	5	6	44	12	67	1	14
PHYS.	6	6	64	18	94	5	15
OTH. SCI.	12	6	162	38	218	5	6
ALL SCI.	42	57	1055	209	1363	40	121
CHEM. E.	8	17	239	47	311	13	24
ELEC. E.	4	5	80	29	118	14	27
MECH. E.	11	8	111	43	173	14	21
OTHER E.	5	7	107	30	149	8	18
ALL E.	28	37	537	149	751	49	90
TOTAL	70	94	1592	358	2114	89	211
Not Given	0	0	2	1	4	0	1
HIGHEST DEGREE							
BS	32	50	690	115	887	24	80
MS	19	19	365	70	473	26	46
PhD	16	24	479	170	689	39	80
NON-DEG.	3	1	41	4	49	0	3
TOTAL	70	94	1575	359	2098	89	212
Not Given	0	0	19	0	19	0	0
YEAR OF DEGREE							
1970 - 72	2	0	20	4	26	4	11
1965 - 69	10	12	268	39	329	20	61
1960 - 64	19	29	449	90	587	20	62
1955 - 59	12	14	316	79	421	18	33
1950 - 54	13	6	164	66	249	4	16
1945 - 49	3	12	148	45	208	8	11
1940 - 45	6	6	83	20	115	7	5
1935 - 39	4	6	62	8	80	2	2
TO 1934	1	9	84	8	102	6	9
TOTAL	70	94	1594	359	2117	89	212

APPENDIX TABLE 11 (continued)

FORM II & IIA - DEGREE OF SUCCESS

CHARACTERISTIC	Unsat.	Below Expect.	Sat.	Above Expect.	All Degrees	Not Obs.	Not Given
TYPE PROJECT							
GEN. RES.	9	19	276	76	380	16	10
EXPL. RES.	6	9	186	35	236	19	0
MAJ. DEV.	13	9	268	75	365	15	146
PROD. IMP.	24	27	468	89	608	19	6
TECH. SERV.	11	28	254	45	338	10	13
GEN.	7	1	96	31	135	8	1
OTHER	0	1	32	6	39	2	3
TOTAL	70	94	1580	357	2101	89	179
Not Given	0	0	14	2		0	33
ROLE							
TECH. PROJ.	50	56	980	156	1242	59	169
TECH. STAFF	12	25	248	40	325	6	13
MKT.	0	0	11	0	11	1	0
PROJ. LDR.	4	13	193	84	294	11	6
MGR.	4	0	128	73	205	9	13
OTHER	0	0	24	4	28	1	3
TOTAL	70	94	1584	357	2105	87	204
Not Given	0	0	10	2		2	8
SOURCE							
COLLEGE	17	27	506	71	621	40	84
OUTSIDE	23	23	443	91	580	15	26
WITHIN R&D	5	22	386	134	547	14	33
WITHIN CO.	19	17	161	38	235	16	27
AERO.	3	0	25	4	32	1	0
ARM. FORCES	2	1	19	5	27	1	2
TEACHING	0	3	34	11	48	1	2
OTHER	1	0	15	5	21	1	7
TOTAL	70	93	1589	359	2111	89	181
Not Given	0	1	5	0		0	31
POSITION LEVEL							
1	22	29	485	54	590	24	36
2	27	32	520	94	673	22	131
3T	11	12	241	67	331	16	13
4T	5	9	71	23	108	4	8
5T	0	1	14	6	21	5	1
3A	1	8	112	41	162	7	9
4A	2	0	92	31	125	6	4
5A	1	0	34	27	62	3	9
6	0	0	1	4	5	0	0
TOTAL	69	91	1570	347	2077	87	211
Not Given	1	3	24	12		2	1

APPENDIX TABLE 11 (continued)

FORM II & IIA - DEGREE OF SUCCESS

CHARACTERISTIC	Unsat.	Below Expect.	Sat.	Above Expect.	All Degrees	Not Obs.	Not Given
PREVIOUS POSITION LEVEL							
0	18	27	480	71	596	39	137
1	15	15	347	53	430	7	8
2	20	24	335	99	478	12	35
3T	10	14	152	57	233	12	9
4T	1	4	32	16	53	1	1
5T	0	0	3	5	8	0	0
3A	2	4	80	21	107	4	6
4A	2	3	59	18	82	4	4
5A	1	1	15	6	23	5	1
6	0	0	1	3	4	0	0
TOTAL	69	92	1504	349	2014	84	201
Not Given	1	2	90	10		5	11

APPENDIX TABLE 12

DATA FROM ADDITIONAL QUESTION NO. 2

ALL INDUSTRY GROUPS COMBINED

The purpose of this question is to obtain **YOUR** current assessment of the extent to which applicants are available, and the extent to which those who are available meet your job requirements for industrial research positions.

A. Please check the appropriate blocks to indicate your overall evaluation of availability and qualification of applicants in the categories indicated.

LEAVE BLANK THOSE ENTRY SPACES WHICH YOU FEEL ARE NOT APPROPRIATE OR DO NOT APPLY TO YOUR ORGANIZATION.

For example, you may not feel it is appropriate to assess the managerial skills of a new graduate with an AAS degree.

		3 Availability of Applicants			Qualifications of Applicants											
					4 Technical Ability			5 Project Leadership			6 Managerial Skill			7 Adaptability		
1 Source	2 Level	Short-Age	Adequate	Surplus	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
New Graduates	AAS*	17	35	12	41	19	2	4	9	5	3	5	10	25	13	2
	BS	4	21	50	59	16	0	6	26	9	5	19	11	28	17	3
	MS	5	28	48	62	12	0	15	28	4	5	23	8	33	23	3
	PhD	3	13	62	65	12	0	25	24	3	9	26	7	32	25	4
Experienced Personnel Outside Hire	Technician	18	34	19	40	22	1	5	16	4	4	7	9	31	16	0
	Levels 1-2	1	29	40	41	29	1	15	26	6	7	26	18	37	23	1
	Level 3	6	30	34	26	31	2	19	25	4	15	27	6	29	30	2
	Levels 4-5 T	14	35	28	35	19	4	25	18	4	20	15	9	24	22	4
	Levels 4-5 A	6	34	24	35	14	4	12	30	17	26	15	2	24	17	4
Experienced Personnel Available Within Organization	Technician	21	41	6	38	22	0	9	8	23	11	33	8	34	21	6
	Levels 1-2	24	49	4	47	20	0	8	14	30	17	29	5	39	18	6
	Level 3	27	46	3	52	13	3	8	43	17	25	28	2	38	18	6
	Levels 4-5 T	29	39	3	47	12	2	11	41	12	29	21	2	28	26	2
	Levels 4-5 A	25	47	2	29	13	2	10	42	13	40	19	5	34	11	1

*Associate in Applied Science degree (2 years)

APPENDIX

SAMPLE QUESTIONNAIRE

QUESTIONNAIRE ON THE

SUPPLY AND DEMAND OF TECHNICAL PERSONNEL

The Supply and Demand of Technical Personnel is concerned with the future as well as the present and recent past. For a variety of particular circumstances, each company will be prepared differently to provide estimates of future requirements and conditions in this area. You can further assist us in analyzing the data you provide by indicating which of the following circumstances best describes your situation as you complete this questionnaire.

The first list is concerned with estimating your future needs for technical personnel. Please check ONE.

☐ 1. Future requirements (next five years) for professional people in our industrial research activities have been estimated. Barring unforeseen circumstances, we believe we are fairly clear about the number of qualifications and likely assignment of additional, future professional personnel.

☐ 2. Future requirements for the number and level of professional personnel in our industrial research activities have been estimated. However, we are less clear about the qualifications and assignments associated with these future positions. For the purpose of this questionnaire we have used our best judgment.

☐ 3. Present circumstances do not permit good estimates of future funding and program emphasis. Consequently, we are only able to guess for the purpose of this questionnaire at our future requirements for professional personnel.

☐ 4. Present circumstances preclude an attempt to estimate future requirements. Accordingly, we have not provided estimates where consideration of such future requirements would be involved.

☐ 5. Other (describe) ________________________________.

The second list is concerned with your perception of the potential supply of technical personnel and how you expect to utilize people. Please check ONE.

☐ 1. We have been in a position to consider and attempt to anticipate the changing supply and demand (including qualifications) of technical personnel and, accordingly, to modify our expectations of how we expect to utilize the various specialities and levels and kinds of education and experience.

☐ 2. We have reviewed information on the changing supply and demand of technical personnel and considered some of the potential implications to us. However, we have not yet reformulated our guidelines. Therefore, for the purposes of this questionnaire, we have only guessed at the consequences of these changes.

☐ 3. We have reviewed information on the changing supply and demand of technical personnel and considered some of the potential implications to us. However, we have not yet reformulated our guidelines. Therefore, for the purposes of this questionnaire, we have assumed that our <u>current</u> experience will apply to the future.

☐ 4. Present circumstances preclude an attempt to estimate changes in the potential supply and utilization of technical personnel. Entries on the questionnaire which relate to such estimates have been left blank.

☐ 5. Other (describe) ________________________________.

The third list is concerned with the extent with which you have been in a position to foresee future recruiting, personnel and organizational practices, and fringe benefits. Please check ONE.

☐ 1. We have had an opportunity to consider the more important factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits. As a result we are anticipating changes which our answers to this questionnaire reflect.

☐ 2. Although we have reviewed some of the factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits, we have not anticipated changes. Therefore, our answers to this questionnaire are only guesses which have been made solely for the purposes of this questionnaire.

☐ 3. Although we have reviewed some of the factors which might affect our future recruiting, personnel and organizational practices, and fringe benefits, we have not anticipated changes. Therefore, our answers to this questionnaire anticipate none.

☐ 4. Present circumstances preclude an attempt to estimate changes in these practices and benefits. Entries on the questionnaire which relate to such estimates have been left blank.

☐ 5. Other (describe) ________________________________.

INDUSTRY CLASSIFICATION______________GEOGRAPHIC AREA______________

FORM I

EMPLOYMENT OF PROFESSIONAL TECHNICAL PERSONNEL IN INDUSTRIAL RESEARCH LABORATORIES

INSTRUCTIONS

This form is intended to provide statistics on changes in the employment of professional technical personnel by field and degree level in your industrial research organization between 1971 and 1977. Please note the following instructions before filling out the form.

1. **STUDY THE DEFINITIONS** in the enclosed yellow instruction sheets. The categories used in this survey are mostly the same as used for the I.R.I. salary surveys with which you may already be familiar.

2. **DO NOT LEAVE BLANK SPACES IN A LINE OF DATA** Our computer program requires that data be complete and consistent from year to year. If figures for a year are not known exactly, give your best estimate. Note that the figures in Column 3 minus those in Column 4 plus those in Column 5 must equal the figures in Column 6. Likewise, the figures in Column 6 minus those in Column 7 plus those in Column 8 must equal the figures in Column 9.

3. **BE SURE** to fill in your **INDUSTRY CLASSIFICATION** and **GEOGRAPHIC AREA** above and on every sheet of the questionnaire.

		Number of Personnel - Actual								Number of Personnel - Estimated									
1	2	3		4		5		6		7		8		9		10		11	
Technical Field Of Work Specialty	Position Level	Employed 1-1-71		Losses 1971		Gains 1971		Employed 1-1-72		Losses 1972		Gains 1972		Employed 1-1-73		Employed 1-1-74		Employed 1-1-77	
Degree Level		B-M	D	B-M	D	B-M	D	B-M	D	B-M	D	B-M	D	B-M	D	B-M	D	B-M	D
Biology	1-2																		
	3																		
	4-5																		
Chemistry	1-2																		
	3																		
	4-5																		
Geology	1-2																		
	3																		
	4-5																		
Mathematics	1-2																		
	3																		
	4-5																		
Physics	1-2																		
	3																		
	4-5																		
Other Sciences	1-2																		
	3																		
	4-5																		
Chemical Engineering	1-2																		
	3																		
	4-5																		
Electrical Engineering	1-2																		
	3																		
	4-5																		
Mechanical Engineering	1-2																		
	3																		
	4-5																		
Other Engineering	1-2																		
	3																		
	4-5																		

INDUSTRY CLASSIFICATION ______________ GEOGRAPHIC AREA ______________

FORM II

DESCRIPTION OF PROFESSIONAL TECHNICAL POSITIONS IN INDUSTRIAL RESEARCH FILLED DURING 1971

INSTRUCTIONS

This form is designed to provide information on actual personnel movements during calendar 1971 (or the closest 12-month period for which you have records) including transfers and promotions within your organization. **EVERY** professional technical position which was filled in your industrial research laboratory during this period should be listed. There is a line on this form for each position filled, whether by outside hire, internal transfer, or advancement.

1. **SEE THE YELLOW INSTRUCTION SHEETS** for definitions and abbreviations of the categories used.
2. **WE DO NOT WANT TO KNOW THE IDENTITY** of individuals, but to make it easier for you to fill out the form a **TEAR-OFF STRIP** is provided on the left hand margin on which you can write personnel information for your own use. Please remove this strip before returning the completed form.
3. We recognize that **LEVEL OF PREVIOUS POSITION** (Column 9) may not always be known precisely in the case of people hired from outside, in which case give your best estimate. Use level 0 for new graduates without previous experience.
4. In the case of positions at **LEVELS** 3, 4, and 5 be sure to include A or T to differentiate between administrative and technical positions.
5. One result we hope to obtain is a realistic estimate of the **DEGREE OF SUCCESS** achieved in various types of transfers. Please be objective in filling out this part of the form (Column 10).

Name

1	2	3	4	5	6	7	8	9	10
Person No	Year of BS	Highest Degree	Technical Field	Position Level	Type Project	Role	Source	Level of Previous Position	Degree of Success
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									

INDUSTRY CLASSIFICATION ______________ GEOGRAPHIC AREA ______________

FORM II

DESCRIPTION OF PROFESSIONAL TECHNICAL POSITIONS IN INDUSTRIAL RESEARCH FILLED DURING 1971

Please make additional copies of this page if required to accommodate your listing of all professional technical positions filled during 1971.

Name

1	2	3	4	5	6	7	8	9	10
Person No.	Year of BS	Highest Degree	Technical Field	Position Level	Type Project	Role	Source	Level of Previous Position	Degree of Success

INDUSTRY CLASSIFICATION ______________ GEOGRAPHIC AREA ______________

FORM IIA

DESCRIPTION OF SELECTED PROFESSIONAL TECHNICAL POSITIONS IN INDUSTRIAL RESEARCH FILLED DURING 1969 AND 1970

INSTRUCTIONS

This form is designed to provide information on those of your actual personnel movements during 1969 and 1970 which are of greatest interest to **R&D** managers. Professional technical positions which were filled in your industrial research laboratory **IN ANY OF THE FOLLOWING WAYS** during 1969 and 1970 should be listed.

- Shifted, promoted, or hired from **TECHNICAL** to **ADMINISTRATIVE** position.
- Shifted, promoted, or hired from **ADMINISTRATIVE** to **TECHNICAL** position.
- Promoted or hired into industrial research positions **ABOVE** Level 5.
- Transferred from **CORPORATE STAFF** or **OPERATIONS** position to industrial research position.
- Hired **DISPLACED AEROSPACE** or **DEFENSE** professional, civilian or **ARMED FORCES** returnee.
- Hired from **TEACHING** career in a college or university.

1. **SEE THE YELLOW INSTRUCTION SHEETS** for definitions and abbreviations of the categories used.

2. **WE DO NOT WANT TO KNOW THE IDENTITY** of individuals, but to make it easier for you to fill out the form a **TEAR-OFF STRIP** is provided on the left hand margin on which you can write personnel information for your own use. Please remove this strip before returning the completed form.

3. We recognize that **LEVEL OF PREVIOUS POSITION** (Column 9) may not always be known precisely in the case of people hired from outside, in which case give your best estimate. Use level 0 for new graduates without previous experience.

4. In the case of positions at **LEVELS** 3, 4, and 5 be sure to include A or T to differentiate between administrative and technical positions.

5. One result we hope to obtain is a realistic estimate of the **DEGREE OF SUCCESS** achieved in various types of transfers. Please be objective in filling out this part of the form (Column 10).

Name	1 Person No	2 Year of BS	3 Highest Degree	4 Technical Field	5 Position Level	6 Type Project	7 Role	8 Source	9 Level of Previous Position	10 Degree of Success
	1									
	2									
	3									
	4									
	5									
	6									

INDUSTRY CLASSIFICATION ______________ GEOGRAPHIC AREA ______________

FORM IIA

DESCRIPTION OF SELECTED PROFESSIONAL TECHNICAL POSITIONS IN INDUSTRIAL RESEARCH FILLED DURING 1969 AND 1970

Please make additional copies of this page if required to accommodate this SELECTED listing of professional technical positions filled during 1969 and 1970.

Name	1 Person No.	2 Year of BS	3 Highest Degree	4 Technical Field	5 Position Level	6 Type Project	7 Role	8 Source	9 Level of Previous Position	10 Degree of Success

INDUSTRY CLASSIFICATION ____________ GEOGRAPHIC AREA ____________

FORM III

DESCRIPTION OF PROFESSIONAL TECHNICAL POSITIONS IN INDUSTRIAL RESEARCH TO BE FILLED DURING 1972

INSTRUCTIONS

This form is intended to provide information on professional technical positions in industrial research that you plan or expect to fill during 1972, or have already filled so far this year.

1. Provide information on all such positions that you reasonably expect to fill barring drastic changes in other circumstances.
2. For **YEARS EXPERIENCE SINCE BS** (Column 7) give your estimate of the experience you would normally prefer an applicant to have. For people without a BS degree use age 22 as equivalent. Consider an MS degree as equivalent to one year's experience and a PhD as equivalent to three years.
3. In Columns 8 and 9 indicate the **SOURCE AND PREVIOUS POSITION LEVEL** from which you would prefer or would normally expect to fill the particular position in question.
4. In Column 10 indicate by check marks in the appropriate boxes if the position is one for which any or several of the following kinds of experience would be advantageous:

   T - previous TECHNICAL experience.
   A - previous ADMINISTRATIVE experience.
   C - CORPORATE STAFF or OPERATIONS experience.
   D - DEFENSE or AEROSPACE civilian experience.
   M - MILITARY service.
   U - Teaching experience in a college or UNIVERSITY

5. Column 11 is intended to provide information on the real potential for use of the technical expertise, organizational skills and leadership abilities of surplus industrial research supervisory and management personnel in technical project work or as technical service consultants. Where the level of the position to be filled is either 3T, 4T or 5T (Column 2), please indicate in Column 11 by check marks in the appropriate boxes if surplus personnel in levels 3A, 4A, 5A and 6 could be utilized advantageously. You may select previous levels which are higher, equal to or lower than the level of the position to be filled.

POSITION TO BE FILLED				PREFERRED QUALIFICATIONS					10 Advantageous Experience						11 Advantageous Use of Surplus Ind Res Mgrs Etc			
1 Job No.	2 Position Level	3 Type Project	4 Role	Field	6 Degree Level	7 Years Experience Since BS	8 Preferred Source	9 Previous Position Level	T	A	C	D	M	U	3A	4A	5A	6
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		

SAMPLE

INDUSTRY CLASSIFICATION ______________ GEOGRAPHIC AREA ______________

FORM III

DESCRIPTION OF PROFESSIONAL TECHNICAL POSITIONS
IN INDUSTRIAL RESEARCH TO BE FILLED DURING 1972

Please make additional copies of this page if required to accommodate your listing of professional technical positions to be filled during 1972.

POSITION TO BE FILLED				PREFERRED QUALIFICATIONS					10 Advantageous Experience						11 Advantageous Use of Surplus Ind. Res. Mgrs. Etc.			
1 Job No.	2 Position Level	3 Type Project	4 Role	5 Field	6 Degree Level	7 Years Experience Since BS	8 Preferred Source	9 Previous Position Level	T	A	C	D	M	U	3A	4A	5A	6
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		
21																		

INSTRUCTIONS FOR ENTERING DATA IN FORMS AND QUESTIONS

Industry Classification — Pick one from the following list and enter the appropriate letter at the top of the data sheet. Where applicable, Bureau of the Budget Standard Industry Classification numbers have been indicated to assist you in determining the definitions of the classifications.

A. Food, tobacco & kindred products (SIC Nos. 20 & 21).

B. Paper & allied products (SIC No. 26).

C. Chemicals, plastics & allied products (SIC Nos. 28 & 30 except No. 283).

D. Drugs & pharmaceuticals (SIC No. 283).

E. Petroleum refining & related industries (SIC No. 29).

F. Primary metal industries (SIC No. 33).

G. Fabricated metal products (SIC No. 34).

H. Machinery, except electrical (SIC No. 35 except No. 3573).

I. Electrical machinery, equipment & supplies (SIC Nos. 361, 362, 363, 364 & 369).

J. Electronic equipment and computers (SIC Nos. 365, 366, 367 & 3573).

K. Professional, scientific, and controlling instruments, photographic & optical goods, watches & clocks (SIC No. 38).

L. Other (specify).

Geographic Area — Enter the appropriate number from the following list corresponding to the ar   of the country in which the personnel reported are located.

1. NEW ENGLAND - Maine, New Hampshire, Vermont, Rhode Island, Massachusetts, & Connecticut.

2. MIDDLE ATLANTIC - New York, New Jersey & Pennsylvania.

3. EAST NORTH CENTRAL - Ohio, Indiana, Illinois, Michigan & Wisconsin

4. WEST NORTH CENTRAL - Minnesota, Iowa, Missouri, North Dakota South Dakota, Nebraska & Kansas.

5. SOUTH ATLANTIC - Delaware, Maryland, Washington D.C., Virginia, West Virginia, North Carolina, South Carolina, Georgia & Florida.

6. EAST SOUTH CENTRAL - Kentucky, Tennessee, Alabama & Mississippi.

7. WEST SOUTH CENTRAL - Arkansas, Louisiana, Oklahoma & Texas.

8. MOUNTAIN - Montana, Idaho, Wyoming, Colorado, New Mexico, Nevada, Arizona & Utah.

9. PACIFIC - Washington, Oregon, California, Alaska & Hawaii.

Technical Field — Indicate the broad technical field of work specialty by the following code:

B - Biology
C - Chemistry
G - Geology
M - Mathematics, Statistics, Computer
P - Physics
S - Other Science (including medicine)
CE - Chemical Engineering
EE - Electrical Engineering
ME - Mechanical Engineering
E - Other Engineering

Highest Degree — Indicate B.S., M.S., Ph.D., or equivalent, by the single letters, B, M, or D, respectively. For those people who do not hold degrees but are considered the equivalent of professional workers, enter the letter G.

Date of B.S. — The last two digits of the year in which the B.S. was awarded are sufficient (such as 48 for 1948). For those people who do not actually hold a B.S. degree but are considered professional, record the year in which they attained the equivalent of professional status.

Person No. — Where "person number" is indicated, there should be a line of data for each professional person in industrial research work. The order in which they are reported is not important since a punched card will result for each line.

Type of Project* — Indicate the type of project in which a person or position is primarily involved by the following code.

R - Research to increase useful knowledge in technical areas of major importance to company's business.

* Gee, Robert E., "A Survey of Current Project Selection Practices," Research Management, September 1971, p. 38.

XR - Exploratory Research to provide basis for new developments through discovery and/or unique application of physical phenomena.

ND - Major New Developments of products and/or processes aimed at new businesses or other developments of potentially high impact, and which involve higher-than-normal risk.

DI - Product or Process Developments and Improvements for maintaining or improving the profitability of the company's established businesses.

TS - Technical Services to Operations which include expert consultations and laboratory services.

G - Duties are general - "Type of Project" cannot be indicated.

O - Other, not included above.

<u>Role</u>

Indicate the general role performed by the individual, using the following code:

TP - Technical Projects (Participates in one or a few projects as a member of the project team).

TS - Technical Staff Services (A member of a laboratory group which provides staff services to the laboratory and its projects; e.g. math., chem. anal., eng. econ.).

MK - Marketing

PL - Project Leader

M - Manager or Director

O - Other, not included above.

<u>Source</u>

Indicate the source from which the employee is obtained, using the following code:

C - College, new graduate including post doc.

H - Outside hire with previous experience.

W - Within the industrial research organization itself.

E - Elsewhere from within the company.

A - Displaced aerospace or defense professional (civilians).

V - Armed forces returnee.

F - From a teaching career in a college or university.

O - Other, not included above.

Degree of Success

Indicate how well the hire, transfer, or promotion worked out according to the following code:

U - Unsatisfactory

B - Below expectations, but worked out after initial problems.

S - Satisfactory, equal to expectations.

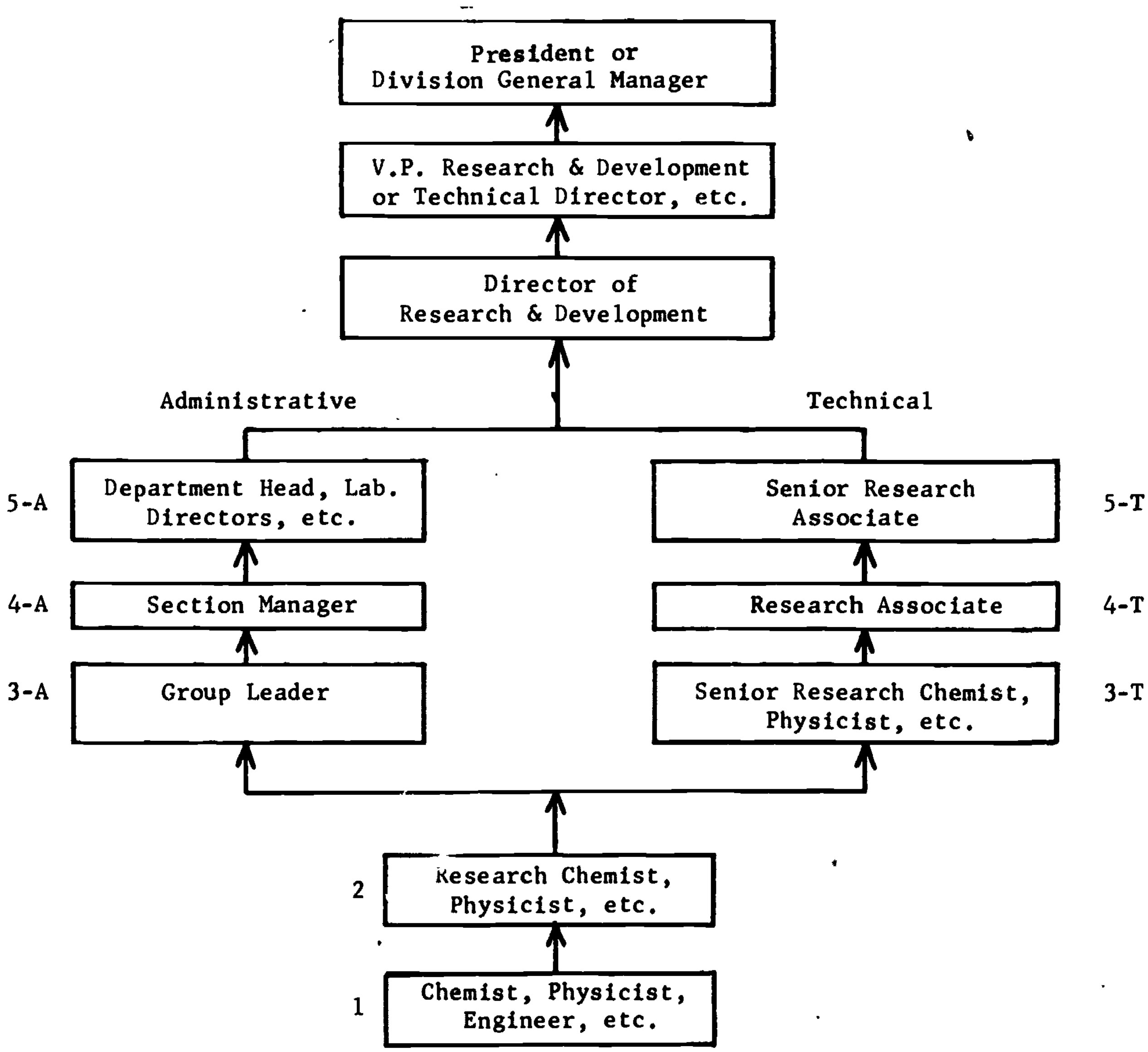
A - Above expectations, outstanding success.

N - Not enough time to make final decision, or not observed.

Position Level

Enter the appropriate arabic numeral and letter suffix code according to the sample organization chart below. For further detail on the position descriptions refer to the following pages.

SPECIFY NUMERAL AND LETTER FOR LEVELS 3 THROUGH 5



POSITION TITLES AND LEVEL DESCRIPTIONS

The following descriptions represent the continuum of professional development. Also, they represent levels at which professional development may cease.

Level 1

GENERAL: This is an apprenticeship period with the incumbent progressively developing his professional maturity, judgment, and experience. For the person who continues to develop, this period would cover the first few years beyond the bachelor's degree.

TECHNICAL DIRECTION RECEIVED: Detailed.

TECHNICAL DIRECTION GIVEN: May give general technical direction to several non-professional personnel.

ADMINISTRATIVE RESPONSIBILITY: None.

SCOPE: Seeks solutions to technical problems. Work may range from the use of defined methods to the exercise of some degree of technical judgment.

Level 2

GENERAL: At this stage, the engineer or scientist is working at a professional level and could be termed a journeyman in his field. His responsibilities are likely to encompass a project and he receives general supervision from more senior professionals in his area of competence. He may be directing one or more technical personnel who are at Level 1 as well as some non-professional assistants.

TECHNICAL DIRECTION RECEIVED: General, with responsibility for the choice of decisions and interpretations within the assigned project.

TECHNICAL DIRECTION GIVEN: May give technical direction to a group of professional and non-professional personnel.

ADMINISTRATIVE RESPONSIBILITIES: None.

SCOPE: Plans and executes complex technical projects; expected to recommend the initiation of new projects within existing programs; prepare periodic and final reports for review by Supervision.

Level 3

At this level there emerges a duality in the direction of professional progression. The two facets are characterized as Level 3 -- Technical and Level 3 -- Administrative. The former is characterized by high technical competence and ultimately leads to a technical or scientific expert, in contrast to the latter which has an administrative orientation.

Level 3 -- Technical

GENERAL: This level is characterized by concentration in a technical or specific speciality leading to recognition within the company, or the profession, on the basis of technical competence.

TECHNICAL DIRECTION RECEIVED: Works with little or no technical guidance.

TECHNICAL DIRECTION GIVEN: May give technical direction to a group of professional or non-professional personnel.

ADMINISTRATIVE RESPONSIBILITIES: Minimal.

SCOPE: Plans and executes technical programs within his area of speciality; expected to initiate new projects within an existing program.

Level 3 -- Administrative

GENERAL: This level involves technical supervision with responsibility covering several projects and a considerable area of classical supervisory problems. Level 3 -- Administrative is normally considered to be first line management or supervision.

TECHNICAL DIRECTION RECEIVED: Receives general technical guidance from Level 4 -- Administrative.

TECHNICAL DIRECTION GIVEN: Gives technical direction to the lowest organizational entity which normally consists of one to thirty professional and non-professional personnel. Such direction includes the planning, scheduling, and assignment of work within a program area.

ADMINISTRATIVE RESPONSIBILITIES: Normally spends 10 to 50% of his time on administrative responsibilities.

Implements safety, security, and disciplinary policies.
Interviews and makes recommendations to hire -- transfer -- terminate personnel.
Responsible for the orientation and development of personnel.
Reviews performances and recommends adjustment in compensation.

SCOPE: Participates in the formulation, implementation and termination of problems, projects and programs.

Performs liaison across company lines.
Recognizes and pursues patent potentialities.
Assists in the preparation, editing and approval of project reports,
Prepares periodic progress reports to higher management.
May participate in planning and administering the budget.
Originates, initiates, and directs new projects within an approved program area.

Level 4

The two directions which emerge in Level 3 are developed to a much higher degree in Level 4.

Level 4 -- Technical

GENERAL: The technical specialist exhibits superior scientific proficiency and is a recognized expert in his field. He would have minimum administrative responsibilities; be expected to perform advanced studies and to give technical guidance to others in the organization.

TECHNICAL DIRECTION RECEIVED: Capable of independent work including initiation, planning, and execution of broad program assignments with no professional guidance.

TECHNICAL DIRECTION GIVEN: May have technical responsibility for those working with him in his field of specialization.

ADMINISTRATIVE RESPONSIBILITIES: Minimal.

SCOPE: Conducts independent research and investigations to define and develop the functional theory of a proposed product or process.

- Conceives and expands theories pertaining to new applications of existing products and/or processes along with the modification of product and/or processes in order to broaden the scope and application.
- Invents and designs complex products and processes and may assist in engineering these into production.
- Analyzes and evaluates the scope and objective of inventive ideas.

Level 4 -- Administrative

GENERAL: This level is normally considered to be second line management or supervision with responsibility for a substantial technical activity.

TECHNICAL DIRECTION RECEIVED: Minimal.

TECHNICAL DIRECTION GIVEN: Gives technical direction to one or more organizational entities of professional and non-professional personnel (normally in excess of 25 people). Such activity includes the planning, implementing, directing, coordinating, and interpreting of one or more major technical programs.

ADMINISTRATIVE RESPONSIBILITIES: Normally spends 20 to 60% of his time on administrative duties.

- Responsible for safety, security, and disciplinary actions.
- Initiates action to hire, compensate, transfer, and terminate personnel
- Responsible for appraising, counseling, orienting, and developing lower levels.

SCOPE:
- Establishes program objectives in line with company interests.
- Establishes budget for approval by higher management and controls expenditures within the approved budget.
- Originates and initiates new program areas.
- Responsible for inter-and intracompany liaison.
- Participates in the formulation, interpretation, transmission, and administration of research and development policy and actions.

Participates in patent decisions.
Reviews and communicates technical programs to higher management.
Conceives and recommends new programs to broaden the product or process application, modifying the existing product or process and create entirely new products or processes.

Level 5

GENERAL: In order to emphasize that the scientist can and does attain growth beyond that of Level 4 -- Technical, this level would include those personnel who have demonstrated outstanding technical excellence and normally have received national or international recognition of their contributions.

The stature of Level 5 scientist is comparable to that of the top research and development management function. He covers a wide organizational span for his contributions can affect not only top research and development management, but also corporate management.

The duties of this level are primarily of a consulting and independent research nature coupled with broad latitude for the selection of programs.

(EXCERPTED FROM RESEARCH MANAGEMENT, VOLUME IV, AUTUMN 1961).