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An inquiry into engineering career choice and career satisfaction

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AN INQUIRY INTO ENGINEERING CAREER CHOICE AND CAREER SATISFACTION

by

Gunars Bachs

Thesis submitted to the Faculty of the Graduate School of
New Jersey Institute of Technology
in partial fulfillment of the requirements for the degree of
Master of Science in Management Engineering

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ABSTRACT

Title of Thesis: An Inquiry into Engineering Career Choice and Career Satisfaction
Gunars Bachs, Master of Science in Management Engineering, 1984
Thesis directed by: Professor John Mihalasky

The purpose of this thesis was to ascertain factors that motivate a person to study engineering, and to examine the aspects of engineering career satisfaction. This study was conducted as a survey by means of a mail questionnaire, which was distributed among graduates of New Jersey Institute of Technology. Another sample, comprised of master's degree recipients of NJIT who had received their bachelor's degree from other undergraduate schools, served as a control group.

Motivation factors and positive and negative aspects of the engineering career were established and ranked in order of their importance. A method to measure career satisfaction was devised. Change of career satisfaction with change in age and work experience were studied, and trend lines were obtained that showed a slight rise in job satisfaction for NJIT graduates and a slight drop for the graduates of other schools.

The tallied up figures showed that about one quarter of the respondents from each sample were dissatisfied with their careers.

PREFACE

Engineering manpower studies and planning in the American society are handled by the federal government, state and local agencies, colleges and universities, private organizations, such as professional societies and industrial corporations, all of which operate in much the same fashion as any other market research group: from the point-of-view of supply and demand.[1]

Somewhere at the bottom of this system are the millions of individuals who comprise the prospective manpower pool. These individuals have their own desires, ambitions and capabilities that determine their equally varied decisions in search for a place in this pluralistic society, within a complicated and highly unpredictable economic framework.

It is then small wonder that manpower researchers have to tackle increasingly complex multivariate methods of analysis that may involve the simultaneous effect of as many as 40 to 60 variables.[2] This is an examination from the point-of-view of society, rather from the point-of-view of an individual. Also, such terms as "manpower" or "output

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[1] John K. Folger et al., Human Resources and Higher Education, New York, 1970, p.347

[2] Ibid., p.5.

of a school", although convenient, may be demeaning to the human beings involved.[3]

When does this all leave a young person of 17 or 18, about to graduate from high school? He is faced with one of the most difficult and important decisions of his life, if not with the most important one. This decision is two-fold: it involves an educational choice and an occupational choice. For the prospective engineering student this distinction may not generally be significant, for choice of an engineering education usually presupposes pursuit of an engineering career.

Does he evaluate his interests and abilities and is he looking for a fulfillment of a mission in his life? Or does he weigh this educational choice in terms of direct and opportunity costs, regarding it as a financial investment; or from the standpoint of utility, as a consumption good?[4] This points to the interrelationship between society and individual, for this personal investment in engineering education adds to the human capital of the nation.[5]

In the present-day energy and resource conscious world "...the ultimate resource is human imagination, knowledge and spirit. When given free rein, these can overcome all other resource scarcities - discovering new reserves, or

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[3] Ibid., p.XVI

[4] "Ph.D. Phoolery," The Wall Street Journal, Aug. 18, 1981, p.32.

[5] Loc. cit.

better ways to extract resources, or more economical ways of using them or new resources altogether."[6] Thus the most important resource America has, may well be her own people.

Studies from the individual's point-of-view are dwarfed by manpower supply and demand data. Still less information is available on how this individual fares after graduation (with the exception of employment and salary data). The aim of this thesis is to inquire into both areas and to attempt to correlate them: engineering career choice and career satisfaction.

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[6] Julian L. Simon, The Ultimate Resource, Princeton, 1981, p.22

To my daughter Baiba -

a future engineer and manager

ACKNOWLEDGMENTS

I would like to express my sincere thanks to Professor John Mihalasky of the Department of Industrial and Management Engineering, New Jersey Institute of Technology, to whom I owe special appreciation for his guidance and assistance, even during his sabbatical year.

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I also wish to express my gratitude to Dr. Katye M. Monroe and Messrs. Eugeen E. Goossens and Warren P. Murphy who took time out from their busy schedules to read the draft of this thesis and offer their comments.

TABLE OF CONTENTS

		Page
PREFACE		ii
DEDICATION		v
ACKNOWLEDGEMENTS		vi
LIST OF TABLES		x
LIST OF FIGURES		xi
CHAPTER I.	CHOOSING THE ENGINEERING PROFESSION IN A CHANGING WORLD	
	A. The Setting of the Problem	1
	B. Occupational Choice	5
	C. Interest as Basis for Occupational Choice	6
	D. Interaction of the Individual with Environment	7
	E. Factors that Affect Engineering Career Choice	9
	F. Career Satisfaction	12
	G. Career Dissatisfaction	15
	H. Engineering Colleges and the Shortage of Engineers	18
	J. Summary	21
CHAPTER II.	THE SURVEY	
	A. Design of the Questionnaire	24
	B. The Sample	25
	C. Collection of the Data	
	1. Response to the Survey	26
	2. Inherent Differences Between Samples	27

Page

D. Processing of the Data

1. Definition of Terms 28

2. Treatment of the Data 30

3. Presentation of the Data 30

E. Discussion of Results

1. Motivation Factors 45

2. Positive Aspects of Career 45

3. Negative Aspects of Career 45

4. Change of Career Satisfaction with Age 46

5. Change of Career Satisfaction with Increase in Work Experience 47

6. Combinations of Motivation Groups 48

7. Career Satisfaction 49

F. Answers to Write-in Questions

1. Motivation 50

2. Positive Aspects 50

3. Negative Aspects 51

G. Summary 52

CHAPTER III. CONCLUSIONS 55

CRITICAL COMMENTS 57

NOTES TO CRITICAL COMMENTS 58

APPENDIX "A" QUESTIONNAIRE 60

APPENDIX "B" COVER LETTER 61

APPENDIX "C" ANSWERS TO WRITE-IN QUESTION 12 62

APPENDIX "D" ANSWERS TO WRITE-IN QUESTION 18 67

Page

APPENDIX "E" ANSWERS TO WRITE-IN QUESTION 24 71

APPENDIX "F" SEPARATE NOTES INCLUDED WITH QUESTIONNAIRE 77

BIBLIOGRAPHY 79

LIST OF TABLES

Table		Page
I.	Motivation Factors in Percent of Sample	32
II.	Answers to Aspects of Job, Career or the Engineering Profession in Percent of Sample	33
III.	List of Motivation Factors Ranked According to Percent of Replies Received	34
IV.	List of Career Aspects in Order of Percent of Replies Received	35
V.	Career Satisfaction as Percent of Total Sample	36

LIST OF FIGURES

Figure		Page
I.	Motivation Factors in Percent of Sample	37
II.	Aspects of Job, Career or the Engineering Profession in Percent of Sample	38
III.	Career Satisfaction vs. Age - NJIT Sample	39
IV.	Career Satisfaction vs. Age - Other Schools Sample	40
V.	NJIT Sample - Career Satisfaction vs. Years Since Graduation (B.S.)	41
VI.	Other Schools Sample - Satisfaction vs. Years Since Graduation	42
VII.	Relative Distribution of Motivation Groups Within Sample	43
VIII.	Career Satisfaction in % of Sample	44

I. CHOOSING THE ENGINEERING PROFESSION IN A CHANGING WORLD

A. The Setting of the Problem

Whether we are on the threshold of a third industrial revolution will be ascertained in future years. It is not the purpose of this study. It must be noted, however, that hand-in-hand with an economic emergency important changes in technology are taking place that affect industrial production and management methods. All these changes have their impact on engineering schools, students and graduates.

Up to quite recently there has been a long term, high demand trend for engineers, as well as rising pay rates at all levels. Also, undergraduate enrollement has skyrocketed, causing engineering schools to consider enrollment limiting. Thus, according to a survey by American Society of Engineering Educators "...faculty shortages and facilities problems have forced 16 out of 30 of the largest and most respected engineering schools to limit their undergraduate enrollment."[7] However, the most pressing problem is faculty shortage. Of 1650 unfilled engineering faculty positions over half have been vacant for at least one year due to a

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[7] Mark D. Zimmerman, "Controlling Engineer Supply", Machine Design, vol.53, No.13, June 11, 1981, p.29.

large extent to the higher salaries offered by industry.[8] Although freshmen enrollment in 1982 has been more than twice as large as in 1973, graduate enrollment is down. American dominance in world's technology is rapidly falling off and alarm is being expressed about the condition of engineering education.[9]

Although the shortage of engineers has been accepted almost as axiomatic, there are voices who caution: "The data on the overall shortage are difficult to establish."[10] And a professional magazine that reported a record level in technical recruitment in 1980, talks about a mid-season slump in the job market at the end of 1982 and of layoffs of recently hired graduates in its March 1983 issue.[11] One of the hardest hit branches seems to be the chemical industry.[12] Also, starting salaries of mid-career engineers

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8 Jeanne McDermott, "Technical Education: The Quiet Crisis," High Technology, Vol.2, No.6, Nov/Dec. 1982, p.87.

9 Dr. Glen Wade, "Engineering Education: The Good News and the Bad," The Bent of Tau Beta Pi, Vol. LXXIV No. 1, Winter 1983, p.14.

10 "Engineer Shortage? Well, that Depends," The New York Times, March 28, 1982, Section 12, p.5.

11 "Personal and Professional," Machine Design, Vol.52, No.1, Jan.10, 1980, p.2; Vol.54, No.28, Dec.9, 1982, p.273; Vol.55, No.6, March 24, 1983, p.181.

12 "Chemical Employment Hurt by Recession," Chemical & Engineering News, Vol.60, No.35, Aug.30, 1982, p.4.

have increased at a slower rate than those of younger ones. In spite of industry complaints of engineer shortages, mid-career engineers find it difficult to relocate. Things are especially hard for engineers with 20 to 30 years experience.[13]

In the meantime industry is looking for the ideal engineer - a special blend of technical expert and cooperative team member.[14] As there is increasing evidence that American workers are growing more negative in their attitude toward work, industry recognizes that more attention must be directed toward fulfilling their basic needs to avoid frustration and unhappiness.[15]

How does this rather confusing environment affect the young person who is about to enter college? Available literature states that "...human behavior involves, first, wants or desires which are to be satisfied by reaching some goal."[16] In the broadest sense that may mean success in life. However, it is hard to measure success in life. There

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13 "Engineers Hit Several Snags," Machine Design, Vol.55, No.19, Aug.26, 1982, p.210.

14 Eugene Raudsepp, "The Ideal Engineer," Machine Design, Vol.55, No.1, Jan.6, 1983, p.71.

15 Charles E. Taylor, "Graphoanalysis - Letting the Fingers Do the Talking," Management World, Vol.8, No.12, Dec.1979, p.15.

16 Edward K. Strong, Jr., Vocational Interests of Men and Women, Stanford, 1943, p.4.

are material standards of income to serve as yardsticks. Satisfaction and enjoyment in one's job. What are the factors that relate to occupational success and what control does the individual have over them? In a relatively mobile society, perceived prestige and status could be arranged in a certain hierarchical order that in a way forms an occupational pyramid, where education is often perceived as a means of moving up this social and occupational ladder.[17] Individuals on lower rungs of this ladder stress as sources of satisfaction economic factors, security, a chance to get ahead, a need for recognition as persons. People on upper levels of this pyramid define satisfaction in terms of "interesting work," a chance to use their abilities and to work at challenging tasks. For the group on the lower rungs of the ladder, satisfaction is derived from sources external to work; for those on the higher rungs satisfaction is identified with internal feelings derived from a sense of accomplishment and involvement in work.[18] All these may be only some of the factors that influence a person to choose engineering as a profession and contribute to his job satisfaction.

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17 John G. Darley & Theda Hagenah, Vocational Interest Measurement, Minneapolis, 1955, p.3.

18 Ibid., p.9.

B. Occupational Choice

The concept "occupational choice" may have different meanings during the lifetime of an individual. Thus it may mean something that he would mostly like to do, also what he will try to do and, finally, what he actually does come to do.[19] Choosing an occupation is a continuous process, starting with childhood.[20] All through elementary and high school attitudes of children change. At the college level, however, the situation is different. Studies indicate that between 53% to 70% of college students have decided upon a vocation before entering college. Of those students who have decided upon their future career, one third have selected the particular college because of their occupational choice. The rest have made their choice by their junior year. The latter fact, of course, is not surprising, since most colleges require students to declare their major at this point, at the latest. This, however, does not mean that the choice is carried out.[21]

This continuous process is an interaction between factors born out of the individual's personality and outside influences. It involves personal dynamics and environmental realities. The number of possible solutions open to

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19 Anne Roe, The Psychology of Occupations, New York, 1956, p.251.

20 Ibid., p.253.

21 Ibid., p.264

an individual are limited by family, social situation, capacities, needs and motives. A person during his lifetime makes some identification with a group he respects. This then may lead to a particular vocational interest. He may continue on this path as long as no serious discrepancies occur between his own capacities and the requirements of the particular vocation. He may become reoriented toward another occupation if serious obstacles emerge. Thus a pattern of interests is formed that provides a basis for planning. Initially there is a trend toward more practical and workable interests. However, some researchers say that studies of interests show less variation than this interplay of personal and environmental factors would produce.[22]

C. Interest as Basis for Occupational Choice

From the point-of-view of experimental psychology, interest is a response of liking.[23] Interest is aroused when we are aware of an object or, more precisely, of our disposition toward the object. Thus interest is an aspect of behavior. Interests are acquired and learned, since they involve reactions to specific things.[24] Interest is also an

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22 Roe, Op. Cit., p.268

23 Strong, Op. cit., p.4.

24 Ibid., p.10.

indicator that performance has been successful. It is, however, not related directly to achievement. It is merely an indicator of satisfaction. An important ingredient of satisfaction is desire for social approval. Interests may come and go, but a surprising permanence of occupational interests is observed among adults and college students and, to a lesser degree, among high school students when this interest is not defined as a single choice but as the sum of many interests that are related to an occupational career.[25] However, as far as patterns of interest go, evidence exist that they are fairly well established in many children by fifteen years of age.[26] Research also indicates that a relationship exists between interests and abilities.[27]

D. Interaction of the Individual with Environment

The observation that no two individuals are alike is one of the most fundamental generalizations in biology. This variation is traced to the interaction of heredity and environment. The degree and kind of this variation are important for occupational psychology.

The individual has some basic needs that act as drives. Yet men do not work just to make a living, and these

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25 Strong, Op. cit., p.13.

26 Ibid., p.12.

27 Ibid., p 24.

drives are not limited only to search for food and shelter. There are other basic needs that act as drives: psychological and safety needs, need for belongingness and love, for importance, respect, self-esteem, independence.[28]

There is also the status and role of the individual with respect to society. Important is the general situation of the community, country he is living in with the accompanying characteristic cultural elements, the degree of conformity this society demands, and also the ease with which education may be obtained.[29] It is also very likely that a child will remain in or near his father's socioeconomic group. There is hardly a society where the father's position does not in some way influence the child's position in the society, including occupation.[30] In addition to the influence of father, the background of mother, such as her parents occupation, determine the level of the individual's socioeconomic level of interest.[31]

Thus the individual's pattern of interests is limited within a certain scope. Yet, either voluntary or not, a choice still remains. Thus, when students are asked: "Why

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[28] Roe, Op. cit., p.25

[29] Ibid., p.103.

[30] Ibid., p.105.

[31] Ibid., p.108

did you choose this occupation?" the most common answer is: "I like it." This shows that interest is also a basis for choice.[32] No matter how independent this choice may be, at least on third to one half of students are not free to choose occupations as they please. Thus a study shows that about 37% college men and 46% college women do not give the same occupation as both their chosen and their preferred because of the following reasons: pressure by family and friends, desire to marry, opportunity to become immediately established, lack of finances to finish education, lack of necessary ability, lack of necessary personality, lack of requisite health, lack of information about preferred and competing occupations, so that adequate plans cannot be formulated.[33]

E. Factors that Affect Engineering Career Choice

Studies show that men, engaged in an occupation have, as a group, a characteristic pattern of qualities, likes and dislikes different from the patterns shown by other occupations. Investigation of characteristics common to engineers indicate that both academic and mechanical ability are high. A study of 1000 freshmen at Illinois Institute

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[32] Strong, Op. cit., p.28

[33] E. G. Williamson, How to Counsel Students, New York, 1939, p.428.

of Technology show the following differences: High persuasive but low science scores tend to enter sales. High in mechanical, science, social service scores, but low in persuasive tend to enter engineering. Other studies of engineering student populations show that they rate high in intelligence tests and computational interests, are of average body build, low in physical performances, near the top in intelligence and with almost exclusively intellectual hobbies, such as reading, especially technical, chess, etc.[34]

An outline for career planning mentions as motivation factors pride, self-preservation, possession, imitation.[35] Most people are basically hero worshippers and career planning efforts may be stimulated by imitation that has been derived from love of parent or relative. Also constructiveness (such as creativity in engineering), money, prestige, security (including pay, health, well-being). Father's and relatives' occupations are mentioned also in other works.[36]

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34 Roe, Op. cit., p.201.

35 Leonard J. Smith, Career Planning, New York, 1959, p.100.

36 Engineers' Council for Professional Development, The Guidance of Young Men Interested in Engineering Education and the Engineering Profession, New York, 1936, Appendix "A", p.2.

Moreover, external influences, such as high school counseling, recruitment by colleges and industry are very much in evidence, including vocational aptitude measurements. A powerful motivator is also interest in things technical and engineering in general.[37] Demand for engineers has already been mentioned and certainly cannot go unnoticed by high school students and their advisors. Also local concentration of industry provides work experience that may stimulate interest in engineering.[38] Other reasons for selecting an engineering school are reputation, tuition, location close to home.[39]

A valuable exception (rather than the rule) among the numerous studies related to engineering manpower is a survey by Purdue University[40] since it is individual-oriented. It mentions people who influence students to study

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37 Strong, Op. cit., p. 549.

38 US Bureau of the Census, Selected Characteristics of Persons in Fields of Science and Engineering, 1976.

39 American Society for Engineering Education, Engineering Expectations, Washington, D.C., 1975, p.213.

40 Carolyn M. Jagacinski and William K. LeBold, "Comparison of Men and Women Undergraduate and Professional Engineers," Engineering Education, Dec. 1981, p.213.

engineering: father, mother, relatives, friends, famous engineers, high school teachers and counselors. Other important factors include high school courses that have relationship to engineering and vocational education information.

Thus the following factors that have an impact upon the choice of an engineering career may be crystallized out:

Influence of father.

Influence of relatives and friends.

High school counseling, vocational aptitude tests, recruiting by engineering colleges and industry.

Success in engineering related high school courses.

Real interest in engineering.

The prestige of being an engineer.

Income.

Financial factors - tuition.

Location of engineering school.

Work experience in engineering related field.

F. Career Satisfaction

Researchers have listed various factors that enhance employee satisfaction. Thus a survey, conducted among upper income brackets by means of a questionnaire with a sample size 67, lists the following general concepts; recognition and approbation, affection and interpersonal relationships,

mastery and achievement, dominance, social welfare, self-expression, socioeconomic status, moral value scheme, dependence, creativity and challenge, economic security, independence.[41] A.H. Maslow suggests in ascending order a hierarchy of human needs: physiological, safety, friendship and love, self-esteem and self-respect and, as the highest need, self-fulfillment through development of powers and skills and a chance to use creativity.[42]

Another survey by Opinion Research Co., Princeton, N.J., through personal interviews of 265 engineers, employed by large companies and with salaries above the median, states that observations by engineers, whether they are recent graduates, or persons with years of experience, always point to the satisfying nature of the work itself, the opportunity fo creativity. Their work, they say, is challenging and offers variety. Personal satisfaction is derived from seeing their projects completed. Financial rewards are mentioned in the sense that pay is adequate but not superior, although the tone is such that the money alone is sufficient justification to

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41 Roe, Op. cit., p.284.

42 Ernest Dale, Management: Theory and Practice, New York, 1969, p.437.

choose engineering as a career. Other characteristics of engineering as a career: opportunity for progress and advancement, also into management. Valuable also to some engineers is opportunity for service to the betterment of human life, health and standard of living.[43]

A mail questionnaire study among 393 female and 420 male engineering graduates of Purdue University of the years 1958-74, lists the following factors, rated quite or very important: opportunity to use skills and abilities in challenging work, well-managed company, cooperation among workers, participation in important work-related decisions, superiors willing to delegate responsibilities, adequate income, opportunity to innovate, preparation and advancement into management, opportunity to enhance social status and prestige.[44]

Both, the Public Opinion Research and the Purdue surveys comprise engineers with 3 to 25 years experience, and their answers, of course reflect their opinions at the time of the survey. There are other studies that report that job satisfaction is cyclical. Thus D.E. Super reports that job satisfaction (not necessarily among engineers) changes with

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43 The Professional Engineers' Conference Board for Industry, Career Satisfaction of Professional Engineers in Industry, Washington, D.C., 1957, p.10.

44 Jagacynski & LeBold, Op. cit., p.219

age. Satisfaction is general between the ages 20-24, dissatisfaction si common from 25 to 34, followed by satisfaction with a temporary decrease at 45-54.[45]

Condensing from all the above elements, the following emerge as important aspects of a satisfying engineering career:

Chance to use skills, abilities or ideas to perform challenging or innovative work.

Employment that yields the expected financial security.

Preparation or opportunity for advancement.

Varied experience.

Enhancement of social status and prestige.

G. Career Dissstisfaction

In general, the major causes of career dissatisfaction may be discrepancies between aspirations and reality, supervisor's behavior, inadequate opportunity for advancement. Also unpleasant work, lack of opportunity to make decisions, uncertainty of continued employment, working hours, monotony, compensation.[46]

The Opinion Research Co. survey is not as explicit about career dissatisfaction as it is on satisfaction. How-

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45 Roe, Op. cit., p.282.

46 Ibid., p.283.

ever, some of the complaints can be extracted. Many professional engineers feel that their training and experience has not prepared them for managerial responsibility. The most lacking aspects of their jobs are in the following areas:

> Unclear definition of authority and responsibility.
> Inadequate private working quarters.
> Not recognized and treated as part of management.
> Lack of clerical assistance for routine work.
> Not certain about their status as professionals.
> Others do not understand engineers' work.
> Shortage of engineers is being overemphasized.
> Engineers are hired and treated as any other trade.[47]

Undoubtedly, every graduating class greets their new career with enthusiasm, and as it is with things emotional, they are bound to plateau out, ebb and eventually fade. All the great expectations about using skills and abilities to do challenging work may not materialize, and with good reason, since engineering is a practical branch of man's endeavor. Costs and deadlines hardly leave room for experimentation and innovation. The watchword is "proven technology" or "what was good for our fathers must be good enough for us." An engineer writes: "Design engineering is basic and practical rather than exotic and sophisticated. Innovation, research and development and publication not only are unrewarded, but they are systematically and definitely discouraged.[48]

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[47] Prof. Engrs. Conf. Board, Op. cit., pp.17-56.

[48] "Point & Counterpoint" Machine Design, Vol.52, No.2, Jan. 24, 1980, p.32.

A committee of the American Society for Engineering Education states: "Both the secondary school student and the general public believe that the profession of engineering demands top talent and great effort while it returns only medium income and status."[49]

Moreover, salaries of middle-level engineers have not risen as fast as those for engineers just out of college. This is the so-called "salary compression." Also, as already mentioned, data on the overall shortage of engineers are difficult to establish. "The truth lies somewhere between a shortage and a glut."[50]

In spite of the enactment of the 1967 Age Discrimination Act, at least 25% of engineers report feeling age discrimination.[51] A member of National Society of Professional Engineers says: "Engineers are touted as a vital national resource, then subjected to the same laws of supply and demand that apply to unskilled laborers."[52]

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49 Folger et al., Op. cit., p.95.

50 Elizabeth M. Fowler, "Engineer Shortage? Well, That Depends," The New York Times, March 28, 1982, Sect.12, p.5.

51 Mark D. Zimmerman, "The Mid-Career Crisis: Impasse or Opportunity?" Machine Design, Vol.52, No.18, Aug.7, 1980, p.67.

52 Zimmerman, Loc. cit.

Engineering has also remained unwilling and unable to formalize the hierarchies that have been evolving in the profession.[53] Thus its status and prestige suffer.

In view of the above, the following negative aspects of engineering may cause career dissatisfaction:

Work pressures and limitations impair job satisfaction.

Effort spent in studying engineering may not be fully rewarded.

Employment opportunities are not as good as one may believe.

Although referred to as a vital resource, engineers are often treated as ordinary labor.

Compared to other professions, engineering does not have as high a status and prestige.

H. Engineering Colleges and the Shortage of Engineers

A 1968 staff report of the Commission on Human Resources and Advanced Education states that the prospects for meeting the demand for engineers at the bachelors' level are very poor. An estimate of the National Science Foundation at that time has projected that about 61% of the entrants to the field of engineering would be made up of engineering graduates, while the rest would be drawn from other sources. Because of an inadequate supply of engineering graduates the demand has been met by employing less educated people

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[53] "Engineering a Sub-Profession?" High Technology, Vol.2, No.6, Nov./Dec. 1982, p.90.

who have obtained experience on the job.[54] While this may have been true for entry level jobs, shortages for experienced engineers have always been doubted.[55] Assignments in new technologies go to younger engineers, while older engineers are doomed to obsolescence and possible unemployment.[56]

The 1970 staff report of the Commission on Human Resources and Advanced Education states that since the need for engineers has been so widely publicized, it is doubtful that more freshmen can be attracted in engineering programs. Yet, in spite of fluctuations in the economy, more and more students have been attracted. Even during the current recession, when the College Placement Council reports that graduates are receiving 50% less job offers, the Fall '82 engineering enrollment has reached an all time high.[57,58]

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54 Folger et al., op. cit., p.97

55 Prof. Engrs. Conf. Board, op. cit., p.56.

56 Zimmerman, op. cit., p. 70.

57 "Personal and Professional," Machine Design, Vol.55, No.13, June 9, 1983, p.179.

58 "Personal and Professional," Machine Design, Vol.55, No.23, Oct. 6, 1983, p.253.

Committee for the Analysis of Engineering Enrollment points out:

> "Methods do not exist for making reliable and meaningful forecasts of demand for engineering graduates, whether long-term or short-term forecasts. If it is possible to develop such methods, it will be at great cost. Both short-term and long-term forecasts are heavily biased by the economic condition existing at the time they are made. Accordingly, forecasts have limited usefulness."[59]

The same staff report also mentions that the American educational system produces more college graduates than are required for the growth of the occupational structure thus resulting in what it calls "educational upgrading", which primarily occurs in periods of slow economic expansion and during a change in the occupational structure. Even during periods of continued economic growth, over a quarter of the graduates would be available to upgrade the educational level of occupations. The cost of an inadequate supply of educated persons is, according to this report, probably greater than carrying the surplus.[60] Thus one can reason in a similar fashion that an upgrading of the engineering community is taking place during the current recession. The staff report also observes that colleges, besides providing education, also channel students into occupations and careers, eliminating those who seem to lack the prerequisites for entry to a profes-

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[59] Folger et al., op. cit., p.98

[60] Ibid., p.41.

sional occupation.[61]

The report points to the high attrition rate among engineering students. This rate is higher than the average for all college students. The committee suggests to study the problems affecting retention of engineering students, as, for instance, overly rigorous curriculum, ineffective teaching practices and failure to hold interest in engineering.[62]

J. Summary

Today the entering college freshman, who considers an engineering career, is faced with a changing economic and technological environment. The long-term high demand for engineers has come to an abrupt end, still leaving a legacy of overcrowded colleges and a shortage of faculty, with a threatened deterioration in the quality of education. In industry there are changes in work ethic, a declining demand for engineers and an increase in unemployment. All this forces a decision upon the prospective engineering student who is looking for a fulfillment of his needs and desires.

Choosing an occupation is a continuous process. It is an interaction between the individual's personality

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61 Folger et al., op. cit., p.13.

62 Ibid., p.95.

and outside influences, that limit the number of possible solutions. Eventually a pattern of interests is formed that provides a basis for planning.

Interest is a response to a positive disposition toward an object. It is an aspect of behavior and is acquired through learning. The sum of many interests forms a pattern as, for instance, a pattern of occupational interests. There are indications that a relationship exists between interests and abilities.

The degree and kind of interaction between an individual's heredity and his environment is important for occupational psychology. On one side there are his needs and drives, on the other side there is his status and role in society with its cultural traits. There is hardly a society where the father's position does not influence occupational choice. While interest is a basis for choice, the direction of this choice is often altered by outside pressures. Frequently it is directed by the course of the person's life.

Men engaged in an occupation have a common pattern of interests. Also a certain set of factors that motivate entry into engineering may be identified, such as influence of father, relatives and friends, vocational counseling, aptitude tests, recruiting by industry and schools, success in in engineering related high school courses, particular interest in engineering, prospective income,

tuition and location of school, previous technical work experience.

A series of aspects that provide for a satisfying engineering career can be listed, such as challenging or innovative work, financial security, advancement, social status and prestige. Career satisfaction is cyclical, alternating with dissatisfaction.

Similarly, negative aspects may be listed that can cause dissatisfaction: work pressures and limitations, effort spent in engineering studies not fully rewarded, employment opportunities less than expected, engineers not treated as professionals, lack of status compared to other professions.

The widely publicized shortage of engineers may be a factor that motivates many people to take up engineering. However, forecasts for demand of engineers are heavily biased by the economic condition at the time they are made. The resulting cyclical surplus of college graduates causes an educational upgrading of the society. Colleges also channel students into occupations and careers and screen out the unfit. A problem of retention of engineering students exists.

II. THE SURVEY

A. Design of the Questionnaire

From the initial concept on, this study was planned to be carried out on the basis of survey, conducted by means of a mail questionnaire.

Since the rate of response to a mail questionnaire depends very much upon how easy it is to answer, the main task was to condense the various factors and aspects so, that everything mentioned here would be included within a minimum number of questions.[63] The only freedom the respondent was to be allowed, was to decide whether a question is pertinent or not. If his decision would turn out positive, he would put a check mark in the provided space. If not, he would leave it blank. This would avoid long, wordy "excursions" and ambiguities, and would make the task of answering possibly easy. Being fully aware that not all possible factors and aspects had been included in the questions, an open-ended, write-in question was added at the end of each section. This open question served a dual purpose: it would catch anything that was missed in the design of the questionnaire and would also provide a "safety valve outlet" for the respondent who would feel

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63 Julian L. Simon, Basic Research Methods in Social Sciences, 2nd. Ed., New York, 1978, p.197

"locked in" by the rigid form of the questionnaire.

Besides the check-off type questions, it also asks for the respondent's age entering college, at graduation and at present, also whether a graduate of NJIT or other school. The questionnaire itself consists of two main parts. The first part asks the respondent what motivated him to choose the engineering profession. The second part asks him to list aspects of his job, career or the engineering profession. This second part has two sections, one for positive aspects, one for negative. A copy of the actual questionnaire, distributed in the course of the survey, is to be found in Appendix "A".

As the response rate may also be influenced by the cover letter, it was composed stressing the respondents interest in the survey.[64] The anonymity of the survey was maintained. A copy of the cover letter is added as Appendix "B".

B. The Sample

A total of 303 questionnaires were mailed to NJIT B.S. degree recipients of the classes of '75, '76, '77, '78 and '79.

Of the above, residents by state were: Arizona 2, California 6, Connecticut 5, Florida 6, Illinois 3, Louisiana 2, Maryland 3, Massachusets 1, Michigan 1, New York 17, Ohio 5, Pennsylvania 9, Texas 2, Virginia 3,

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64 Simon, loc. cit.

Washington 2, West Virginia 2, Wisconsin 1. The rest of the addressees were New Jersey residents, or 76.6%. Seven of the addressees were women. This sample will be referred to as "NJIT Sample."

Furthermore, 204 questionnaires were mailed to NJIT M.S. degree recipients of the years 1972 through 1979 who had received their bachelor's degrees from schools other than NJIT.

In this group residents by state were: Arkansas 1, California 2, Colorado 1, Connecticut 1, Delaware 1, Florida 5, Illinois 2, Louisiana 2, Maryland 4, Michigan 1, New York 8, Ohio 3, Pennsylvania 8, Rhode Island 1, Texas 7, Virginia 1, Washington 1. The rest were New Jersey residents, or 76.0%. One addressee was a woman. This sample will be referred to as "Other Schools" sample.

Only engineering degree recipients were considered for the survey.

C. Collection of the Data

1. Response to the Survey

A number of questionnaires were returned by the post office as undeliverable. From the NJIT batch of questionnaires 15.5% were returned and from the other schools batch 17.6%.

A total of 160 responses for the NJIT sample were received. Assuming that all unreturned questionnaires reached the addressees, this means a 62.5% response.

For the other schools sample a total of 86 questionnaires were received, giving a 51.2% response. In a number of cases the respondents had not indicated their undergraduate schools. These responses were considered invalid for the purpose of this study, since the meaning of the other schools sample was to provide a comparison, a control group for the NJIT sample. Questionnaires marked "undergraduate school NJIT" were also voided for the other schools sample, but were added to the NJIT sample. Thus a total of 18 or 21% of the other schools sample were considered invalid. Therefore the final size of the other schools sample became 68.

A total of 10 responses for the other schools batch had been marked "undergraduate school NJIT". These were added to the NJIT sample making its final size 170.

2. Inherent Differences Between Samples

While both samples were practically identical as far as New Jersey residency is concerned (76.6% NJIT, 76.0% Other Schools), their age make up was different. The weighted average age of the NJIT Sample was 30.53 years, with 24 years as the minimum and 56 as the maximum. The majority (81%) was concentrated in the 25 - 36 year range.

The weighted average of the Other Schools Sample was 39.43 years (29 min., 65 max.) with 50% in the 33 - 39 year range.

Work experience, measured in terms of years since graduation (B.S.) for the NJIT Sample was 6.04 years

weighted average, with 83.5% in the 3 - 8 year range, 3 years minimum, 26 years maximum. For the Other Schools Sample the weighted average work experience was 16.6 years since receipt of B.S. degree, with 50% in the 12 to 17 year range. This sample had also a weighted average of 7.9 years since receipt of master's degree (2 min., 22 max.) with 76% in the 3 to 10 year range.

7% of the NJIT respondents and 6% of Other Schools respondents had omitted their age data, which made it impossible to include them in those parts of this study where such data were required.

D. Processing of the Data

1. Definition of Terms

For the purpose of processing the data a few definitions have been devised.

The first part of the questionnaire (Questions 1 - 12), dealing with motivation factors, is arranged according to the following logic: Respondents to questions 1, 2, 3, that list as motivation factors father, relatives, friends, vocational counseling and recruiting, may be considered influenced by outside factors. They could be termed "outer directed." For those who have checked off questions 4, 5, 6, (engineering related high school courses, real interest in engineering and prestige of the engineering profession) motivation has been born out of their inner feelings and realization. They could be called "inner directed." Ques-

tions 7 and 8, expected income and demand for engineers, are practical considerations and these respondents could be called "utility directed." Questions 9, 10, 11, financial factors, lack of choice of school nearby, work in technical field are outside limitations, occuring in the course of the person's life. These respondents could be called "course-of-life directed."

To facilitate evaluation and to avoid an excessive fragmentation of the sample, the following motivation factor groups have been defined:

Motivation Group	I	- Outer Directed	(qq 1, 2, 3)
"	II	- Inner Directed	(qq 4, 5, 6)
"	III	- Utility Directed	(qq 7, 8)
"	IV	- Life Directed	(qq 9, 10, 11)

The second part of the questionnaire lists 12 aspects of career, 6 positive and 6 negative (including write-in questions.) In order to attempt a quantitative evaluation of career satisfaction, each positive aspect was assigned one (+1) satisfaction point, and each negative aspect one (-1) dissatisfaction point. For each respondent the sum of these points would give a measure of his satisfaction or dissatisfaction. For each age, year or motivation group the mean of these sums would result in a satisfaction coefficient.

It is fully recognized that each individual sets a different value on each of these aspects. This, however, would be impossible to measure, even more so, since each of the respondents would be hard put to assign a value to

to a single career aspect for himself.

2. Treatment of the Data

All entries in the questionnaires were copied on work-sheets, separate for each sample. From these data each respondent was assigned his motivation factor groups and satisfaction measure. Then respondents were classified according to the various combinations of their motivation factor groups. Furthermore, respondents were arranged according to age and years since receipt of bachelor's and master's degrees. All through this process each retained his identity (anonymous, however) through an identification number, assigned upon the return of the questionnaire. He also retained through each step of processing his basic data: age, years since graduation, motivation factor groups and satisfaction measure.

3. Presentation of the Data

All the answers to single questions in the questionnaires have been tallied up and expressed as a percent of each sample. The results are shown in Tables I and II, where opposite to the question number and its wording are entered in two columns (NJIT and Other Schools) the percent amounts of each sample that have checked off this question. As a next step, these figures have been presented visually in the form of bar charts in Figures I and II. Then satisfaction/dissatisfaction data have been plotted as a func-

tion of age (see Figures III and IV) and also as a function of years since graduation (Figures V and VI). From the points plotted in these diagrams trend lines have been developed by means of linear regression.

Furthermore, the relative distribution of motivation groups within each sample is shown (Figure VII). This is again a modified bar chart, where the height of each column corresponding to a particular motivation group combination shows the fraction size of the sample belonging to this combination. Superimposed upon each bar is the mean satisfaction coefficient represented both as a figure and as a vector (to scale). This vector shows visually the relative magnitude and direction (plus or minus) of the satisfaction of the particular sample fraction. Coefficients and their vectors have been omitted where the size of the fraction is not statistically significant.

The last step in the processing is represented by Table V, which shows the percent of both samples belonging to the 13 possible values of the satisfaction numbers (+6 through -6). These figures are illustrated by bar charts in Figure VIII. Table V also indicates how many percent of each sample are satisfied, neutral or dissatisfied.

TABLE I

MOTIVATION FACTORS IN PERCENT OF SAMPLE

Quest. #		NJIT SAMPLE	OTHER SCHOOLS SAMPLE
1.	Influence of father	25.9	32.4
2.	Influence of relatives or friends	26.5	26.5
3.	High school counseling, voc. aptitude tests, recruiting	34.7	25.0
4.	Success in H.S. math, physics, chemistry or drafting courses	72.9	80.9
5.	Real interest in engineering	59.4	58.8
6.	Prestige of the engineering profession	27.1	35.3
7.	Expected income	44.7	42.6
8.	Apparent demand for engineers	34.7	44.1
9.	Financial factors (could not afford tuition for preferred non-engineering major, tuition refund by employer, etc.)	8.2	1.5
10.	Lack of choice of college in the immediate vicinity of domicile	2.9	4.4
11.	Work in engineering related field led to engineering studies	21.2	4.4
12.	Answers to write-in question	21.8	17.6

TABLE II

ANSWERS TO ASPECTS OF JOB, CAREER OR THE ENGINEERING PROFESSION IN PERCENT OF SAMPLE

Quest. #		NJIT SAMPLE	OTHER SCHOOLS SAMPLE
13.	My employment in engineering lets me use my skills, abilities or ideas to perform challenging or innovative work	68.8	69.1
14.	My employment in engineering yields the expected financial security	54.1	64.7
15.	My position offers preparation or opportunity for advancement	59.4	51.5
16.	My work gives me varied experience	78.2	73.5
17.	Being an engineer enhances my social status and prestige	30.6	35.3
18.	Write-in question (positive)	22.9	22.1
19.	Work pressures and limitations do not let me perform my work to my satisfaction	32.9	27.9
20.	Effort spent in acquiring my engineering degree does not fully justify the obtained returns	15.3	23.5
21.	Employment opportunities in engineering are not as wide as I was led to believe	23.5	25.0
22.	Engineers are often referred to as a vital national resource, yet they are subjected to the same laws of supply and demand as ordinary labor	50.0	57.4
23.	Engineering as a profession, has not been able to establish its status and prestige to the same degree as other profs.	53.5	73.5
24.	Write-in question (negative)	28.2	27.9

TABLE III

LIST OF MOTIVATION FACTORS RANKED ACCORDING TO PERCENT OF REPLIES RECEIVED

NJIT Sample	%	Other Schools Sample	%
H.S. subjects	72.9	H.S. Subjects	80.9
Real Interest	59.4	Real Interest	58.8
Expected Income	44.7	Demand for engineers	44.1
Counseling & recruiting	34.7	Expected Income	42.6
Demand for Engineers	34.7	Prestige of Engrg.	35.3
Prestige of Enginrg.	27.1	Influence of Father	32.4
Relatives and friends	26.5	Relatives and friends	26.5
Influence of father	25.9	Counseling & recruiting	25.0
Work experience	21.2	College near home	4.4
Financial (e.g. tuition)	8.2	Work experience	4.4
College near home	2.9	Financial (e.g.) tuition	1.5

TABLE IV

LIST OF CAREER ASPECTS RANKED IN ORDER OF PERCENT OF REPLIES RECEIVED

NJIT Sample	%	Other Schools Sample	%
		Positive Aspects	
Varied experience	78.2	Varied experience	73.5
Challenging or innovative work	68.8	Challenging or innovative work	69.1
Advancement	59.4	Financial Security	64.7
Financial Security	54.1	Advancement	51.5
Status and Prestige	30.6	Status and Prestige	35.3
		Negative Aspects	
Engineering as profession not established	53.5	Engineering as profession not established	73.5
Engineers treated as ordinary labor	50.0	Engineers treated as ordinary labor	57.4
Cannot perform work to own satisfaction	32.9	Cannot perform work to own satisfaction	27.9
Employment opportunities not as wide	23.5	Employment opportunities not as wide	25.0
Effort spent in studies not fully rewarded	15.3	Effort spent in studies not fully rewarded	23.5

TABLE V

CAREER SATISFACTION AS PERCENT OF TOTAL SAMPLE

Satisfaction Number	% of NJIT SAMPLE	% of Other Schools SAMPLE
+6	1.8	0.0
+5	5.3	4.4
+4	8.8	8.8
+3	14.7	11.8
+2	13.5	13.2
+1	15.9	22.1
0	15.9	13.2
-1	14.1	11.8
-2	3.5	4.4
-3	3.5	5.9
-4	2.4	1.5
-5	0.6	1.5
-6	0.0	1.5
% of Sample Satisfied	60.0	60.3
% of Sample Neutral	15.9	13.2
% of Sample Dissatisfied	24.1	26.5

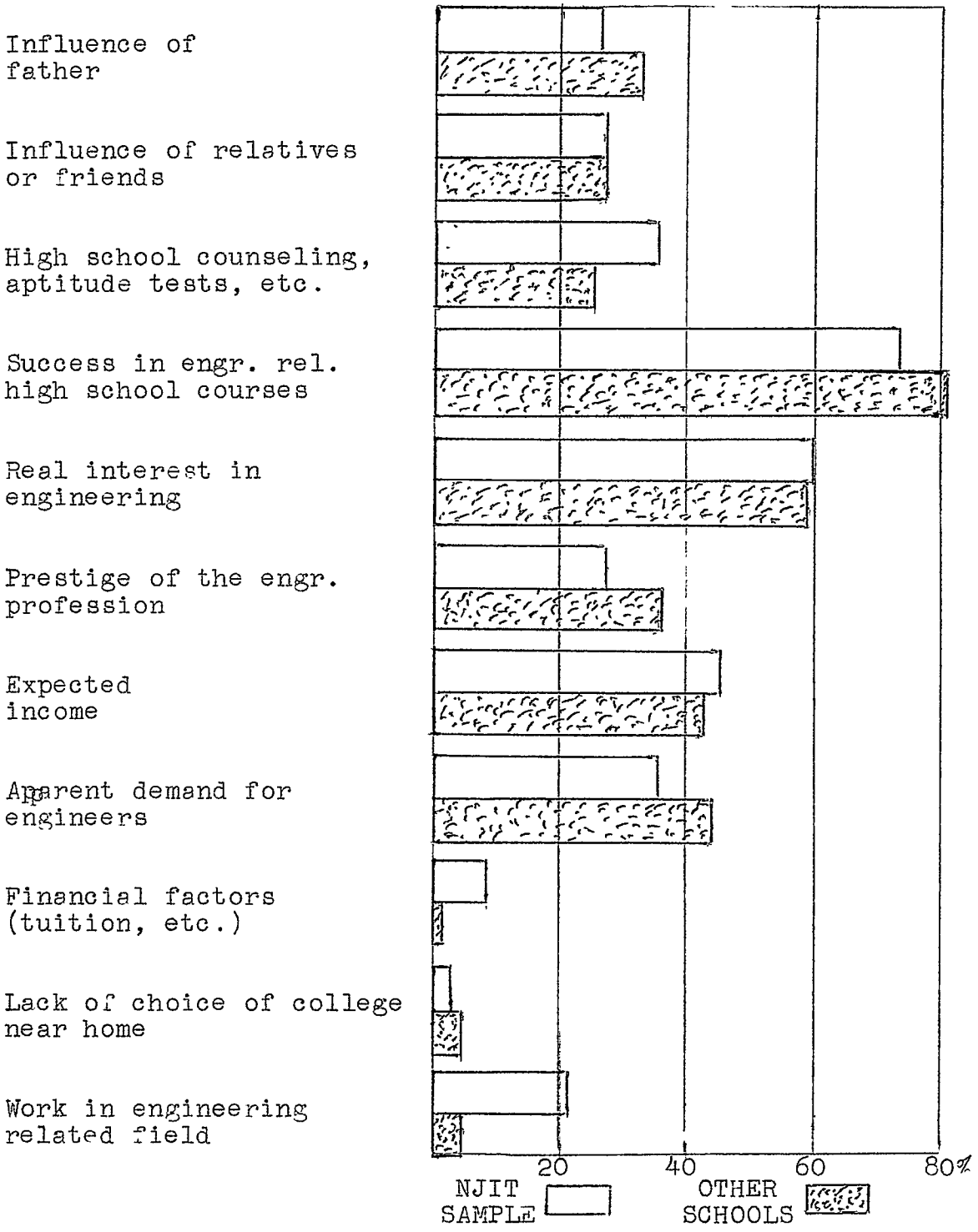


FIGURE I

MOTIVATION FACTORS IN PERCENT OF SAMPLE

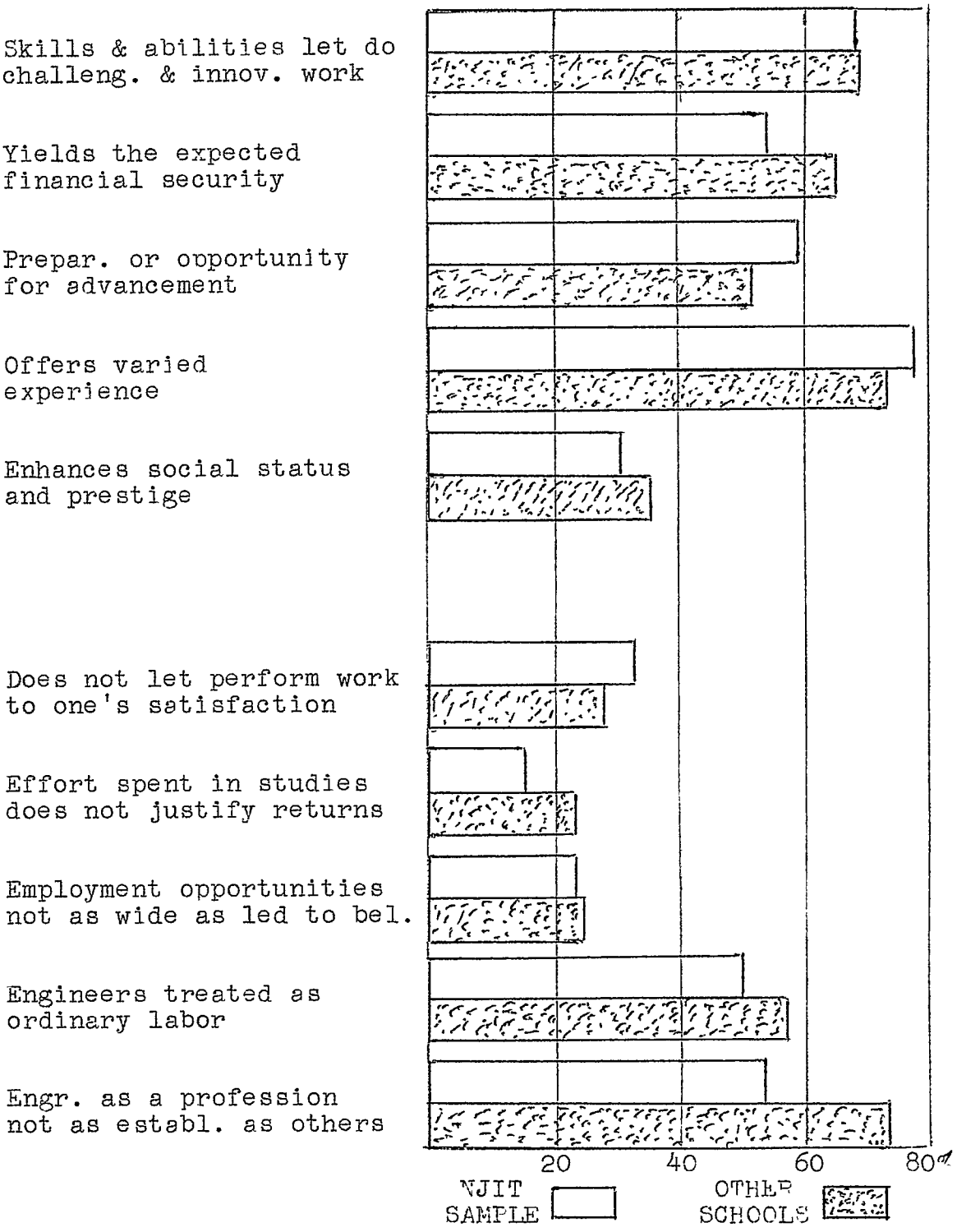


FIGURE II

ASPECTS OF JOB, CAREER OR THE ENGINEERING PROFESSION
IN PERCENT OF SAMPLE

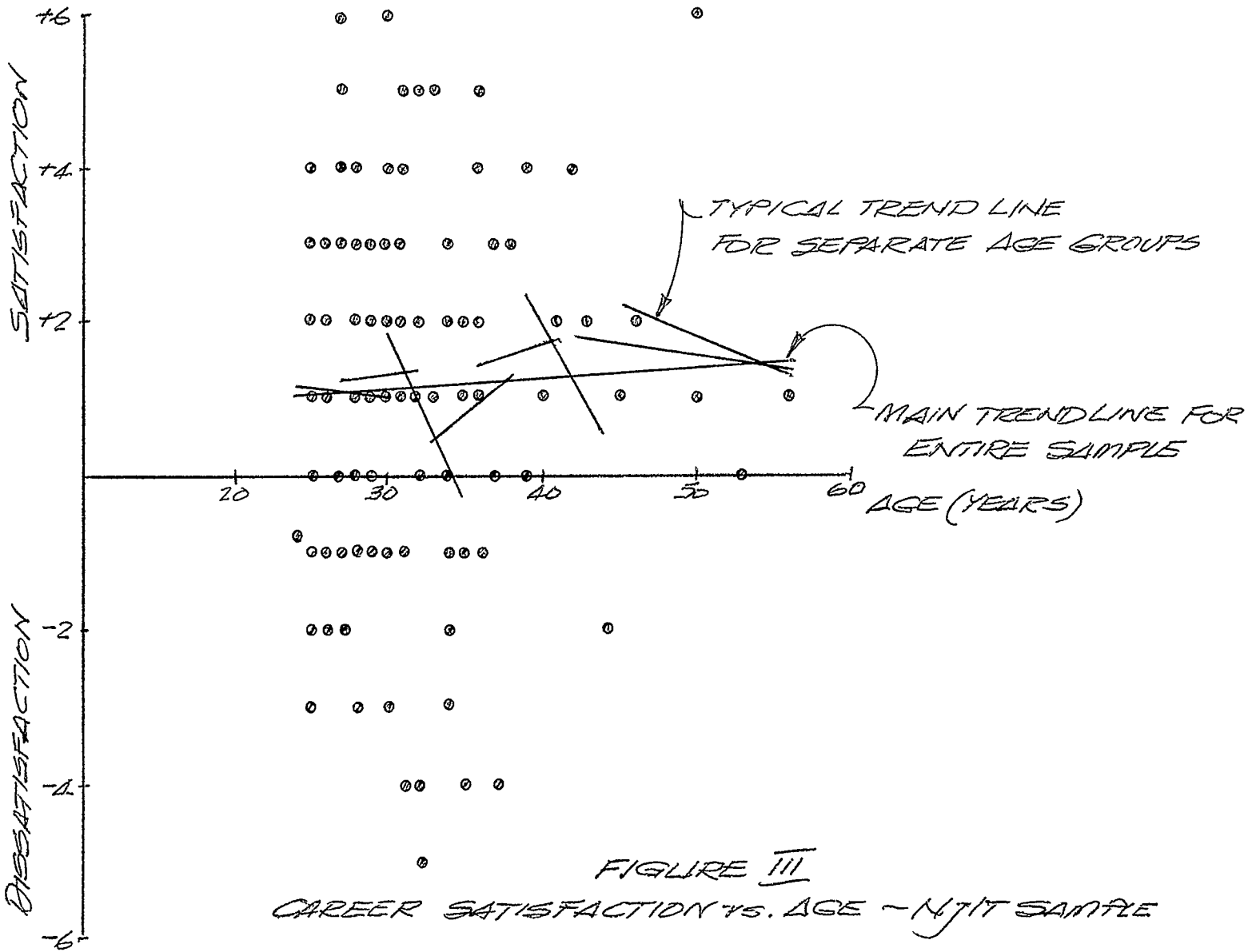


FIGURE III

CAREER SATISFACTION vs. AGE – NJIT SAMPLE

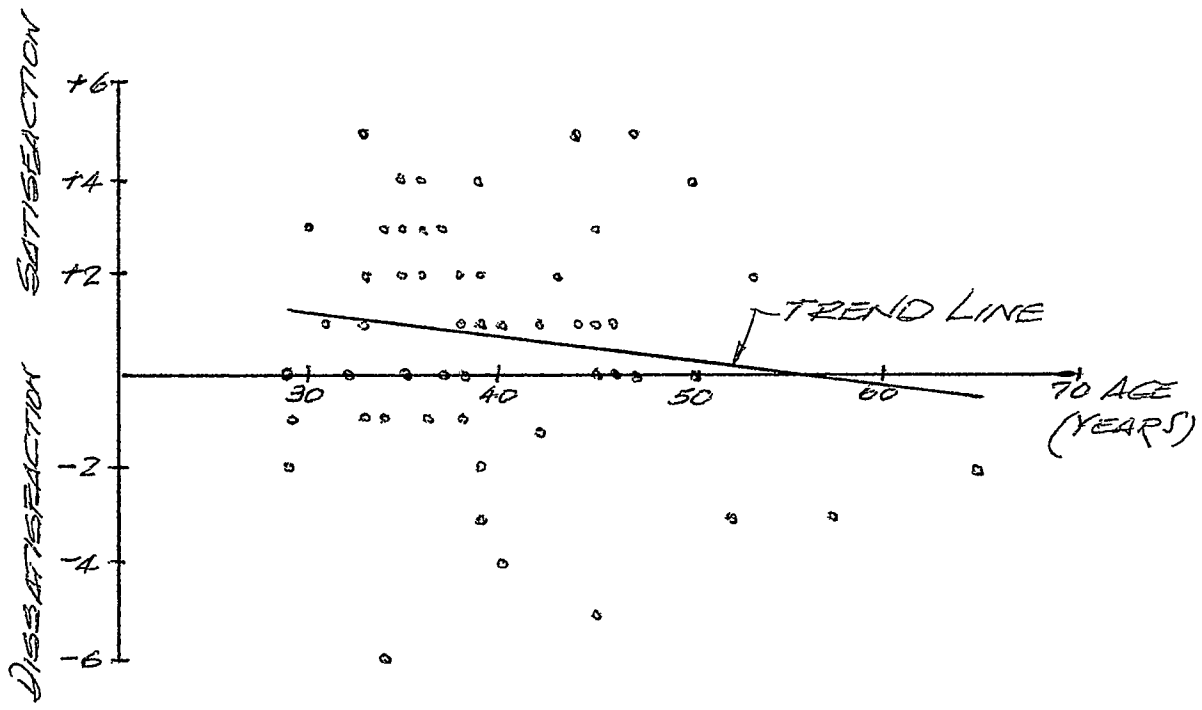


FIGURE IV
CAREER SATISFACTION VS. AGE
OTHER SCHOOLS SAMPLE

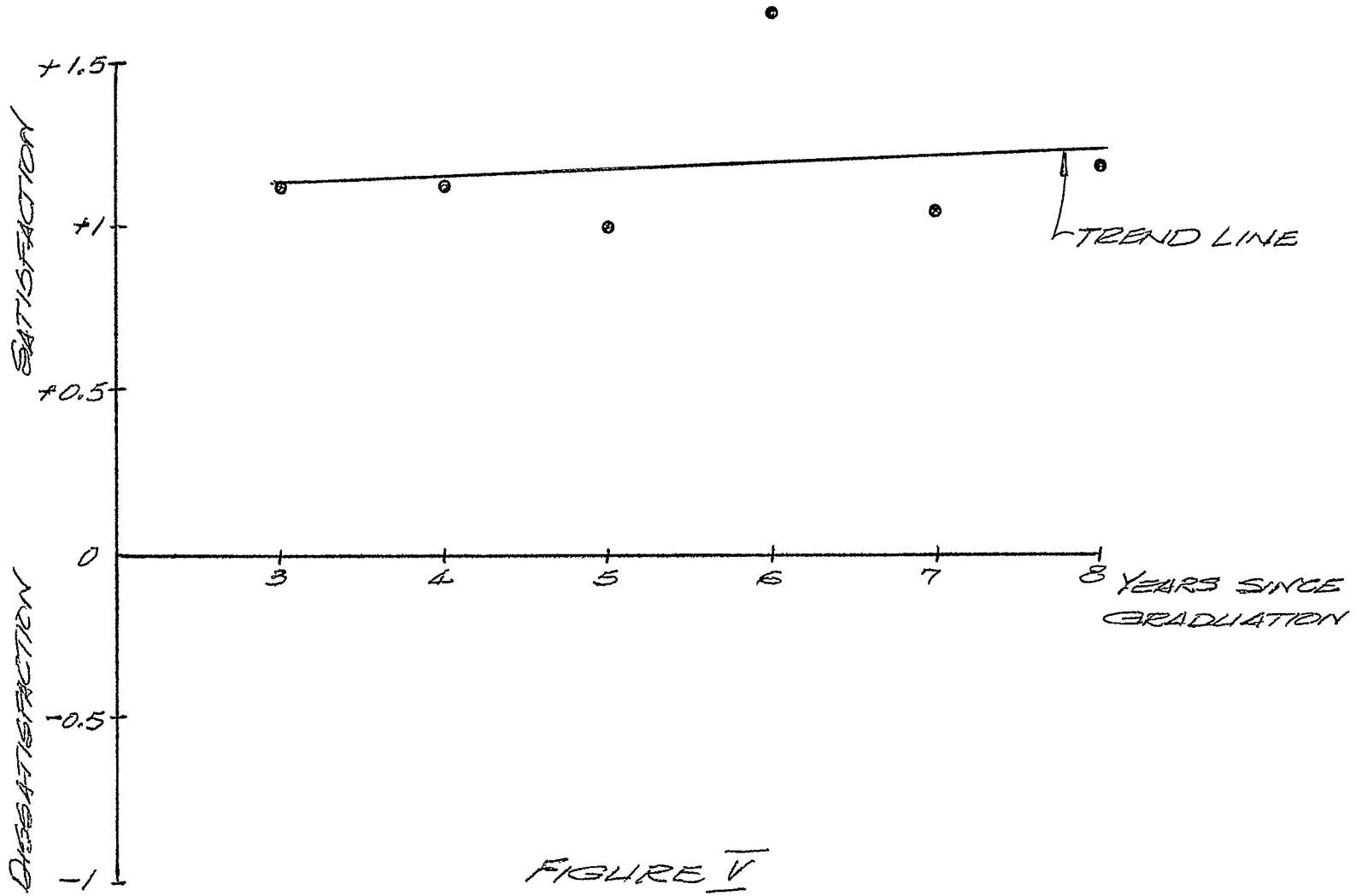


FIGURE V

NJIT SAMPLE

SATISFACTION VS. YEARS SINCE GRADUATION (B.S.)

SIMPLIFIED REPRESENTATION - SATISFACTION COEFFICIENTS CALCULATED SEPARATELY FOR EACH YEAR

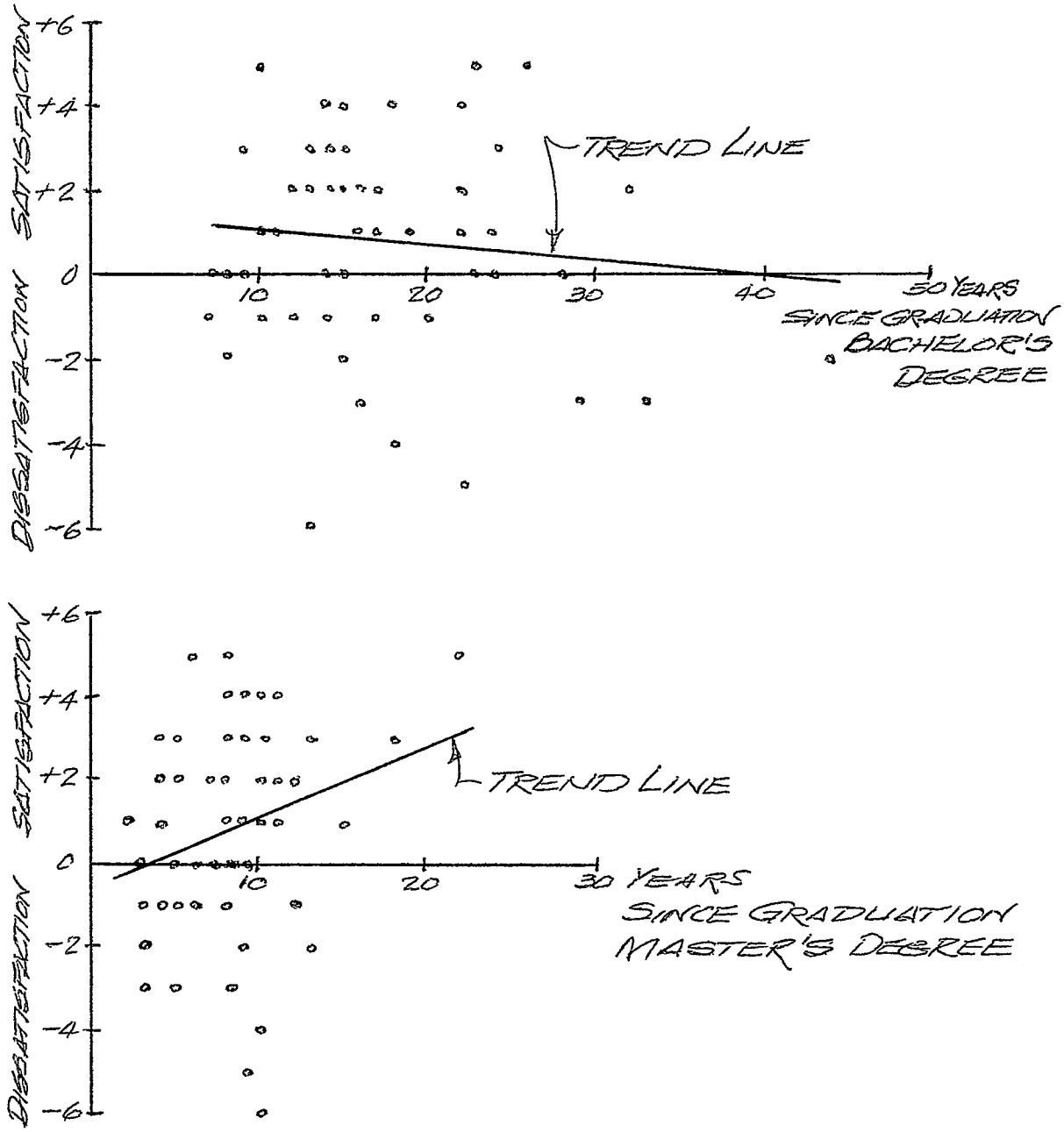


FIGURE VI

OTHER SCHOOLS SAMPLE

SATISFACTION vs. YEARS SINCE GRADUATION

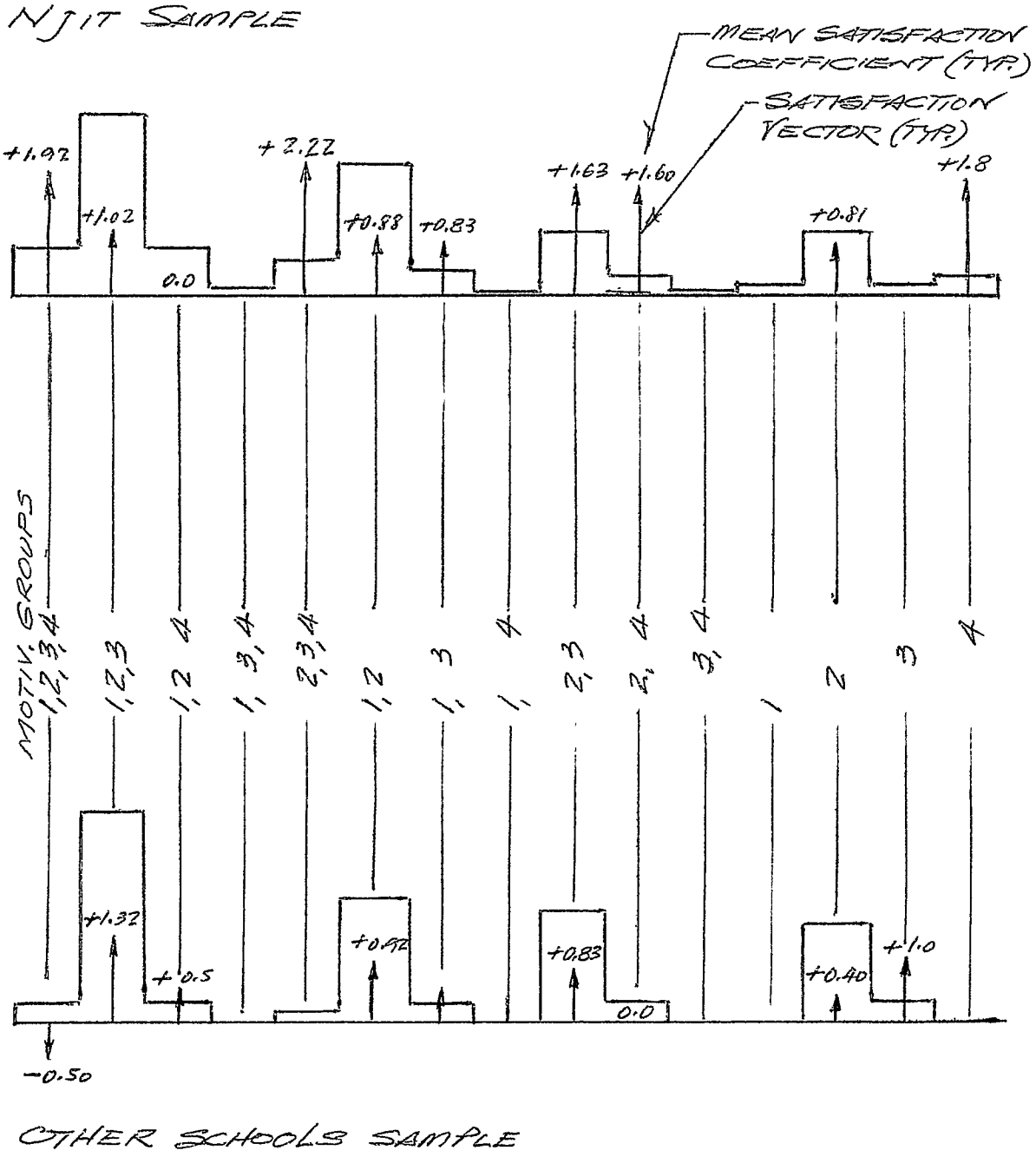
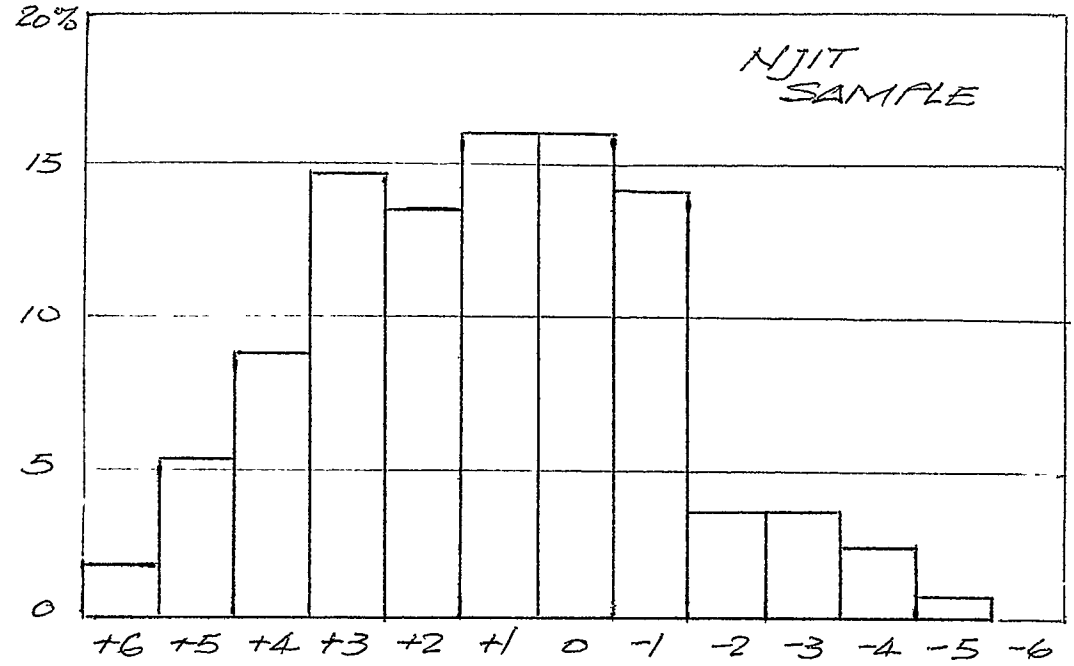


FIGURE VII

RELATIVE DISTRIBUTION OF MOTIVATION GROUPS WITHIN SAMPLE



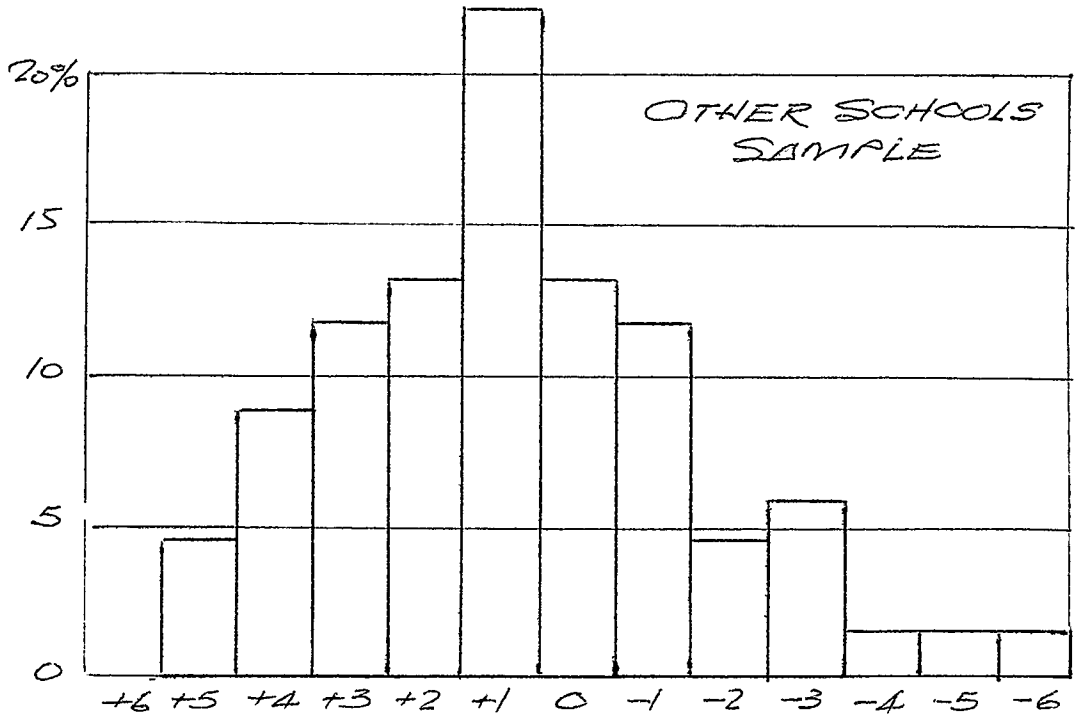


FIGURE VIII
CAREER SATISFACTION IN % OF SAMPLE

E. Discussion of Results

1. Motivation Factors

The presentation in tabular form (Table I.) and visual bar chart form (Figure I.) show that the most popular motivation factor for both samples is success in engineering related high school courses (72.9% NJIT, 80.9% Other Schools.) Then follows real interest in engineering (59.4% NJIT, 58.8% Other Schools.) The third largest group within the NJIT Sample is expected income (44.7% NJIT, 42.6% Other Schools.) Within the Other Schools Sample third largest is apparent demand for engineers with 44.1% (34.7% NJIT.) For an arrangement of motivation factors according to percent within each sample see Table III.

2. Positive Aspects of Career

Of the five positive aspects of the engineering career most respondents in both samples have entered varied experience (78.2 NJIT, 73.5% Other Schools.) As the second largest group appears challenging or innovative work (68.8% NJIT, 69.1% Other Schools.) The least number of people feel that being an engineer enhances social status and prestige (30.6% NJIT, 35.3% Other Schools.) See Table IV. for a list of career aspects ranked in order of percent of replies received.

3. Negative Aspects of Career.

Most people in both samples have checked the aspect

that engineering as a profession does not have the status and prestige as other professions (53.5% NJIT, 73.5% Other Schools.) As second ranks "engineers are subjected to the same laws of supply and demand as ordinary labor" (50% NJIT, 57.4% Other Schools.) The least number of people feel that effort spent in acquiring an engineering degree does not justify the obtained returns (15.3% NJIT, 23.5% Other Schools.) See Table IV. for an arrangement of these aspects according to the sample fraction size that agree with these statemants.

4. Change of Career Satisfaction with Age

Here satisfaction measure is plotted against age. These plots appear as scatter diagrams in Figures III. and IV. From these points trend lines have been obtained by linear regression. For the NJIT sample the trend line is slightly ascending, (slope 0.01) signifying a rise in career satisfaction with age. This trend line is also well in the positive region of the plot and always stays above +1. Since the size of the sample warrants it, additional trend lines are shown for overlapping age groups. They have more pronounced slopes, both positive and negative. It is possible that the entire plot represents some oscillating function whose average value is the main trend line, indicating the cyclic nature of work satisfaction.

Figure IV. shows a trend line with a negative slope

for the Other Schools Sample which is somewhat steeper (slope -0.05) signifying a drop in career satisfaction with advancing age. This line starts above +1 (+1.33) and crosses the horizontal age axis into the negative region at about age 56.

The trend lines, superimposed on the scatter diagram plot have been obtained by a least squares fit of pairs of data points, reducing these separate pairs to the equation of a straight line with the general form $y = mx + b$, where m is the slope of the line and b is the y-intercept. However, not too much of a mathematical significance could be attached to this, since the coefficients of determination are very low: 0.001 for the NJIT overall plot and 0.03 for the Other Schools Sample. Yet they indicate the general tendency of a change in satisfaction with advancing age. Therefore the term "trend line" is used throughout this and other chapters.

5. Change of Career Satisfaction with Increase in Work Experience

Work experience here is measured in terms of years since graduation. Data have been treated in the same manner as for satisfaction vs. age, (see Figures V. and VI.) For the NJIT Sample the trend line is ascending (slope 0.019, coefficient of determination 0.024) as in the age function, signifying increase in career satisfaction with increase in experience. The trend line is also located in approximately the same portion of the

positive region as in the age plot.

For the Other Schools Sample two plots are shown (Figure VI.) The plot of satisfaction vs. years since receipt of bachelor's degree has a similarly negative trend line as in satisfaction vs. age. The slope is -0.04, meaning a decrease in career satisfaction with increase in work experience. The line is also located in approximately the same region as in the age plot (somewhat lower, though). On the other hand, the plot of satisfaction vs. years since graduation with a master's degree has a much steeper positive slope (0.17), starting at -0.25 and crossing into the positive region at about 3 years. This means a general increase in career satisfaction. The coefficients of determination are 0.01 for years since graduation with a bachelor's degree and 0.07 for years since receipt of master's degree.

6. Combinations of Motivation Groups

In pages 28 and 29 four motivation groups were defined: outer directed, inner directed, utility and life directed, to which the respondents belong by virtue of the motivation factors checked off in their questionnaires. Only a minority of the respondents belong to single motivation groups. Most belong to a combination of motivation groups, as illustrated in Figure VII. In the NJIT Sample all 15 possible combinations of the four motivation groups are represented. The Other Schools Sample is smaller, there-

fore also less fragmentated. Here only 10 combinations are represented. For both samples the largest sample fractions belong to (1,2,3), (1,2), (2,3) and (2) combinations, with the (1,2,3), outer, inner, utility directed as largest for both respondent groups. Figure VII. also shows the satisfaction coefficient for each combination within a sample, except where the number of respondents is statistically insignificant.

Thus Figure VII. is also an attempt to correlate motivation factors with career satisfaction.

7. Career Satisfaction

Career satisfaction is represented in Table V., showing the percent of each sample corresponding to the 13 satisfaction numbers. The data of this table are incorporated in the bar charts of Figure VIII. Within the NJIT Sample the largest groups are those with satisfaction numbers +1 and 0 (15.9% each). The second largest is the +3 group (14.7%). In the Other Schools Sample the largest is the +1 group (22.1%) with +2 and 0 following (13.2% each.) Table V. also shows the percent of each sample that are satisfied with their careers (plus numbers), neutral (zeros) and dissatisfied (minus numbers.) 60% within both the NJIT and Other Schools Samples are satisfied. 24.1% of the NJIT Sample and 26.5% of the Other Schools Sample are dissatisfied.

The mean satisfaction of the NJIT Sample was +1.15

with standard deviation 2.28. The mean satisfaction of the Other Schools Sample was +0.81, with a standard deviation 2.39. A test of means was performed which confirmed the hypothesis that the satisfactions of the NJIT Sample and the Other Schools Sample were equal at a level of significance of 0.01.

F. Answers to Write-in Questions

1. Motivation

In general, all answers to write-in questions confirm the purpose for which this item has been added to the rigid check-off type questions: to provide a "safety valve outlet" for those respondents who would not be satisfied with merely checking off items or passing them over. There has been, however, a second reason: a hope to catch additional motivation factors, which may have escaped the preliminary research for the design of the questionnaire. Examining the answers for both, NJIT and Other Schools Samples, none have been found that would not fit in any of the "pre-digested" eleven categories.

Answers to these write-in questions have been compiled in Appendix "C".

2. Positive Aspects

There are about ten respondents (counting both samples) who state each in his own words that they enjoy their work and are satisfied. Many find that being employed in the

engineering field helps in decision making, provides for an analytic approach to tackle everyday problems methodically. Two respondents state service to public, and another two responsibility as positive aspects of their careers. Additional entries name employment opportunities and chance to move into management as positive points.

A compilation of these comments is to be found in Appendix "D".

3. Negative Aspects

Some of the more prevalent grievances are: engineers are not paid for the high degree of responsibility they hold, also complaints about salary compression, a very limited application of college education, college education not up-to-date. Schools should also stress more communications skills. Other negative points are: the cyclical nature of employment, a currently depressed chemical engineering field, competition by foreign engineers and lack of job security. Engineers are controlled by accountants and not fully viewed as professionals. It is also very difficult to find a job that does not require a high degree of specialization. One respondent writes: "Women are more criticized in the engineering field. There are pressures plus when a woman (is) in a 'major' man's field." There are also comments about the rapid obsolescence of engineering knowledge, especially in electronics, and about difficulties in communicating with non-engineer-

ing types of managers.

These remarks are to be found in Appendix "E".

3. Summary

The basis for this study was a survey, conducted by means of a mail questionnaire. It consisted of one part inquiring into the reasons for choosing engineering as a profession and of another part asking for positive and negative aspects of the engineering career. To facilitate ease of answering, most questions were of the check-off type with one write-in space each for motivation factors, positive and negative career aspects.

The survey was anonymous and was conducted among NJIT Bachelor of Science graduates of the years 1975 - 79. These respondents were defined as "NJIT Sample." Questionnaires were also mailed to NJIT Master of Science graduates of the years 1972 - 79 who had received their B.S. degrees from other schools. These respondents acted as a control group and were defined as "Other Schools Sample." Thus, inherently, the control group was older. The age difference, on the average, was about 9 years, while their average work experience was about 10 years higher. Only holders of engineering degrees were included in the both samples.

To perform a quantitative evaluation of career satisfaction each answer to a positive aspect of career was

assigned one satisfaction point and each negative aspect one dissatisfaction point.

The answers in terms of a percent of each sample are shown in Tables I. and II. and Figures I. and II. Satisfaction/dissatisfaction data have been plotted as a function of age in Figures III. and IV. and as a function of work experience in Figures V. and VI. Motivation factors have been ranked according to percent of replies in Table III. which shows engineering related high school courses in first place. Career aspects, ranked in order of percent of replies received, have been listed in Table IV, which shows varied experience as first positive item for both samples and engineering as not having been able to establish itself as a profession as first negative aspect for both samples. Trend lines have been developed from the satisfaction data plots that show a slight rise in career satisfaction with increase in age for the NJIT Sample and a slight drop for the Other Schools Sample. A similar condition is shown in change of career satisfaction since receipt of bachelor's degree: a rise for NJIT, a drop for Other Schools. However, Other Schools Sample shows an increase in satisfaction with increase of years since receipt of master's degree. Also, an attempt has been made to correlate motivation factors with job satisfaction, as illustrated in Figure VII.

Career satisfaction has been quantified and shown in

Table V and Figure VIII. A statistical evaluation has been performed showing that the general level of satisfaction for both samples is about equal.

Write-in answers to the motivation part of the questionnaire did not show any more factors besides those enumerated in the questionnaire. These write-in comments, as well as those dealing with career aspects were compiled in Appendices "C", "D" and "E".

III. CONCLUSIONS

In retrospect, the questionnaire has served its purpose well. A proof of this is the average number of checked-off answers: 8.98 for each respondent in the NJIT Sample (standard deviation 2.78,) and 9.25 in the Other Schools Sample (standard deviation 2.61.) The maximum number of answers in the NJIT group was 15, the minimum 3. For the Other Schools Sample maximum was 17 and minimum also 3. This means that the respondents were able to identify themselves or their problems with 37% or 38% of the items in the questionnaire.

The obtained results have been already discussed in Chapter II. There is, however, one item that deserves special attention. As mentioned in Chapter I., page 14, D.E. Super has reported that job satisfaction changes with age. This may be also confirmed by the alternating slopes of the trend lines for overlapping age groups in Figure III, Career Satisfaction vs. Age - NJIT Sample. Unfortunately, the limited size of the sample does not allow a closer scrutiny of this phenomenon. It would be desirable for any further studies to expand to a greater extent on this subject.

Alarming are the dissatisfaction figures in Table V. which mean that about a quarter in each sample are dis-

satisfied with their careers. A consolation may be that the method employed in the satisfaction measurement is not absolute.

Absolute is the fact that 15.3% of the NJIT Sample and 23.5% (again a quarter!) in the Other Schools Sample could identify themselves with the statement: "Effort spent in acquiring my engineering degree does not fully justify the obtained returns." This is cause for concern.

CRITICAL COMMENTS

Designers of plants and machinery for man-made fibers and films

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July 19, 1983

Mr. Gunar Bachs
22 Maple Street
New Brunswick, NJ 08901

Dear Gunar,

I have read with much interest your paper on "Career Choice and Career Satisfaction" in engineering. Though the sample was necessarily limited, too limited for in depth conclusions, some very encouraging facts can be flagged out. The percentage of students selecting to go into engineering based on their proven abilities in mathematics and science and because of the innovative work is for me bigger than expected.

As far as the career aspects and the reported complaints, I would like to point out:

1) That the survey is done at a very unfavorable period of economic recession and instability with lay-offs, postponed promotions, postponed salary raises, even salary reduction. A similar sample, surveyed the same way with the same questionnaire during the boom after WWII would have given a completely different result I am sure.

2) The average engineer should and does have more than one job during his career. Satisfaction and dissatisfaction can indeed change rapidly.

   Specially the start of a career when "school knowledge" gets tested against practical problems and needs, can can be a tough period for a junior engineer if not well guided and supported by older peers and supervision.

   On the other hand, the older engineer answering the questionnaire will have gone to highs and lows in career satisfaction.

The question as posed resulted probably in an answer based on the present status of mind of the subject, which can be very negative because of recession influences.

Perhaps a question should be asked: How satisfied were you in the beginning, middle and last part of your career?

3) A last question I would have liked to see included would be:
How well did your engineering education prepare you for what the real engineering world was expecting of you once you entered the career!

Did the schools really give the young engineers a solid enough base to have a good chance on a satisfactory start in their careers.

A most interesting question the answers to which would be very valuable to the colleges involved.

There is too little contact, interaction between engineering schools and industry. Industry would have an advantage by participating more in the engineers formation, by making available lecturors to the schools.

The schools would profit by having a more complete program, resulting in a better preparation of the young engineer for actual life in industry.

As said above, I read your paper with much interest. Somebody should follow-up on it, perhaps a group of students to be able to extend the sample and fine tune and where necessary add to the questions.

With best regards,

Eugeen E. Goossens
Senior Vice President - Engineering

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Dr Ronald F Larkin
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Vice Principal

December 14, 1983

Mr. Gunars Bachs
22 Maple Street
New Brunswick, NJ 08901

Dear Mr. Bachs:

I have read your paper "An Inquiry Into Engineering Career Choice and Career Satisfaction" and find it very interesting and appropriate research to be used by career counselors as they counsel students into the technical field of engineering. Most interesting are the motivating factors for success in engineering as related to high school subjects.

Here at New Brunswick High School students interested in engineering are encouraged in the academic areas, most especially Math and Science. They are also encouraged to participate in Raritan Indroduction to Minorities in Engineering (RIME). These students find the work challenging and feel that this type career will enhance their social status.

Thank you so much for sharing your paper with me. I would like to have a copy to share with my colleagues in the curriculum department.

Sincere best wishes for success!

Very truly yours,

Katye M. Monroe, Ed.D.
Vice Principal for
Curriculum and Instruction

/lm

VERMONT YANKEE NUCLEAR POWER CORPORATION

P. O BOX 157
GOVERNOR HUNT ROAD
VERNON, VERMONT 05354

October 13, 1983

Mr. Gunars Bachs
22 Maple Street
New Brunswick, NJ 08901

Dear Gunars,

Thank you for the opportunity to review the draft of your thesis "An Inquiry into Engineering Career Choice and Career Satisfaction".

Upon reading your thesis, my previous beliefs as to why one selects an engineering career and derives satisfaction were confirmed and supported by statistical data.

As the title already indicates, the thesis actually consists of two parts. The subject matter of the first part is to identify the various motives that induce students to take up engineering studies. Your success in identifying these factors is attested by the close agreement between the main survey sample and its control group. This is also illustrated by the histogram in Figure I.

In the second part of your thesis, you attempt to identify various aspects of the engineering career and profession. There, a similar agreement between the two samples is evidenced by Figure II. There was disagreement between the two samples in the change in career satisfaction with advancing age and increase in work experience. The only way to resolve this disagreement is to take a larger sample and look at results. I think that an attempt to increase the population sample would be a waste of time since their are many factors which effect career satisfaction. Age alone may not be significant. The steep increase in career satisfaction after receipt of a Master's degree was interesting. This may prove the value of continuing engineering studies after graduation and provide a basis for company sponsored educational reimbursement.

The method that you have designed to quantify and to measure job satisfaction is interesting. Instead of posing an outright question: "Are you satisfied with your career?" you have set up a series of positive and negative factors. As already mentioned, the validity of these factors is substantiated by Figure II. With the respondent's reaction to these factors you are, in a way, forcing him to reveal his true feelings, and thus arrive at the answer in a round-about way. As you point out, the method is not mathematically absolute. Nevertheless, it is interesting and valid.

As far as the questionnaire is concerned, readers of your thesis might be curious to see the family and social backgrounds of your respondents, as well as a relationship of these backgrounds to the answers about the status and prestige of the engineering profession.

In this age of mass production, not only of goods, but also of engineers, it is important not to lose sight of the individual, his needs and desires. In this sense your study is an important step in this direction. I am positive your thesis will be of value to both, engineering recruiters and recruits alike.

Very truly yours,

Warren P. Murphy
Vice President and Manager of Operations

WPM:pk

NOTES TO CRITICAL COMMENTS

It is true that the survey was carried out during a severe recession. However, as the chronology in Chapter I., page 2 shows, a 1982 mid-season slump was reported in the Dec. 9, 1982 issue of "Machine Design" and extensive lay-offs in the March 24, 1983, issue of the same magazine. The survey was conducted during February 1983, with the bulk of the questionnaires returned during February and March. Thus, in hindsight, the best timing for the survey would have been sometime during, say October 1982, somewhere between feast and famine. If it had been performed earlier in 1982, it would have run the risk of being optimistically biased.

However, it is inconceivable that all or most respondents have been swayed by the economic recession. As far as engineering jobs go, the recession had not progressed that far at survey time. Also, not only engineering positions were affected, but almost all jobs, and some even earlier than those in the field of engineering. That some have been influenced is entirely probable. Not only the respondents, but also those who did not care to respond, maybe just because of the recession.

As mentioned in Chapter III, the cyclic nature of career satisfaction should be specifically explored.

Inclusion of family and social backgrounds in the survey would be highly desirable, as the material discussed in Chapter I indicates, also satisfaction in the beginning, middle and present phase of career. This, however, would expand the questionnaire tremendously and thus risk scaring away the prospective respondents.

All these suggestions are extremely valuable and should be considered for future surveys.

APPENDIX "A"

QUESTIONNAIRE

Age: Entering College ____

At Graduation { B.S. ____ / M.S. ____

At Present ____

Undergraduate School { NJIT ☐ / Other ☐

Graduate School { NJIT ☐ / Other ☐

WHAT MOTIVATED YOU TO CHOOSE THE ENGINEERING PROFESSION?

(Please check ☑ as many factors as you feel are applicable)

1. Influence of father. ☐
2. Influence of relatives or friends. ☐
3. High school counseling, vocational aptitude tests, recruiting by engineering colleges and industry, etc. ☐
4. Success in high school mathematics, physics, chemistry or drafting courses. ☐
5. Real interest in engineering. ☐
6. Prestige of the engineering profession. ☐
7. Expected income. ☐
8. Apparent demand for engineers. ☐
9. Financial factors (could not afford tuition for preferred non-engineering major, tuition refund by employer, etc.) ☐
10. Lack of choice of college in the immediate vicinity of domicile. ☐
11. Work in engineering related field led to engineering studies. ☐
12. Others: (Please list as many as you feel necessary)

_____

_____

_____

_____

_____

_____

ASPECTS OF YOUR JOB, CAREER OR THE ENGINEERING PROFESSION:

(Please check ☑ as many as you feel are true)

13. My employment in engineering lets me use my skills, abilities or ideas to perform challenging or innovative work. ☐
14. My employment in engineering yields the expected financial security. ☐
15. My position offers preparation or opportunity for advancement. ☐
16. My work gives me varied experience. ☐
17. Being an engineer enhances my social status and prestige. ☐
18. Please list, if you care to, any other positive aspects of your career:

_____

_____

_____

19. Work pressures and limitations do not let me perform my work to my satisfaction. ☐
20. Effort spent in acquiring my engineering degree does not fully justify the obtained returns. ☐
21. Employment opportunities in engineering are not as wide as I was led to believe. ☐
22. Engineers are often referred to as a vital national resource, yet they are subjected to the same laws of supply and demand as ordinary labor. ☐
23. Engineering, as a profession, has not been able to establish its status and prestige to the same degree as other professions. ☐
24. Please list any other negative aspects of your career:

_____

_____

_____

APPENDIX "B"

COVER LETTER

Gunars Bachs
22 Maple Street
New Brunswick, N.J. 08901

February 22, 1983

Dear Fellow Alumnus:

Many studies have been conducted that deal with the problems of engineering manpower supply and demand. Generally, they are handled from the point-of-view of industry and engineering colleges. They disregard the problems and interests of both, you and me, who are the real suppliers and consumers of schools and industry. Thus we are relegated to the role of a "silent majority."

I am your fellow alumnus, Class of '78, and also a graduate student at NJIT, Department of Industrial & Management Engineering. In partial fulfillment of my program requirements, I have decided to write a master's thesis, inquiring into engineering career choice and career satisfaction.

For this purpose I have developed a questionnaire, which I am enclosing here, I would greatly appreciate it, if you could spare the time and answer the questions to the best of your satisfaction, thus also allowing your voice to be heard. Your desire to remain anonymous will be fully respected. Therefore, please, do not put your name on the questionnaire or on the return envelope.

Please return the questionnaire in the enclosed, stamped and pre-addressed envelope as soon as it is possible for you.

Thanking you in advance,

Sincerely yours

APPENDIX "C"

ANSWERS TO WRITE-IN QUESTION 12

ANSWERS TO WRITE-IN QUESTION 12
MOTIVATION

B.S. Graduates of NJIT

Enjoyment of the mechanical engineering field.

Continued college because of financing by Veterans Administration and promotional opportunities at work.

Interest in engineering and expected income led me to a 2 year tech. school. As a technician to increase income and the tuition refund led me to NCE for an eng. degree.

Watching the space program on TV while growing up.

Decision to enter engineering was my own.

Mechanically inclined.

I wanted to be an engineer.

Go to college.

Desire to enter a "different" field with a vast potential for upward mobility.

I picked engineering because of the sciences. If something went sour with engineering, I could always drop down to programing or something.

I was looking towards an engineering field which would give me flexibility of working both in the office and in the field. The engineering field I chose was civil engineering.

Became interested in civil engineering from engineering experience in Navy Seabees.

Visited many construction sites with my father when I was young. Was encouraged by my counselor to go into architecture.

A profession that you use your hands and your mind.
Chance.
Thought the transfer from school to work would be the easiest.

Re #8 - As you may recall, the demand for engineers when we started the program was at an all time low (1974) and almost prevented me from pursuing the field, but the courses suited my interests to keep me going anyway.

#11 was the strongest influence.

Had interest in construction.

I dropped out of B.S. physics, then out of B.S. computers. Then I became a stock broker and left that after 2 years. Subsequently I came to the U.S. and worked as a laborer. The latter motivated me to become an engineer (chemical) as I had an aptitude in that direction, the field was well paid and there was a demand for engineers - so I went for it.

Interested in auto mechanics since very young. Always seem to want to figure out how things work.

I knew Iwanted to be an engineer since I was seven years old. I am an EE because it is a harder concept to grasp and further segregates me from the majority of people in the world.

Watching (on TV) the first Mercury spacecraft lifting off into space.

It was obvious that a college education was necessary to make it in the future hi-tech society. Engineering seemed the only college route that was not a waste of time.

Inexpensive architecture school was not located nearby at time of graduation from high school.

Satisfaction of performing creative work - prime factor.

Received erector set at a very young age.
Love of construction.
Feeling of pride I felt from people I knew in construction and in my own works.

Outside interests, hobbies, etc.

Personal desire to become a mechanical engineer.

Influenced by a personal acquaintance who had an engineering degree.

NCE had a good reputation - tuition was relatively inexpensive - I lived near the campus. (All of these were strong influences) I lived near Rutgers and Montclair St. but was not really interested in either.

Financial factors and commuting distance.

Always had an interest in how electrical/ electronic things worked.

Scholarship, relative low cost for education, reputation of school.

Mechanical aptitude, curiosity how and why devices work.

Variety in job offers in one field.

Helpful guidance at NJIT during orientation.

Graduated from technical school then went to work - discovered a BS degree would greatly enhance my chances for job and financial advancement.

Main desire was to get into management with an engineering background.

B.S. Graduates of Other Schools who Received their M.S. from NJIT

My interest in how and why things worked or did not work.

First interest was in construction (B.S.)
M.S. in civil eng. (Constr. Mgmt.)

Achievement of a professional skill.

Specialization in last year M.S. (Mathematics) gave choice of only 2 colleges and engineering college was preferable.

B.S. from University of Havana. I wanted to be M.S.

Mathematics too abstract in college led to engineering degree.

Graduated high school during depression - no jobs were available - City College of N.Y. was free tuition.

I got B.S. of Architecture in Korea, 1959 (too old.)
I came to America in 1973 and obtained M.S. in Civil at NJIT. So I am in a different situation with you or other young men. Good luck!

Love of math.

Wanted college curriculum which was stimulating as opposed to passive.

Non-specific - really drifted into profession.

Natural talent for this field.

Item #4 comes the closest - although I enjoyed moderate success when studying the sciences, I also enjoyed trying to understand them, even when the effort was less successful and even frustrating. I think the key was - and is - I liked what I was doing.

APPENDIX "D"

ANSWERS TO WRITE-IN QUESTION 18

ANSWERS TO WRITE-IN QUESTION 18
POSITIVE ASPECTS

NJIT Sample

I enjoy the work I do.

Constantly changing technology yielding new learning experiences and challenges.

There is a chance for growth in one's career and personal satisfaction.

Great looking secretaries.

Engineering studies got me into technical sales then into management.

Prepared me for a health science career.

Boundless areas of responsibility.

I am in high demand by other employers.

Opportunities for travel are almost always available.

At the present, I very much enjoy the work I am involved with. I am my own boss.

Education was broad enough to allow me to quickly expand my skills in computer programing and shape my future.

Performing engineering tasks for good of the public.

I enjoy my work and the people I'm working with.

Satisfaction of a working instrument.
Pass knowledge to others.

Engineering prepares graduate for a multitude of employment opportunities.

Helps me in decision making not only at work but in every day situations.

Adapting my attitude, patience and analytical approach to work problems has changed and helped me in everyday problems.

Engineering skills allowed me to move into management position within manufacturing operation.

Engineering knowledge is applicable to everyday events, whether mechanical in nature or financial evaluation, etc.

Glamor.

Personal satisfaction is most important and it has been attained.

At about the age of 30 I found a great desire to be a heat transfer engineer.

It gives you a better appreciation for things outside of work because anywhere you go or anything you do can be related to engineering in one form or another. In other words, I feel being an engineer makes life in general more interesting.

(This comment is referred to Question # 15 - advancement) You have to request what you want (position) and if it is not given, then you look for a new job.

My engineering background can be used in different fields, other than engineering.

My job gives me experience and lets me make contacts that may help me start my own business some day.

Working in civil service position gives the feeling of satisfaction knowing that you are aiding other citizens.

Have not secured an engineering profession at this time.

I love it: dirt, concrete and steel. I design and build and enjoy seeing work completed.

Employer provides for continuous education. Salary is good but inflation and cost of living and taxes has taken its bite.

16 thru changes of job.

International relationships, lots of opportunity for interaction with many different people.

Present job is plant manager for a paper converting facility.

I feel that a B.S. in engineering is a good base to build upon.

Dealing with technically oriented people.

My career has already resulted in real upward mobility for me and my family.

Easy to change jobs. Easy to relocate. Respect by non-engineers.

Continuous learning.

Allows me to make a career out of what is also a hobby.

Other Schools Sample

Engineering discipline develops my personality better enabling me to tackle other problems methodically and work toward a solution.

I do part time consulting work in forensic engineering. This is very satisfying.

Using basic knowledge of engineering one can develop other skills - management, labor and personnel relations.

Responsibility for handling projects which involve large capital sums. Responsibilities in guiding and directing people. Opportunity to be self employed, though difficult.

I obtain a great deal of satisfaction from my work.

My employer allowed me to go full time with full pay plus expenses in school and traveling to obtain D.Sc.

Sound basis for branching out into related sales fields.

None

Total job satisfaction which has ocurred only very recently after 17 years in engineering.

Being able to think rationally and logically about other non-engineering matters.

Engineering led me to engineering management (projects) which I enjoy.

Teaches a broad way of thinking.

Stable employment.

Job satisfaction in design and seeing hardware being manufactured.

Can enter other fields with engineering education.

APPENDIX "E"

ANSWERS TO WRITE-IN QUESTION 24

ANSWERS TO WRITE-IN QUESTION 24
NEGATIVE ASPECTS

NJIT Sample

I feel we are sometimes not paid for the amount of responsibility we hold.

Very limited use of college learned skills.
Company loyalty to its employees is questionable
Financial compensation increases seem to be much lower than other. less technical professions.
Pay is not in order with learned skills.

Engineering is very cyclical.
Immigration of foreign engineers of lower quality is disconcerting.

Engineers since not unionized are subject to layoffs, pay cuts and are in more vulnerable position.

Conflict with people in higher position and their petty views prevent my achieving my goals in engineering.

Negative aspects? Nothing that would make me change my field.

Politics in the world stop us from solving world problem and cause limited solution at work. Too much responsibility for the money.

Working for a man who is out of date with today's technology.

I am presently unemployed (9 months) BSChE (1977)
Seems like there are no opportunities right now.

We are sometimes viewed as necessary evil especially in the construction field in which I am now working. We don't make money for the company, superintendents do.

None.

Most of the brightest engineers are not native born Americans (at least in my field).

At the present I have no negative aspects, only positive ones.

One can never hope to employ all of the knowledge learned in school to a job. The only true drawback I have is that the college does not offer the courses on the material I am working on, i.e. it is behind the times to a limited degree.

My perception of consulting is not the same as I perceived in college. I was led to believe that consulting was a design review process, whereas it requires review of standards and report writing.

Distractions that break thinking process.

Low compensation. Non-technical management.

Engineers are basically controlled by accountants and not fully viewed as professionals. Attempts to computerize engineering (CAD, CAM) is continually misunderstood by non-professional engineering types, delegating our profession to support status. Basic difference between Japanese and our economy is this connotation of the necessity for more accountants and lawyers and less engineers, thus the lag in our technology and ability to compete with foreign products. This country's heyday commenced with the engineering breakthroughs in the 30's, 40's, 50's and 60's, due to the engineering proficiency of such corporations as Chrysler, G.E., IBM, etc. Many of these companies are now run by accountants who can turn a profit for the short run, but leave a bankrupt Co. (case in point, Chrysler).

Not much negative, I accept the profession for what it is and would do it all over again.

None.

Government regulations.

I'm not looking for status - just work that I enjoy.

Rapidly move out of engineering to management.

Graduate engineers start out making good money but the raises one receives are not comparable. Often a graduate engineer makes as much if not more than one who's been working for 2 or 3 years. This encourages proplr to job hop rather than stay with one company, learn their system and become a good engineer in that particular position.

Working for a small company limits your salary potential.

As a profession we are still thought of as hired help even though society couldn't enjoy life without us. We should make a 100K a year or up like doctors who do nothing more than look at a patient through our equipment for diagnostic check.

The majority of engineers will not stay with one employer for their entire career. This due to the following reasons: increasing one's technical expertise, promotion, pay, benefits. There is an unofficial fact that engineers leave the technical end of the field before the age of 40 and become managers. This is based on companies believing that engineers become technically stale. I know of several engineers who are changing their careers because of this reason. The engineering profession (electrical engineering) is a short lived one. This is one of the reasons why there is a shortage of engineers.

Women are more criticized in the engineering field. There are pressures plus when a woman in a "major" man's field.

It is very difficult to find a job that does not require a high degree of specialization.
It is always necessary to be practical in engineering. Engineering education does not emphasize practicality very much.

In order to gain high salaries in engineering one must be willing to relocate or work their own engineering practice.

Employment opportunities largely depend on geographical location (mostly urbanized regions). It seems that you must move from co. to co. to gain a varied experience.

As in Question 23, the engineering profession does not receive the respect or economic reward that professions of equal status receive (i.e. law, medicine).

(Refers to Qu.23) A key factor.

Without licensure as a civil engineer you are in limbo destined to allow some other engineer profit from your talents and education.

The same varied experience in Qu. 16 also leads to extremely unrelated (engineering) assignments.

Note: Currently unemployed due to plant closing. The current market demand for BSChE's is extremely poor.

Corporate politics appear to play a more significant role than economic technical factors. More often than can be justified.

Presently I am working as a safety engineer for an insurance company and that type of position lacks prestige and respect (compared to other engineering fields.)

For my 7 years in this field the work has been very cyclical. As of two months ago my office of 450 people was reduced through layoffs to 95.

The engineering curriculum does not prepare one for human relationships. Should stress more communications skills.

Salaries for engineers are usually not more than that of ordinary labor.

Engineers are treated as technicians rather than professionals and underpaid.

Compensation for time required does not seem justified when balanced against requirements of family life.

The general public does not know or understand what engineers do, why they are important or how their lives have been affected by engineering.

Engineers are basically treated as highly paid blue collar workers - opportunities for varied experience and advancement not as accessible as I thought they'd be.

Unemployed.

Fast changes can make you obsolete quickly.

Repetition of some work activities.

Other Schools Sample

If you don't like it,it stinks, but that's true of anything.

Engineers have to become managers to move up in a company, they are not as skillful as their business counterparts.

Monetary rewards and growth are limiting to an extent which in part is a function of knowledge, growth and achievement, required by the profession and contract rate structuring.

Engineers are usually neglected by consultants. Also it is very difficult to work for Civil Service where the best opportunities are. I am P.E. and M.S. and I feel frustration about engineering profession. My first degree was 1953.

It is very difficult to move up from level of senior engineer, unless you are involved in politics.

Engineering had many opportunities when I graduated in 1974, however, slow now.
Too much competition from foreigners that keep salaries down and take respect away from profession.

Typically poor working conditions (office and lab. facilities.)

Engineers do not have collective strength as in other professions, such as doctors, lawyers, athletes, etc. Engineers, supposedly bright people are not smart enough to organize independent unions, associations, etc.

Need to change employers too often.
Company politics supersedes technical achievement.

No job security, very little financial security, no security of living where you want to live, very little chance for advancement for engineers.

Too many engineers - should be a limit on number of engineers in school.

Too much emphasis on specialization.

Day to day engineering is often boring, you must draw satisfaction from early part of each assignment.

Hard to have regular conversation with non-technical people.

The Chemical Engineering Society is not as independent from industry and colleges as it should be, nor nearly as strong as it should be.

Corporate politics.

Many hours spent, family life suffers.

Lack of security, foreign students displacing engineers, layoffs of over 40, wage busting by government, fake government figures on engineer shortages.

Engineers sometimes work for non-engineer supervisors, managers.

APPENDIX "F"

SEPARATE NOTES INCLUDED WITH QUESTIONNAIRE

SEPARATE NOTES INCLUDED WITH QUESTIONNAIRE

Gunars,

Sorry to take so long in responding but I've been extremely busy. I think your topic is an extremely pertinent and timely one. The current market for engineers, particularly Ch.E's. is very depressed right now due to the current recession and dropping oil prices (postponing or cancelling many synthetic fuel projects). However, if the energy situation tightens up again, companies will be falling over each other to hire new engineers and from my experience, they'll hire too many, too fast and eventually the bottom will drop out of the market again.

I believe that colleges and private industry are totally incapable of planning more than a year or two into the future and these boom-or-bust cycles will continue to repeat themselves. Correspondingly, engineers will continue to ride a roller-coaster of either high salaries, security and prestige in good times, and stagnation, layoffs and low morale in poor times. This type of atmosphere does not enhance the prestige of engineering as a profession makes it very difficult to recommend it as a career at this time.

Finally, I believe that much of the problems and frustrations of engineers could be helped by the encouragement of further education by employers - particularly in non-engineering and business fields. In my own experience, I would like to obtain my M.B.A. but the schools in the area are not very good. My company is starting to offer a program toward obtaining an M.S. in Ch.E. but that is all. Perhaps the program will expand to other disciplines but it will be slow in coming.

Good luck in your endeavor.

Dear Mr. Bachs:

I congratulate you. Persons like you are necessary to change the scope of engineering, especially my field in this country. I hope this questionnaire will give good luck to you and help our profession going to better ways. I hope in the future our children will be proud to be engineers and will live on the same level as MD's, lawyers, dentists, etc.

Thanks

N. Ramirez

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