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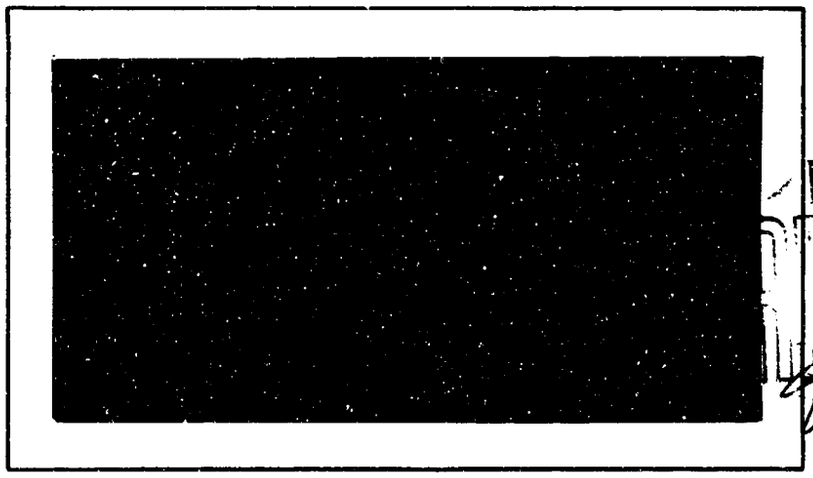

SCHOOL OF ENGINEERING

WRIGHT-PATTERSON AIR FORCE BASE, OHIO

AN EXPLORATORY STUDY OF PERCEIVED CAREER PROGRESS AMONG CIVIL SERVICE SCIENTISTS AND ENGINEERS ASSIGNED TO AIR FORCE LABORATORIES

THESIS

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AN EXPLORATORY STUDY OF PERCEIVED CAREER PROGRESS AMONG CIVIL SERVICE SCIENTISTS AND ENGINEERS ASSIGNED TO AIR FORCE LABORATORIES

THESIS

Presented to the Faculty of the School of Engineering

of the Air Force Institute of Technology

Air University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

by

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Graduate Systems Management

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Preface

This report is the climax to three months of research into the area of perceived career progression. It is hoped that the findings reported herein are beneficial to the managers of Air Force personnel and will provide them with insights to the higher order needs of the personnel under their direction. It is also hoped that the results of the research benefit the broad field of management itself.

The research took a great deal of time and effort, some of which was not that of the researchers. In expressing appreciation for the time and effort that was not our own, we would like to thank Lieutenant Colonel Robert Henry McIntire for his assistance in the preparation for and conduct of the study, as well as for the permission to utilize his copyrighted scale for attitude measurement. We would also like to thank Mr. Charles King, Hq AFSC; Mrs. Dorothy Krehl, Hq AFSC; Dr. Paul Polishuk, AFSC/FDL; Mr. Max Davis, AFSC/FDL; the Commanders/Directors of the individual laboratories involved; the individuals in each laboratory who provided the lists of the scientific and engineering employees; and all the many, many others who assisted us so graciously during this research project. They are all a pleasure to work with and a credit to the United States Air Force.

We would like to thank our wives, Wanda and Kathy, for their assistance, understanding, and patience during this hectic period. It is to them that this research effort is dedicated.

Thomas J. Mackey

and

John C. Totten

Contents

Page

VI. (Continued)

List of Figures

List of Tables

Abstract

This was an experimental study conducted on scientists and engineers to determine the perceptions they had concerning their career progression. The data for the research was obtained through the use of a questionnaire which was distributed to a random sample of scientists and engineers working in the United States Air Force laboratories. The questionnaire asked the individuals sampled to rate their career aspirations, their career expectations, and to rate how conducive their job situation was in allowing them to reach their aspirations. In addition, they were asked to rate Herzberg's 5 factors of motivation: (1) recognition, (2) advancement, (3) responsibility, (4) achievement, and (5) the job itself, according to the level of the factor they perceived to be present in their jobs. They were also asked to assign a weight to each of these 5 factors according to the importance they felt each had to career progression. The sum of these weights would be equal to 100.

The results show that the average individual aspires to reach a level within 23 percent of the top position in the laboratory system, the top position being that of Chief Scientist, and the bottom that of Junior Engineer, while he expects only to reach to within 35 percent of this top position. The results also show that the average individual feels the motivation factors listed above, which ideally should be present in amounts of 100 percent, are only present in amounts of 60, 50, 71, 67, and 75 percent, respectively. The average individual

weights these factors as: (1) recognition - 16.5, (2) advancement - 17.3, (3) responsibility - 18.6, (4) achievement - 21.6, and (5) job interest - 26.0, in importance to career progression.

In the study, the data is stratified by individual laboratories, salary groups, age groups, educational background, years of experience, supervisory and non-supervisory positions, years at present position, and job content. Significant differences were found in the areas of career aspirations and expectations, perceptions of motivational factors in the environment, and in the ranking of these motivational factors. These differences were found in comparing the following groups: the salary groups, the age groups, the educational groups, the groups having different amounts of supervisory experience, the supervisory level groups, and the job content groups.

AN EXPLORATORY STUDY OF PERCEIVED CAREER PROGRESS AMONG CIVIL SERVICE SCIENTISTS AND ENGINEERS ASSIGNED TO AIR FORCE LABORATORIES

I. The Problem and its Environment

Introduction

This study consists of research about people at work. More precisely, it concerns their attitudes toward their jobs. For the purpose of this study, these job attitudes have been broken into two distinct, but not readily separable, components. These are attitudes concerning motivation and career progression. The more specific task is to determine whether scientists and engineers working in Air Force laboratories perceive their career progression and motivation the same or differently than other Civil Service scientists and engineers working in the same or different Air Force laboratories.

Specific Objectives

1. To identify a representative sample of Air Force laboratories from which to draw a sample of Civil Service scientific and engineering people.

2. To identify the Civil Service scientific and engineering people who are currently working in Air Force laboratories.

3. To identify a representative sample of these scientific and engineering people, and determine how these individuals perceive their career progression and motivation.

4. To measure the perceived career progression and motivation

of the individuals chosen in the sample.

5. To make a comparative analysis of the perceived career progression among the individuals chosen in the sample, and to determine if there are significant differences in their perceptions.

6. To identify the factors responsible for significant differences in the career progression perceptions by measuring the individual's motivation perceptions.

7. To determine whether perceived career progression and motivation of scientists and engineers differ significantly with respect to the individual's employment organization, his age, income, educational background, experience, or position in the organization.

8. To determine how the individuals sampled rate the motivational factors relative to each other.

Significance of the Problem

Career progression is moving forward in a profession or other calling, which demands special preparation, and is undertaken as a lifetime vocation. This, for the purpose of this research study, shall be the definition of career progression. True, this is not a universally accepted definition, but for this research, it will be adequate to indicate an individual's forward motion in his work environment, or more precisely, at his job.

The significant factor in career progression is not the actual career progression itself, but the perceived career progression. An individual will act or react to a situation not according to how the situation is in actuality, but, rather, to how he perceives the situation to be. So, it can be seen that the perception of an

individual, or of individuals, is the significant and important factor. This factor is important in career progression in that a person will sample his feelings concerning career aspirations, then sample his environment to determine what his career expectations can reasonably be. The individual will integrate this information, along with other factors, and mentally compute his career progression. This will be his perceived career progression; his forward motion as he visualizes it.

The other factors that are components in this integration will be obtained from the individual's work environment, and will all be related to his job. Herzberg, Mausner, and Synderman explored job "factors" contributing to the satisfaction and dissatisfaction of engineers and accountants (Ref 15:44). They found these factors to be related to the work environment, but not as a continuous grouping. Rather, they found these variables to be related to two distinct groupings: job-content and job-context. The variables related to the job-context were called "hygiene factors," while those related to job-content were called "motivators." The motivators include: (1) achievement, (2) recognition, (3) advancement, (4) responsibility, and (5) the work itself. These are the factors which were found to provide satisfying job situations.

A research study into the area of perceived career progression would not be complete in itself unless it included study in the area of perceived job satisfaction. So, when measuring an individual's career progression perceptions, we must also measure his perceived job satisfaction. This will be done by measuring his perception of the fulfillment that his job and its environment provides in the

areas of achievement, recognition, advancement, responsibility, and the work itself.

Once, the quantities to be measured have been identified, an appropriate sample population must be found. Scientists and engineers were chosen to be the sample population for the following reasons. First, this group correlates very closely with the group used by Herzberg in his original study. Secondly, there has been research done on the perceptions of scientists and engineers, such as that done by McIntire. Thirdly, and most important, scientists and engineers represent a valuable commodity whose scarcity on the labor markets make it all the more crucial to a technical organization.

The scientific and engineering employees have a high investment in themselves because of their extensive education and professional preparation. They are strongly achievement motivated, and because of this, require recognition, status, and opportunities for growth.

Because of their relatively high position in today's industrial civilization, scientific and engineering employees receive more rewards than the typical employee, but their need structure is more advanced. Thus, the net result is that scientists and engineers are no more satisfied than other employees. Since they do emphasize higher level needs, scientific-engineering employees respond favorably to motivational factors of achievement, recognition, responsibility, advancement, and the work itself. These distinguishing features make the scientific-engineering employee an ideal subject for this research project.

Environment of the Problem

The distinguishing features of scientific and engineering work are that it is intellectual in nature and focused on a particular specialty, which requires intellectual preparation for proficiency. Thus, some formal training, or education beyond high school, is required.

The number of scientific and engineering workers in the United States is expanding rapidly. The 3,500,000 in 1940, more than doubled to 7,500,000 in 1960, and the U. S. Department of Labor estimates that over 13,000,000 will be needed by the mid-1970's (Ref 92:44). Many of these scientists and engineers are moving into the field of R & D (Research and Development). Direct expenditures in 1960, for research and development, were about $10,000,000,000, but it is estimated that by the 1970's, these expenditures will triple to over $30,000,000,000. Much research and development is supported by the government, but private business is also investing large amounts of its own funds (Ref 8:286).

A decade ago, the United States was spending less than $12,500,000,000 a year for research and development. Research and Development expenditures, today, are approaching the $26,000,000,000 mark. Many factors have contributed to this fantastic increase in scientific and technological Research and Development: the birth of the space age; the race to the Moon; the race for missile and nuclear superiority; pressing Vietnam War needs, expansion of the computer and electronics field; Man's increasing concern for his health and welfare; and the growth in the market for new goods and services.

It was the scientists and engineers who responded to this challenge. They produced such diverse developments as manned exploration of outer space, landing Man on the Moon, photographing the planet, Mars, at close range, to determine if it was capable of habitation, orbiting communication satellites, nuclear power to provide light and heat for many cities, jumbo aircraft, lasers, and many, many other innovations.

During this accelerated period of research and development, the mere mention of Research and Development seemed to be like magic. The mention of these two words brought forth additional funds for both new and old programs. There was a widespread feeling that anything was possible, if enough funds were made available.

Today, this period is gone. Proposals for Research and Development work no magic spells. Due to the many competing uses for resources, proposals for Research and Development may have a negative effect on the acquisition of funds. This is not necessarily the way it should be—for our research boom, that started a decade ago and brought us so many wonderful and needed advancements, could soon vanish. Tomorrow, Research and Development could get the "shot-in-the-arm" it seems to need. If this occurs, the Air Force will sorely need its cadre of highly trained and competent scientists and engineers. These are the scientists and engineers, who are employed in Research and Development laboratories, that are the focal point of this study (Ref 46:62-66).

Scope and Limitations

The scope of this study is limited to the investigation of the

perceived career progression and motivation of scientists and engineers. This study is restricted to an investigation of these individuals as found in typical Government Research and Development laboratories. Because of the available channels of accessibility, this study was further limited to the 9 laboratories under the Director of Laboratories, Headquarters, Air Force Systems Command. From these 9 laboratories, 5 were selected. Four of them, the Aero Propulsion Laboratory, the Avionics Laboratory, the Flight Dynamics Laboratory, and the Materials Laboratory, are located at Wright-Patterson Air Force Base, Ohio, and would be readily accessible. The 5th laboratory, Rome Air Development Center, was chosen partially because of its size, and partially because it was geographically separated from the other laboratories. Together, these 5 laboratories constitute 66 percent of the total civilian scientific and engineering manpower in the Air Force Systems Command laboratories.

Procedures Used

The Research and Development laboratories in this study were selected because of the type and number of scientists and engineers it employed. All the engineers and scientists used in the sample were full-time employed Civil Service workers. The data collected were obtained from the sample through the use of questionnaires. The sample included individuals from different age groups, laboratories, organizational levels, GS grades and levels, years of experience, educational backgrounds, and individuals who were supervisory and non-supervisory personnel. The total sample consisted of 300 scientists and engineers. The questionnaire was designed to probe,

as deeply as possible, into the feelings of these individuals in the areas of career progression and motivation.

Data Collection and Research Methods

This study is concerned with an individual's perceived career progression, and his perceptions on how well his job satisfies his higher order needs. The data collection, then, would be limited to these two areas.

A search of existing and available literature indicates that a great deal has been written about careers in general, but literature concerning perceived career progression was almost non-existent. In the area of an individual's higher order needs, much has been written by many authors. One of particular interest, and the one chosen for primary reference in this study, was that of Frederick Herzberg.

Herzberg pointed out that the respondents in his study reported feeling happy with their jobs when events indicated to them that they were successful in the performance of their work, and to the possibility of professional growth. The lack of this, however, did not indicate dissatisfaction (Ref 15:113).

He went on to say that:

> The factors that lead to positive job attitudes do so because they satisfy the individual's need for self actualization in his work. The concept of self-actualization, or self-realization, as a man's ultimate goal has been focal to the thought of many personality theorists. For such men as Jung, Adler, Sullivan, Rogers, and Goldstein, the supreme goal of man is to fulfill himself as a creative, unique individual according to his own innate potentialities and within the limits of reality. When he is defected from his goal he becomes, as Jung says, "a crippled animal."
>
> Man tends to actualize himself in every area of his life, and his job is one of the most important areas. The conditions that surround the doing of the job cannot give

> him this basic satisfaction; they do not have this potentiality. It is only from the performance of a task that the individual can get the rewards that will reinforce his aspirations. (Ref 15:114)

Based on the results of Herzberg's work, we can now say something about what people want from their jobs. These wants shall be divided into two groups. One group centers around the need to develop a personal growth in one's occupation. The other group is essential as the base for the first group. It centers around fair treatment in compensation, supervision, working conditions, and administrative practices. It is measurement within the first of these groups on which this study will concentrate.

The instrument used to measure an individual's perception was developed by McIntire (Ref 93). The instrument constructed by him was merely a straight line. It is the way in which it is used that makes this line unique. In the survey, the line is placed following a question in which a person is asked to rate a particular aspect of his work. The person rating the aspect is asked to think of the line, or scale, as starting at 0 and going to 100 percent. At the ends of the scale, categories are indicated. As an example, a question asked of the individual could be to rate his chances for advancement. At the left-hand end of the scale, the category indicated would be "no opportunity for advancement," while at the other end, the category indicated would be "maximum opportunity for advancement." The individual is asked to place a mark on the line continuum between these two extremes to indicate his own perception of his advancement opportunity.

This line is 10 centimeters long, and as such, lends itself to

easy scoring on an individual's responses to questions. By placing a 10 centimeter scale under the line, and reading on the scale where the response falls, a numerical rating is given for that response.

It was this measurement device that was incorporated into a questionnaire which provided the data for this study.

Assumptions

It is assumed that the Air Force Laboratory System will continue to exist in its present form, or one similar to it. Due to the large current investment in men and materials, the projects currently under development, and in spite of the recent Congressional cutbacks in military spending, there is no indication this working environment will change drastically in the near future.

The laboratories chosen for this survey accurately represent the Air Force Laboratory System. In choosing the Aero Propulsion Laboratory, the Avionics Laboratory, the Flight Dynamics Laboratory, the Materials Laboratory, and Rome Air Development Center, the population from which we choose our samples constitutes 66 percent of the total civilian manpower in the whole Air Force Systems Command laboratory system. It also gives samples from the area of greatest concentration of laboratories, and a sample from a laboratory (RADC), which, of itself, constitutes 26 percent of the whole system, and is separated geographically from the other laboratories.

We further assume the scientists and engineers, who were randomly selected, will form an accurate cross section of the population we wish to depict.

Personnel will, on the average, respond to the questionnaire in

an honest and forthright manner. In reading the 219 questionnaires, which were returned before the cutoff date, 19 August 1969, there was every indication that all the respondents had been objective in their responses. The comments submitted at the end of the questionnaire were, for the most part, very expressive of that author's feeling on either the questionnaire itself, or the material surveyed. As 30 percent of the respondents did submit comments, we feel that the overall response to the questionnaire was an honest one.

The individual is assumed to react to his perception of his environment, and not to how the environment may actually be. This idea is becoming quite prevalent in the field of behavioral science. As Douglas McGregor states, "He responds to his perception of reality." (Ref 21:216)

The questionnaire, on which the individual is asked to mark his response to his environment, is of the "open form" as opposed to the "closed form." This type of question is used so as not to restrict the respondent in any way in his selection of an answer.

Hypotheses

Following is a list of all the hypotheses that the researchers tested.

1. Scientists and engineers in a given laboratory perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different given laboratories.

2. Scientists and engineers in a given salary group perceive their aspirations, expectations, and security, and rate and weight

motivational factors the same as other scientists and engineers in different given salary groups.

3. Scientists and engineers in a given age group perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different given age groups.

4. Scientists and engineers in a given educational group perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different educational groups.

5. Scientists and engineers in given years of scientific and engineering experience group perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different given years of scientific and engineering experience groups.

6. Scientists and engineers in given years of supervisory experience group perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different given years of supervisory experience groups.

7. Scientists and engineers in given supervisory levels perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different supervisory levels.

8. Scientists and engineers in given total years at present job group perceive their aspirations, expectations, and security, and rate

and weight motivational factors the same as other scientists and engineers in other given years at present job groups.

9. Scientists and engineers in a given job-content group perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in other given job-content groups.

10. If the weighted motivational factors are listed in descending order according to the mean weights given them by the respondents, they will appear in the same order as listed by Herzberg (Ref 15:60).

Plan of Presentation For The Remainder of The Study

The remainder of this Thesis is organized to: (1) summarize what a review of the related research discloses in the career progression and motivational areas, (2) describe the study conducted in five research and development laboratories, (3) present and analyze the data collected, (4) present the results and tests of the hypotheses, and (5) summarize and conclude the study. In particular, this Thesis will emphasize the higher order needs of individuals. These are particularly applicable to the scientists and engineers currently active in this fast moving technological world. Chapter II is concerned with related and applicable research. Chapter III is related to the design and conduct of the experiment. Chapter IV relates the characteristics of the individual laboratories. Chapter V involves the analysis of the data. Chapter VI is the presentation of the results and the testing of the hypotheses. Chapter VII concludes the Thesis, and includes a comparative analysis, as well as a presentation of the implications drawn from the study.

II. Review of Related Research

The purpose of this chapter is to review the literature related to this study. This review will go into the subject areas of motivation theory and job satisfaction, and present the findings of such authors as Herzberg (Ref 15), Maslow (Ref 24), Evans (Ref 50), and Friedlander (Ref 55). Also to be discussed is a Dissertation by McIntire entitled "An Exploratory Study of Perceived Career Progression of Scientist-Engineer Supervisors in Aerospace Organizations." (Ref 93)

There are other areas in which reading was accomplished, but for purposes of unity, they are presented in other chapters. For instance, attitude measurement and questionnaire theory is covered in Chapter III, and the statistical analysis methods are explained in Chapter IV.

Motivation Theory

Introduction

The development of motivation theory has been closely related to the development of Management philosophy. The philosophy, which Management uses to get workers to work, reflects the type of motivation that Management feels is appropriate. During the early phases of Management, when the emphasis was on efficient and low cost production at the expense of the workers, motivation was simple--no work, no pay. Workers were motivated to produce out of fear of being

docked for not meeting their quotas, or of being fired. Management was aided by the over-supply of labor and labor's state of disorganization (Ref 20:146, 147).

Time and events changed the worker's environment, and such fear tactics could no longer be used. The rise of Unions, and of public interest in social conditions, forced Management to shift from authoritarian to paternalistic management. The motivation was one of rewards. However, they were more of an extracurricular nature, not actually linked with the work processes required of the workers. The jobs were not changed. Management tried, instead, to compensate the worker after hours for the mental and physical boredom, frustration, and other factors he put up with on his job (Ref 20:147-149).

While this type of motivation brought a certain amount of appeasement of the worker's complaints, it did little to gain the loyalty of the workers. When the worker could find better forms of compensation elsewhere, he departed, leaving Management with the resultant problems of turnover, re-shuffling, and training (Ref 88:57-62).

Realization of this and other problems in retaining qualified people, plus the advent of a labor scarcity, especially in the more technical and skilled areas, has led to the present period of management and motivation theory (Ref 20:152).

Defying quantification and regimentation, the worker requires he be motivated before he can achieve the high degree of productivity that Management is seeking. This is even more prevalent among personnel of higher levels of education, or of professional or

technical expertise. They must be motivated (Ref 88:57-62), (Ref 55: 392).

Frederick Herzberg

One of the leading theorists in the field of motivation is Frederick Herzberg. Herzberg, using his own study and those of others, has found that the factors affecting job satisfaction or dissatisfaction can be divided into two categories: hygienic factors, and motivation factors.

The hygienic factors are those which could create dissatisfaction in employees. These factors are the basic physiological needs of man, such as food, shelter, and security. The more extrinsic factors related to the job are company policy and administration, relationships with other personnel, and work conditions. The hygienic factors are those which most affect the outer man.

Satisfying the needs of the employees in the hygienic factors minimizes or eliminates job dissatisfaction, but this course of action does not lift the employee's attitude to one of job satisfaction. It merely brings the employee to a neutral position, neither positive nor negative. Attention must be turned to motivators if any degree of job satisfaction is to be achieved.

Herzberg's motivators are factors which are intrinsic to the job itself; those which contribute to the employee's achievement and experience of psychological growth. For example, Herzberg included achievement, recognition for achievement, advancement, the work itself, and responsibility in this category.

A job that meets the employee's motivation needs is one in which

he will find job satisfaction. However, if these needs remain unfulfilled, the result is not job dissatisfaction. It is no job satisfaction, or a lack of job satisfaction. The point is, there are two sets of factors involved here: hygienic factors, which can create job dissatisfaction; and motivators, which can create job satisfaction. A lack of motivators is no more responsible for job dissatisfaction than an overabundance of hygienic factors can create job satisfaction.

Herzberg, from the results of his survey, was able to form a hierarchy of factors, which he called motivators and hygienic factors. Numbering sixteen, their order within the two main subgroups has changed a little since the original study, but they have remained constant as to whether they were motivators or hygienic factors. (The original listing can be found in Appendix A.) (Ref 15:44-49)

Abraham H. Maslow

Another theory of motivation, which is similar in structure, but is not broken out as much as to factors, was that of Abraham H. Maslow. His main theory was every man had a hierarchy of needs, and as the lowest level was satisficed, the man's attention was shifted to the next highest level. Thus, the way to motivate a man was to find out what level of needs he desired most, and offer satisfaction in those needs in return for output. Maslow labeled his levels from the lowest level up: physiological needs, safety and security, belonging and social activity, esteem and status, and self-realization and fulfillment (Ref 24:80-106).

The similarity between the two theories is quite strong when the two are depicted side by side, as in Appendix A. The hierarchy of

Herzberg shows parallel shifts with Maslow's factors. Although Herzberg said nothing about a man moving up by levels, it becomes quite apparent that as an individual receives less dissatisfaction from Herzberg's hygienic factors, and more satisfaction from the motivators, he is, in effect, satisficing and climbing through the levels of Maslow's need priority model. Both models do arrange the more basic needs or factors at the bottom. As the factors or levels go up in both hierarchies, they become more complex and more intrinsic to the individual and his job (Ref 8:37).

Jack H. McQuaig

Jack H. McQuaig, Author of "How to Motivate Men," states:

> He (the manager) soon finds that every man is exactly like every other man in that he has certain needs that he must satisfy, but each man is completely different than every other man in that he has a different combination of needs. (Ref 22:147)

He goes on in his book to list the following factors as man's psychological needs: security, recognition, sense of belonging, being treated with respect and dignity, opportunity, satisfaction from achievement, purpose, and competition. The quote above, and the subsequent listing of factors, paraphrase Maslow pretty closely; the words, in some instances, being the same (Ref 22:148).

Glen U. Cleeton

In the book, "Making Work Human," Glen U. Cleeton discusses the need for meeting man's needs above the physiological level. Cleeton hypothesizes a hierarchy of needs as foll. · (lowest level listed first):

1. Need for food, air, and water.
2. Need for bodily well-being and comfort.
3. Need for activity.
4. Need for mating.
5. Need to share thoughts and feelings with others.
6. Need for dominance.
7. Need for self-determination.
8. Need for achievement, acquisition, and possession.
9. Need for approbation.
10. Need for ideation. (Ref 5:19-20)

The wording, and certainly the sequence of Cleeton's needs, differ little from Herzberg and Maslow.

Besides these Authors, there are many others in this field who are attempting to replicate Herzberg's study, or do studies of their own. Dr. Clifford E. Smith comments, in relation to Herzberg, that when both motivators and hygienic factors are controlled and appropriately employed, the result is more likely to be a motivated and productive worker (Ref 88). Douglas McGregor, on the other hand, states that one does not motivate people. "Man is by nature motivated. When he is not, he is dead." (Ref 88:57-62), (Ref 21:208)

Job Satisfaction

The purpose of motivation is multi-directional in nature. Certainly, it is to create a highly productive work force, but at the same time, it also must create a certain degree of job satisfaction in the work force in order to keep them on the job (Ref 88:57-62).

Job satisfaction is generally accepted as the attitude a worker has toward his job, and its inherent environment. When positive, this attitude is one of satisfaction. On the other hand, when this attitude is negative, the proper name would be dissatisfaction. Positive or negative, this attitude reflects how the worker feels about three major areas concerning his job: (1) its social and technical environment, (2) its intrinsic self-actualizing aspects, and (3) its recognition through advancement (Ref 36:99), (Ref 54:248).

The social and technical environment pertain to the types of people and machinery with which the man works. Here, a man's innate feeling of class consciousness show themselves in his contentment or discontentment to work with certain types of people, whether these people are typed by race, color, creed, or level of intelligence, or even social standing. On the technical side, the worker usually appreciates labor-saving machinery, up-to-date facilities, and modern conveniences, such as air conditioning, lighting, and heating. There are exceptions, such as workers who balk at changing "the old way" of doing something, or whose job itself requires a certain degree of primitiveness and physical labor.

Turning from the work environment, the worker looks to see what he can gain by working. Certainly, a salary and a degree of creature comforts, but for many, they look for opportunities to do what they are capable of doing. This intrinsic self-actualizing is different for all men, and is expressed, even as the opportunities are found, in different ways. These inner goals may range from a major contribution to science, or the arts, to just a higher degree of

craftsmanship.

The third area is recognition through advancement. The worker wants to have his achievements recognized and appropriately rewarded. While informal recognition and praise is needed, it is not sufficient in and of itself to satisfy this area. When the worker feels his degree of skill and expertise advances, he wants his title, job, and salary to reflect this.

The measurement of this attitude, done by questionnaire or by personal interview, generally involves a further break out of these three areas into a list of more specific factors. The theory seems to be that it is easier to get a more specific answer or feeling indication from the respondent if the question is about a specific subject or aspect of the job. The answers to these specific questions can then be analyzed to give a picture of how the individual feels about the situation in general.

The problem that arises is the treatment of the answers which result from the various questions. How does one combine the numbers resulting into a single index, which accurately reflects the true feeling of satisfaction or dissatisfaction of the respondent? Researchers have come up with different summations of the factors, straight answers, differences between satisfaction and importance ratings, or summations of the products of the satisfaction and importance weightings. The selection of a particular method varies from one source to another, for varying reasons (Ref 50:393-397).

In addition to a review of literature on the areas of motivation theory and job satisfaction, a Dissertation by McIntire was closely

studied (Ref 93). It was from this Dissertation that we obtained the questionnaire used in the data collection. In an effort to correlate McIntire's findings, and those of our own, discussed in Chapter VI, the Career Progression Index was calculated, as well as the Index of Frustration. The Career Progression Index is a summation of the products of the ratings of motivation factors and their relative importance weightings. The Frustration Index is the mathematical difference between the individual's career aspiration ratings and his career expectation ratings.

Definition of Terms

Words and their meanings are largely a function of the context for the use and the background of the reader. This study uses many key terms having varied meanings. To avoid confusion, and to further the purposes of communication, these key words are defined as to their meaning in the context of this study.

1. Achievement is the obtaining of a conclusion to one's efforts which is meaningful to the individual. This conclusion may be the completion of a project, or the employment of techniques or data developed. What constitutes a meaningful achievement will vary from individual to individual, and from self-satisfaction of a job done to public acclaim.

2. Advancement is the progression upward in an organizational hierarchy, or in a technical or professional standing.

3. Job interest is the appeal of the work to the individual and it is inherent in a job. This may be due to the similarity, challenge

of the job requirements, and the individual's own interests, or just due to the benefits of the working conditions or worker associations.

4. Recognition is a feedback from one's environment, which indicates a reaction to one's actions. In this case, the recognition is from other people, and may take any of the varied forms from a formal commendation to a friendly pat on the back.

5. Responsibility is basically accountability. Whether accountable for his own time and effort, or for a multi-million dollar project, each individual finds a degree of accountability or responsibility in his job.

6. Security, in this paper, is used in the sense of confidence one has in his environment, and his own ability to accomplish his objectives in this environment. Security is thus an inversely proportional indicator of the amount of frustration in a man's life.

7. Motivation, very simply put, is a reaction to an unsatisfied need. In the worker, it means he will expend effort in the direction he feels is most likely to satisfy his needs. By the same token, he will not work at something he feels will not satisfy his needs. For Management, the importance of this definition is that motivation is based on an individual's perceptions of his needs and how to satisfy them.

8. Research and development includes the basic and applied research in the sciences and in engineering and design development of prototypes and processes. (This definition excludes items such as product testing, research in the social sciences, or other non-technological activities or services.) It includes scientific and

engineering investigations to arrive at new or improved products, processes, or their requirements (Ref 96).

9. Finally, the oft-mentioned group, scientists and engineers, is defined. The scientists and engineers are those individuals involved in highly technical research, design, and development, or similar functions involving the application of fundamental scientific concepts and principles to the discovery of new facts, principles, or techniques. A professional in this area, as defined under the Wages and Hours Law:

> . . . is one who performs intellectual and varied duties as opposed to routine, manual, or physical work. He must exercise discretion and judgment. His education must have been in the field of science or learning customarily acquired by a prolonged course in specialized and intellectual study, as distinguished from general academic training, apprenticeships, or trade courses. (Ref 19 :341), (Ref 98)

Summary

The present is thus one of new theories and old habits. Management, as yet, lacks the tools to test and prove the validity or invalidity of a theory. Even in practice of a particular theory, the results are inconclusive, due to environmental conditions and the variability of human behavior (Ref 20:148).

So far, the discussion has been on the problem and its environment, and the review of related research. In addition to this, it is necessary to discuss the design of the experiment, by which this study proposes to gather data and build upon the foundations laid thus far.

III. Design of the Experiment

The purpose of this chapter is to describe the design of the experiment; that is, to measure the perceived career progression of scientists and engineers working in Government Research and Development laboratories. It is the feeling of the researchers that certain factors which make up the work-content environment should be discussed because of their applicability to an individual's career progression perceptions. These factors will be discussed first, and will be followed by a general discussion on the design of the experiment. A more specific discussion will follow that, and its topic shall be the design of the questionnaire and the questions themselves.

Career Progression

As was discussed earlier in the study, career progression is the forward motion of an individual in his chosen field of endeavor. This forward motion is not to be confused with a promotion or an advancement alone. It is the combination of promotion and other factors that are provided by and through the job environment.

Psychological research, that was conducted by Herzberg, Mausner, and Snyderman, on engineers and accountants, provided some very useful information on individuals in their work environment. Herzberg explored job "factors" contributing to the satisfaction and dissatisfaction of these employees. As a result of the research, they were able to conclude that factors which make up the environment for

job satisfaction were entirely different from those factors causing dissatisfaction. They also found that the absence of the satisfaction factors did not cause dissatisfaction, and that absence of dissatisfaction factors did not cause satisfaction (Ref 15:113).

Herzberg and his associates found that five factors stood out very strongly when situations of job satisfaction were expressed. They were: (1) recognition, (2) advancement, (3) responsibility, (4) achievement, and (5) the work itself (Ref 15:72). It is these same five factors that make up the environment which produces job satisfaction. These same factors form the base of this study.

Since an individual's needs and wants are always higher than those that are provided by his present level, he will aspire to a higher level. At work, his aspirations are to attain a higher level, and thus fulfill some of his insatiable needs. It is only from the performance of the job task that an individual can receive rewards which will enforce his aspirations (Ref 15:114). These rewards are the same items that make up job satisfaction: (1) recognition, (2) advancement, (3) responsibility, (4) achievement, and (5) the work itself. These same factors affect the individual's perception of his career progression. This is why we measure these motivational factors, along with the individual's aspirations and expectations, to get a true picture of his perceived career progression.

Choice of a Topic

The subject of this research was chosen because of its appropriateness to the field of Management--Systems Management in particular. As engineers, and as candidates for Master's Degree in

Systems Management, the researchers of this study felt the valuable information and understanding that could be gained from this research, and thus added to the field of Management, would be well worth the effort it would take to obtain and develop it.

Another reason for the choice of this topic was the work that had already been done by McIntire. His study of "Perceived Career Progression of Scientist-Engineer Supervisors in Aerospace Organizations" provided these researchers with the data and insights necessary to make this study.

Preparation and Submission of the Initial Research Proposal

After the topic for research had been chosen, it was necessary to develop a research proposal. The proposal was necessary in order to explain what the problem was, and how we expected to research it. The proposal was to aid us in collecting our thoughts and organizing them, thus providing an outline of the proposed research study. The proposal contained a statement of the problem, as we then visualized it. This was followed by a section explaining the purpose of the study. Also present in the proposal were tentative assumptions and tentative hypotheses, which seemed appropriate. The remainder of the proposal explained the scope of the problem, some of the background research that had been done, and what our expected approach would be.

This study has changed, somewhat, from the way it was initially proposed. The proposal, however, was necessary as a catalyst for our ideas, and as an outline from which to explain our study.

Acceptance of the Topic

The proposed Thesis topic was readily accepted by our Thesis

Advisor. The next step was to obtain approval from the individuals having control over the group we wished to sample. This involved, first of all, selecting a population having the characteristics needed in the sample. Secondly, permission of the sample's supervisors would have to be obtained.

Since Dr. Paul Polishuk, of the Air Force Flight Dynamics Laboratory, had expressed an interest in the work being done by students of Management at the Air Force Institute of Technology, it was suggested that he be our first contact. It was our task to obtain his approval of the research proposal so that we might use the Flight Dynamics Laboratory as one of the facilities at which research could be conducted. Dr. Polishuk expressed an interest in the study and recommended we obtain the approval of the Air Force Systems Command, the parent organization of the laboratories. This approval was obtained. (See Appendix B for copies of correspondence for approval.)

The next step was to gain the acceptance of the individual laboratory Directors/Commanders. This acceptance was necessary as the research would be conducted on employees assigned to the laboratories headed by these Directors/Commanders. Gaining their acceptance and approval would also provide a permissive atmosphere in which to conduct the research. In this way, no emotional biases would be present which could unfavorably influence the results of the study. This acceptance was obtained and accomplished by telephone, and through briefings of the individuals concerned.

Selection of the Sample

When selecting a sample, the following points should be kept

in mind:

1. The sample should yield an unbiased picture of the population of which it purports to be a sample.
2. The sampling method chosen should be the most efficient way of securing the desired information with the funds available. The sample should be relatively easy to plan, to select, to collect information from, to test, and to interpret.
3. The sample should be so defined that there is no question as to which groups are included or excluded, or as to what group it represents.
4. The sample should be large enough to give statistically reliable results for the characteristics which are to be measured by the survey.
5. The sampling method is said to be satisfactory for the questions under consideration if it can be depended upon to yield samples (less than 100 percent) that lead to the same action as would have been taken on the basis of a complete count.
6. When possible, the sampling plan should be designed so that the sample cases will be selected in the office rather than in the field.
7. When the type of sampling is being decided upon, the difficulty of locating persons who fit several of the qualifications must be borne in mind.
8. No plan for sampling human beings is satisfactory unless it includes techniques for handling the nonresponses, the

refusals, the not-at-homes, and other problem groups. (Ref 29:114)

Bearing the above points in mind, the sample was chosen in the following manner. First, the universe or population had to be defined. This involved little more than specifying the individuals whom we wished to sample. As stated earlier in the study, these individuals were scientists and engineers currently working in Government Research and Development laboratories. Next, the population was narrowed to Research and Development laboratories, which operated under the Air Force Systems Command. This specific Command is responsible for the development of technology and its application to operational aerospace weapons systems.

From a list obtained from the Air Force Systems Command, stating the number of scientists and engineers employed in each of the laboratories, five laboratories were chosen for the sample. These laboratories were chosen primarily because of the number of scientific and engineering personnel they employed. Secondly, they were chosen because of their locations. The laboratories chosen were: (1) Aero Propulsion Laboratory, (2) Avionics Laboratory, (3) Flight Dynamics Laboratory, (4) Materials Laboratory, and (5) Rome Air Development Center. The first four of these laboratories are located at Wright-Patterson Air Force Base, Ohio, while the fifth laboratory is located at Griffiss Air Force Base, New York.

The next task was to locate up-to-date name rosters of the scientific and engineering personnel employed at each laboratory. Once these were obtained, a sample had to be drawn. Parten says the following about sampling:

In studies of human populations the sample of cases selected for study in actual practice is seldom exactly the same as the one from which data are obtained and tabulated.

Random sampling is the term applied when the method of selection assures each individual or element in the universe an equal chance of being chosen. The selection is regarded as being made by "chance." The requisite of random selection is, that every unit in the population or universe has the same chance of being selected as every other unit. If the sample is chosen at random and if the number of cases is sufficiently large, it will represent all the groups in the universe in approximately correct proportions. Thus a large enough random sample, properly drawn, is both representative and a proportional sample.

To insure each unit an equal chance of inclusion, the following principles must be observed:

1. The population to be sampled and the units composing it must be clearly defined so that there will be no question as to what the sample represents.
2. A universe composed of many small units is preferable to one composed of fewer but larger units.
3. The units should be of approximately equal size.
4. If any unit appears more than once in the population to be sampled, all other units should appear the same number of times.
5. All the units should be independent of each other so that if one is drawn it will in no way affect the choice of another.
6. The same unit should be used in sampling and in tabulation and analysis.
7. The chance of selecting a certain unit in the total population must be uniform from one sample to another.
8. The universe must be present or catalogued so that every unit in it is listed or can be given an identifying symbol to be used during the drawing of the sample.
9. The method of selecting the sample should be completely independent of the characteristics to be examined.
10. All the units in the population should be available at the time the sample is drawn.
11. In order for the sample to remain random throughout the survey, every unit drawn must be accessible to the surveyor for the collection of information.
12. Once selected, no unit drawn at random can be discarded without risk of introducing bias or changing the universe of which the sample is representative. (Ref 29:106)

Based upon the necessity to obtain a representative cross section of the population, and the advantages of random sampling, the above was chosen as the best method in which to sample. This random selection was performed by assigning numbers to each individual working in a specific laboratory. At the same time, individual pieces of cardboard, all of which were approximately the same size, were numbered and thrown into a box. Sixty pieces were then chosen at random from the box. The individuals, whose numbers corresponded to those on the cardboard pieces chosen, became the sample. This process continued until a sample was chosen for each individual laboratory.

Since an optimum sample is one fulfilling the requirements of efficiency, representativeness, reliability, and flexibility, a sample size of sixty individuals from each laboratory was decided upon.

The next task consisted of transcribing names, office symbols, etc., of the individuals chosen in the sample. This list was checked against the sample criteria and the population to assure its appropriateness.

Development of the Questionnaire

> A questionnaire is not just a list of questions or a form to be filled out. It is essentially a scientific instrument for measurement and for collection of particular kinds of data. Like all such instruments, it has to be specially designed according to particular specifications and with specific aims in mind, and the data it yields are subject to error. In a questionnaire we not only have to think about the particular wording of the questions but also about the design of the investigation as a whole. (Ref 27:3)

Broadly speaking, all questions in a questionnaire are either "open" or "closed." A closed question is one in which the respondent is offered a choice of alternative replies. Open, or free-answer,

type questions are not followed by a list of alternatives. Rather, they are followed by a space in which the respondent may record his own feelings on the question posed. The chief advantage of the open question is the freedom it gives the respondent. Once he has understood the intent of the question, he can let his mind wander freely, unencumbered by a prepared set of replies. For this reason, the questions in this study will be of the "open" type.

In general, an effective questionnaire should follow these rules:

1. It should be as brief as practicable.
2. The information asked for must not be accessible to the investigator, otherwise, why ask someone to take his time in supplying it.
3. The subject inquired about must not be trivial. It must justify the time and effort involved.
4. The questions should be aimed at obtaining factual data.
5. The wording of every item should be understandable, familiar, and capable of the respondent's comprehension.
6. The items should be arranged in a neat and logical order.
7. The questionnaire should be conveniently planned and set up to take up a minimum of the respondent's time.
8. Clear instructions must be included as to the way the answers are to be indicated. (Ref 16:202)

Based on criteria for good questions, and for a good questionnaire, the researchers found the questionnaire developed by McIntire (Ref 93) to be adequate for adaptation to this study. The questions on career progression were reworded, somewhat, to make them applicable

to the population being sampled. The section containing general information was also changed to make it applicable to the sample, and, also, to gain additional information with which to classify the respondents. Thus, with McIntire's permission to use his questionnaire, this part of the study was complete.

The next step necessary was the determination of the best way in which to distribute and collect the completed questionnaire. Since mailing the questionnaires to the respondents involved costs and increased the chances for non-responses, it was decided that the best manner in which to distribute the questionnaire would be to utilize the official internal distribution system within each laboratory. To avoid confusion, and to increase the feeling of anonymity, a self-addressed stamped envelope was provided for the return of the completed questionnaire. It was felt this would be the best means of questionnaire collection.

Attitude Measurement and Attitude Scales

The literature on the definition and measurement of attitudes is extensive, and contains many different points of view. However, most definitions seem to agree that an attitude is a state of readiness, a tendency to act or react in a certain manner when confronted with certain situations. Thus, an individual's attitudes are present all the time, but lie dormant most of the time. They become expressed in actions, speech, or other behavior, only when the stimulus of the attitude is perceived (Ref 27:106).

Attitude scales are employed in the measurement of attitudes of individuals, or groups of individuals. The construction of the

scale, and its interpretation, demand expert attention. Even the choice of questions that would indicate a certain attitude, as well as the framing of the questions, requires expert attention. In addition, many other technical problems must be considered.

The effective attitude scale consists of a limited series of varied statements of opinion about some given subject, presented in the form of a questionnaire, and evoking responses from the one being questioned would indicate his attitude toward the given subject. The attitude scale used in this study is the one developed by Lieutenant Colonel McIntire (Ref 93:67).

The above is an adaptation of an interval scale, with the exception that this scale has only one interval. This scale was selected in preference to a Multi-interval Scale, shown below in Fig. 1.

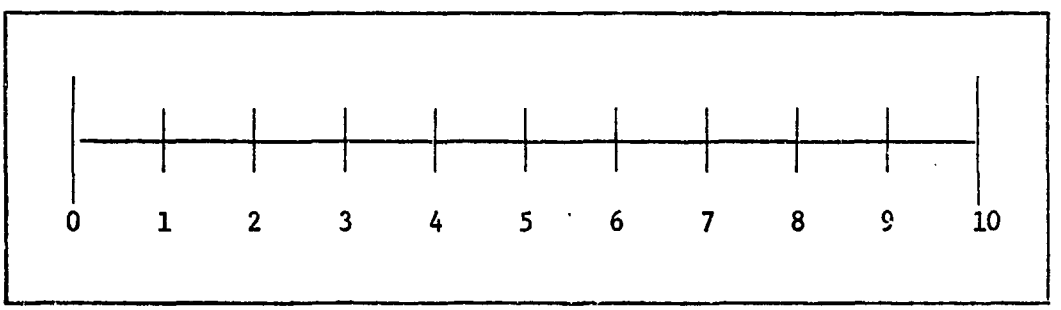


Fig. 1

Multi-interval Scale

Pilot tests conducted with the Multi-interval Scale showed a tendency of the respondent to mark the scale at the graduations along the scale. In this study, responses were desired all along the continuum, rather than at discrete points. For this reason, the identical scale used by McIntire was adopted for use in this study

(Ref 93).

Response Bias

In his study of career progression, McIntire states the following about response bias:

> Response bias is the effect of measurement techniques on the responses of people. In this study response bias should be checked to determine whether the respondent's answers to question (21) are affected by the values they assign to the scales on questions (16-20). [Number in parentheses are ours.] In other words, if a respondent rates advancement high on question (17) and job interest very low on question (20), does he also weight advancement high and job interest very low on question (21)? Weighting factors should be independent of the degree to which such factors are perceived to be present in the work environment. The weighting question was separated from the career progression questions as far as possible to minimize bias.
>
> To test for response bias, a control group of 52 of the respondents in aerospace firm #1 received only the general information questions and question (21). They did not receive questions (16-20). Attached to question (21) were explanations of the meaning of each of the five career progression factors. The mean weight for the five factors was determined from the responses of this control group and compared with the mean weight for each factor of the main group. The control group means are unbiased by questions (16-20) since this group did not receive those questions. Main group and control group mean factor weights are compared to determine whether there are significant differences in the individual factor means. (Ref 93:78)

The results of his study show no response bias. The same should be true of this study since it is a parallel study. In addition, the following sources of bias were eliminated or lessened through careful preparation and conduct of the study: (1) a biased source list, (2) errors during drawing of samples, (3) poor question framing, (4) poor assignment and office procedures, (5) untruthful informants, (6) arithmetical errors, and (7) errors in adjusting returns.

The Questionnaire

The first part of the questionnaire (Appendix C) contained several questions of a general nature concerned with the individual's organization of employment, his grade, age, education, experience, position, and job-content. This information was necessary to provide a basis on which to stratify the samples for analysis.

The following section consisted of questions 13 through 22, which were designed to obtain the individual's feelings or attitudes concerning his career aspirations, expectations, and other factors pertinent to his perception of career progression. The section containing questions on career progression was preceded by a page of instructions and explanatory information. This page was worded as follows:

"Following are questions regarding the feelings you have about your job and your career. We are interested in having you mark the scale that follows each question, after you have given careful thought to that question. Please place a vertical line (|) at the point on the scale that best measures your feelings about the question. Although the scales have no units of measurement, please think of them as covering a range of 0% to 100%."

EXAMPLE:

Advancement

No opportunity for advancement

Maximum opportunity for advancement

The paragraph that preceded each of the questions played a very important role. This was because of semantics. This held especially

true in the area covered by this research, because there were so many definitions of the words: (1) achievement, (2) recognition, (3) job interest, (4) responsibility, and (5) advancement. In this study, they took on still another definition. This made it imperative to define the terms used just prior to the asking of each question. It also gave a definition to the individual, which could be viewed while answering the question on how he rated his job in relation to a defined factor. The last sentence of the paragraph, which contained the definition, asked the respondent to actually rate his job in relation to the factor just defined.

The first question concerned career aspiration. This question was to determine where, on the continuum scale, the individual aspired to reach. The question was presented as follows:

"13. Career Aspiration

Please indicate the highest level in the Air Force Systems Command Laboratory System that you would truly like to reach."

Junior Engineer or Junior in another specialty

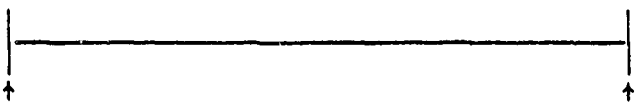
Chief Scientist or Technical Director, AFSC

The next question concerned an individual's career expectations. This question, when answered by the respondent, gives an indication as to where, on the continuum scale, the individual expects to reach. Also, the subtraction of the career expectation rating from the career aspiration rating will reflect the individual's frustration. This difference shall be called an Index of Frustration (IOF).

The question on career expectation was as follows:

"14. Career Expectations

Please indicate the highest level in the Air Force Systems Command Laboratory System that you realistically expect to reach."



Junior Engineer or Junior in another specialty

Chief Scientist or Technical Director, AFSC

Following the questions on career aspirations and expectations, a question concerning security was posed. Security was used in terms of meaning how conducive an individual's work environment was in allowing him to reach his aspirations. The question was worded as follows:

"15. Security

Security means different things to different people. For the purposes of this question, it means freedom from anxiety and doubt that you will be able to accomplish your career objectives in your organization. In other words, one is absolutely secure if he is absolutely confident that he will be able to accomplish his career objectives. He is completely insecure if he has no (zero) confidence that he will be able to do so. Most of us fall somewhere in between these extremes. Using these definitions of secure and security, please indicate your feelings of security on the following scale."

Completely insecure

Absolutely secure

The next five questions dealt mainly with Herzberg's job satisfaction factors (satisfiers). They were asked in order that the perceptions of the individuals on these motivators could be determined.

The importance of these factors has been discussed earlier in Chapters I and II. These questions were worded as follows:

"16. Recognition

Recognition can come from many sources, such as peers, subordinates, friends, or one's supervisors. It may take many forms, ranging from awards and commendations to a friendly pat on the back.

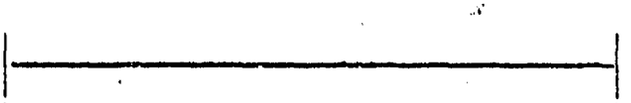
Considering the total sources and forms of recognition, I rate the recognition I have received on my job as follows:

No recognition for my accomplishments — Full recognition for my accomplishments

17. Advancement

Advancement is essential to an individual's career. This advancement may be upward in the organization's structure or it may be upward in one's technical/professional standing.

I believe my overall opportunities for advancement in my organization are:



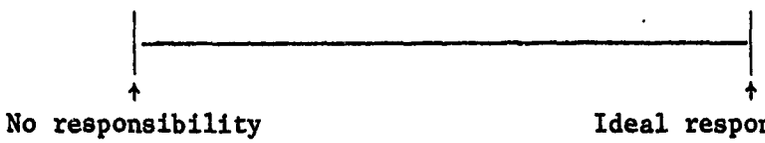
Nil — Excellent

18. Responsibility

There is an ideal amount of responsibility necessary and required to allow one to perform his job efficiently and effectively. This amount of responsibility should be inherent in each organizational position. However, the amount of responsibility that one is

assigned often varies from this ideal.

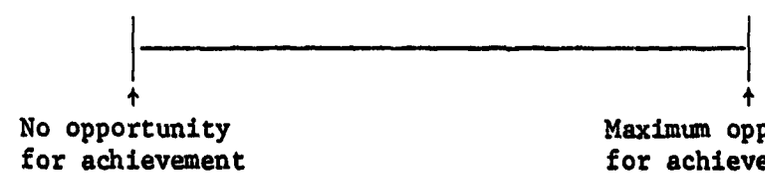
I rate the responsibility assigned to me as follows:



19. Achievement

Organizational positions provide opportunities for an individual to make significant and self satisfying contributions to his organization, his profession, and to society. One's opportunities to make such contributions may be different for each of these categories. However, all three categories should be considered in deciding on your total opportunity for achievement in your job.

I rate the opportunities for achievement in my job as follows:



20. Job Interest

Job interest is dependent upon the challenge of the work inherent in the job, the degree to which this work matches the interests of the individual, and the degree to which the individual feels he can influence the job.

I find my job:

In each of the preceding questions, the individual responding to the questionnaire was asked to indicate his perceptions by marking a scale which followed each question. This scale consisted of a straight line which the respondent was asked to think of as going from 0 to 100 percent. In addition to this, appropriate categorical statements were placed at the ends of the lines. This assisted the respondent in framing an 0, or 100 percent would be in relation to the job. He would then mark the scale somewhere on or between these two categorical extremes to indicate his rating.

The next to the last question asked the respondents to weight Herzberg's five factors: (1) recognition, (2) advancement, (3) responsibility, (4) achievement, and (5) job interest, in relation to their importance in career progression. The purpose of this question was to obtain individual weighting factors to questions #16 through #20. This question was as follows:

"21. Please assign numerical weights to the following five factors in accordance with your estimate of their importance to career progression in your job. Refer back to questions 16 through 20 for meaning of these factors. Assume that these are all the factors that are important to career progression. Choose the weights in such a way that their sum is equal to 100."

1. Recognition _____
2. Advancement _____
3. Responsibility _____
4. Achievement _____
5. Job Interest _____

100

The last question in the questionnaire asked for comments. This question was posed to see if the comments reported would follow any kind of a trend. The question appeared as follows:

"22. Any additional comments that you may have:"

All the questions, #13 through #20, appeared on separate pages to avoid any possible confusion, and to give the respondent one item at a time to think about. It also made it easier to record the data from the returns received.

The means, variances, and the significance of differences between means for all the samples and stratifications thereof are computed from data obtained from the questionnaire. This is done in Chapter VI. In Chapter VII, the identification of factors responsible for significant differences, if any exist, will be discussed.

Recording of the Data

Due to the large sample taken, and the even larger amount of data that had to be recorded from each return, ordinary manual methods of recording were found to be inadequate. In addition, the means and variances, as well as the significant difference tests, of the data would have to be calculated for many, many stratified groupings. For these and other reasons, computer processing of the data was chosen.

The information from the questionnaire was transposed to IBM punch cards in the following manner. The general information from the questionnaire was placed in columns #1 through #17, while the responses to the questions on career progression were placed in columns #19 through #69. The responses to questions #13 through #20 were rated by placing a 10 centimeter scale below the line on which

the respondent marked his answer. Since the answer line was also 10 centimeters long, the score was read directly off the 10 centimeter scale. The scale was read to one decimal place.

An example of a punched card is shown in Fig. 2. Figure 3 is the interpretation of the Example Data Card.

Pay Scale

The sample was stratified in the following five salary groups: (1) $12,499 and under, (2) $12,500 to $14,999, (3) $15,000 to $17,499, (4) $17,500 to $19,999, and (5) $20,000 and above.

The groupings, by grade and step of GS levels, is shown in Fig. 4. (The chart applies to the General Schedule - Per Annum Rates and Steps as it appears in Appendix D.)

Besides using the questionnaire and previously discussed theories to measure and evaluate perceived career progressions, it is worthwhile to examine the sample population with respect to its environment. The characteristics of this environment should be kept in mind, so that analysis of the results will be realistic with respect to this environment.

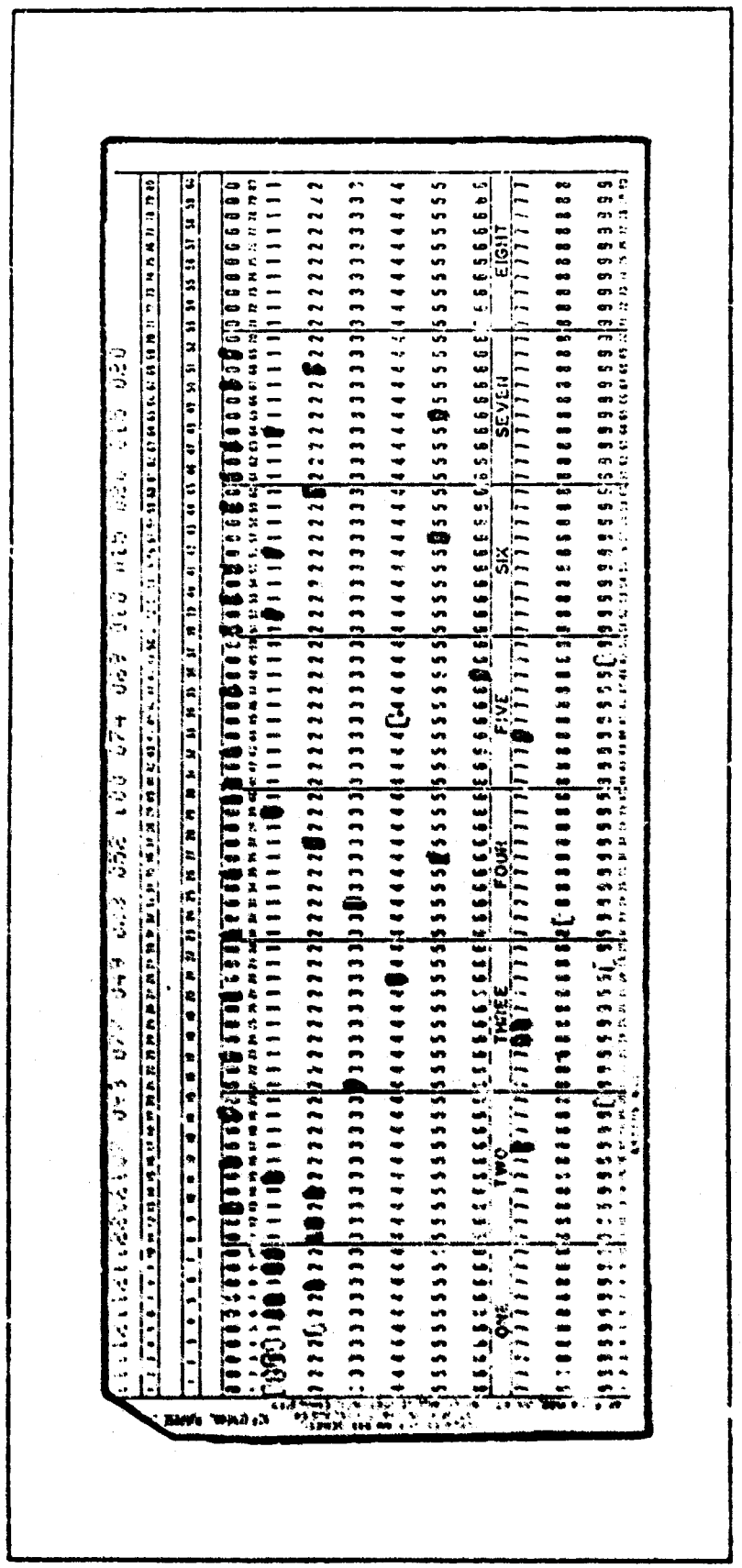


Fig. 2

Example Data Card

COLUMN	RESPONSE	MEANING OF RESPONSE
		(Background Information)
1	1	Individual employed at Aero Propulsion Laboratory.
2&3&4	111	Current GS grade 11, step 1.
5	2	Rated 2 on pay scale. (To be discussed later.)
6	1	Age 26 years or under.
7	1	Highest educational degree obtained, B.S.
8	2	Desires an M.S. degree.
9	1	Total years of S & E work experience, 4 or less.
10	1	Years of supervisory experience, 4 or less.
11	2	Not in a supervisory position.
12	2	Not in a second line or higher supervisory position.
13&14	02	Between 3 and 4 years at present job.
15	1	Job and its content have increased in past 5 years.
16&17	07	Started out at present job as a GS-7.
		(Answers to Questions 13-21)
19-21	093	Rates aspiration as 93 percent of maximum.
23-25	077	Rates expectation as 77 percent of maximum.
27-29	049	Rates security as 49 percent of maximum.
31-33	083	Rates recognition received as 83 percent of full recognition.

Fig. 3

Interpretation of Example Data Card

COLUMN	RESPONSE	MEANING OF RESPONSE
35-37	052	Rates advancement opportunity as 52 percent of excellent.
39-41	100	Rates responsibility as 100 percent or ideal responsibility.
43-45	074	Rates achievement as 74 percent of maximum opportunity.
47-49	069	Rates job interest as 69 percent of being maximum.
51-53	010	Weights recognition as 10 in importance.
55-57	015	Weights advancement as 15 in importance.
59-61	020	Weights responsibility as 20 in importance.
63-65	015	Weights achievement as 15 in importance.
67-69	020	Weights job interest as 20 in importance.

Fig. 3 Continued

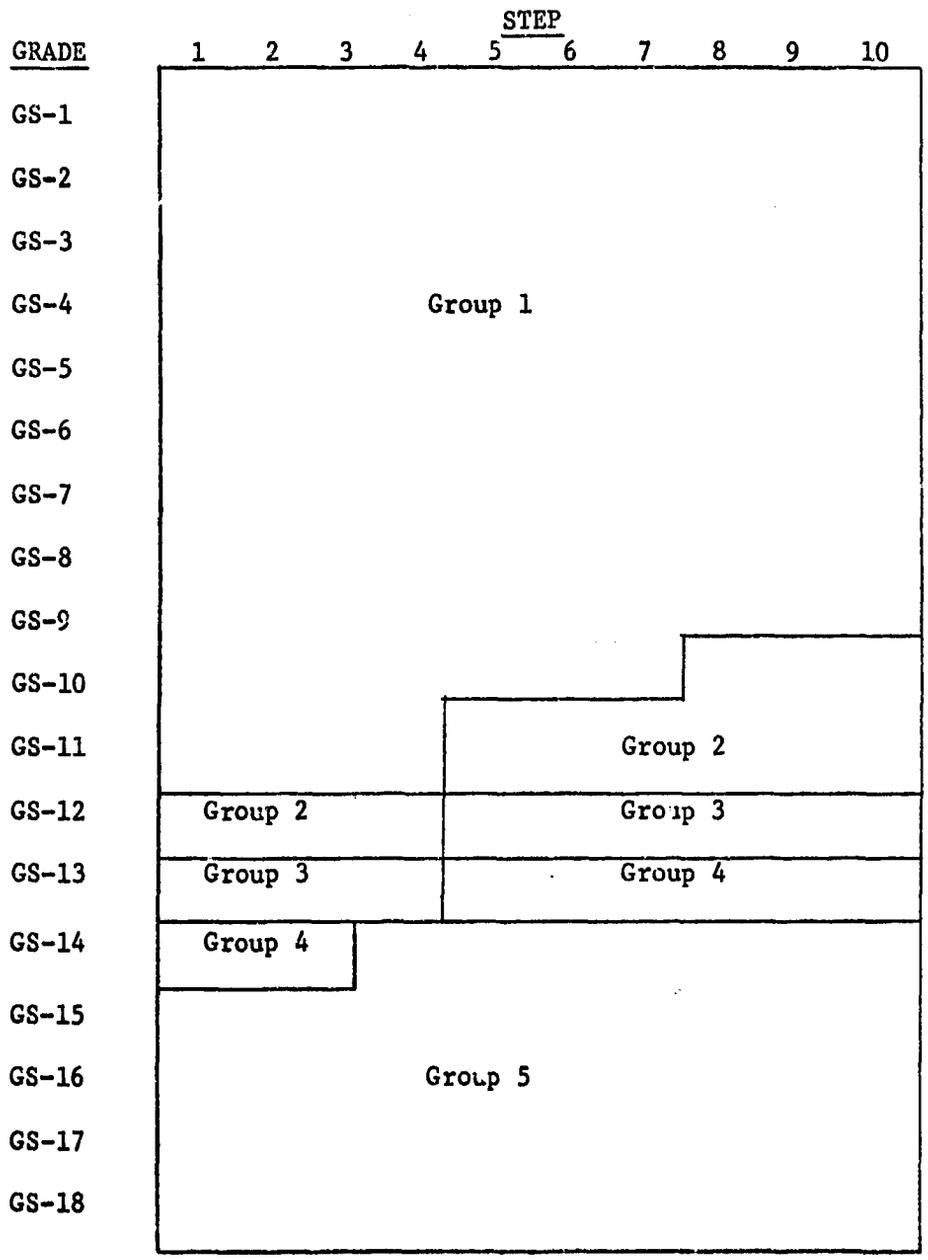


Fig. 4

Salary Group Stratifications

IV. Characteristics of the AFSC Laboratories

The purpose of this chapter is to give a description of the Air Force Systems Command Research and Development Laboratories, in which this study was conducted. Although the chapter is short, it provides a summary of the vital characteristics of the laboratories, as applicable to this study. The scientific and engineering personnel from these laboratories make up the population from which the sample for this study was drawn. The latter part of the chapter contains Tables in which the characteristics of the laboratories and the sample are compared.

Background and Characteristics of the AFSC Laboratories

The Air Force Systems Command Laboratories, in which this research was conducted, are under the direction of the Director of Laboratories (DOL). The DOL was established in Headquarters, Air Force Systems Command (AFSC) as a Deputy Chief of Staff organization in March 1967. It was formed, essentially, by combining the technical manpower resources and functions of the former Deputy Chief of Staff Science and Technology (AFSC), and Headquarters, Research and Technology Division (RTD).

The purpose of this reorganization was to make the Air Force Systems Command more responsive to evolving scientific and technological needs of the Air Force, as well as to adjust to the increasing stringencies of economy.

The mission of the DOL is to monitor the activities of, and provide technical direction to 9 AFSC laboratories, and 24 scientific and technical liaison offices assigned to the DOL. The DOL has staff responsibility for Air Force exploratory and advanced development programs, and exercises cognizance over all technology efforts being performed by or for the Air Force Systems Command.

The Director of Laboratories, and his staff, are concerned with the integration of the total AFSC research and technology program, formulating policy, analyzing and making necessary program and resource adjustments to maintain a proper balance of AFSC laboratory efforts, ensuring a continuum of near-term and long-term effort is preserved after research through exploratory and advanced development supporting systems development, providing timely technical solutions to Air Force military problems, correcting technical deficiencies, satisfying operational needs, and serving as AFSC's technical liaison focal point with industrial, educational, and other governmental research and technology organizations.

The DOL and the Air Force laboratories, under its cognizance, are manned by approximately 6,000 personnel, with 82 of these personnel located in the scientific and technical liaison offices, and 124 personnel assigned to the DOL staff. Of the total, approximately 3,500 personnel are scientists and engineers, of whom 1,100 are military officers. This leaves approximately 2,400 personnel on which this research is based. The academic degrees attained by the scientists and engineers are: Ph.D. - 4 percent; Master's - 22 percent; and Bachelor's - 69 percent.

The DOL is responsible for 1,724 Research and Development contracts, representing a total value of $440,000,000. Yearly operating funds of $328,000,000 have been required to operate the laboratories, and an additional $140,000,000 has been expended yearly on behalf of other governmental agencies engaged in Research and Development work. The technical facilities of the 9 laboratories are valued at more than $400,000,000.

Each of the 9 laboratories, under DOL cognizance, is charged with planning and executing AFSC exploratory and development programs, and serves as the Systems Command focal point for all available information in its assigned areas of technology.

Rome Air Development Center, Griffiss Air Force Base, New York. This laboratory is responsible for intelligence techniques, reliability and compatibility techniques for electronic systems, electromagnetic transmission and reception, ground based surveillance, ground communications, and information processing and display.

Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio. This laboratory is responsible for structural materials, material for seals, sealants, and compliant applications, material for electromagnetic applications, and material for energy transfer. The AFML also manages and directs the Air Force Manufacturing Methods Program.

Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Ohio. This laboratory is responsible for turbine engine propulsion, ramjet propulsion, power generation, electric and advanced propulsion (non-chemical), and other associated areas including fuels,

lubricants, flight vehicle power, and aerospace support techniques.

Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Ohio. This laboratory is responsible for avionics communications; bionics, lasers, and molecular electronics; electro-magnetic vehicle environment; camouflage and antennas; electromagnetic warfare; navigation, guidance, and weapon delivery; and aerospaceborne reconnaissance and surveillance.

Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio. This laboratory is responsible for aerospace flight vehicle structures, flight mechanics, flight control, vehicle dynamics, environmental control, mechanical systems, recovery, and crew stations.

These are the five laboratories at which the research was conducted. The following laboratories are also under the direction of the DOL:

(1) Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, California.

(2) Air Force Armament Laboratory, Eglin Air Force Base, Florida.

(3) Air Force Human Resources Laboratory, Brooks Air Force Base, Texas.

(4) Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico.

All of these laboratories act as a focal point for the Air Force Systems Command for information in the areas assigned to them. They execute their assigned projects, and work closely with the Army, Navy, NASA, ARPA, and other governmental agencies. They support all the Air Force Systems Command programs, and insure the rapid application of research and technology to advanced systems (Ref 96).

Laboratory	Scientists & Engineers	Number Sampled	Percent Sampled
Aero Propulsion	160	48	30.0
Avionics	281	38	13.5
Flight Dynamics	348	44	12.7
Materials	235	41	17.5
Rome Air Development Center	548	44	8.0
TOTALS	1,572	215	13.7

Fig. 5

Sample Characteristics

Category	Sample Number	Sample Percent	Population Number	Population Percent
Educational Level				
B.S.	155	72		69
M.S.	41	19		22
Ph.D.	8	4		4
Other	11	5		5
	215	100		100
GS Grade				
7	4	2	50	3.2
9	8	4	50	3.2
11	9	4	89	5.7
12	44	20	338	21.5
13	87	41	643	40.9
14	33	15	277	17.6
15	12	6	108	6.9
16	5	2	16	1.0
Non-response	13	6		
	215	100	1,572	100.0

Fig. 6

Comparison of Characteristics

V. Data Analysis

The purpose of this chapter is to discuss the methods used in compiling, processing, and analyzing the data obtained. As was indicated in Chapter II, the primary method of gathering data for this study was through the use of a questionnaire. So, the analysis of the data will be concerned with the responses to the questions from this questionnaire. The normalcy assumption, computational forms, data processing methods, and hypotheses tests, as applicable to the data, will be the major topics of this chapter.

The Normalcy Assumption

The respondents to this study constitute a random sample, as explained earlier. After stratifying this sample into groups, the responses were used to calculate the means and standard deviations for each of the questions 13 through 21. The normalcy assumption pertains to these calculated means, and says that their distribution approaches the normal distribution as the sample size increases. This assumption is based upon the central limit theorem, which states that for n sufficiently large, the normal distribution is approximated (Ref 26:272).

Stratification of the Sample Data For Hypothesis Testing

Using the responses from the background information section of the questionnaire, the sample was divided into several groups, which were under nine major subject headings. The responses themselves were

the basis for this stratification. For example, the respondent was asked to indicate his age by checking the proper bracket on the questionnaire, each bracket covering a specific range of years. These brackets were numbered, and stratification was by these numbered codes. The sample was ultimately stratified into 5 laboratory groups, 5 pay groups, 5 age groups, 4 educational groups, 5 groups reflecting the total years of engineering and scientific experience, 5 groups according to years of supervisory experience, 3 supervisory and non-supervisory levels, 10 groups according to the number of years spent on the present job, and 3 groups reflecting the change or lack of change in job-content.

Data Processing

The card bearing the data from the questionnaires was processed on an IBM 1620 Computer. Programs for calculating the mean and the standard deviation are shown in Appendix E. Using these programs, it was only necessary to tell the Computer what group of data to compute on, and then load the main data deck into the card reader. For instance, in calculating the mean of the answers for the respondents from Rome Air Development Center, the first card read told the Computer to check the first data group, the laboratory group code, and to look for a 5--the code number for RADC. Upon finding a 5 in the right column, the Computer carried out the proper calculations. If the 5 was not there, the Computer went on to the next card.

In the actual data runs, it was found to be faster if the data deck was already sorted before loading it into the Computer. Thus, the Computer only had to read those cards which were necessary for the

computation. The card sorting was done electrically with an IBM card sorter, and checked for accuracy by reading a printout of the resultant stratification.

The output cards from the means calculation were used as the input data for the calculation of standard deviations. This program punched out cards bearing the group code number, the number in the group, the group's means, and the corresponding standard deviation. These, in turn, were loaded into the Computer as the input data for the significant difference testing program.

The testing program, Appendix E, has a sorting routine at the start which decides whether the use of the t-distribution test is necessary, as in the case of a sample size of less than 30, or whether the normal distribution Z value calculation is correct to use, as is the case of a sample size of 30 or more. In either case, the Computer calculated a t or Z value, and punched it out, along with the designation of the test used.

These output cards were fed into a printer to obtain a paper copy of the data contained in the cards. The only further processing necessary was to transfer the data to a tabular form for analysis. This analysis yielded levels of significant difference, trends, and the statistical proving of the hypotheses of this paper.

Computational Forms

The equations for the calculation of the mean and of the standard deviation are as follows:

$$\text{Mean} = \bar{X} = \sum_{i=1}^{n} X_i/n \tag{1}$$

$$\text{Standard Deviation} = \hat{S} = \left[\frac{\sum_{i=1}^{n} (\bar{X} - X_i)^2}{(n-1)}\right]^{1/2} \tag{2}$$

where: X_i is the answer rating of the question for which the mean is being calculated.

n is the number of responses received on the question.

The form for the standard deviation has the statistical advantage of being an unbiased estimator of the population standard deviation. Together, the mean and the standard deviation communicate more about the sample data and its distribution than would the body of data itself.

The equations used to calculate the Z values used in the significant difference testing follows.

$$Z = (\bar{X}_1 - \bar{X}_2)/S_D \tag{3}$$

$$S_D = \left[\frac{\hat{S}_1^2}{n_1} + \frac{\hat{S}_2^2}{n_2}\right]^{1/2} \tag{4}$$

where: X_1 and X_2 are the means for the groups to be compared.

S_D is an approximation for the standard deviation of the difference between the two means being compared.

n_1 and n_2 are the respective sample sizes.

S_1 and S_2 are the respective standard deviations.

Where it was necessary to use Students "t" distribution, the following equations were used (Ref 33:176).

$$t = (\bar{X}_1 - \bar{X}_2)/S_D' \tag{5}$$

$$S_D' = \left[\frac{(n_1 - 1)\hat{S}_1^2 + (n_2 - 1)\hat{S}_2^2}{n_1 + n_2 - 2} \cdot \frac{1}{n_1} + \frac{1}{n_2}\right]^{1/2} \tag{6}$$

where: the quantities are defined as before.

Hypothesis Testing

The hypothesis testing, which this study entails, involves the rejection or acceptance of an alternative hypothesis at a given level of confidence on the basis of the comparison of a calculated value with a similar value from a Table. Contained in this brief statement are quantities which bear further elucidation, alternative hypothesis, level of confidence, and the decision rule.

The null hypothesis (H_o) is a hypothesis of no differences. It is usually formulated for the express purpose of being rejected. If it is rejected, the alternative hypothesis (H_1) is accepted. The alternative hypothesis is the operational statement of the experimenter's research hypothesis. The research hypothesis is the prediction derived from the theory under test.

Only two states of nature are allowed to exist: either H_o or H_1. H_o is the null hypothesis, the hypothesis of which we desire proof. H_1 is the alternative hypothesis, saying just the opposite

of what H_o says. In this dichotomous situation, either H_o is true and H_1 is false, or H_o is false and H_1 is true, depending upon the outcome of the decision rule, not discussed as yet.

An important variable in that decision rule is the level of confidence to be used. The level of confidence, usually expressed as a percentage, is equal to $1 - \alpha$, where α is the probability that the error of rejecting a true hypothesis will occur; a Type I error. For instance, if the α assumed is zero, there being zero chance of rejecting a true hypothesis, the corresponding confidence level is 100 percent. If α is 0.05, then the confidence level is 95 percent.

While it would appear that to assume α to be zero is best, there is another error; a Type II error, which can occur with a probability that is inversely related to α. A Type II error is the error of accepting a false hypothesis. The probability of such an error, β, increases as α decreases. The procedure is thus to pick an α, and then to select a decision rule that will minimize β.

The decision rule may take one of three forms: (1) the left-hand tail test, (2) the right-hand tail test, and (3) the two-tail test. Since the latter is the one of concern in this Thesis, it will be defined; the definitions of the first two are analogous. In the two-tail test, the null hypothesis states the statistics describing two populations or samples are equal (i.e., there are no significant differences between them), and the alternative hypothesis would state that they are not equal. The arrangement of equality and non-equality, relative to the null and alternative hypothesis, may go either way. The point is that the first statistic, which is to be compared to the second statistic, may be larger or smaller than the second statistic.

The testing thus must cover both sides, or both tails of the normal curve.

Application of the Decision Rule

As an example, assume the null and alternative hypotheses are the equality and the inequality of sample means, respectively, as used in a previous example. Using the normal distribution, a Z value is calculated using Eq (3), and compared to the Z_c which corresponds to the level of confidence assumed. If Z is less than Z_c, then the alternative hypothesis is rejected, and the null hypothesis is accepted. If Z is greater than Z_c, then the alternative hypothesis cannot be rejected and is accepted.

In the case where the sample sizes are less than 30, Students' t-distribution will be used in an analogous fashion. A "t" computed from the sample data will be compared with the proper t_c from the Table, dependent upon the level of confidence chosen, and the sample sizes.

VI. Hypothesis Testing and Results

The purpose of this chapter is to display the testing of the hypotheses stated in Chapter I, and to present the results of the study. The results include tabulations of the means and standard deviations for the responses to questionnaire questions 13 through 21, and tabulations of the significant difference test results for all groupings and stratifications. The tables containing these results follow each hypothesis and are numbered the same as the hypothesis they relate to. Information on data grouping and stratification may be found in Appendix H.

The significance of rejected or accepted hypotheses will not be discussed in this chapter, rather, it will be discussed in the conclusion. However, in the presentation of data sections following each hypothesis a summary of the hypothesis test results will be stated. The last section of this chapter contains tabulations of the Index of Frustration, and the Career Progression Index.

Tests of the Hypotheses

Hypothesis 1

Scientists and engineers, in a given laboratory, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different laboratories.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where H_o is the null hypothesis.

H_1 is the alternative hypothesis.

u_1 is the mean value of the response to a given question from a given laboratory group.

u_2 is the mean value of the response to the same given question from a different laboratory group.

Presentation of the Data

Since the laboratories in which the research was conducted were 5 in number, this analysis will involve the comparison of the responses from each laboratory, with the other 4 laboratories remaining. Thus, the total analysis will involve C comparisons ($C = \binom{n}{r} = (5)!/(2)!(5-2)!$), or 10 comparisons (Ref 26:24). These comparisons will be made to determine if any significant difference exists between the way personnel from each laboratory respond to questions 13 through 21.

Because of the size of the sample, over 30 respondents from each laboratory, a normal distribution was assumed in testing the hypothesis concerning the difference between 2 means (Ref 33:176). In every case, the means of the responses were calculated and were tested against the means of the responses from other laboratories. There were no significant differences found at the 95 percent level of confidence. The results of the hypothesis tests show that out of 130 comparisons, 127

Table I

Mean Responses and Standard Deviations
For Laboratory Groups

	Laboratory Groups				
Question	Aero	Avionics	FDL	MRL	RADC
13	79*	79	75	75	75
	20	17	18	20	15
14	67	67	61	62	66
	20	18	18	22	15
15	66	67	62	60	71
	23	24	26	22	20
16	56	63	62	61	59
	28	25	25	28	26
17	49	52	46	51	54
	25	30	27	27	26
18	72	72	75	68	68
	21	22	19	25	21
19	64	73	66	65	67
	26	18	21	23	20
20	72	79	72	79	75
	26	18	18	18	19
21a	15	16	18	17	17
	7	10	8	9	8
b	19	15	19	16	17
	7	8	10	7	6
c	17	20	19	19	19
	7	8	7	6	8
d	21	24	21	23	20
	9	15	7	10	7
e	28	25	24	25	28
	11	16	10	12	14
Sample #	(48)	(38)	(44)	(41)	(44)

* $\frac{79}{20}$ where 79 is the mean and 20 is the standard deviation.

Table Ia

Significant Difference Test Results on Laboratory Groups

Lab Groups.....	APL-AVL	APL-FDL	APL-MRL	APL-RADC	AVL-FDL
Type Test.....	z	z	z	z	z
Question					
13 Aspirations	0.254	1.202	1.039	1.287	0.960
14 Expectations	0.008	1.353	1.037	0.238	1.360
15 Security	0.205	0.893	1.423	1.041	1.027
16 Recognition	1.260	1.207	0.872	0.550	0.096
17 Advancement	0.613	0.454	0.486	0.972	0.978
18 Responsibility	0.121	0.680	0.674	0.890	0.502
19 Achievement	1.955	0.391	0.250	0.670	1.678
20 Job Interest	1.502	0.083	1.602	0.687	1.725
Weightings					
21a Recognition	0.615	2.139*	1.542	1.331	1.136
21b Advancement	2.194*	0.169	1.469	1.467	2.000*
21c Responsibility	1.408	0.964	1.097	1.044	0.591
21d Achievement	0.965	0.500	0.582	0.698	1.300
21e Job Interest	0.714	1.741	1.108	0.079	0.536
z_c	1.960	1.960	1.960	1.960	1.960

* Indicates significant difference at the 95 percent level of confidence.

Table Ib

Significant Difference Test Results on Laboratory Groups

Lab Groups.....	AVL-MRL	AVL-RADC	FDL-MRL	FDL-RADC	MRL-RADC
Type Test.....	z	z	z	z	z
Question					
13 Aspirations	0.813	1.033	0.070	0.013	0.086
14 Expectations	1.044	0.247	0.176	1.258	0.912
15 Security	1.525	0.746	0.434	1.841	2.503*
16 Recognition	0.328	0.718	0.247	0.647	0.354
17 Advancement	0.161	0.223	0.888	1.368	0.428
18 Responsibility	0.739	0.940	1.263	1.554	0.116
19 Achievement	1.693	1.439	0.128	0.289	0.401
20 Job Interest	0.087	0.960	1.860	0.735	1.072
Weightings					
21a Recognition	0.677	0.488	0.483	0.756	0.243
21b Advancement	0.895	1.015	1.351	1.331	0.091
21c Responsibility	0.517	0.432	0.103	0.149	0.057
21d Achievement	0.537	1.423	1.074	0.205	1.263
21e Job Interest	0.146	0.599	0.494	1.427	0.904
z_c	1.960	1.960	1.960	1.960	1.960

* Indicates significant difference at the 95 percent level of confidence.

were accepted and 3 were rejected.

Hypothesis 2

Scientists and engineers, in a given salary group, perceive their aspirations, expectations, and security, and rate and weight the motivational factors the same as other scientists and engineers in different given salary groups.

The statistical hypotheses are:

$$H_0: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from a given salary group.

u_2 is the mean value of the response to the same given question from a different given salary group.

Presentation of the Data

This analysis consisted of a comparison between 5 salary groups. Thus, the total analysis will involve 10 comparisons. These comparisons will be made to determine if any significant differences exist between the way personnel from different salary groups respond to questions 13 through 21.

The means for the responses of the different salary groups were calculated and tested to see if any were significantly different from each other. Significant differences were found, as indicated in the Table of Significant Difference Test Results. The * in the Table of Results indicates where these significant differences were found. The absence of the * mark indicates that no significant differences were found in that particular category. The results of the hypothesis tests

Table II

Mean Responses and Standard Deviations For Salary Groups

Question	Salary Groups 1	2	3	4	5
13	71*	76	75	79	81
	22	19	19	14	18
14	60	63	59	66	72
	18	19	19	17	18
15	56	63	61	62	78
	21	23	23	26	15
16	61	57	57	58	68
	23	23	29	28	22
17	60	53	45	46	58
	21	21	29	25	27
18	66	67	68	72	77
	21	22	23	21	18
19	66	63	62	67	76
	18	21	24	20	20
20	63	73	71	79	81
	20	21	23	15	19
21a	17	15	17	17	17
	8	7	9	8	7
b	17	18	17	18	17
	6	7	7	8	9
c	20	18	18	19	20
	5	6	7	8	7
d	20	22	21	22	22
	13	7	9	8	8
e	23	27	27	25	25
	12	11	13	9	12
Sample #	(15)	(34)	(62)	(53)	(40)

* $\frac{71}{22}$ where 71 is the mean and 22 is the standard deviation.

Table IIa

Significant Difference Test Results on Salary Groups

Salary Groups.....	1-2	1-3	1-4	1-5	2-3
Type Test.....	t	t	t	t	z
Question					
13 Aspirations	0.832	0.714	1.796	1.807	0.301
14 Expectations	0.537	0.111	1.227	2.190*	0.918
15 Security	1.039	0.799	0.945	4.427*	0.400
16 Recognition	0.513	0.506	0.400	1.038	0.074
17 Advancement	1.093	1.920	2.076*	2.835*	1.551
18 Responsibility	0.160	0.399	1.060	1.992	0.329
19 Achievement	0.512	0.652	0.089	1.575	0.238
20 Job Interest	1.511	1.138	3.419*	2.979*	0.529
Weightings					
21a Recognition	1.105	0.184	0.280	0.381	1.194
21b Advancement	0.154	0.039	0.218	0.169	0.265
21c Responsibility	1.150	1.094	0.914	0.396	0.207
21d Achievement	0.646	0.314	0.805	0.670	0.582
21e Job Interest	1.084	0.949	0.530	0.494	0.744
D. F.	47	75	66	53	
Z_c					1.960
t_c	2.015	2.000	2.000	2.010	

* Indicates significant difference at the 95 percent level of confidence.

Table IIb

Significant Difference Test Results On Salary Groups

Salary Groups.....	2-4	2-5	3-4	3-5	4-5
Type Test.....	z	z	z	z	z
Question					
13 Aspirations	0.859	1.196	1.474	1.745	0.553
14 Expectations	0.800	2.083*	2.037*	3.378*	1.546
15 Security	0.085	3.236*	0.334	4.484*	3.647*
16 Recognition	0.079	2.031*	0.156	2.190*	1.950
17 Advancement	1.514	0.891	0.079	2.318*	2.298*
18 Responsibility	1.130	2.209*	0.908	2.137*	1.266
19 Achievement	0.815	2.587*	1.171	3.087*	2.068*
20 Job Interest	1.565	1.664	2.526*	2.456*	0.368
Weightings					
21a Recognition	1.080	0.993	0.122	0.227	0.103
21b Advancement	0.103	0.428	0.398	0.237	0.536
21c Responsibility	0.027	0.697	0.255	0.882	0.652
21d Achievement	0.236	0.094	0.842	0.640	0.124
21e Job Interest	1.004	0.730	0.982	0.691	0.129
Z_c	1.960	1.960	1.960	1.960	1.960

* Indicates significant difference at the 95 percent level of confidence.

show that out of 130 comparisons, 108 were accepted and 22 were rejected.

Hypothesis 3

Scientists and engineers, in a given age group, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different age groups.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from a given age group.

u_2 is the mean value of the response to the same given question from a different given age group.

Presentation of the Data

This analysis consisted of a comparison between 5 age groups. Thus, the total analysis will involve 10 comparisons. These comparisons will be made in order to determine if any significant differences exist between the way personnel of different age groups respond to questions 13 through 21.

The means for the responses of the different age groups were calculated and tested to see if any significant differences existed. For sample sizes of 30 and more, the normal distribution was used, but for sample sizes of less than 30, the Students' "t" distribution was used in the significant difference calculations. Significant differences were found at a confidence interval of 95 percent. The groups between which differences were found are indicated in the Table of Significant Difference Test Results by an * beside the

appropriate grouping. The results of the hypothesis tests show that out of 130 comparisons, 13 were rejected.

Hypothesis 4

Scientists and engineers, in a given educational group, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different educational groups.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from a given educational group.

u_2 is the mean value of the response to the same given question from a different given educational group.

Presentation of the Data

This analysis consisted of a comparison between 4 educational groups. Thus, the total analysis will involve 6 comparisons. The comparisons will be made to determine if any significant differences exist between the way personnel from different educational groups respond to questions 13 through 21.

The means for the responses of the different educational groups were calculated and tested to see if any significant differences existed. For sample sizes of 30 or more, the normal distribution was used, but for sample sizes of less than 30, the Students' "t"

Table III

Mean Responses and Standard Deviations For Age Groups

Question	Age Groups 1	2	3	4	5
13	72*	77	78	80	73
	21	19	18	17	17
14	63	65	63	69	62
	17	19	19	18	18
15	64	64	64	63	68
	20	20	20	20	23
16	60	56	63	58	59
	24	27	28	25	26
17	70	51	50	48	47
	17	25	27	28	28
18	67	72	70	71	71
	24	21	21	26	19
19	68	63	66	66	71
	18	26	21	24	20
20	70	72	71	81	79
	22	25	21	15	17
21a	14	15	19	17	15
	6	7	10	10	6
b	17	18	19	17	16
	6	7	7	10	6
c	21	19	17	18	20
	4	7	6	10	6
d	22	22	21	19	24
	13	8	9	8	11
e	25	27	23	30	28
	12	11	10	18	10
Sample #	(14)	(43)	(63)	(40)	(55)

* $\frac{72}{21}$ where 72 is the mean and 21 is the standard deviation.

Table IIIa

Significant Difference Test Results on Age Groups

Age Groups.....	1-2	1-3	1-4	1-5	2-3
Type Test.....	t	t	t	t	z
Question					
13 Aspirations	0.721	1.081	1.401	0.202	0.437
14 Expectations	0.300	0.018	1.088	0.186	0.423
15 Security	0.129	0.117	0.027	0.741	0.007
16 Recognition	0.482	0.362	0.262	0.127	1.262
17 Advancement	2.545*	2.653*	2.772*	2.872*	0.287
18 Responsibility	0.789	0.579	0.542	0.562	0.392
19 Achievement	0.637	0.392	0.241	0.526	0.498
20 Job Interest	0.309	0.218	2.187*	1.668	0.208
Weightings					
21a Recognition	0.161	1.967*	0.953	0.493	2.836*
21b Advancement	0.139	0.514	0.246	0.948	0.566
21c Responsibility	0.820	1.756	1.034	0.568	1.109
21d Achievement	0.153	0.051	0.851	0.693	0.345
21e Job Interest	0.564	0.435	0.873	0.286	1.545
D. F.	55	75	52	67	
Z_c					1.960
t_c	2.010	2.000	2.010	2.000	

* Indicates significant difference at the 95 percent level of confidence.

Table IIIb

Significant Difference Test Results on Age Groups

Age Groups.....	2-4	2-5	3-4	3-5	4-5
Type Test.....	z	z	z	z	z
Question					
13 Aspirations	0.876	0.891	0.523	1.528	1.937
14 Expectations	1.088	0.716	1.581	0.320	1.863
15 Security	0.197	0.945	0.203	0.932	1.013
16 Recognition	0.392	0.531	0.933	0.779	0.190
17 Advancement	0.615	0.743	0.384	0.499	0.068
18 Responsibility	0.174	0.438	0.142	0.054	0.183
19 Achievement	0.566	1.644	0.154	1.452	1.032
20 Job Interest	2.038*	1.483	2.872*	2.184*	0.788
Weightings					
21a Recognition	1.208	0.397	1.221	2.801*	0.997
21b Advancement	0.521	1.528	0.980	2.287*	0.614
21c Responsibility	0.581	0.459	0.246	1.820	0.991
21d Achievement	1.622	0.980	1.339	1.323	2.467*
21e Job Interest	0.765	0.487	1.875	1.193	1.144
D. F.					
Z_c	1.960	1.960	1.960	1.960	1.960
t_c					

* Indicates significant difference at the 95 percent level of confidence.

distribution was used in the calculation of significant difference. Using a confidence interval of 95 percent, significant differences were found. The groups between which differences were found are indicated in the Table of Significant Difference Test Results by an * beside the appropriate grouping. The results of the hypothesis tests show that 8 comparisons out of 78 were rejected, and, thus, 70 were accepted.

Hypothesis 5

Scientists and engineers, in given years of scientific and engineering experience groups, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different given years of scientific and engineering experience groups.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from a given scientific and engineering experience group.

u_2 is the mean value of the response to the same given question from a different scientific and engineering experience group.

Presentation of the Data

Since the years of scientific and engineering experience groups are 5 in number, this analysis will involve 10 comparisons. These comparisons will be made to determine if any significant difference exists between the way personnel from different scientific and

Table IV

Mean Responses and Standard Deviations For Educational Groups

Question	Educational Groups B.S.	M.S.	Ph.D.	Other
13	74*	84	93	72
	18	15	11	13
14	62	68	89	64
	19	15	11	19
15	64	65	65	77
	23	24	32	18
16	59	64	64	58
	26	27	33	27
17	49	53	61	47
	26	30	33	25
18	72	70	67	70
	20	25	34	19
19	66	67	66	77
	20	26	33	21
20	74	77	82	79
	20	24	24	12
21a	17	16	15	16
	8	9	7	8
b	18	16	17	14
	8	7	8	7
c	19	18	15	19
	7	7	6	8
d	21	24	27	22
	9	11	15	6
e	26	26	27	29
	13	10	19	19
Sample #	(155)	(41)	(8)	(10)

* $\overset{74}{\underset{18}{}}$ where 74 is the mean and 18 is the standard deviation.

Table IVa

Significant Difference Test Results on Educational Groups

Educational Groups...	1-2	1-3	1-4	2-3	2-4	3-4
Type Test.....	z	t	t	t	t	t
Question						
13 Aspirations	3.323*	2.884*	0.370	1.671	2.190*	3.711*
14 Expectations	2.127*	3.966*	0.179	3.792*	0.862	3.336*
15 Security	0.256	0.056	1.663	0.062	1.356	0.988
16 Recognition	1.021	0.533	0.113	0.022	0.604	0.430
17 Advancement	0.731	1.258	0.318	0.697	0.623	1.064
18 Reponsibility	0.453	0.556	0.182	0.225	0.085	0.242
19 Achievement	0.209	0.050	1.563	0.123	1.066	0.826
20 Job Interest	0.776	1.076	0.726	0.511	0.192	0.377
Weightings						
21a Recognition	0.563	0.696	0.192	0.366	0.112	0.432
21b Advancement	1.599	0.422	1.667	0.286	0.934	0.847
21c Responsibility	0.950	1.488	0.009	0.965	0.450	1.088
21d Achievement	1.840	1.736	0.558	0.545	0.502	0.832
21e Job Interest	0.305	0.252	0.748	0.142	0.622	0.224
D. F.		161	163	47	49	16
z_c	1.960					
t_c		1.960	1.960	2.015	2.014	2.120

* Indicates significant difference at the 95 percent level of confidence.

engineering experience groups respond to questions 13 through 21.

The means for the responses of the different scientific and engineering experience groups were calculated and tested to see if any significant differences existed. In the calculation of significant difference, the normal distribution was used for sample sizes of greater than 30. and the Students' "t" distribution was used for sample sizes of less than 30. Using a confidence interval of 95 percent, a significant difference was found. They are indicated in the Table of Significant Difference Test Results by an * beside the appropriate category. The results of the hypothesis tests show that out of 130 comparisons, 117 were accepted and 13 were rejected.

Hypothesis 6

Scientists and engineers, in given years of supervisory experience groups, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different years of supervisory experience groups.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from given years of supervisory experience groups.

u_2 is the mean value of the response to the same given question from a different years of supervisory experience grcup.

Presentation of the Data

This analysis consisted of a comparison between 4 supervisory

Table V

Mean Responses and Standard Deviations For Scientific and Engineering Experience Groups

Question	Experience Groups 1	2	3	4	5
13	75*	75	78	76	77
	23	20	16	18	17
14	65	64	63	64	68
	20	18	19	19	18
15	61	63	62	66	71
	20	22	25	21	24
16	56	58	62	58	62
	23	27	27	25	27
17	68	51	47	51	47
	16	24	26	28	29
18	66	70	73	73	69
	24	19	21	25	22
19	71	61	66	71	70
	18	24	20	23	22
20	69	70	73	77	83
	23	22	21	18	17
21a	13	16	19	17	15
	6	7	9	10	7
b	18	19	18	17	15
	6	6	8	9	7
c	20	19	18	19	19
	4	6	7	7	9
d	24	21	22	21	21
	15	6	11	8	9
e	23	26	23	27	29
	13	10	10	14	16
Sample #	(13)	(51)	(59)	(44)	(47)

* $\frac{75}{23}$ where 75 is the mean and 23 is the standard deviation.

Table Va

Significant Difference Test Results on Total Scientific and Engineering Experience Groups

Scientific and Engineering Groups...	1-2	1-3	1-4	1-5	2-3
Type Test.....	t	t	t	t	z
Question					
13 Aspirations	0.003	0.640	0.155	0.415	0.987
14 Expectations	0.228	0.392	0.271	0.448	0.283
15 Security	0.323	0.116	0.721	1.409	0.285
16 Recognition	0.242	0.722	0.316	0.765	0.762
17 Advancement	2.441*	2.829*	2.006*	2.482*	.923
18 Responsibility	0.556	1.028	0.840	0.457	0.865
19 Achievement	1.425	0.859	0.029	0.128	1.155
20 Job Interest	0.136	0.555	1.279	2.339*	0.651
Weightings					
21a Recognition	1.095	1.896	1.356	0.963	1.942
21b Advancement	0.645	0.181	0.231	1.128	0.608
21c Responsibility	0.929	1.160	0.782	0.447	0.450
21d Achievement	1.353	0.596	1.225	0.933	0.802
21e Job Interest	1.005	0.126	0.847	1.268	1.586
D. F.	62	70	55	58	
Z_c					1.960
t_c	2.000	2.000	2.010	2.010	

* Indicates significant difference at the 95 percent level of confidence.

Table Vb

Significant Difference Test Results on Total Scientific and Engineering Experience Groups

Scientific and Engineering Groups...	2-4	2-5	3-4	3-5	4-5
Type Test.....	z	z	z	z	z
Question					
13 Aspirations	0.254	0.635	0.732	0.346	0.386
14 Expectations	0.079	1.066	0.192	1.355	1.097
15 Security	0.588	1.761	0.845	1.963*	1.189
16 Recognition	0.096	0.790	0.657	0.065	0.690
17 Advancement	0.091	0.719	0.895	0.096	0.726
18 Responsibility	0.674	0.056	0.038	0.832	0.673
19 Achievement	2.051*	1.997*	1.148	1.050	0.138
20 Job Interest	1.642	3.134*	1.051	2.635*	1.566
Weightings					
21a Recognition	0.993	0.140	0.633	2.006*	1.077
21b Advancement	1.176	2.750*	0.618	1.993*	1.138
21c Responsibility	0.009	0.405	0.401	0.771	0.360
21d Achievement	1.076	0.293	0.814	0.451	0.352
21e Job Interest	0.076	1.010	1.341	2.178*	0.834
D. F.					
Z_c	1.960	1.960	1.960	1.960	1.960
t_c					

* Indicates significant difference at the 95 percent level of confidence.

experience groups. Thus, the total analysis will involve 6 comparisons. These comparisons will be made to determine if any significant differences exist between the way personnel from the different supervisory experience groups respond to questions 13 through 21.

The means for the responses of the different supervisory experience groups were calculated and tested to see if any significant differences existed. For comparisons between groups which contained 30 or more respondents, the normal distribution was used, but when the sample sizes were less than 30, the Students' "t" distribution was used in the calculation of significant difference. Using a confidence interval of 95 percent, significant differences were found. The groups between which significant differences were found are indicated in the Table of Significant Difference Test Results by an * beside the appropriate grouping. The results of the hypothesis tests show that out of 78 comparisons, 9 were rejected and 69 were accepted.

Hypothesis 7

Scientists and engineers, in given supervisory levels, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in different supervisory levels.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from given supervisory level groups.

Table VI

Mean Responses and Standard Deviations For Supervisory Experience Groups

Question	Experience Groups 1	2	3	4
13	76*	79	79	82
	18	16	20	19
14	63	64	69	69
	18	18	19	19
15	63	61	78	81
	23	25	17	13
16	58	60	71	64
	27	27	19	25
17	50	51	57	47
	26	29	27	32
18	70	73	78	70
	21	26	1/	20
19	65	68	77	72
	22	22	23	17
20	72	80	85	85
	21	17	13	22
21a	17	17	14	16
	9	8	6	9
b	17	18	17	16
	7	6	12	6
c	18	19	20	17
	7	7	9	8
d	21	21	25	24
	9	6	14	15
e	26	25	24	26
	13	12	12	14
Sample #	(140)	(29)	(20)	(18)

* 76_{18} where 76 is the mean and 18 is the standard deviation.

Table VIa

Significant Difference Test Results on Supervisory Experience Groups

Experience Groups	1-2	1-3	1-4	2-3	2-4	3-4
Type Test.....	z	t	t	t	t	t
Question						
13 Aspirations	0.688	0.811	1.498	0.131	0.647	0.413
14 Expectations	0.404	1.445	1.369	0.917	0.804	0.156
15 Security	0.317	2.846*	3.802*	2.629*	3.550*	0.622
16 Recognition	0.426	2.086*	1.065	1.528	0.540	1.016
17 Advancement	0.314	1.202	0.518	0.691	0.583	1.157
18 Responsibility	0.482	1.420	0.230	0.688	0.549	1.433
19 Achievement	0.775	2.247*	1.444	1.298	0.596	0.869
20 Job Interest	2.212*	2.714*	2.866*	1.112	0.969	0.005
Weightings						
21a Recognition	0.247	1.101	0.090	1.209	0.251	0.864
21b Advancement	0.413	0.459	0.683	0.535	0.960	0.060
21c Responsibility	0.642	1.040	0.816	0.368	1.048	1.151
21d Achievement	0.400	1.422	1.311	1.320	1.133	0.098
21e Job Interest	0.486	0.599	0.103	0.184	0.256	0.393
D. F.		158	163	34	53	43
Z_c	1.960					
t_c		1.960	1.960	2.032	2.010	2.018

* Indicates significant difference at the 95 percent level of confidence.

u_2 is the mean value of the response to the same given question from different supervisory level groups.

Presentation of the Data

Since there were only 3 supervisory levels--non-supervisory, first line supervisors, and above first line supervisors--this analysis will involve only 3 comparisons. These comparisons will be made to determine if any significant differences exist between the way personnel from different supervisory levels respond to questions 13 through 21 of the questionnaire.

The means for the responses of the different supervisory level groups were calculated and tested to see if any significant differences existed. In the calculation of significant difference, the normal distribution was used for sample sizes of greater than 30, and the Students' "t" distribution was used for sample sizes of less than 30. Using a confidence interval of 95 percent, significant differences were found. They are indicated in the Table of Significant Difference Test Results by an * beside the appropriate category. The results of the hypothesis tests show that out of 39 comparisons, it was accepted 24 times and rejected 15 times.

Hypothesis 8

Scientists and engineers, in given years at present job groups, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in other given years at present job groups.

Table VII

Mean Responses and Standard Deviations For Supervisory Level Groups

Question	Supervisory Level Groups: 2nd Level and Above	First Level	Non-Supervisory
13	87*	78	74
	15	18	18
14	79	68	61
	16	18	18
15	78	72	61
	16	21	24
16	70	64	57
	25	25	27
17	55	55	48
	29	28	26
18	77	78	68
	17	18	23
19	78	73	63
	16	19	23
20	87	79	72
	15	15	21
21a	16	15	17
	8	8	9
b	16	18	17
	6	9	7
c	19	20	18
	7	9	7
d	25	21	21
	13	9	9
e	23	26	26
	10	13	13
Sample #	(28)	(40)	(147)

* $\overset{87}{15}$ where 87 is the mean and 15 is the standard deviation.

Table VIIa

Significant Difference Test Results on Supervisory Level Groups

Supervisory Groups.....	1-2	1-3	2-3
Type Test.....	t	t	z
Question			
13 Aspirations	2.215*	3.564*	1.170
14 Expectations	2.450*	4.952*	2.230*
15 Security	1.287	3.666*	2.925*
16 Recognition	0.861	2.394*	1.718
17 Advancement	0.072	1.261	1.487
18 Responsibility	0.156	1.987*	2.867*
19 Achievement	1.108	3.256*	2.774*
20 Job Interest	1.963	3.445*	2.431*
Weightings			
21a Recognition	0.926	0.399	1.771
21b Advancement	1.086	0.804	0.591
21c Responsibility	0.379	0.811	1.240
21d Achievement	1.616	1.961*	0.167
21e Job Interest	1.070	1.187	0.034
D. F.	66	173	
z_c			1.960
t_c	2.000	1.960	

* Indicates significant difference at the 95 percent level of confidence.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from given years at present job groups.

u_2 is the mean value of the response to the same given question from different years at present job groups.

Presentation of the Data

Since the years at present job groups are 6 in number, this analysis will involve 15 comparisons. These comparisons will be made to determine if any significant differences exist between the way personnel from different years at present job groups respond to questions 13 through 21 of the questionnaire.

The means for responses of the different years at present job groups were calculated and tested to see if any significant differences existed. In the calculation of significant difference, the normal distribution was used for sample sizes of greater than 30, and the Students' "t" distribution was used for sample sizes of less than 30. Using a confidence interval of 95 percent, significant differences were found. They are indicated in the Table of Significant Difference Test Results by an * beside the appropriate grouping. The results of the hypothesis tests show that out of 195 comparisons, it was rejected 20 times and accepted 175 times.

Table VIII

Mean Responses and Standard Deviations For
Total Years at Present Job Groups

Question	Present Job Groups 0-2	3-4	5-6	7-8	9-12	13-
13	77*	79	82	78	67	68
	18	16	19	14	21	17
14	65	66	69	67	60	58
	18	18	19	16	22	18
15	63	66	71	65	65	59
	27	21	21	21	25	21
16	54	66	64	63	62	50
	24	25	26	27	24	32
17	57	50	52	48	49	43
	27	25	24	25	29	30
18	64	72	73	77	73	69
	25	21	21	17	18	22
19	62	70	65	73	69	67
	24	19	23	22	24	19
20	68	75	77	77	79	78
	25	20	16	21	19	17
21a	15	18	16	18	17	16
	8	8	7	9	8	8
b	17	17	19	18	17	17
	8	6	9	6	6	9
c	18	18	20	19	17	21
	7	6	6	8	5	10
d	23	22	21	23	21	21
	12	5	7	11	6	13
e	27	25	25	23	28	28
	12	8	13	12	16	16
Sample #	(49)	(42)	(33)	(30)	(32)	(29)

* $\frac{77}{18}$ where 77 is the mean and 18 is the standard deviation.

Table VIIIa

Significant Difference Test Results on Years at Present Job

Present Job Groups	1-2	1-3	1-4	1-5	1-6
Type Test.....	z	z	z	z	t
Question					
13 Aspirations	0.381	1.073	0.295	2.145*	2.243*
14 Expectations	0.176	0.864	0.380	1.150	1.864
15 Security	0.618	1.435	0.402	0.371	0.696
16 Recognition	2.337*	1.754	1.449	1.447	0.605
17 Advancement	1.262	0.867	1.501	1.273	2.088*
18 Responsibility	1.711	1.899	2.872*	1.970*	0.919
19 Achievement	1.694	0.490	2.118*	1.199	0.969
20 Job Interest	1.490	2.047*	1.639	2.193*	1.921
Weightings					
21a Recognition	1.520	0.428	1.266	1.223	0.248
21b Advancement	0.060	0.990	0.406	0.129	0.134
21c Responsibility	0.313	1.212	0.246	0.922	1.185
21d Achievement	0.509	0.934	0.060	0.805	0.595
21e Job Interest	0.761	0.838	1.391	0.317	0.261
D. F.					76
Z_c	1.960	1.960	1.960	1.960	
t_c					2.000

* Indicates significant difference at the 95 percent level of confidence.

Table VIIIb

Significant Difference Test Results on Years at Present Job

Present Job Groups	2-3	2-4	2-5	2-6	3-4
Type Test.....	z	z	z	t	z
Question					
13 Aspirations	0.757	0.086	2.490*	2.693*	0.829
14 Expectations	0.686	0.205	1.264	1.968	0.476
15 Security	0.908	0.193	0.175	1.403	1.039
16 Recognition	0.356	0.537	0.745	2.361*	0.185
17 Advancement	0.339	0.372	0.213	1.068	0.665
18 Responsibility	0.295	1.179	0.247	0.603	0.804
19 Achievement	1.002	0.735	0.205	0.558	1.509
20 Job Interest	0.550	0.339	0.843	0.707	0.121
Weightings					
21a Recognition	1.060	0.005	0.200	1.108	0.892
21b Advancement	1.095	0.498	0.081	0.098	0.635
21c Responsibility	1.567	0.513	0.639	1.446	0.790
21d Achievement	0.680	0.519	0.490	0.340	0.904
21e Job Interest	0.315	0.907	0.848	0.836	0.456
D. F.				69	
Z_c	1.960	1.960	1.960		1.960
t_c				2.000	

* Indicates significant difference at the 95 percent level of confidence.

Table VIIIc

Significant Difference Test Results on Years at Present Job

Present Job Groups	3-5	3-6	4-5	4-6	5-6
Type Test.....	z	t	z	t	t
Question					
13 Aspirations	2.872*	3.021*	2.411*	2.598*	0.071
14 Expectations	1.761	2.435*	1.041	2.096*	0.485
15 Security	0.949	2.187*	0.001	1.150	1.050
16 Recognition	0.344	1.884	0.135	1.640	1.640
17 Advancement	0.494	1.291	0.126	0.652	0.737
18 Responsibility	0.067	0.837	0.944	1.656	0.833
19 Achievement	0.671	0.450	0.804	1.150	0.267
20 Job Interest	0.366	0.227	0.419	0.301	0.138
Weightings					
21a Recognition	0.799	0.138	0.174	0.955	0.873
21b Advancement	1.108	0.939	0.539	0.448	0.031
21c Responsibility	2.168*	0.227	1.015	0.817	1.784
21d Achievement	0.221	0.100	0.784	0.604	0.039
21e Job Interest	0.939	0.863	1.362	1.266	0.054
D. F.		60		57	59
Z_c	1.960		1.960		
t_c		2.000		2.000	2.000

* Indicates significant difference at the 95 percent level of confidence.

Hypothesis 9

Scientists and engineers, in a given job-content group, perceive their aspirations, expectations, and security, and rate and weight motivational factors the same as other scientists and engineers in other given job-content groups.

The statistical hypotheses are:

$$H_o: \ u_1 = u_2$$

$$H_1: \ u_1 \neq u_2$$

where: u_1 is the mean value of the response to a given question from a given job-content group.

u_2 is the mean value of the response to the same given question from a different given job-content group.

Presentation of the Data

Since there are only 3 job-content groups, this analysis will involve only 3 comparisons. These comparisons will be made to determine if any significant differences exist between the way personnel from different job-content groups respond to questions 13 through 21 of the questionnaire.

The means for the responses of the different job-content groups were calculated and tested to see if any significant differences existed. In the calculation of significant difference, the normal distribution was used for sample sizes of greater than 30, and the Students' "t" distribution was used where sample sizes were less than

30. Using a confidence interval of 95 percent, significant differences were found. They are indicated in the Table of Significant Difference Test Results by an * beside the appropriate grouping. The results of the hypothesis tests show that out of 39 comparisons, it was rejected 20 times and accepted 19 times.

Hypothesis 10

If the weighted motivational factors are listed in descending order according to the mean weights given them by the respondents, they will appear in the same order as listed by Herzberg.

Thus, the null hypothesis is that the listings are the same, and the alternative hypothesis is that they are different.

Presentation of the Data

The mean weights were calculated and listed according to the weights given them. Herzberg's listing of motivational factors is according to the frequency in which they appeared in his study of engineers and accountants. The results of this comparison are shown in Table X, and indicate that the two listings are different. Although, no statistical significance is attached to this difference, it is felt that the difference is significant in itself.

Table IX

Mean Responses and Standard Deviations
For Job-Content Groups

Question	Job-Content Groups: Increased	Stayed The Same	Decreased
13	78*	65	81
	18	19	10
14	66	55	61
	18	19	17
15	67	63	37
	22	21	33
16	63	46	29
	25	24	28
17	54	35	21
	26	24	29
18	73	60	53
	20	26	31
19	69	59	45
	21	23	26
20	77	64	61
	18	26	33
21a	16	17	18
	8	7	12
b	17	17	11
	7	9	7
c	19	18	9
	7	6	8
d	22	20	24
	9	6	23
e	25	27	38
	12	12	26
Sample #	(176)	(29)	(8)

* $\frac{78}{18}$ where 78 is the mean and 18 is the standard deviation.

Table IXa

Significant Difference Test Results on Job-Content Groups

Content Groups.....	Incr-Same	Same-Decr	Incr-Decr
Type Test.....	t	t	t
Question			
13 Aspirations	3.462*	2.185*	0.458
14 Expectations	2.873*	0.823	0.684
15 Security	0.867	2.692*	3.587*
16 Recognition	3.501*	1.778	3.817*
17 Advancement	3.645*	1.455	3.576*
18 Responsibility	3.143*	0.669	2.757*
19 Achievement	2.444*	1.414	3.094*
20 Job Interest	3.484*	0.315	2.498*
Weightings			
21a Recognition	0.285	0.185	0.344
21b Advancement	0.053	1.956	2.484*
21c Responsibility	0.404	3.619*	3.895*
21d Achievement	0.653	0.818	0.745
21e Job Interest	0.603	1.815	2.803*
D. F.	203	35	182
t_c	1.960	2.032	1.960

* Indicates significant difference at the 95 percent level of confidence.

Table X

Motivation Comparison Listing-Herzberg vs. Study

Motivation Factors Listed According To Weights Given Them By Respondents		Motivation Factors As Listed by Herzberg	
Job Interest	26.0	Achievement	28.6
Achievement	21.6	Recognition	23.1
Responsibility	18.6	Work Itself	18.2
Advancement	17.3	Responsibility	16.1
Recognition	16.5	Advancement	14.0

(From Ref 15:60)

The Index of Frustration and the Career Progress Index are shown in Tables XI and XII. The Index of Frustration has a possible range of values of 0 to 100, the increasing value indicating an increasing amount of frustration found by the individual in his environment. The Career Progression Index has the same range of values and by its increasing size indicates an increasing degree of satisfaction of those factors important to career progression.

Table XI

Index of Frustration*

Stratifications					
Groups	1	2	3	4	5
Laboratories	13	14	13	9	10
Salary	11	13	15	13	9
Age	9	12	15	11	11
Education	12	15	4	9	
Supervisory Level	8	10	13		

* This is the difference between career aspirations and expectations.

Table XII

Career Progression Index*

Stratifications

	1	2	3	4	5
Laboratories	63	70	65	66	66
Salary	62	64	62	66	73
Age	67	64	64	67	67
Education	65	67	69	69	
Supervisory Level	74	71	62		

* The career progression index is the summation of the motivation factor ratings multiplied by their respective weightings.

VII. Summary, Conclusion, and Recommendations

Summary

Of the many authors who have written on the subject of motivation and job satisfaction, the researchers found the works of Frederick Herzberg to be most appropriate to use as a basis for this study. In his research on motivation and job satisfaction, Herzberg studied accountants and engineers in order to determine what made them satisfied or happy about their job. The results of his research indicated that the factors of achievement, recognition, work itself (job interest), responsibility, and advancement provided job satisfaction to these individuals. These factors were called "motivators."

Using Herzberg's "motivators" as a foundation, the researchers embarked on an exploratory study of perceived career progression among scientists and engineers assigned to Air Force laboratories. The prime reason for the study was that of research, hoping that some correlation could be found among the scientists and engineers in relation to their perceived career progress. The study entailed the selection of a sample and the measuring of that sample's perceptions on career progress.

The sample selected consisted of a set of scientists and engineers assigned to five of the Air Force Systems Command laboratories. The next thing necessary was the measurement of the sample's career perceptions. This measurement was accomplished

through the use of a questionnaire, which was an adaptation of the one used by McIntire in a similar study.

The questionnaire consisted of two basic sections: one requesting general information about the respondent, and the other requesting the respondent to rate factors concerning career progression. The respondent rated the factors by placing a mark on a scale, which appeared just below the question concerning that factor. The scale was a continuum which went from 0 to 100, 0 being the bottom, or lowest, and 100 being the top, ideal, or maximum. The respondent rated his career aspirations, career expectations, and the security or conduciveness of his organization in allowing him to reach his aspirations or goals. Following that, the respondent was asked to rate Herzberg's motivators of achievement, recognition, work itself, responsibility, and advancement in relation to the amount of each found in the respondent's job. The last question asked the respondent to assign weights to each of the "motivators" in relation to their importance to career progression.

The responses to the questionnaire were tabulated, and mean ratings and weightings calculated to determine if any differences existed in the way scientists and engineers from different groups responded to the questions. This grouping was accomplished through the use of data obtained in the general information section of the questionnaire. The grouping broke the sample into nine sections consisting of: (1) laboratory groups, (2) salary groups, (3) age groups, (4) educational groups, (5) scientific and engineering groups, (6) supervisory experience groups, (7) supervisory level groups,

(8) years at present job groups, and (9) job-content groups. In addition, these groups were stratified so that comparisons could be made between the stratifications within groups.

The results of the study show that almost no differences exist between the career perceptions of scientists and engineers assigned to different laboratories, but that differences do exist between salary groups, age groups, educational groups, scientific and engineering experience groups, supervisory experience groups, supervisory groups, total years at present job groups, and job-content groups.

The interpretation, and implications of the results are discussed in the Conclusions which follow.

Conclusion

The purpose of this study was that of exploration into the perceived career progression of scientists and engineers assigned to Air Force laboratories. From the results of this exploration, it was hoped that inferences could be drawn. These inferences would be concerned with the way in which the sampled scientists and engineers responded to questions concerning their career aspirations and expectations; and the way in which they rated and weighted the motivation or job satisfaction factors of: (1) achievement, (2) job interest, (3) responsibility, (4) advancement, and (5) recognition.

From the results of the study, conclusions have been drawn, and explanations of differences in the data are given. These conclusions are concerned primarily with the major differences, trends of the differences, and trends of sameness where it existed. The conclusions drawn from the analysis of the data follow.

Since, in testing Hypothesis 1, there were only 4 significant differences found in the 130 comparisons made between the laboratories on each of the 13 responses, it is concluded that scientists and engineers from different laboratories perceive their career progression to be the same. This would imply that little difference exists among the laboratories. The laboratories are organized in much the same way, and the scientists and engineers work under the same Civil Service system; so, the fact that little difference exist is not surprising. In addition, the Career Progression Index for these groups also indicates that little difference exists. Any differences which might appear in these responses can be attributed to chance.

In the comparison of salary groups, Hypothesis 2, one of the salary stratifications turned out to be significantly higher than the other 4 stratifications in the responses to questions 13 through 20. The means of the responses increased as the salary increased, but the major increase was between groups 4 and 5. While 6 significant differences were found in comparing groups 1 through 4, there were 20 significant differences found in comparing these same groups with group 5. Hence, we conclude that the group making $20,000 and above have higher aspirations, and expectations, and rate their motivation factors higher than those who make less.

It is significant that all 5 groups weighed the motivational factors the same, there being no significant differences in this area, question 21, a-e. This would indicate that scientists and engineers weight the motivational factors equally, regardless of their present pay scale.

The results of the comparisons made between the age groups,

Hypothesis 3, did not disclose any major distinctions. The significant differences that did occur were limited to 6 of the 13 responses. The major distinction was in reference to the rating of advancement. Here, the age group of 26 and under rated advancement higher than any of the other age groups. This is understandable since this age group is at the bottom of the GS grade levels for scientists and engineers, and their advancement initially is rapid.

There is a trend for the two upper age groups, 39 to 44 and 45 and above, to rate job interest higher than do those of a younger age. There are 4 of a possible 6 significant differences to support this trend. On the basis of this trend, we would conclude that those individuals in age groups 4 and 5 are somewhat financially independent and advanced to the point where the important criteria is the challenge and appeal of a job. The other significant differences found were not of such a nature as to establish a trend, or to lend themselves to meaningful interpretation.

The educational groups, Hypothesis 4, showed a very definite distinction in their responses on career aspirations and career expectations. The conclusion to be drawn here is that career aspirations and expectations increase significantly as one goes from the group having no degree, or a non-science degree, to the Bachelor of Science degree group, to the group holding Master's Degrees, to the group holding Ph.D. Degrees; each perceiving higher than the prior group. This is understandable in light of the scientific and technical nature of their work, the organization, and its functions. The other significant differences which occurred were again possibly due more to chance than anything else.

In comparing the groups who have differing years of scientific and engineering experience, Hypothesis 5, the significant differences occurred in the same pattern as that in the age group comparisons. Again, the lowest group, having 4 or less years of experience, rated opportunities for advancement the highest of all the groups, and the highest group, having 20 or more years, rated job interest the highest of all. This stratification of significant differences led to conclusions that parallel those developed from the age groups; namely, that the younger personnel perceive greater opportunities for advancement, and the older perceive more job interest in their jobs.

The groupings by years of supervisory experience, Hypothesis 6, show 9 significant differences, but the arrangement of these differences are such that there can be no conclusions drawn except as to the homogeneity of supervisory personnel. Supervisors perceive and weight the motivation factors the same, and their career aspirations and expectations are the same also.

In Hypothesis 7, however, comparing the levels of Management and non-Management, significant differences show definite distinctions between the classes. As one considers, in turn, the non-Management personnel, first line supervisors, and supervisors of the second level and above, one finds that in all areas of career aspiration, career expectation, and motivation factor ratings (questions 13 through 20), the means are increasing. From this, we would conclude that in the Civil Service system in the laboratories, as one moves upward through the levels of non-Management and Management, one finds more satisfaction in one's job, aspires to go further, and can reasonably expect to rise further. This general satisfaction is more than likely due to

the increased salary, increased status, and increased opportunity for achievement and recognition, which is inherent in such positions.

The fact that the groups all weigh the motivation factors in an equal fashion (question 21, a-e) bears out again the homogeneity of the importance of these factors to all scientific and engineering personnel.

The significant differences resulting from the comparison of groups who have spent differing numbers of years at their present job, Hypothesis 8, are scattered in a random pattern. From this, we are led to conclude that the length of time a man has spent at his present job has no appreciable effect on his rating and weighting of motivational factors, or on his career aspirations or expectations.

The significant differences resulting from the comparison of job-content groups, Hypothesis 9, indicates strong differences between these groups. The group who reported that their job had decreased in content over the past period of years rated lowest of all the motivational factors present in their jobs, and lowest in their aspirations and expectations. On the other hand, those who reported that their jobs had increased in content, rated higher, in almost all questions, the amount of job satisfaction that they found. This would lead to the conclusion that an increase or decrease in an individual's job-content is directly related to the individual's satisfaction. That is, an individual whose job-content has increased will be more satisfied than one whose job-content has decreased.

In summary, one can draw the following major conclusions. Scientists and engineers, when compared by organizations, do not differ significantly in their career progression perceptions, but

when compared by upper and lower salary groups, age groups, educational groups, supervisory groups, and job-content groups, they do perceive their career progress differently. It appears that the higher salary groups, educational groups, and supervisory groups are more satisfied than lower groups in the same categories.

Finally, there are trends which are indicated by the Index of Frustration data, Table XI, and the Career Progression Index data, Table XII. These trends, however, are inconsistent with the conclusions drawn on the basis of the study data. In light of these inconsistencies, and since these indices are merely manipulations of the study data, the trends they indicate are not accepted as meaningful.

Recommendations For Further Study

The researchers feel there is valuable work to be done in two areas in relation to this Thesis. First, it is recommended that further analysis of the original data of this study be done with the intent of finding a correlation factor, or factors, which can be used to combine the 13 responses to the questions 13 through 21(e) into a single index. This index should be an accurate and responsive indicator of the general feeling of the group to which it is applied.

Second, it is recommended that further work be done to correlate this study with that done by McIntire. The sample populations are similar, though of different environments. This difference should provide some interesting insights into scientists and engineers, and their management.

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Appendix A

Davis Chart Comparing Herzberg and Maslow

Maslow's Need-Priority Model	Herzberg's Motivation-Maintenance Model
Self-realization and fulfillment	Work itself Achievement Possibility of growth Responsibility
Esteem and Status	Advancement Recognition Status
Belonging and Social Activity	Interpersonal relations Supervisor Peers Subordinates Supervision-technical
Safety and Security	Company policy and administration Job security Working
Physiological Needs	Conditions Salary Personal Life

A comparison of Maslow's Need-Priority Model with Herzberg's Motivation-Maintenance Model. (Ref 8:37)

Appendix B

Communications For Questionnaire

and Research Approval

GSM/SM/69-15

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (AU)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

REPLY TO
ATTN OF: AFITSE-S

SUBJECT: Research Questionnaire Approval

TO: AU (AUKS)

1. Enclosed is a Questionnaire concerning perceived career progression of Civil Service scientists and engineers assigned to Air Force Systems Command laboratories. It has been developed by two graduate Systems Management students to provide the data base necessary to conduct their thesis research.

2. This entire research effort has been approved by the Director of Air Force Systems Command laboratories, Brigadier General Raymond A. Gilbert, and the Director of Personnel AFSC, Mr. Charles King. We are forwarding this Questionnaire for your approval and RCS number.

3. Due to the short time available for this research, we would appreciate it if you could confirm your initial approval by telephone. We can be reached at Wright-Patterson AFB, Extension 52514 or 55758.

R. H. McINTIRE, Lt Col, USAF
Assoc. Prof. of Management
Dept of Systems Management
School of Engineering

Atch

cy to: AUEV

GSM/SM/69-15

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR UNIVERSITY
MAXWELL AIR FORCE BASE, ALABAMA 36112

JUL 24 1969

REPLY TO
ATTN OF: AUKS-5/Mrs. Royal/5838

SUBJECT: Research Questionnaire Approval (Your ltr, undated)

TO: AFITSE-S

1. AU Survey Control Number AU-P20 is assigned to the survey "Perceived Career Progression of Civil Service Scientists and Engineers Assigned to Air Force Systems Command Laboratories". Results of the survey should be provided this office upon completion of the survey.

2. AU Survey Control Number AU-P20 should be included on the Questionnaire that is forwarded to respondents.

FOR THE COMMANDER

JOHN WARD
Deputy Dir, Data Automation
DCS/Comptroller

GSM/SM/69-15

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE SYSTEMS COMMAND
ANDREWS AIR FORCE BASE, WASHINGTON, D.C. 20331

REPLY TO ATTN OF: SCT

14 JUL 1969

SUBJECT: Scientist and Engineer Perceived Career Progression Study

TO: AFAL AFML RADC
AFAPL AFFDL

(Commander/Director)

1. In recent years there has been an increased interest in the field of managing scientific and professional personnel. As managers of these types of personnel, it would be to our advantage to be aware of new developments, as well as to participate in any additional research that would benefit the Air Force.

2. To date, the results of research and study indicate that the performance of scientific and engineering personnel is primarily regulated by the motivation of the individual. This motivation is based upon the individual's perception of how well his job fulfills his needs in the areas of recognition, advancement, responsibility, achievement, job interest, career aspiration, and security. These individual perceptions can be summarized under one subject, perceived career progression. That is, an individual's perceived career progress is the basis for his motivation.

3. Within the next few weeks, you will be contacted by two Air Force Institute of Technology students, Lt Thomas J. Mackey and Lt John C. Totten. They are conducting research in the area of perceived career progression of Air Force civilian scientists and engineers. They wish to submit questionnaires to a random group of your scientific and engineering personnel to determine the perceptions they have concerning their career progression.

4. It is requested that you support this research effort, and provide the assistance that may be required. It is anticipated that the results of this research will benefit the Air Force in this area of management.

FOR THE COMMANDER

Raymond A. Gilbert

RAYMOND A. GILBERT
Brigadier General, USAF
Director of Laboratories

1 Atch
Sample Questionnaire

Appendix C

The Questionnaire

An Exploratory Study
Of Perceived Career Progression
Among Civil Service Scientists and Engineers
Assigned to Air Force Laboratories

QUESTIONNAIRE

INSTRUCTIONS

1. Please complete the enclosed Questionnaire as accurately as possible.

2. Place the completed Questionnaire in the addressed envelope provided and place it in the mail.

3. Due to time constraints inherent in this research effort, your timely completion and mailing of this Questionnaire on or before 1 August 1969 will be greatly appreciated.

GENERAL INFORMATION

Please indicate your response to the following questions by checking the appropriate category or filling in the blank, as the question may require.

1. The organization to which you are currently assigned:

   1. ( ) Aero Propulsion Laboratory
   2. ( ) Avionics Laboratory
   3. ( ) Flight Dynamics Laboratory
   4. ( ) Materials Laboratory
   5. ( ) Rome Air Development Center

2. Your current G.S. grade ____, Step ____.

3. Your age:

   1. ( ) 26 or under
   2. ( ) 27 - 32
   3. ( ) 33 - 38
   4. ( ) 39 - 44
   5. ( ) 45 +

4. The highest educational degree you have obtained:

   1. ( ) B.S.
   2. ( ) M.S.
   3. ( ) Ph.D.
   4. ( ) Other

5. The highest educational degree you desire:

   1. ( ) B.S.
   2. ( ) M.S.
   3. ( ) Ph.D.

6. Your total years of engineering/scientific work. (Round answer off to nearest whole year)

   1. ( ) 4 or less
   2. ( ) 5-9
   3. ( ) 10-14
   4. ( ) 15-19
   5. ( ) 20-

7. Years of supervisory experience. (Round answer off to nearest whole year)

   1. ( ) 4 or less
   2. ( ) 5-9
   3. ( ) 10-14
   4. ( ) 15-19
   5. ( ) 20-

8. Are you presently in a supervisory position?

   1. ( ) Yes
   2. ( ) No

9. Are any of the personnel that you supervise also in a supervisory position?

   1. ( ) Yes
   2. ( ) No

10. Your total years at present job. (Round answer off to nearest whole year)

    1. ( ) 2 or less
    2. ( ) 3-4
    3. ( ) 5-6
    4. ( ) 7-8
    5. ( ) 9-10
    6. ( ) 11-12
    7. ( ) 13-14
    8. ( ) 15-16
    9. ( ) 17-18
    10. ( ) 19-

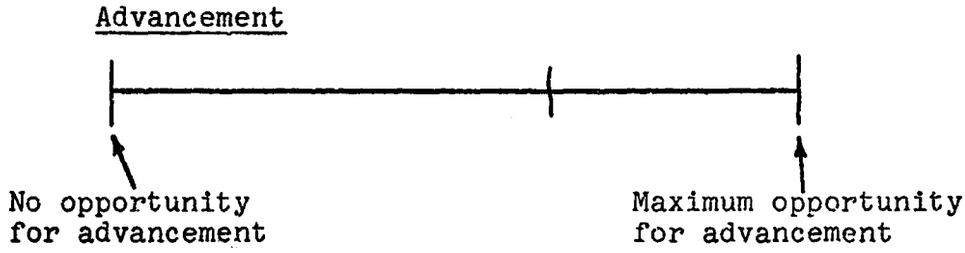
11. During the past few years has your job and its content:

    1. ( ) Increased
    2. ( ) Stayed the same
    3. ( ) Decreased

12. The G.S. grade you had when initially assigned to your present job:_____.

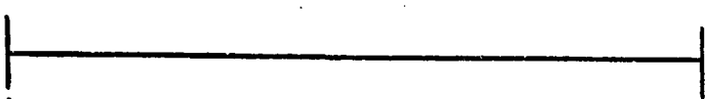
Following are questions regarding the feelings you have about your job and your career. We are interested in having you mark the scale that follows each question, after you have given careful thought to that question. Please place a vertical line (|) at the point on the scale that best measures your feelings about the question. Although the scales have no units of measurement, please think of them as covering a range of 0% to 100%.

EXAMPLE:



13. Career Aspiration

Please indicate the highest level in the Air Force Systems Command Laboratory System that you would truly like to reach.

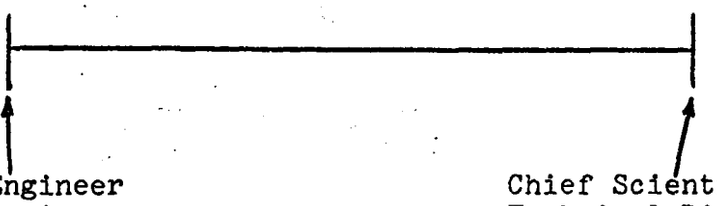


Junior Engineer or Junior in another specialty

Chief Scientist or Technical Director, AFSC

14. Career Expectations

Please indicate the highest level in the Air Force Systems Command Laboratory System that you realistically expect to reach.

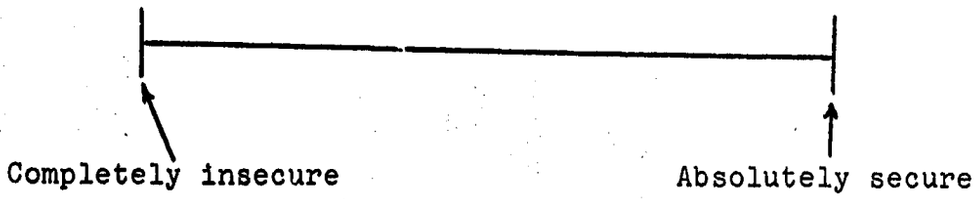


Junior Engineer or Junior in another specialty

Chief Scientist or Technical Director, AFSC

15. Security

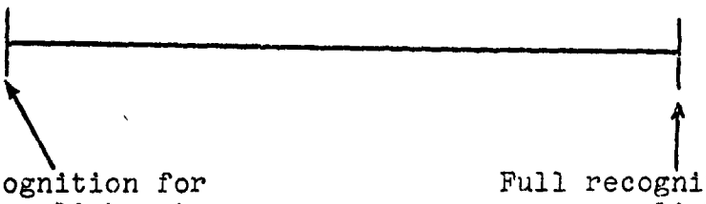
Security means different things to different people. For the purposes of this question, it means freedom from anxiety and doubt that you will be able to accomplish your career objectives in your organization. In other words, one is absolutely secure if he is absolutely confident that he will be able to accomplish his career objectives. He is completely insecure if he has no (zero) confidence that he will be able to do so. Most of us fall somewhere in between these extremes. Using these definitions of secure and security, please indicate your feelings of security on the following scale.



16. Recognition

Recognition can come from many sources, such as peers, subordinates, friends, or one's supervisors. It may take many forms, ranging from awards and commendations to a friendly pat on the back.

Considering the total sources and forms of recognition, I rate the recognition I have received on my job as follows:



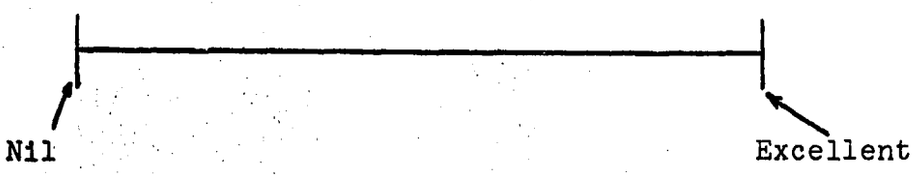
No recognition for my accomplishments

Full recognition for my accomplishments

17. Advancement

Advancement is essential to an individual's career. This advancement may be upward in the organization's structure or it may be upward in one's technical/professional standing.

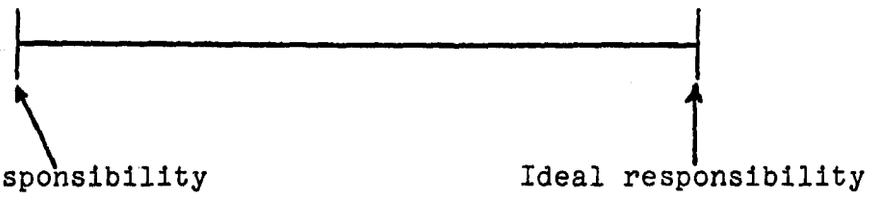
I believe my overall opportunities for advancement in my organization are:



18. Responsibility

There is an ideal amount of responsibility necessary and required to allow one to perform his job efficiently and effectively. This amount of responsibility should be inherent in each organizational position. However, the amount of responsibility that one is assigned often varies from this ideal.

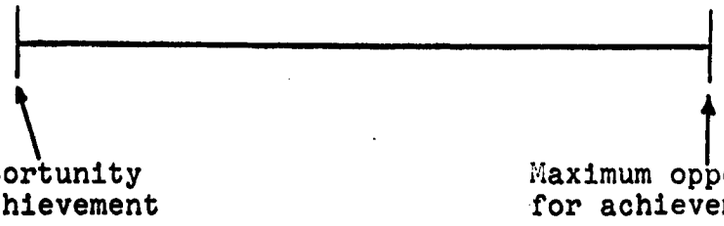
I rate the responsibility assigned to me as follows:



19. Achievement

Organizational positions provide opportunities for an individual to make significant and self satisfying contributions to his organization, his profession, and to society. One's opportunities to make such contributions may be different for each of these categories. However, all three categories should be considered in deciding on your total opportunity for achievement in your job.

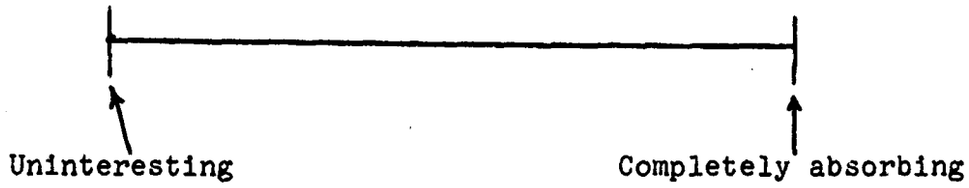
I rate the opportunities for achievement in my job as follows:



20. Job Interest

Job interest is dependent upon the challenge of the work inherent in the job, the degree to which this work matches the interests of the individual, and the degree to which the individual feels he can influence the job.

I find my job:



21. Please assign numerical weights to the following five factors in accordance with your estimate of their importance to career progression in your job. Refer back to questions 16 through 20 for meaning of these factors. Assume that these are all the factors that are important to career progression. Choose the weights in such a way that their sum is equal to 100.

1. Recognition ____
2. Advancement ____
3. Responsibility ____
4. Achievement ____
5. Job Interest ____
100

22. Any additional comments that you may have:

Appendix D

Laboratory Pay Scale

GENERAL SCHEDULE - PER ANNUM RATES AND STEPS

The following chart reflects Civil Service employees pay rate in effect on and after 13 July 1969.

GRADE	1	2	3	4	5	6	7	8	9	10
GS-5	6,176	6,382	6,588	6,794	7,000	7,206	7,412	7,618	7,824	8,030
GS-6	6,882	7,111	7,340	7,569	7,798	8,027	8,256	8,485	8,714	8,943
GS-7	7,639	7,894	8,149	8,404	8,659	8,914	9,169	9,424	9,679	9,934
GS-8	8,449	8,731	9,013	9,295	9,577	9,859	10,141	10,423	10,705	10,987
GS-9	9,320	9,631	9,942	10,253	10,564	10,875	11,186	11,497	11,808	12,119
GS-10	10,252	10,594	10,936	11,278	11,620	11,962	12,304	12,646	12,988	13,330
GS-11	11,233	11,607	11,981	12,355	12,729	13,103	13,477	13,851	14,225	14,599
GS-12	13,389	13,835	14,281	14,727	15,173	15,619	16,065	16,511	16,957	17,403
GS-13	15,812	16,339	16,866	17,393	17,920	18,447	18,947	19,501	20,028	20,555
GS-14	18,531	19,149	19,767	20,385	21,003	21,621	22,239	22,857	23,475	24,093
GS-15	21,589	22,309	23,029	23,749	24,469	25,189	25,909	26,629	27,349	28,069
GS-16	25,044	25,879	26,714	27,549	28,384	29,219	30,054	30,889	31,724	

Appendix E

Data Analysis

```
C    C TOTTEN   MEANS
     DIMENSION P(16),NN(16),Q(16)
  31 READ,N,M,MM
     R=M
     KJ=1
     DO 102J=1,13
     NN(J)=0
 102 Q(J)=0.
  30 IF(MM-KJ)110,108,108
 108 READ29,I,J,K,L,II,IJ,IK,IL,JI,JJ,JK,JL,KI,III,IIJ,IIK,IIL,IJI,
    1IJJ,IJK,IJL,IKI,IKJ,IKK,IKL,KII
     KJ=KJ+1
     A=I
     B=J
     C=K
     D=L
     E=II
     F=IJ
     G=IK
     H=IL
     AA=JI
     BA=JJ
     CA=JK
     DA=JL
     EA=KI
     P(1)=III
     P(2)=IIJ
     P(3)=IIK
     P(4)=IIL
     P(5)=IJI
     P(6)=IJJ
     P(7)=IJK
     P(8)=IJL
     P(9)=IKI
     P(10)=IKJ
     P(11)=IKK
     P(12)=IKL
     P(13)=KII
     IF(N-1)1,1,13
  13 IF(N-3)2,3,14
  14 IF(N-5)4,5,15
  15 IF(N-7)6,7,16
  16 IF(N-9)8,9,17
  17 IF(N-11)10,11,18
  18 IF(N-13)12,19,19
   1  IF(A -R) 30,105,30
   2  IF(B -R) 30,105,30
   3  IF(C -R) 30,105,30
   4  IF(D -R) 30,105,30
   5  IF(E -R) 30,105,30
   6  IF(F -R) 30,105,30
```

```
  7  IF(G -R) 30,105,30
  8  IF(H -R) 30,105,30
  9  IF(AA-R) 30,105,30
 10  IF(BA-R) 30,105,30
 11  IF(CA-R) 30,105,30
 12  IF(DA-R) 30,105,30
 19  IF(EA-I) 30,105,30
105  DO 101 J=1,13
     IF(P(J)-150.)103,101,103
103  Q(J)=Q(J)+P(J)
     NN(J)=NN(J)+1
101  CONTINUE
110  CONTINUE
     IF(MM-KJ)106,30,30
106  DO 107 J=1,13
     RN=NN(J)
107  P(J)=Q(J)/RN
     PUNCH,N,M,MM
     PUNCH,(P(J),J=1,13)
     PUNCH,(NN(J),J=1,13)
 29  FORMAT(I1,I3,8I1,I2,I1,I2,8I4,5I4)
     GO TO 31
     STOP
     END
```

```
C    C TOTTEN STANDARD DEVIATIONS
       DIMENSION P(16),NN(16),Q(16),S(16),T(16)
    31 READ,N,M,MM
    52 READ,(T(I),I=1,13)
       R=M
       KJ=1
       DO 102J=1,13
       NN(J)=0
   102 Q(J)=0.
    30 IF(MM-KJ)110,108,108
   108 READ29,I,J,K,L,II,IJ,IK,IL,JI,JJ,JK,JL,KI,III,IIJ,IIK,IIL,IJI,
      1IJJ,IJK,IJL,IKI,IKJ,IKK,IKL,KII
       KJ=KJ+1
       A=I
       B=J
       C=K
       D=L
       E=II
       F=IJ
       G=IK
       H=IL
       AA=JI
       BA=JJ
       CA=JK
       DA=JL
       EA=KI
       P(1)=III
       P(2)=IIJ
       P(3)=IIK
       P(4)=IIL
       P(5)=IJI
       P(6)=IJJ
       P(7)=IJK
       P(8)=IJL
       P(9)=IKI
       P(10)=IKJ
       P(11)=IKK
       P(12)=IKL
       P(13)=KII
       IF(N-1)1,1,13
    13 IF(N-3)2,3,14
    14 IF(N-5)4,5,15
    15 IF(N-7)6,7,16
    16 IF(N-9)8,9,17
    17 IF(N-11)10,11,18
    18 IF(N-13)12,19,19
     1 IF(A -R) 30,105,30
     2 IF(B -R) 30,105,30
     3 IF(C -R) 30,105,30
     4 IF(D -R) 30,105,30
     5 IF(E -R) 30,105,30
```

```
     6   IF(F -R) 30,105,30
     7   IF(G -R) 30,105,30
     8   IF(H -R) 30,105,30
     9   IF(AA-R) 30,105,30
    10   IF(BA-R) 30,105,30
    11   IF(CA-R) 30,105,30
    12   IF(DA-R) 30,105,30
    19   IF(EA-R) 30,105,30
   105   DO 101 J=1,13
         IF(P(J)-150.)103,101,103
   103   Q(J)=Q(J)+(T(J)-P(J))**2
         NN(J)=NN(J)+1
   101   CONTINUE
   110   CONTINUE
         IF(MM-KJ)106,30,30
   106   DO 107 J=1,13
         RN=NN(J)
   107   S(J)=(Q(J)/(RN-1.))**.5
         PUNCH,N,M,MM
         PUNCH,(T(J),J=1,13)
         PUNCH,(S(J),J=1,13)
         PUNCH,(NN(J),J=1,13)
    29   FORMAT(I1,I3,8I1,I2,I1,I2,8I4,5I4)
         GO TO 31
         STOP
         END
```

```
C    C TOTTEN  SIGNIFICANCE DIFFERENCE TESTING
      DIMENSION TM(13),TMM(13),V(13),VV(13),S1(13),S2(13),S3(13)
      DIMENSION TEE(13),Z(13)
   31 READ,ID,N,(TM(J),J=1,13),(V(J),J=1,13)
   32 READ,IDD,NN,(TMM(J),J=1,13),(VV(J),J=1,13)
      RN=N
      RNN=NN
      IF(RN-30.)199,99,99
   99 IF(RNN-30.)199,100,100
  100 DO 101 J=1,13
      S1(J)=(((V(J)**2)/RN)+((VV(J)**2)/RNN))**.5
      Z(J)=(TM(J)-TMM(J))/S1(J)
  101 CONTINUE
      PUNCH 2
      PUNCH,ID,IDD,RN,RNN
      PUNCH,(Z(J),J=1,13)
      GO TO 36
  199 DO 201 J=1,13
      S2(J)=(((RN-1.)*((V(J))**2))+(RNN-1.)*((VV(J))**2))/(RN+RNN-2.)
      S3(J)=((S2(J)/RN)+(S2(J)/RNN))**.5
      TEE(J)=(TM(J)-TMM(J))/S3(J)
  201 CONTINUE
      PUNCH 1
      PUNCH,ID,IDD,RN,RNN
      PUNCH,(TEE(J),J=1,13)
    1 FORMAT (8HTEE TEST)
    2 FORMAT (8HZ FACTOR)
   36 GO TO 31
      STOP
      END
```

```
C    C TOTTEN CPI AND FRUSTRATION INDEX
       DIMENSION Q(20),F(6),A(13)
    30 READ,GC,GN,(Q(I),I=13,20),(F(I),I=1,5),(A(I),I=1,13)
     1 CPI=(Q(16)*F(1))+(Q(17)*F(2))+(Q(18)*F(3))+(Q(19)*F(4))
     3 CPI=(CPI+(Q(20)*F(5)))/100.
     5 FRDX=Q(13)-Q(14)
       PUNCH,GC,CPI,FRDX
       GO TO 30
       STOP
       END
```

Appendix F

Computer Printout of Data Cards

114665115511011l4	075	060	083	031	023	063	064	076	010	020	020	025	025
116565135511031l5	099	084	090	067	077	090	089	100	020	020	020	020	020
116665225511021l5	099	096	098	098	097	100	100	100	015	020	020	020	025
114154235511021l4	100	098	073	100	076	070	075	100	010	025	010	025	030
114464134412011l4	100	090	087	067	088	075	075	088	010	020	015	015	040
115354234311031l4	099	082	083	077	073	080	098	099	015	015	015	025	030
115265114311011l4	091	091	053	081	082	090	094	088	010	015	020	040	015
100065305322011l0	089	089	098	089	090	092	099	100	005	005	010	040	040
113655115122051l2	072	050	077	017	014	047	058	077	015	025	015	025	020
113445114222021l0	064	047	060	074	048	068	069	066	015	025	020	010	030
114664124312011l4	035	026	080	050	065	078	076	062	010	040	010	010	030
113443112122052l7	020	022	083	090	030	087	092	064	020	015	010	025	030
112643113122012l2	057	038	048	035	026	064	037	008	030	025	025	010	010
113243123122023l2	079	039	027	020	046	100	064	035	025	025	005	020	025
113343132122031l1	100	086	090	059	071	086	074	087	020	030	020	010	020
113653233122011l3	090	044	084	015	007	028	017	039	005	010	005	050	030
113553123122061l5	095	080	076	040	043	078	077	097	020	020	020	020	020
113553123122010l3	083	066	094	098	048	078	055	086	010	010	030	015	035
113553123122051l5	089	066	028	058	031	090	086	090	015	030	020	020	015
111534124112041l5	080	075	095	072	053	094	093	094	005	015	020	030	030
112434133122021l2	090	077	015	025	020	050	036	078	030	010	010	020	030
113654114122011l3	079	074	063	055	047	087	073	092	015	010	020	015	040
113654114122011l3	073	060	084	092	038	093	025	051	010	025	030	015	020
112332122112021l9	077	061	034	061	060	077	060	077	015	020	025	015	025
112232232122011l1	045	047	047	075	073	080	081	071	019	019	019	019	021
112432232122012l2	063	046	040	022	029	030	035	007	025	020	015	010	030
112432122122012l2	058	061	080	076	068	047	061	063	010	015	020	020	035
112432122122021l1	098	056	059	058	053	039	045	051	005	025	020	030	020
112232122122021l1	054	058	042	052	042	074	073	082	010	010	010	020	050
113342112122043l7	070	048	034	034	008	044	007	001	010	010	000	005	075
113342222122032l2	076	052	036	023	030	037	025	066	010	020	010	020	040
112[42122122032l1	075	073	090	011	017	089	011	069	015	015	020	020	030
113[42122122042l7	081	080	064	037	054	080	065	048	015	010	020	030	025
113[42122122021l2	050	048	036	065	046	073	065	080	030	015	010	025	020
113[42233122011l3	099	087	083	048	070	079	073	074	010	025	010	040	015
113242132122041l7	100	100	073	080	074	084	080	088	010	020	020	025	025
113242122122041l5	100	076	070	001	016	056	030	049	010	030	030	020	010
113442233122012l3	080	047	051	029	009	083	026	017	025	020	015	020	020
113242122122051l9	093	087	049	005	016	088	083	099	025	010	025	015	030
113552123112051l5	079	066	087	092	089	085	080	095	020	020	010	010	040
114252123112051l2	100	093	087	070	023	087	094	095	005	010	025	025	035
114252232122051l3	074	072	040	076	024	045	011	096	010	020	010	030	030
112433112122011l2	098	075	098	035	049	050	062	063	016	021	021	021	021
111121121122021l7	093	077	049	083	052	100	074	069	010	015	020	015	020
109721121122022l7	032	031	052	028	032	023	063	042	020	020	020	025	015
111631131122021l7	076	058	084	095	086	073	089	077	018	023	018	023	018
111531121122011l7	090	084	083	049	068	048	066	100	010	015	015	020	040
112332232122031l7	099	075	042	052	048	082	082	089	010	010	030	020	030

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Appendix G

Response Characteristics and Calendar

Response Characteristics

Returns by Laboratory

	Sent Out	Returned	Percent Returned
Aero Propulsion	60	48	80
Avionics	60	38	63
Flight Dynamics	60	44	73
Materials	60	41	68
Rome Air Development	60	44	73
TOTAL	300	215	72

Number of Respondents Commenting - 65 (30%)

Return Calendar

Date	APL	AVL	FDL	MRL	RADC	TOTAL
25 July					5	5
26 "					2-7	7
28 "					18-25	25
29 "			1			26
30 "	4	1		1	9-34	41
31 "		2-3			3-37	46
1 Aug		2-5	7-8	1-2	1-38	57
2 "		8-13	1-9	1-3		67
4 "					1-39	68
5 "	15-19	2-15	2-11	5-8		92
6 "	18-37	13-28	23-34	15-23	1-40	162
7 "	1-38	2-30		2-25	1-41	168
8 "	1-39	2-32	1-35	8-33		180
9 "	2-41	1-33	2-37	2-35		187
11 "	2-43	2-35	1-38	1-36		193
12 "		1-36				194
13 "	1-44	1-37		4-40		200
14 "	2-46		4-42	1-41	1-42	208
15 "		1-38			1-43	210
16 "	1-47		2-44		1-44	214
18 "	1-48					215
TOTALS	48	37	44	41	44	215

(Not counted in the above totals are the four returned questionnaires which were eliminated. Respondents were not of defined sample population.)

APPENDIX H

Data Grouping and Stratification

GROUP TITLE	STRATIFICATIONS
Laboratory	1. Aero Propulsion Laboratory
	2. Avionics Laboratory
	3. Flight Dynamics Laboratory
	4. Materials Laboratory
	5. Rome Air Development Center
Salary	1. $12,499 and under
	2. $12,500 to $14,999
	3. $15,000 to $17,499
	4. $17,500 to $19,999
	5. $20,000 and above
Age	1. 26 and under
	2. 27 to 32
	3. 33 to 38
	4. 39 to 44
	5. 45 and above
Education Level	1. B.S.
	2. M.S.
	3. Ph.D.
	4. Other

GROUP TITLE	STRATIFICATIONS
Total Years of Engineering/Scientific Work	1. 4 or less
	2. 5 to 9
	3. 10 to 14
	4. 15 to 19
	5. 20 and over
Years of Supervisory Experience	1. 4 or less
	2. 5 to 9
	3. 10 to 14
	4. 15 and above
Supervisory Level	1. Non-supervisory
	2. First Level Supervisor
	3. Second Level and above
Total Years at Present Job	1. 2 or less
	2. 3 to 4
	3. 5 to 6
	4. 7 to 8
	5. 9 to 12
	6. 13 and above
Job-Content	1. Increased
	2. Stayed the same
	3. Decreased

VITA

Thomas J. Mackey was born on 26 September 1941 in Salem, Massachusetts. He graduated from high school in Salem, Massachusetts in 1959, attended Wentworth Institute, and received his Associate Degree in 1962. In 1966, he graduated from Lowell Technological Institute, from which he received his Bachelor of Science Degree, and a commission in the United States Air Force. He served as an Electrical Engineer while assigned to the Headquarters of the United States Air Force Security Service in San Antonio, Texas. He was awarded the Air Force Commendation Medal for meritorious duty performed while assigned to the Air Force Security Service.

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This thesis was typed by Mrs. Mary E. Mahaffey.

VITA

John Carl Totten was born on 5 April 1944 in San Antonio, Texas. He graduated from high school in Harmon Air Force Base, Newfoundland, Canada in 1962. He attended Austin College and the University of Texas, from which he received the degree of Bachelor of Science, and a commission in the United States Air Force in 1968. From there, he was assigned to the Air Force Institute of Technology, where he received the degree of Master of Science in Systems Management in 1969.

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