Engineering Based Careers:

A Study of the Relation to Work at Mid-Career

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July 1974   715-74

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For well over a century, social analysts have been concerned with the problem of alienation from work. Primarily, the debate has centered on the industrial worker--on the phenomenon of the "blue collar blues"--but with the new urgency lent the discussion by the slowing down of economic growth and by changes in values (particularly among the young) the "blues" may be infecting white collar, managerial, and even professional ranks.

Some attribute this phenomenon to a loss in spirit, to a reduction in the "work ethic." They feel that people are no longer interested in working hard because they are now less concerned with achievement and success and more with personal relations and intense experiences. Yet there is evidence, as in the recent report of the Department of Health, Education and Welfare, Work in America, [1972], that indicates the contrary. It concludes that people are indeed interested in work and the intrinsic satisfactions it can provide them, and object only to the conditions of their employment. What they really want, according to the HEW report, "is to become masters of their immediate environments and to feel that their work

and they themselves are important--twin ingredients of self-esteem,"
ingredients, also, one would assume, of work at the highest levels of the
occupational hierarchy. Jobs at this level "provide scope for wider and
deeper aspirations than do jobs at the bottom" (Fox, 1971), and ought,
therefore, to provide immunity against the "blues."

But do they? Or are there people trained and qualified for
top jobs who find themselves at some points in their career dissatisfied
and alienated from their work? These are the kinds of questions being
raised in an analysis of a survey of MIT alumni from three classes in
the 'fifties: 1951, 1955, and 1959. The more than 1300 respondents in
this study are men who relatively early in their lives decided to pursue
some of the most demanding occupations in our society--or they would not
have come to MIT. They pursued a rigorous course of technical study and
began their careers with the expectation that work would satisfy their
intrinsic needs for self-fulfillment as well as their instrumental needs.
In 1970, when our data were collected, ten to twenty years had passed
since their graduation (they were in their mid to late thirties or early
forties) and presumably they were approaching the height of their careers
and the maximum return on their educational and personal investment in
their work. They provide, therefore, an excellent source of information by
which to ascertain the extent of alienation from work in the upper ranks,
and to try to pinpoint some of the conditions under which it is more or
less likely to appear.

We ascertained these alumni's relation to their work by a series
of questions dealing with their level of involvement with work and with
the satisfaction they get from it and from their careers in general (Table 1).

These items, selected from a large pool of career-related questions by means of an analysis of the interrelations among all of them, were combined in such a way that a resulting score was obtained for every person between 1.0 and 5.0, with 5.0 indicating a highly involved relation to work, and 1.0 indicating great alienation.

Thus, for a person to receive a score of 5.0, he would strongly agree with the statements "I like to think about my work, even when off the job" and "my main satisfactions in life come from the work I do" and strongly disagree with the statements "my only interest in my job is to get enough money to do the other things that I want to do" and "I wish I were in a completely different occupation," and would rank his career and occupation as giving him the most satisfaction in his life. Thirty-two people (some 2% of the sample) did indeed answer in this way, indicating very high involvement with their work, to the exclusion of almost every other aspect of their lives.

Only one person, in contrast, had a score of 1.0: strongly disagreeing with the statements about thinking continuously about his work and gaining his main satisfactions from it, strongly agreeing with those indicating purely instrumental interest in work and showing a desire to be in a different occupation, and not ranking career or occupation as among the top three aspects of his life that give him the most satisfaction. A further 22 people (not quite 2% of the sample) had an average score of 1.5, but, at the other end of the scale, 257 respondents (almost 20% of the sample) had a score of 4.5. Thus the distribution of scores in this sample was toward the involved end—the mean score was 3.64—a not unsurprising result, given the character of the population surveyed. Perhaps

more surprising is the extent to which there were any scores on the low end.
Over 12% of the respondents (almost one out of every eight who answered the
questionnaire) had average scores below the mid-point of 3, and another 13%
had an average score of 3.0.

Obviously, it is difficult to interpret the exact values of such
scores in any precise fashion. We can, however, say that a little over
one-fifth of our sample answered these questions in such a way that their
scores were 4.5 or more--on the very involved end of the scale--whereas the
average scores of almost a quarter of the sample were ≤ 3.0, indicating a
fair amount of uninvolvement, or alienation, even among this very highly
educated group of technically-oriented people (Table 2).

The meaning of this measure can be further clarified by looking
at some of the ways in which the "alienated" group differs from the involved
group (Table 3): they are much less satisfied with their present jobs;
they see themselves as much less successful in their work; they indicate
hardly any frustration at the hypothetical prospect of having to change the
kind of work they do. Further, they show a certain lack of response to the
cues stemming from their work situation. About one-sixth of our sample,
when asked how long they expect to stay in their present jobs, responded
with an emphatic "forever" or "till I die"--an indication, presumably, of
a positive reaction to their working conditions. This response, not unex-
pectedly, occurs considerably more frequently among those respondents who
are very satisfied with their present jobs than it does among those whose
jobs do not please them so much. Not unexpectedly, that is, except for
those who are alienated: here we find no relation between expressed inten-
tion to stay permanently in their jobs and the satisfaction derived from

them. Why the intentions of this alienated group do not reflect the way

they feel about their jobs cannot be ascertained exactly, but it seems as

if these people are not only alienated from their work, but also have with-

drawn from active consideration of the implications of what happens to them

on the job for other aspects of their lives. I do not want to dwell on this

item too much because the differences are not enormous, but it gives an

indication that alienation from work as measured by our index represents a

phenomenon with fairly widespread consequences for any number of aspects of

a person's involvement with and reaction to the working part of his life.

And so we see that there is a group of people in this sample

whose relation to their work is problematic. And this is true in spite of

the fact that the sample represents a highly trained, obviously capable

population, one in which the probability of finding challenging and satisfy-

ing work in our society would seem to be maximal.

But despite these common elements in the sample, there are,

naturally, differences as well. Notwithstanding the standard core curriculum

they all participated in, our respondents did major in different fields.

Further, they differed in the education they received after their under-

graduate years: some stopping, some going on for masters degrees, others

for doctorates. And, of course, though they were destined for a relatively

circumscribed set of technically based careers when looked at from the point

of view of the total spectrum of jobs in our society, in itself the set is

certainly wide enough to encompass quite a number of different career paths.

It turns out that all of these differences, these sub-divisions

within our sample, affect the respondents' relation to their work. In

particular, graduates of the School of Engineering end up more alienated and

less involved with their work than do alumni who majored in the sciences or in architecture (Table 4).* Also, the more graduate education an alumnus received, the more likely he is to be involved with his work (Table 5). Further, those whose first jobs were in science, as opposed to engineering or management, are much more involved and less alienated from their work over a decade later (Table 6). Since 61% of the graduates from science departments received doctorates as opposed to only 21% of those whose undergraduate degrees were in engineering, it is obvious that these distinctions are not independent of each other. They indicate that alumni headed for technical careers of the more scientific-professional kind are less alienated than those whose emphasis was initially more on the applied-engineering end of the spectrum.

All of these differences are highlighted when we look at the present occupational roles of our sample. Here the differences in relation to work are fairly striking (T.6). Staff engineers, followed closely by business staff, are the most alienated of any group; scientists, and particularly academics**are the most involved (Table 7).

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*The high alienation shown by alumni whose bachelors were in management is probably accounted for by the fact that at that time the management major was a frequent fall-back position for students who did not succeed in the other departments. Indeed, almost half (48%) of all management graduates entered MIT with plans to major in something else, whereas 82% of those who graduated with engineering degrees never changed their undergraduate majors-- (the equivalent figure for the science departments is 68%). And we know that those management graduates who at the time of our survey were in engineering staff positions (some 10% of the group) are particularly dissatisfied with the course of their careers.

**It must be mentioned here that almost a third (32%) of the professors are professors in engineering. Since our evidence indicates that the academic career for engineers represents a very different career line from any other engineering based career, much more akin to the scientific-professional pattern, the engineering professors are not included in the engineering based careers considered in this paper.

In an attempt to isolate the influence of occupational role from the factors of training and initial work experience, we selected from our total sample a group quite homogeneous in terms of their early career history. The initial selection was made by one of the Sloan Fellows this year, himself an engineer now in a managerial role, and interested in the effect of different occupational roles on engineers (Madrazo, 1974). It includes in the category of engineering based careers only those alumni who graduated from the School of Engineering (some two-thirds of the MIT graduates in the 'fifties--a figure, interestingly, reduced in the'seventies to only one-third); who neither went on to get a doctorate (though they might have a masters or an engineering degree) nor a degree in management or business administration; and whose first jobs were in engineering staff positions in private industry (eliminating those in government or non-profit labs, as well as those who started in non-technical positions) (Table 8). Almost half of this group are still--some ten to twenty years after graduation--in engineering staff positions, the other half are more or less evenly divided between those in engineering management, and those who have left the technical area altogether and are managers in a non-technical, functional area or are in positions of general management.*

Though it reduces our sample size considerably, such a selection allows us to highlight a particular set of careers, what we have called the engineering based careers. It enables us to ascertain the effects on a person of his occupational position, without confusion with those background

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*The forty-five people who are in other professions are eliminated in subsequent discussion.

characteristics, such as type of training or first job, that are usually associated with a particular occupational role. When, then, we look at the relation to work of this reduced more homogeneous group, we find that the difference in alienation seen in the previous table still persists: those engineers in staff positions well over a decade into their careers are more alienated and less involved with their work than are those whose jobs also include managerial duties (Table 9). And since this difference occurs in a carefully selected homogeneous group, it lends empirical support to the proposition that engineering is an alienating occupation.

But the table also shows that not all engineers are alienated, some, indeed, are very involved with their work. It makes sense, therefore, to try to isolate the conditions under which such alienation does or does not occur. Previous research on engineers (e.g. Ritti, 1971, Perrucci and Gerstl, 1969, Gerstl and Hutton, 1966) has sought reasons for this phenomenon in certain very general structural conditions of employment: obsolescence, underutilization of technical knowledge, lack of decision making powers have all been blamed. Our study, by reversing the usual research design and dealing with engineers in different job environments but with the same educational and early career backgrounds, allows us to ascertain some of the more specific individual factors that are related to an engineer's alienation from his work.

First, however, we must raise the question of whether differences in income account for the differences in relation to work of our three occupational roles. On the whole, we find that alumni whose professional incomes are higher tend to be less alienated and more involved with their work: 30% of those whose total professional income is under $15,000 (1970 figures) are

alienated from work, as opposed to 14% of those with incomes over $50,000.*

We also know, and our data confirm, that people in staff positions get paid

less than those whose duties include managerial responsibilities. Only 5%

of the managerial groups have professional incomes of $15,000 or less as

compared to 22% of the staff engineers; and NONE of the staff engineers in

our selected group makes more than $30,000 a year: almost one-third of the

general managers (31%) and close to one of eight technical managers (12%)

exceed this amount.

The question we must raise, therefore, is whether these income

differences account for the differences that exist in the relation to work

of these alumni. Not very much, it turns out. Even among the highest paid

engineers, over 30% are alienated from their work, and at virtually all in-

come levels--particularly among the majority in the middle range--the aliena-

tion of the engineers is higher than that of the managerial groups at the

same level of income. For all groups, in other words, low incomes are associ-

ated with higher alienation, but income does not explain the differences

between the occupational roles, since these persist even within groups in

which income has been controlled.

There are, however, some conditions that do reduce the alienation

of staff engineers below the 30% point, down to the level of the managerial

groups (Table 10). Some of these factors (items 4, 5, 6) are those previously

shown to be aspects of a person's relation to his work. In other words,

there is a group of engineers who are very satisfied with their work; who

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*Since the low income group includes many of the younger, very highly involved
professors, we normalized income for each age-occupational group. Using this
normalized measure, we find, in the total sample, that 40% of those whose
incomes are more than one standard deviation below the means of their occupa-
tional-age group are alienated, as compared to 18% of those whose incomes are
more than one standard deviation above the respective means.

would, as a matter of fact, feel very frustrated if they had to change it; and who see themselves as very successful in it. And this group is no more alienated than the equivalent managerial groups. But though these differences elucidate the meaning of alienation from or involvement with work, they do little more than reiterate the fact that there are some staff engineers who can overcome the potential for alienation in their jobs.

Other items, on the other hand--less closely related to the definition of the relation to work--tell us more about what kinds of engineers can most successfully do this. First, we see (item 1) that engineers with higher undergraduate grade point averages (averages of A or B) are less likely to be alienated from their jobs. This is interesting because it must be remembered that we have limited our sample to those engineers without doctorates, hence the higher grade point average does not indicate a higher level of education. Whether this signifies a greater capability for engineering work, a better absorption of the necessary technical and scientific knowledge on which engineering is based, or merely, indirectly, a greater confidence in one's technical competence, this difference would seem to argue against the interpretation of alienation as resulting from the underutilization of technical knowledge. For if that were the case, one would expect those with higher grade point averages to feel it even more.

Rather, the operating factor seems to be the professionalization of the engineer. We see that those engineers with a cosmopolitan orientation (item 3)--by which we mean those who see their professional colleagues, rather than their employers, as their reference group--show a reduction of alienation. Hence the professionally oriented and technically most competent engineers are the ones most able to retain their involvement with their work.

In other words, though it has sometimes been stated that only a move to management can satisfy the engineer, these results would indicate that for some engineers, those whose orientation is more scientifically professional, technical work can continue to be involving. These are the people, presumably, who are more interested in working with things than with people (item 2). Their orientation was and remains technical, and given the right conditions they remain involved with their technical duties even many years into their careers.

It is the engineers whose technical orientation is less, who are more interested in working with people, whose alienation in a staff position is particularly high. Whether they have always had these inclinations and hence would have been better off in a different field from the beginning, or whether these tendencies represent new developmental stages which point to the desirability of a mid-career change after an involving initial decade or so of technical work, we do not know. At this point in their careers, however, we must assume that this group, as opposed to the more professionally oriented one referred to before, would benefit less from opportunities for technical up-dating than from those, such as training in management, that would help them with a mid-career transition.

Finally, we would like to raise one more point. Whatever the repercussions of an engineer's alienation from work may be for his employing organization, he, as an individual, will react to it very differently if there is another area of his life that is fully involving than if it is part of a general syndrome of dissatisfaction with his lot. Our data, though not too helpful in answering this question, allow us at least to get a rough indication of the extent to which our respondents are satisfied with the role arrangements

in their families--that is, with the division of work and family responsibili-
ties between husband and wife. They enable us, therefore, at least to raise
the question of whether alienation at work is to some extent compensated for
by an accompanying greater satisfaction from the family situation.

On the whole, some such compensating mechanism seems to be operating.
There is a general tendency, in the sample as a whole, for the alienated group
to be more satisfied with their family situations than are those involved with
their work. And, as a matter of fact, in the initial analysis of the interre-
lations of career items already mentioned, some questions dealing with a per-
son's relation to his family were included. The results of that analysis
showed that people involved with their work are less concerned with family
needs and derive less satisfaction from their families than do those not so
involved, though, it must be added, the direction of causality here is by no
means clear.

When we look at the three selected engineering based careers we find
this same trend to hold true, but to a somewhat different degree in each occu-
pational role (Table 11). Virtually all of the alienated general managers
are fully satisfied with their current family situations. Whatever the
reason may be for a general manager not to be involved with his work, he at
least has a family situation that he likes and in which a number of his needs
are presumably met. This is much less true of the more technical occupational
roles, particularly the staff engineer. More than 20% of the alienated
engineers indicate a real discrepancy between their present family arrange-
ments and their ideal. Not only are they dissatisfied with their work, but
they feel deprived in their family life as well, a situation that may well en-
hance the significance to them of the problematic relation they have with their

work.*

In conclusion, we have identified a group of alienated engineers who are a problem not only for the companies that employ them but also for themselves--who find themselves approaching mid-career with jobs that do not satisfy some of the things they value most, such as working with people. They represent the less scientifically-professional, more applied end of the spectrum. But, from the other end of the spectrum, we have seen that there are also engineers, no more highly trained and having followed very similar career tracks, who are as involved at around the age of forty in their technical work as managers are in theirs. It is important to keep this distinction in mind before deciding that any one avenue, be it technical up-dating, managerial training or whatever, best fits the mid-career needs of people in engineering based careers.

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*Very few of the single respondents in the total sample are satisfied with their family situations--most would prefer to be married. They are, however, more likely than those who are married to be involved with their work, probably because of a compensating mechanism in the other direction. But the staff engineers in our selected group do not exhibit this compensating behavior either. Whereas NONE of the 12 single technical or general managers are alienated from their work, 9 (fully 60%) of the 15 single staff engineers are. The presence of this single group among the alienated staff engineers--almost none of whom are satisfied with their family situations--is partly responsible for their "double jeopardy" situation.

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TABLE 1

RELATION TO WORK

I. Work Orientation

Please indicate the extent to which you agree with the following statements by circling the appropriate number.

	Strongly disagree				Strongly agree
I like to think about my work, even when off the job........	1	2	3	4	5
My only interest in my job is to get enough money to do the other things that I want to do..................	1	2	3	4	5 (Reverse)
I wish I were in a completely different occupation..........	1	2	3	4	5 (Reverse)
My main satisfactions in life come from the work I do...	1	2	3	4	5

II. Career Satisfaction

Which three aspects of your life give you the most satisfaction? In the following list, place a 1 next to the item that gives you the most satisfaction in life; a 2 next to the one that gives you the next most satisfaction, and a 3 next to the third most satisfying aspect of your life.

                                                                     Rank

Career or occupation.....................................   _____   (Reverse)

Scores range from 1.0 to 5.0

TABLE 2

Relation to Work
of M.I.T. Alumni

	N	%
Alienated ($\leq$3.0)	335	26%
Medium (3.5–4.0)	687	52%
Involved ($\geq$4.5)	289	22%
TOTAL:	1311	100%

TABLE 3

Other Aspects of the Alumni's

Relation to Work

		Alienated (N=335)*	Involved (N=289)*
1.	**Job Satisfaction**		
	% very satisfied with their jobs	10%	39%
	% not satisfied	50%	12%
2.	**Job Permanence**		
	% definitely expecting to stay with their present jobs	16%	18%
	of those very satisfied	19%	30%
	of those not satisfied	15%	9%
3.	**Perceived Success**		
	% very successful now or at height of career	23%	46%
	% not successful now or at height of career	17%	7%
4.	**Reaction to Change in Work**		
	% very frustrated	1%	20%
	% not at all frustrated	40%	16%

*Reduced by those not answering a given item.

TABLE 4

Relation to Work

by Undergraduate Major

	% Alienated	% Involved
Management (N=168)	31%	14%
Engineering (N=852)	27%	20%
Humanities & Social Science (N=31)	23%	29%
Science (N=211)	17%	35%
Architecture (N=49)	14%	31%

TABLE 5

Relation to Work by Highest Degree

		% Alienated	% Involved
Bachelor's Degree	(N=539)	32%	17%
Master's Degree	(N=441)	25%	19%
[MBA (N=132)]		[19%]	[19%]
Doctorate	(N=331)	16%	33%

TABLE 6

Relation to Work by First Job*

		% Alienated	% Involved
Engineering	(N=622)	29%	20%
Engineering Mgt.	(N=109)	26%	16%
Non-technical Mgt.	(N=104)	25%	23%
Science	(N=125)	13%	40%

*Information on first jobs is missing for 148 people. The remaining 203 had first jobs in business staff positions, or taught, consulted, or did research in unspecified fields or in architecture, medicine, law, or social science.

TABLE 7

Relation to Work by Current Profession*

		% Alienated	% Involved
Staff Engineer	(N=299)	39%	10%
Business Staff	(N=69)	36%	7%
Engineering Manager	(N=230)	27%	20%
General Manager	(N=312)	21%	20%
Scientist	(N=78)	18%	30%
Professor	(N=135)	10%	44%

*The remaining 188 people are in architecture and planning, in consulting firms, or in other professions such as medicine or law.

TABLE 8

ENGINEERING BASED CAREERS

	N	
Graduates of School of Engineering	878	(65% of total sample)
Who did not get Doctorate or MBA	619	(70% of engineering graduates)
Whose first jobs were in engineering in private industry	374*	(67% of non-Ph.D. non-MBA engineering graduates with information on first jobs)

currently in:

	N	
General Management	84	(22%)
Technical Management	87	(23%)
Staff Positions	158	(43%)
Other Professions	45	(12%)

* - 58 did not give information about first jobs.

TABLE 9

Relation to Work of Respondents
in Engineering Based Careers

PRESENT POSITION

	GENERAL MANAGEMENT	TECHNICAL MANAGEMENT	STAFF
% Alienated	26%	28%	42%
% Medium	51%	49%	45%
% Involved	23%	23%	13%
TOTAL	100% (N=78)*	100% (N=87)	100% (N=156)*

*Respondents who did not answer all the questions on relation to work are excluded from the table.

TABLE 10

Conditions of Reduced
Alienation in Staff Engineers

			% alienated
1.	Undergraduate grade average B or more	(N=60)	28%
2.	More interested in working with things than people	(N=63)	25%
3.	Cosmopolitan orientation	(N=24)	29%
4.	Frustrated if had to change work	(N=29)	21%
5.	Already very successful	(N=17)	24%
6.	Very satisfied with current job	(N=22)	18%
	TOTAL GROUP	(N=156)	42%

TABLE 11

Work and Family in
Engineering Based Careers

% satisfied with their family situations

Present Position:	Alienated	Involved
General Managers	95% (N=20)	67% (N=18)
Technical Managers	83% (N=24)	70% (N=20)
Staff	78% (N=64)	67% (N=21)