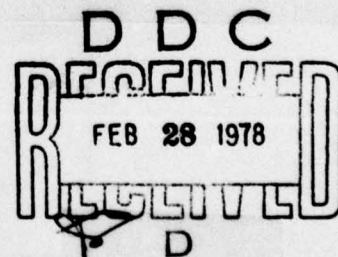①

DEFENSE SYSTEMS
MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

THE STEREOTYPES OF
SCIENTISTS AND ENGINEERS:
FACT OR FICTION

STUDY PROJECT REPORT
PMC 77-2

WILLIAM RICHARD BURCHAM
LCDR   USN

D D C

FEB 28 1978

D

FORT BELVOIR, VIRGINIA 22060

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) THE STEREOTYPE OF SCIENTISTS AND ENGINEERS: FACT OR FICTION		5. TYPE OF REPORT & PERIOD COVERED Study Project Report 77-2
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) WILLIAM R. BURCHAM		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS DEFENSE SYSTEMS MANAGEMENT COLLEGE FT. BELVOIR, VA 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEFENSE SYSTEMS MANAGEMENT COLLEGE FT. BELVOIR, VA 22060		12. REPORT DATE 77-2
		13. NUMBER OF PAGES 44
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) UNLIMITED		

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)
18. SUPPLEMENTARY NOTES
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)   SRR ATTACHED SHEET
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)   SEE ATTACHED SHEET

DD FORM 1473 1 JAN 73   EDITION OF 1 NOV 65 IS OBSOLETE

DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE:

THE STEREOTYPE OF SCIENTISTS AND ENGINEERS; FACT OR FICTION

STUDY PROJECT GOALS:

To identify the "Scientist/Engineer" stereotype as associated with advanced R&D agencies. To identify significant real world deviation from this stereotype and this deviation's impact on an appropriate management technique.

STUDY REPORT ABSTRACT:

The management of research and engineering personnel is a topic of particular interest to those who find themselves, or may find themselves, so involved. A review of the basic theories of human behavior upon which much of motivational management practice is based is conducted. A study of the behavioral patterns of scientists and engineers in a Government Laboratory is conducted. The relationships between the results of this study and current psychological and managerial theory are briefly discussed.

Organizational Behavior (15.03).
Perception (15.03.03)

NAME, RANK, SERVICE	CLASS	DATE
William R. Burcham, LCDR, USN	PMC 77-2	10-23-77

THE STEREOTYPES OF SCIENTISTS AND ENGINEERS:

FACT OR FICTION

Individual Study Program

Study Project Report

Prepared as a Formal Report

Defense Systems Management College

Program Management Course

Class 77-2

by
William Richard Burcham
LCDR   USN

November 1977

Study Project Advisor
LT COL D. S. Fujii, USAF, Ph.D.

EXECUTIVE SUMMARY

Management literature and senior DoD management personnel have been shown to attribute a group of characteristics that comprise a stereotype to scientists and engineers as distinguished from other occupational groups. A study of the behavioral patterns of 38 professional scientists and engineers in a Government Laboratory supported the stereotype presented by the literature and endorsed by those DoD managers interviewed. However, the study also indicated that there is substantial diversity of behavioral *patterns present among scientists and engineers* and that there is a need for a careful, complex, and thoughtful approach when managing research and development professionals.

PREFACE

This report is a study of a stereotype commonly held by managers who must deal with scientists and engineers. I gained new insight in the topical area through many hours of research and personal discussions with managers of scientists and engineers. The inadequacies of the data used in this report are recognized and acknowledged. No attempt is made to defend the findings of this report from a statistical viewpoint, rather it is hoped that readers will use this report to stimulate their awareness in their future dealings with scientists and engineers.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I.

INTRODUCTION

Within our population one group of individuals can be identified as making the largest contribution to the maintenance of technological expertise. That group is composed of scientists and engineers. To make the most efficient use of this group's talents, managers must develop an understanding of the nature of the individuals who compose scientific and engineering personnel. To develop this understanding managers must determine the answers to the following basic questions: Can scientists and engineers be managed differently from other personnel? Is there a collective image, a stereotype, that might assist the manager when dealing with scientists and engineers? If a stereotype exists, is it a valid tool or does it present additional encumberances to efficient management of scientists and engineers?

This report reviews the current literature dealing with the general issue of approaches to the management of personnel. It also reviews the literature to ascertain if there is justification for acknowledging a stereotype of scientists and engineers. Sufficient justification was found within the literature to support the existence of a scientist/engineer stereotype. Next, interviews were conducted with six Department of Defense managers who substantiated the stereotype's existence within the Government's management of major Defense programs. Finally, this report questions the validity of the scientist/engineer stereotype as a valuable tool for managing scientific and engineering personnel in the Government.

1

Administrators of research and engineering activities often find them-
selves concerned with the identification and implementation of those management
practices that promote positive motivation among research and engineering
personnel while avoiding, or attempting to minimize those practices that create
a counter-productive atmosphere. The application of motivational techniques
requires not only a continuous monitoring of the environment in which the scien-
tist and/or engineer operates, but also a knowledge of those human factor
problems that affect the achievement of research and engineering objectives.
The subject of human behavior is so complex that people are often confused
about their own needs and desires, let alone those of others around them. The
following quotations are provided to establish a foundation for this paper.

Frederick Herzberg writes,

Studies of the sources of job satisfaction and dissatisfaction among
managerial and professional people suggest that opportunities for
"self-actualization" are the essential requirements of both job
satisfaction and high performance. The researchers find that "the
wants" of employees divide into two groups. One group revolves around
the need to develop in one's occupation as a source of personal growth.
The second group operates as an essential base to the first and is
associated with fair treatment in compensation, supervision, working
conditions, and administrative practices. The fulfillment of the
needs of the second group does not motivate the individual to high
levels of job satisfaction and ... to extra performance on the job.
All we can expect from satisfying [this second group of needs] is the
prevention of dissatisfaction and poor job performance.[1]

Douglas McGregor took these thoughts further. He noted, "A cursory review
of the incentives provided on the job will reveal that they can be divided
into two broad categories - those provided through the interpersonal rela-
tionships with fellow workers on the job ... and those provided through the
nature of the work."[2]

It is noted from these quotations that motivation is personal. It resides
within an individual. It cannot be practiced on, or taught to, employees.

2

In the words of Fred J. Carvell, "Motivation refers to why people want things and try to get them. When studying motivation, one studies the needs, wants, desires, and impulses within the individual and how he goes about satisfying them."[3] Motivation, therefore, must be considered the internal province of the individual, and as such is instrumental in the shaping of the image one projects to others.

A. H. Maslow, in his book Motivation and Personality, breaks down the needs of man into five primary categories.[4] These categories are:

1. Physiological: Those physical needs that must be satisfied in order for the individual to continue to survive. These needs are generally taken for granted until provisions for them are missing or inoperable. Restrooms and drinking fountains provide good examples of facilities provided by management for the alleviation of physiological needs.

2. Safety: Those physical and psychological needs that relate not only to survival, but also the avoidance of pain. While safety of employees must be considered paramount in any potentially hazardous occupation, it should be noted that good management must be careful to not provide for this need in excess. Again in the words of Carvell, "An individual can atrophy in the warmth of security until he no longer can endure the severity of tough times. He can become too dependent upon others for his existence and, consequently, lose his effectiveness as an autonomous human being."[5]

3. Social: Those needs reflected by the drive to belong to a group or to be with other people. Most human beings, not all, strive for harmonious and friendly relationships with their fellows. Managers, as human beings, often experience this need. Care must be taken however to prevent the social drive from interfering with the primary objective of getting the work done. As with safety, balance is the key word.

4. Esteem: Those needs that reflect a desire for self respect, recognition, and dignity are included in this group. This group may provide the primary motivation for younger scientists and engineers. The drive to be recognized by his peers has often been voiced by those scientists and engineers under forty with whom the author is acquainted. A good synonym for this group of needs among scientists and engineers is "professional recognition".

5. Self-realization: These highest order needs of man that are totally psychological in nature. Often reflected by industrialized man

in a phenomenon known as middle aged depression - a recognized psychological phase generally associated with the fortieth birthday - these needs are based on an individual's desire for personal fulfillment. A good manager recognizes this need as real, particularly among the older members of a research and engineering environment. Intelligent and creative people must, while being directed, also be allowed the room and freedom to exercise and express their individuality and independence.

While all five categories of needs are present in each of us, some individuals respond more readily to, or find deeper motivation from one category as opposed to the others. The reasons for these differences are complex and many and represent a field of study beyond the scope of this paper. It is sufficient for this work to note that the cumulative effect of an individual's inward drives as witnessed by those with whom he associates is his outward, or overt, behavior.

Management activity is based largely upon an understanding of human behavior. There are currently two well known assumptions about human behavior upon which managerial decisions or actions are based. These assumptions were first articulated by Douglas McGregor and are identified as Theory X and Theory Y.

The three primary characteristics associated by McGregor with Theory X assumptions are:

1. The average human being has an inherent dislike of work and will avoid it if he can.

2. Because of this human characteristic of dislike of work, most people must be coerced, controlled, directed and threatened with punishment to get them to put forth adequate effort toward the achievement of organizational objectives.

3. The average human being prefers to be directed, wishes to avoid responsibility, has relatively little ambition, and wants security above all.6

Several noted authors of managerial texts have proposed management practices based upon these fundamental assumptions about people. When addressing the function of setting goals and establishing objectives, Dr. Mortimer Feinberg of the City University of New York states:

> Make sure that the basic objectives or policies are established by management. If you don't set realistic goals for them, then your employees will set their own. On occasions when this has happened, the self-set goals by employees have been neither as high nor as effective as those established by management.[7]

By investing total authority for this vital activity exclusively in the hands of management, vice a cooperative management-employee effort, Dr. Feinberg (relative to this area of management) endorses the precepts of Theory X. A second quote from Dr. Feinberg's work, a quote that is attributed to the Research Institute of America, reveals what may well be one of the possible causes of Theory X behavior in industry. He stated:

> The mediocrity of colleagues can muzzle the initiative of the dynamic doer who has high standards for his own performance - especially when the "mediocres" (sic) are permited to stand on the sidelines and throw darts at new ideas. Management often tolerates a certain percentage of people whom they have given up on - men who will never pull their own weight. But if these people are permitted to remain in key positions, just the simple fact of their presence can cost the company the loss of an endless chain of worthwhile people who don't have to work against such odds. And, incidently, whether they remain on the payroll or leave for greener fields, you've lost a man if he decides it doesn't pay to knock himself out.[8]

The relevance of this information to the plight of civil servants tasked to conduct meaningful research and development in Government laboratories should be clear to those who have operated in that theater. The protective structure of Civil Service fosters an environment identical to that described, and observation confirms the results.

As a counter-point to Theory X assumptions, McGregor offered Theory Y. The primary assumptions of Theory Y behavior are:

1. The expenditure of physical and mental effort in work is as natural as play or rest.

2. External control and the threat of punishment are not the only means for bringing about effort toward organizational objectives. Man will exercise self-direction and self-control in the service of objectives to which he is committed.

3. Commitment to objectives is a function of the rewards associated with their achievement.

4. The average human being learns, under proper conditions, not only to accept but to seek responsibility.

5. The capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the solution of organizational problems is widely, not narrowly, distributed in the population.

6. Under the conditions of modern industrial life, the intellectual potentialities of the average human being are only partially utilized.[9]

This theory of human behavior has won the support of several authors. Perhaps one of the most outspoken has been Eugene Raudsepp. In his book, Managing Creative Scientists and Engineers, Mr. Raudsepp makes the following comments relative to the motivation of creative men:

Basic to creative performance is a strong desire or need to create. Any genuine creative scientist or engineer wants to transcend his past performance, to give at every new occasion of problem solving his best, and thus achieve more than he had aspired to achieve before. He is ready to engage in meaningful problem-solving purely for the satisfaction it gives, even when no other reward lies ahead. The creative technical man likes to deal primarily with problems intrinsically of high interest to him, and he is intensely stimulated by his own ideas and thoughts.[10]

Mr. Raudsepp's faith in the positive attitude and the desire to achieve exhibited by engineers and scientists clearly supports the more overtly optimistic Theory Y assumptions of human behavior.

6

Richard W. Wallen in his article, "Unlocking Human Creativity", provides yet another example when he discusses the professional behavior of creative people. He points out that several things can and do interfere with the creative individual.

> One interference is being pushed to solve a problem that doesn't concern us. When we are fascinated we feel the problem pulling us. We do not feel pushed into it. The fascinating problem is the one that we choose, one that somehow belongs to us. People do not need to be driven to do things that have an intrinsic attraction.[11]

The self motivation versus forced motivation theme is clearly evident in much of the current literature. The central principle of those who follow the Theory X school is to direct and control through strongly exercised authority. Those who advocate the use of Theory Y as a basis of management decision making follow the tack of integrating their personnel directly into the decision making process. In the unique environment of modern research and development programs, the question of which theory to subscribe to, Theory X or Theory Y, provides a constant challenge to middle and upper management.

As stated earlier, there is a generally accepted recognition that the overt behavior of individuals is the cumulative result of their inward motives and the degree to which their needs and desires are being met. If this is truly the case, then individuals of similar backgrounds, employed in similar occupations in the same environment should display some degree of commonality of behavior, and a collective approach to the development of management techniques should apply. Another way of expressing the same theory would be; persons having similar motivations will, in seeking an

environment most gratifying to their needs and desires, tend to gravitate
to the same type or types of occupations and will thus be consistently
responsive to a generalized management strategy.

Research and engineering organizations, due to the highly specialized
nature of the personnel involved, provide an ideal setting for examining
the validity of the assumptions stated above. If the assumptions are true,
the highly trained engineers and scientists who operate in a research and
development environment - particularly a government laboratory where condi-
tions are standardized by careful regulation - should exhibit similar
behavioral patterns and thus be identifiable as a valid stereotype.
Stereotypes exist when individuals are preceived in terms of their group
membership rather than by their personal attributes. If such a pattern
can be proven, the process of management could be simplified.

The literature provides some basis for the scientist and engineer
stereotype. In Characteristics of Engineers and Scientists, Lee Danielson
notes, "Engineers, as a group, are characterized by different attributes
from that of the average employee; therefore, the approach to engineering
management must differ from the conventional application."[12]
Another of the leading texts in this area is Scientists in Organizations
by Donald Pelz and Frank Andrews.[13] This text reports the results of ten
years of research in a variety of scientific and engineering organizations.
Four criteria for measuring the effectiveness of scientist and engineers
were developed and used to correlate organizational and individual attitudes
and characteristics. The measures of effectiveness were: individual

published papers and patents, unpublished reports, ratings of scientific contribution, and over-all usefulness. These measures were applied to Ph.D's who were involved in research and in development, engineers in development, and assistant scientists in research. The book points out two major conditions that contribute most to the productivity of scientists and engineers. These conditions were security and challenge. Security included autonomy, self-reliance, power to influence decisions, shared interest, specialized competence, interpersonal cohesiveness, and self-confidence. Challenge covered a spectrum from diversity in functions performed to stimulation internal and external to the work environment. Included in this spectrum were a broad interest in new areas, a vigorous interaction with colleagues, openness to influence, diversity of strategies, intellectual competition, and a large number of specializations. Pelz and Andrews noted that their findings are applicable as ratings of effectiveness only for groups of scientists and that they are not applicable to the individual. They also identify the importance of leadership and its effect on scientific productivity. The important factors noted from this work were: Scientists and engineers were handled as a group and given characteristics as a group, and that leadership was identified as critical to effective, productive effort within this group.

Having noted that a sterotype has been identified concerning scientists and engineers, it is necessary to identify some of the chief characteristics of that stereotype. John Lloyd and Robert Gray note in Supervision of Scientific and Engineering Personnel,

"In general, the engineer desires to work with minimum supervision. He wants information for guidance but objects to detailed direction of individual projects."[14]

Alvin Brown wrote in <u>Management's Role in the Retention of Engineers in the Air Force</u>:

> Engineers will not accept technical direction from non technical managers. ... Supervision is a vital part of the controlling process because of its close relations to the human factor. Since people are involved no set pattern is practiced in the typical activity, but each particular branch chief has his own methods of supervising. However, some general observations can be made. First, the majority of branch chiefs provide little close supervision. An engineer having been assigned to a project is usually left alone until he reports back to the supervisor. Next, the supervisor gets closely involved with projects only when serious delays are encountered or pressure is applied by higher management. Finally, much of the supervisor's time is spent on coordination.[15] ... not on direct supervision.

Brown concluded that, "Operatives stress the need for the supervisor (1) to deal with subordinates as individuals, (2) to allow freedom for subordinates to set their own goals, and (3) to possess technical competence."[16]

An important element of this study project was the design of an interview to complement the data collected from the literature. It was necessary to develop an interview format that would enable the author to extract the necessary information from each interviewee in an unbiased fashion. A structured interview format was chosen to insure each interviewee received the same opportunity to answer identical questions.

The major purpose of each interview was to ascertain how each interviewee perceived scientists and engineers relative to the management styles required to direct them. All interviewees were asked the following questions:

10

Question No. 1: In your experience, what have you found to have been effective management techniques when dealing with scientists/engineers?

Question No. 2: Conversely, in your experience what have been examples of poor management techniques for scientists and engineers?

Question No. 3: What skills, techniques or practices do you feel are most necessary for a manager to possess when dealing with scientists and engineers as opposed to non-technical personnel?

        a) 1. Independence of operation allowed
           2. Flexibility required
           3. Technical competence
           4. Need for detailed direction
           5. Review frequency required
           6. Other.

        b) How would you rank these in order of importance?

Question No. 4: Do you feel that scientists and engineers as a group differ from non-technical workers in regards to their motives, goals, and/or personal traits?

Six individuals within the Department of Defense were interviewed. Four were active duty military managers and two were executive level civilian personnel. Within their Services, each dealt primarily with the acquisition of defense hardware.

Questions 1 and 2 were utilized to loosen the conversation and responses were not recorded unless they were supportive of Questions 3 and 4. The responses received to Questions 3 and 4 were remarkably similar. Five of the six interviewees felt an ability to converse on a technically equivalent level with the scientist and/or engineer was vitally important. The interviewees were unanimous in their responses concerning flexibility and need for detailed direction. All prescribed maximum flexibility and freedom from detailed direction. Four of the six individuals contacted felt they could "speak the language". Five of the six interviewed felt the need

11

for allowing independent action on the part of the scientists and engineers was the most important factor involved in managing these professionals successfully. Two of those responding remarked that close scrutiny of financial expenditures was necessary when dealing with scientists and engineers in order to prevent pet projects from funneling off specific project funds. Finally, Question 4 received a unanimously affirmative response. It was noted that the responses to this question included such common comments as, "blue-sky thinkers, and ivory tower dreamers". Scientists were singled out as a group in this case. Engineers were not mentioned per se, yet one could assume a more pragmatic character was ascribed to them.

The high correlation among the responses given would indicate that a stereotype of scientists and engineers does exist, at least among the six managers who were interviewed. The literature tends to support the existence of this stereotype. The data gathered do not warrant or support a detailed definition of the intricate character of this stereotype, however, some general characteristics do appear to be evident. The scientist/engineer stereotype seems to be that of an individualist, a self-actualizer who is technically competent and neither desires not requires close supervision. The stereotype's existence is further reinforced by the remarks of the managers interviewed. In describing scientists and engineers the managers interviewed consistently used collective descriptors. As previously noted, those interviewed even attributed a "language" to scientists and engineers. A foundation for and the validity of this stereotype is examined in Chapter 2.

CHAPTER II.

RESEARCH AND FINDINGS

In two recent administrations, scientists and engineers at a leading
Government Laboratory were given tests to determine their individual
behavioral patterns. The results of these tests will be used to illustrate
the extent of the validity of the assumption that scientists and engineers
have gravitated to their occupations due to like behavioral patterns, or
conversely, an occupation may instill a common behavioral pattern upon
those engaged in its pursuit.

The inadequacies of the tests - sample size, composition, etc. - are
recognized and therefore the results are presented in a descriptive fashion
and only a superficial attempt is made at a statistical analysis. The
sample studied consisted of nine scientists and 11 engineers in the first
group, and eight scientists and 10 engineers in the second group for totals
of 17 scientists and 21 engineers. All participants possessed a grade level
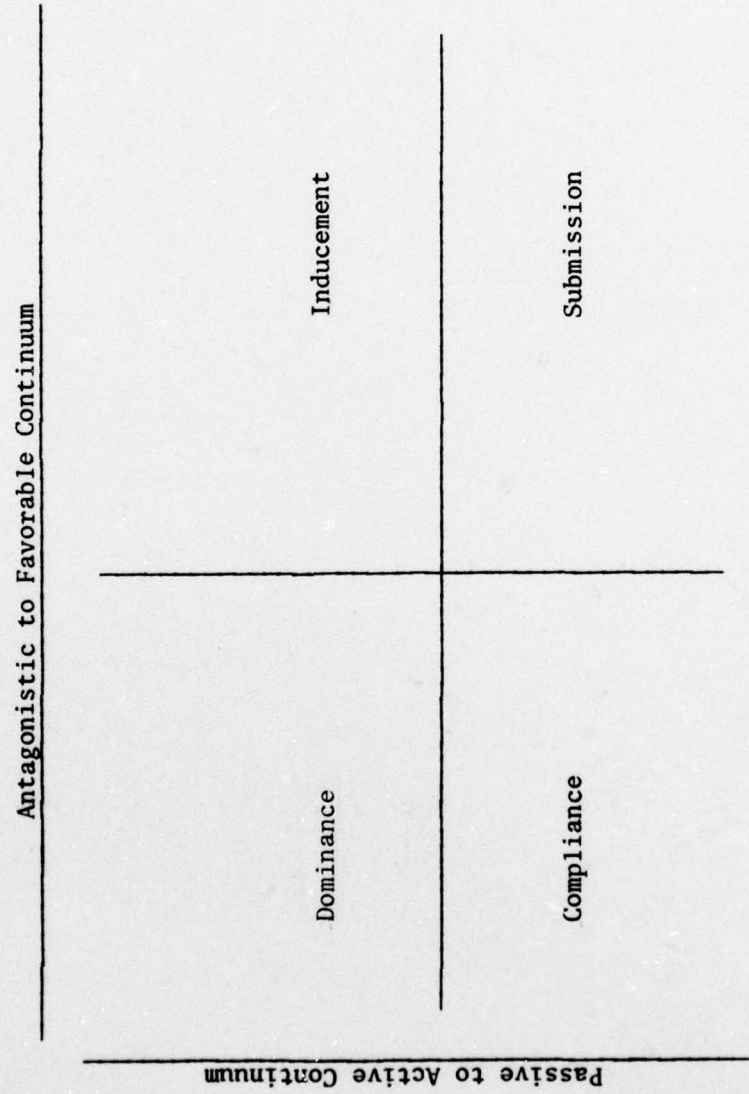of GS-12 or above.

In order to undertake the testing it was first necessary to find an
adequate and appropriate instrument. Donelly, Mahan and McManus have des-
cribed the problem of behavioral testing as, "Recognition that the prediction
of human performance is dependent upon an understanding of the interaction of
many variables is commonplace nowadays and yet assessment procedures as
utilized in education, government and industry rarely reflect this knowledge."[17]
The recommendation of Mr. McManus was to utilize the Dominance, Inducement
Submission, and Compliance (DISC) instrument which consisted of a

forced-choice adjective checklist that assumed an individual had a style of coping with his environment and that this style was closely related to the way in which he saw himself. The value of such a self-description instrument is that it provides insights which a manager can use to supplement his knowledge about his subordinates.

Initial research warned against the hazards of the misuse of self-description testing and indicated the need for professional interpretation of the results. The American Psychological Association notes that the effective interpretation of self-description instruments (such as DISC) requires a clear understanding of the theoretical statistical implications of the instrument. The administration and scoring of the instrument can be performed by an intelligent clerical employee, but the interpretation of the profile and its use in personnel decisions should be restricted to appropriately-trained persons.[18] For these reasons special assistance was sought from Mr. Leo F. McManus during the interpretation of the test results.

Mr. McManus pointed out that the DISC instrument chosen for this experiment is based upon the early work of W. Marston[19] who assumed human behavior could be described as a function of environment and the individual's method of response to that environment. The environment was considered to be a continuum ranging from antagonistic to favorable, and the possible responses represented a second continuum ranging from active to passive. See Figure I for a two dimensional representation of Marston's Model. Active responses to antagonistic environments were assigned to the quadrant identified by dominance-D. An active response to favorable

14

Figure I. Two Dimensional DISC Model

Antagonistic to Favorable Continuum

Dominance

Inducement

Compliance

Submission

Passive to Active Continuum

environments fell into the quadrant identified by inducement-I.

Submission-S identified the locus of passive responses to favorable environ-
ments, and compliance-C identified passive or cautious responses to antag-
onistic environments. The initials DISC provide the identification for
the self-description test used during the development of this paper.

Marston's model was expanded by Abraham M. Maslow[20] who identified
eight classical patterns of human behavior, psychological models, and deter-
mined their interrelationship with the four dimensions of the DISC. This
number has recently been expanded to include a ninth behavioral pattern.
The current accepted practice includes nine identifiable patterns that are
related to the DISC model as shown in Figure II.

Donald Super[21], in an article entitled, "The Psychology of Careers",
published in Harpers magazine, expanded upon the work of Marston and noted
that while it could be assumed that most normal people would show all four
of the DISC dimensions at specific times given the proper conditions, every
individual has developed his own life style that places particular emphasis
on certain dimensions while placing less on the others. This personal life
style development was characterized as an evolutionary process highly
dependent upon the reactions and responses of others to one's efforts to
establish one's own self-styled mode of behavior. Of primary interest,
however, was the fact that Super felt the culmination of an individual's
efforts for self-image would be a personal style of behavior that the
individual would strive to maintain and would enunciate in overt behavior.
Therefore, in his attempts to maintain his self-image a person would be
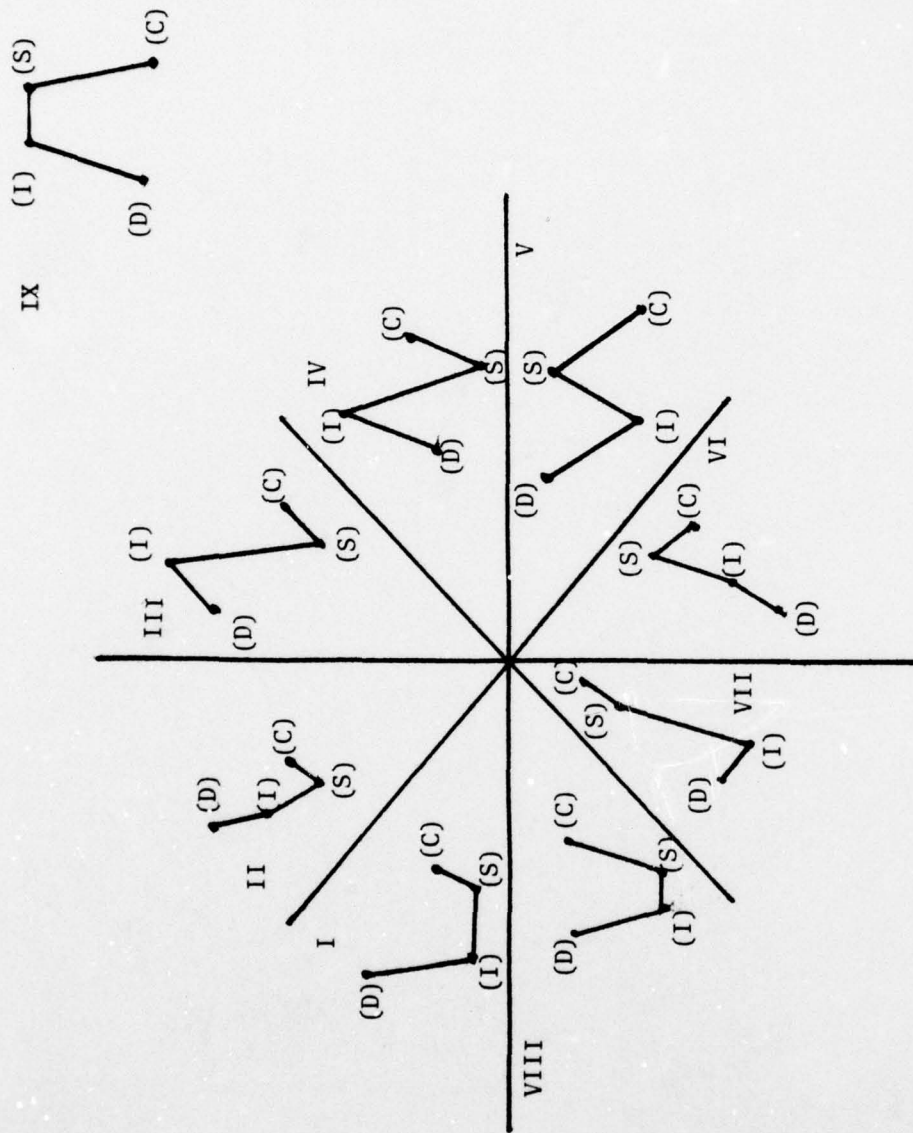compelled to seek roles and occupations that were in keeping with his

Figure II. Behavioral Patterns and DISC

impression of himself. If Super were correct, personality types for given occupations should be identical and general management techniques - founded upon Theory X or Theory Y - for these occupations, could be tailored for them based upon the expected behavioral patterns.

The administration of the DISC is rather simple. The subject is given a series of questions consisting of groupings of four adjectives. He is asked to choose from each grouping the word that most nearly describes himself and the one that least applies. The totals for most descriptive terms are made independently from the totals for the least descriptive. Subtotals are made for those terms that indicate dominance, inducement, submission, and compliance. These subtotals are then compared with a standard population and a relative positioning for dominance, inducement, submission and compliance is established for both the most-like and least-like findings. Finally, a total composed of an average of both the most and the least scores, is determined. An example is shown in Figure III for a theoretical individual, Mr. X.
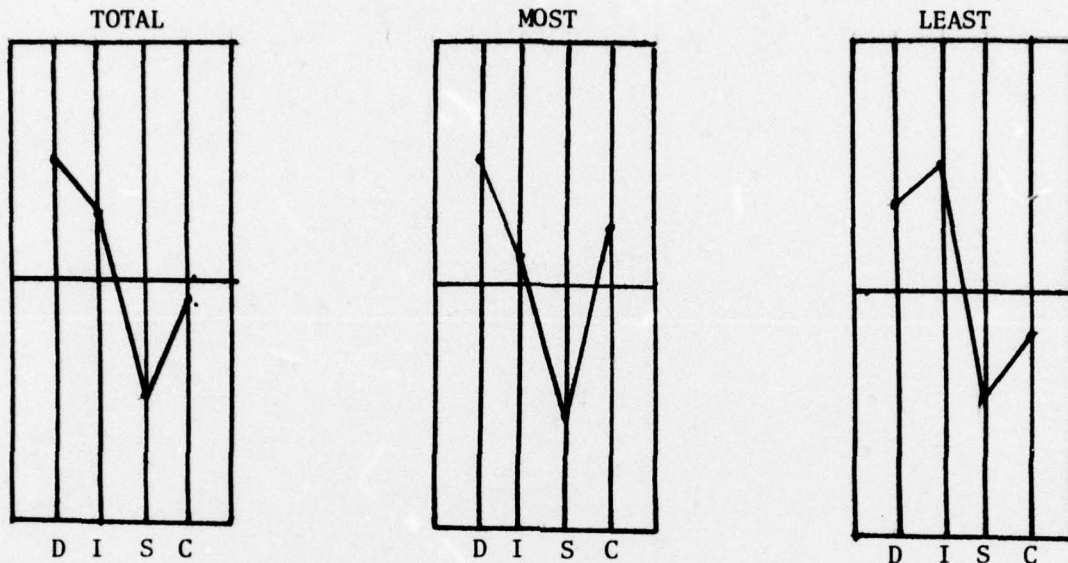
CASE OF MR. X

FIGURE III

An actual interpretation of the scores is based on a pattern approach. The scores on the individual dimension do not have an absolute meaning. They take on their meaning in relation to the other dimension scores. There is no assumption of a one-to-one correspondence between individual responses and personality types. Interpretation is based upon a correspondence between patterns of responses as they are developed within combinations of all four factors. That is to say, certain patterns of responses are indicative of certain behavioral types.

The results of the tests conducted are shown as the small circled numbers in Figure IV and are tabulated in Table 1.
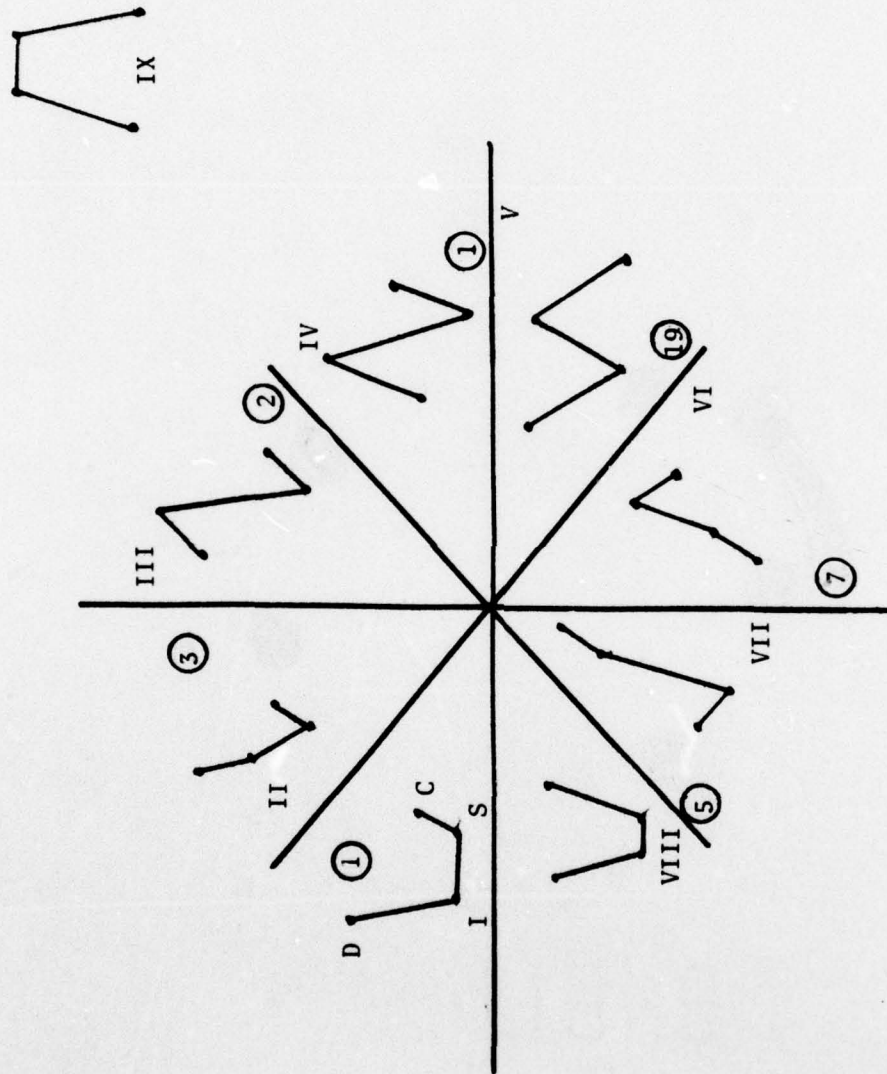
19

Figure IV. Behavioral Patterns and DISC (DISTRIBUTION)

① Observed Personnel Distribution

Table 1. Results of Testing

Behavioral Pattern	Number of Individuals	
	Group One n = 20	Group Two n = 18
I	1	0
II	2	1
III	1	1
IV	0	1
V	10	9
VI	4	3
VII	2	3
VIII	0	0
IX	0	0

There was a clustering of subjects centered upon behavioral type V which represented half of the test subjects in each group. Behavioral pattern VI was next with eighteen percent of the total sample. Professional interpretation of these results was provided by Mr. Leo F. McManus and was based upon the work of J. P. Cleaver.[22]

The one person who fell into behavioral pattern I is described as forceful and direct. He is the type of person who tends to be a strong individualist. He can be expected to be progressive and forward looking and competitive when seeking to attain goals. He is curious, has a wide range of interests, and constantly seeks new horizons due to an innate restlessness. Logical, incisive and critical in his problem-solving activities, he is able to by-pass convention and can be expected to come up with imaginative and unusual solutions to complex problems.

21

Unfortunately, this person is likely to have difficulties with people who often view him as cool, blunt, and overbearing. Because he tends to be self-centered and lacking in empathy, he can be highly critical and faultfinding with others when his standards are not met. Impatient and dissatisfied with routine tasks this individual can be difficult to control and may overstep his prerogatives. Due to his strong self identity he will find it difficult to identify with the company and will resist efforts to have him participate as part of a team.

The behavior of this individual is most likely based upon a strong desire for freedom from controls, supervision and details. His personal preference is for the unusual and the adventurous. He desires an ever-changing environment *wherein he can find answers for himself.* Because of his strongly personalized self-interest the opportunity for advancement and challenge are important to him as are authority and important assignments.

When dealing with this person special note must be taken of his potential impact on other people. It should be recognized that unique or stimulating assignments that challenge and extend are the jobs for this individual. Finally, it should be remembered that due to his strong self image this person must be reminded that he is a member of a larger organization and that sanctions on his activities do exist. He may require occasional blunt direction.

The three individuals who were identified as behavioral type II are described as being agressive types who can take a creative idea and make it serve a practical purpose. While they use a

22

direct method, they consider people and can convince them through persuasiveness when necessary. Aggressive and confident, they are goal-minded and harness people to help them attain their goals. They can be expected to plan well in advance and to integrate their activities to aid them in getting results. They are versatile, eager self-starters who act positively in both competitive and social environments.

These people have a tendency to be impatient and irritable when things don't happen fast enough. They can exhibit a loss of interest in projects once the challenge is gone and often show little desire for details. They can overstep their prerogatives and may sulk and/or become troublemakers when not in the limelight. High turnover rates early in their careers is to be expected.

These people are driven by a desire for authority, prestige and position. They seek earned respect from their associates. While desiring variety and change, they prefer to run operations where tangible, measurable results can be shown and progress can be measured. They like challenging assignments that offer an opportunity to move up the management ladder where more independence of wide-scope operation can be found.

When dealing with these people one should attempt to negotiate commitments on a man-to-man basis. These personnel can profit from exposure to techniques based on practical experience, however they must be allowed freedom and the opportunity to express themselves in order to vent some of their powerful inner drive. Finally, they should be protected from spreading themselves too thin and may need to be shown how to relax and pace themselves.

The two individuals who fell into group III are described as integrative leaders who work with and through people. They have a pronounced interest in people and an ability to gain the respect and confidence of varied types. They are good coordinators who are willing to delegate. They will strive to do business in a friendly way while pushing forward to win their objective and win their point of view. Generally poised, they will exhibit confidence in most situations.

Impulsive, they may tend to be unattentive to the little things. They may be overly enthusiastic and oversell. Trapped by their dependence upon people, they may overestimate their ability to motivate them and thus may be too optimistic regarding the possible results of their projects or the potential of their people.

These individuals desire challenging assignments that offer the opportunity for varied contact with people. Public recognition and status symbols are important to these men as are authority and prestige. They may prefer assignments that involve frequent travel.

When dealing with these men it is well to remember that they desire a variety of activities and the opportunity to deal with people. They will have to be supplied with analytical data. Responding best to a cooperative democratic supervisor, they enjoy travel and assignments that present challenge and a chance to show results.

The one individual who exhibited behavioral type IV was characterized as being gregarious and at home with strangers. He displays remarkable poise and a social capability to easily make friends. He can be expected to help others promote their projects as well as his own. He is an optimistic

person and uses a large and active network of contacts to provide himself
with a basis for influence.

His limiting features include a difficulty in planning and control-
ling his time, leaping to favorable conclusions without considering all the
facts, seeking good relations at the expense of direct results, misjudging
the ability of others, and inconsistency in his conclusions.

When dealing with this individual it is important to note his need to
develop more objectivity and profit emphasis. This individual needs close
supervision although he may desire a freedom from control and detail. As
he wants to deal with people in a favorable, social environment, he will
relate well to a democratic supervisor with whom he can associate. A prime
stimulus for this individual is identification and social recognition. As
such he will do well in assignments requiring the motivation of groups and
the use of network contacts.

By far the largest grouping shown during the testing occurred when
19 of the 38 subjects demonstrated behavioral pattern V. These individuals
are described as being determined and persistent people who bring an inten-
sive and comprehensive approach to the analysis of a problem or the evalua-
tion of the practicality of an idea. They are objective, analytical
persons and dispassionate "anchors of reality". Calm, steady and perser-
vering, they are successful many times, not because of versatility, but due
to dogged determination. They are tenacious after starting a project and
will fight hard for their objectives. They are independent and questioning
in their approaches and will be thorough and possess follow-through.

Unfortunately, they can be expected to show little concern or interest in pleasing people. They can be stubborn and opinionated and may appear coldly blunt and tactless. They are generally non-demonstrative, and will have difficulties selling ideas or generating enthusiasm in others. They may require a forceful approach from a supervisor to get them to follow instructions or change their approach.

These people are motivated by a common desire to operate by themselves and set their own pace in an atmosphere free from close supervision. They prefer work of a technical nature rather than an involvement with people and desire challenging assignments that can be followed through to completion on an independent basis.

When dealing with these *people one* must realize that they respond to logic rather than emotion. They need difficult assignments requiring independent and penetrating analysis. Finally, they need to be helped in developing an understanding of people so that they may be more willing to change their pace or approach to accommodate others.

Those seven whose behavior was classified as type VI are described as patient, controlled, and deliberate. Usually amiable and easy-going they plan their work carefully so as to work consistently in directed channels. Characterized as considerate and modest they fit in well with most people. They will maintain a steady pace in an established work pattern. Accommodating individuals and steady consistent performers, they move with calculated moderation and are always willing to help those they consider their friends.

Quiet by nature these individuals are slow to accept change and prefer to maintain a status quo. Contented with things as they are, these people

will wait for orders before acting and may then have trouble meeting deadlines. Because of their quiet natures these individuals may conceal a grievance and harbor a grudge.

Having deep family ties, these people prefer not to travel and have a relatively small circle of close relationships. They desire a familiar work environment with a predictable pattern particularly in a specialized area of endeavor. They require a long time to adapt to change.

When dealing with these persons one should practice constant inspiration and sincere appreciation. When change must occur, preparation and conditioning should be provided prior to the event. Assignments of a specialized nature where short-cut methods and starting help are available will assist these people in meeting deadlines. Finally, these people are most comfortable as integral parts of their groups.

The last five individuals in the sample fell into behavioral group VII and are described as being systematic, precise thinkers who tend to follow procedure in both their professional and business lives. They proceed in an ordered, predetermined manner and are precise and attentive to detail. They are usually highly tactful and diplomatic and often display a good sense of timing and shrewdness in selecting the right decision at the right time. They are extremely conscientious persons and are painstaking in work that requires accuracy and the maintenance of precise standards.

They do, however, have a tendency to become bogged down in details. They are therefore more dependent on their supervisors for decisions since they are so dependent upon procedures and hesitate to act without precedent.

27

They tend to become defensive when threatened and may yield their position in an effort to avoid controversy.

These persons desire standardization and no sudden or abrupt departures from that standard. They enjoy the protection and security of sheltered environments. They desire personal attention and to be reassured. They prefer to share responsibility and therefore seek to be part of a group.

When dealing with these people one must be aware of their need for reassurance and thus key his efforts to the removal of threat. In pressure situations these people will require direct support. They require exact job descriptions and prefer assignments of a precise, planning nature. Detailed explanations are required in times of change.

The observed and expected frequencies of the behavioral patterns of the subjects in the sample are illustrated in Table 2.

Behavioral Pattern

I	II	III	IV	V	VI	VII	VIII	IX
4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
1	3	2	1	19	7	5	0	0

Table 2. Observed and Expected Cell Frequencies

Assuming that the population as a whole is evenly distributed across the nine behavioral patterns, the frequencies of persons expected to fall into each cell for groups of these sizes are shown in the upper right hand corner of each cell.

28

A Chi-square analysis of goodness of fit was performed.

Null Hypothesis: The individuals are uniformly distributed across the nine behavioral patterns

Alternative Hypothesis: The individuals are not uniformily distributed across the nine behavioral patterns.

Chi-square goodness of fit

n = 38 = number in the sample

.005 level

df = 8 = degrees of freedom

R: $\chi^2 \geq 22.0$

χ^2: $\sum_{1}^{9} \frac{(O_j - E_j)^2}{E_j} = \frac{10.24}{4.2} + \frac{1.44}{4.2} + \frac{4.84}{4.2} + \frac{10.24}{4.2} + \frac{219.04}{4.2} + \frac{7.84}{4.2} +$

$$\frac{.64}{4.2} + \frac{17.64}{4.2} + \frac{17.64}{4.2} = 68.94$$

The decision is to reject the null hypothesis. There is no doubt that the individuals tested are not uniformly distributed across the nine behavioral patterns. An understanding of the significance of the lack of uniformity in these distributions provides some insight into the validity of the scientist/engineer stereotype. The heavy clustering of personnel in behavioral pattern V supports the existence of the scientist/engineer stereotype. Additional note should be taken of the similarity of this behavioral type and the characteristics of the scientist/engineer stereotype described by Danielson, Pelz and Andrews, Lloyd and Gray, and Brown, in Chapter I.

It should be remembered that the DISC profiles are of the limited dimensions of the individuals' own self-images. In addition, the pattern shown is not so unusual when taken in the light of the work of James Flanagan.[23] Flanagan, while conducting a factor analysis of the Bernreuter Inventory[24] discovered what he felt were relatively independent scales of human behavior that correspond roughly with the dominance-compliance continuum and the inducement-submission continuum. He called these two scales "self-confidence" and "sociability", terms that denote ego orientation and people orientation, respectively. Those individuals who comprised groups I, II and V, were strongly ego oriented and sought to obtain their goals independently, as free from close supervision as possible. Those who composed groups III, IV, VI and VII were directly people oriented and either sought or required close supervision. Within the ego oriented group, the individuals who composed groups I and II were hard driving, self-starters while those in group V generally accepted assigned projects that they pursued at their own pace, not necessarily an exceptionally fast one. Within the four groups that could be considered people oriented, only the individual in group III could be considered a hard charger. Those in groups IV, VI and VII could be expected to show a tendency for lateness and missed deadlines. These findings are also in agreement with the work of Lief Carter[25] whose factor analysis of interactions in small groups disclosed two individual factors; individual prominence and achievement, and sociability. It is noted that these positions are in line with the conflict between achievement motivation and affiliation motivation commonly seen in production activities.

The results of the tests, particularly the group V clustering of fifty percent of the total sample, indicate that there is validity to the theory that like personalities will gravitate to like occupations in seeking gratification of their needs. There does not seem to be enough of a grouping, however, to justify the development or application of a single, simplified management technique based upon this theory. The diversity of the individuals involved in the remaining groups is simply too great to permit such an undertaking. The manager's technique would be appropriate in only 50% of the cases.

In support of the more general Theory X and Theory Y human behavioral patterns, those who composed groups I, II, III and V would probably function best under management based upon Theory Y, while those who composed groups IV, VI and VII might require management techniques based upon Theory X. It appears that a generalization concerning even these broad bases for managerial decisions cannot be made, for personnel supportive of both were clearly present within the population tested.

The manager in a research and development environment should not attempt to apply a general across-the-board management technique. In short, the elements that motivate one employee may have little appeal to the next. All workers, however, have something they want, or fear **losing**, which will motivate them to work.[26]

CHAPTER III.

CONCLUSIONS AND RECOMMENDATIONS

This study, while not definitive, has shown that there exists within current management literature and thought a stereotypic image concerning the characteristics of scientists and engineers. Further, a study of the behavioral patterns of 38 scientists and engineers who worked at a Government Laboratory lends credence to the existence of a stereotype. In this study fully half of the participants displayed the same behavioral pattern. An equally noteworthy observation concerning the data was the similarity of distribution of behavior patterns exhibited by the two, randomly selected, independent groups, (see Table I) and the fact that two of the nine possible behavioral patterns received no representation.

Difficulty was encountered during the collection of the data due to the inability of those involved to classify themselves as either scientists or engineers. Several subjects felt their educational background was that of a scientist while their occupation was that of an engineer. Only one individual felt the reverse was true. Therefore, no attempt was made to separate scientists and engineers. However, it should be noted that while there is a general stereotype that distinguishes scientists and engineers collectively from the population of workers as a whole, both the literature - most noteably Pelz and Andrews - and the managers interviewed took pains to point out that scientists and engineers differed from each other as groups as well. Although this fact is noted and is considered an item of significant interest, no attempt was made in this study to identify the differences

due to the time constraints. This issue is a prime candidate for future study.

It is noted that there does appear to be validity in the theory that similar behavioral types tend to gravitate to occupations conducive to the gratification of their similar needs. The 19 individuals who represented behavioral pattern V substantiate this. However, for those who are or will become the managers of scientists and engineers it is wise to recall that there is wide variation in the nature of the behavioral patterns of the remaining half of the individuals tested. This diversity of behavioral patterns precludes the use of a single management style for dealing with scientists and engineers.

Following the thought developed above, it is noted that the assumptions of human behavior first identified by McGregor, Theory X and Theory Y, are extremely useful in an academic sense for examining the basis of specific managerial decisions. Managers should not, however, develop a style of management based upon either Theory X or Y assumptions exclusively, for their subordinates will, in all likelihood, be individuals who respond in manners characteristic of each set of assumptions. In practice it is necessary to know each person's desires, and to develop a management style on a one-to-one basis.

Considerable latitude is shown by the authors who have written on topics relating to the characteristics of research and engineering personnel. Students of this topic and/or active managers must exercise care in their choice of doctrine due to the variety and strength of personalities involved in the research and engineering field. A program manager would be

well advised to proceed with caution. The necessity for understanding the individuals with whom one deals, as well as the total environment, is evident. However, as managers are people too, and therefore have personalities of their own, this may become very difficult for those who are not people conscious by nature. Mortimer Feinberg offers several general Dos and Don'ts for managers.[27] They are presented here as an adjunct to the main theme of this paper.

Do's:

1. Know your standards and communicate them, and be consistent.
2. Be aware of your biases and prejudices towards people so that they do not interfere with your evaluation of performances.
3. Let people know where they stand.
4. Give praise when it is appropriate.
5. Keep your employees informed of changes which may affect them.
6. Care about your employees.
7. Perceive people as ends not means.
8. Go out of your way to help.
9. Take responsibility for others.
10. Build independence.
11. Exhibit personal diligence.
12. Be tactful with your employees.
13. Be willing to learn from others.
14. Stay flexible.
15. Demonstrate confidence.
16. Allow freedom of expression.
17. Delegate.
18. Encourage ingenuity.

Don't:

1. Belittle a subordinate.
2. Criticize a subordinate in front of others.
3. Fail to give your subordinates your adequate attention, at least occasionally.
4. Allow your subordinates to think that you are primarily concerned about your own interests.
5. Play favorites.
6. Fail to help your subordinates grow - when they are deserving.
7. Be insensitive to small things.
8. Show up employees.
9. Lower your personal standards.
10. Vacillate in making a decision.[26]

34

Finally, the diversity among that portion of the sample that did not fall within behavioral pattern V, warrants further study. Additionally, similar studies are recommended to ascertain the characteristics of those who aspire to, or have, become Project Managers within the Department of Defense. Such studies may prove valuable in identifying the characteristics most often present in successful Program Managers.

BIBLIOGRAPHY

1. Herzberg, Frederick; Mausner, Bernard; and Snyderman, Barbara Black, The Motivation to Work, New York. John Wiley & Sons, Inc. 1959.

2. McGregor, Douglas, The Human Side of Enterprise, New York. McGraw-Hill Book Company, Inc. 1960. p. 33.

3. Carvell, Fred J., Human Relations in Business, London: The MacMillan Company, Collier-MacMillan Limited, 1970. p. 206.

4. Maslow, A.H., Motivation and Personality, New York: Harper & Row, 1954.

5. Ibid, p. 68-69.

6. Ibid, p. 33.

7. Feinberg, Mortimer, R., PhD., Effective Psychology for Managers, Englewood Cliffs, N.J. Prentice Hall, Inc. 1966, p. 124.

8. Ibid, p. 128.

9. Ibid, p. 131.

10. Raudsepp, Eugene, Managing Creative Scientists and Engineers, New York. The MacMillan Company, 1963. p. 33.24.33.33.

11. Wallen, Richard W., "Unlocking Human Creativity" Machine Design, Vol. 6, March 20, 1958, pp. 132-138.

12. Danielson, Lee E., Characteristics of Engineers and Scientists, Ann Arbor, Michigan, The University of Michigan, 1960, p. 7.

13. Pelz, Donald C., and Andrews, Frank M., Scientists in Organizations: Productive Climates for Research and Development, New York. John Wiley and Sons, Inc. 1966.

14. Lloyd, John T. and Gray, Robert D., Supervision of Scientific and Engineering Personnel, Pasadena, California: Institute of Technology, 1956. p. 76.

15. Brown, Alvin E., <u>Managements Role in the Retention of Engineers in the Air Force</u>, Maxwell AFB, Alabama. 1969. p. 73.

16. Ibid, p. 65.

17. Donelly, Norbert E., Mahen, Thomas We., Jr., and McManus, Leo F., Jr., <u>Self-Description: A Technical Manual</u>, Princeton, N.J., J.P. Cleaver Company, 1965. p. 1.

18. American Psychological Association, "Technical Recommendations for Psychological Tests and Diagnostic Techniques." Washington, D.C.: American Psychological Association, 1954.

19. Marston, W., <u>Emotions of Normal People</u>. New York, Harcourt Brace and Co. 1928.

20. Maslow, Abraham H., "Motivation and Personality", New York, Harpers, 1954.

21. Super, Donald E., "The Psychology of Careers", New York, Harpers, 1957.

22. Cleaver Co., J.P., <u>Evaluation Techniques</u>, Princeton, N. J., J. P. Cleaver Company, 1959.

23. Flanagan, James, <u>Factor Analysis in the Study of Personality</u>, Palo Alto, California. Stanford University Press, 1935.

24. Bernreuter, Robert G., "The Theory and Construction of the Personality Inventory", Journal of Social Psychology, 1933. Vol. 4, p. 387-405.

25. Carter, Lief, "Evaluating the Performance of Individuals as Members of Small Groups", Personnel Psychology, 1954, Vol. 7, p. 477-484 (From 16).

26. Ibid (3) p. 207.

27. Ibid (6) p. 136.