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AFIT/GCM/LSR/88S-2

WORK ATTITUDES OF

SCIENTISTS AND ENGINEERS IN AFLC

THESIS

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THESIS

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Acknowledgments

The battle is finally over and the war has been won. First, I want to thank my wife, Linda, for her support and understanding, for being there at times when I needed her support, and for coping with all those lonely nights and weekends during the past fifteen months. At times when I thought I could do no more, she gave me the strength and encouragement to go on. Next, I would like to tell my two sons, Patrick and Christopher, that now I will be able to spend some "quality time" with them, and thank them for coping with their "grouchy" dad. Finally, I would like to thank Lt Col James Lindsey for his guidance and understanding, and for "turning on a few lights" during my worst burn-out. Lt Col Lindsey gave me the idea, pointed me in the right direction, and never let me wander off the path, and for that I say "Thank You."

-- John T. Breed, Jr.

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Abstract

This research focused on identifying the demographic characteristics and current work attitudes of the civilian scientists and engineers in AFLC. The research was done at the request of the AFLC's Chief Scientist and Engineer.

A 106-question survey was administered to each of the scientists and engineers in AFLC with the objective of measuring such job related areas as job satisfaction, future work plans, job involvement, and professional continuing education (PCE).

Statistical analyses were performed to determine if there were significant differences between scientists and engineers in AFLC.

WORK ATTITUDES OF
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I. Introduction

Research Issue

AFLC has approximately 4200 scientists and engineers it its work force. AFLC's chief scientist and engineer plans to implement a civilian career enhancement program that will allow AFLC to program education and training to help the scientific and engineering work force stay current in their chosen career fields. Before the plan can be implemented, the general characteristics of the scientific and engineering population must be determined. This research effort will investigate the current work attitudes of the civil service scientists and engineers employed by AFLC at the headquarters level and the Air Logistics Centers (ALCs) around the country. Specifically, this research effort will focus on the demographics of the AFLC scientists and engineering population, and other related job related items such as job satisfaction, future work plans, organizational information, work goals, job feedback, job autonomy, and on the opportunities and limitations of professional continuing education.

The research is expected to enhance AFLCs ability to structure appropriate personnel policies in order to improve the motivation and productivity of the current scientific and engineering work force. Scientists and engineers are highly trained individuals. In AFLC, as in other government bureaucracies, scientists and engineers are expected to perform specialized functions within organizations that have high vertical, multi-layered organizational structures.

<u>Background</u>

The Air Force Logistics Command (AFLC) has the primary duty of supporting operational systems throughout the operational life of each system. In addition, AFLC has the responsibility to establish technical support systems for newly developed production items. Since massive amounts of new technology usually accompany the introduction into the inventory of these highly specialized weapon systems, the workload of the scientific and engineering functions within the organization usually increases.

The military and defense industries are among the leading consumers of advanced technology and have a large demand for scientific and engineering personnel. The rapid growth and expansion of weapon systems using advanced technologies places a burden on the Department of Defense (DOD) to recruit new scientists and engineers. This burden is especially heavy in the areas of research and development of new weapons and in finding practical applications for new technologies. The Commander of Air Force Systems Command (AFSC), General Robert T. Marsh, said:

> I rely daily on highly qualified scientists and engineers to make tough technical decisions dealing with the acquisition of the most complex, sophisticated capable systems in the world. Unfortunately, I do not have all the technically qualified and experienced people I need. This shortage hampers the ability of my command to fulfill its mission, and worse, endangers the economic health and defense capability of the country (Marsh, 1982:25).

Unfortunately, the number of scientific and engineering graduates is expected to decline over the next several years. Three reasons are given for this unfavorable situation: ill-prepared and unmotivated high school students that are ill-equipped to pursue highly technical courses of study; a lack of trained faculty to teach the requisite scientific and engineering courses; and lack of adequately equipped training and teaching facilities for scientific and engineering students (Marsh, 1982:26).

Since the national security of this country has become increasingly dependent on our ability to maintain clearly superior weapon systems able to counter any threats posed by a hostile power, the DOD must find a way to compete with private industry for the skilled manpower with scientific and engineering degrees that are about to come on the job market (Carlucci, 1983:13). Without the experienced technical expertise needed to operate the sophisticated systems of today, and without the technically qualified personnel to keep the equipment in good repair, even the most well designed and cost effective weapon system program is useless (Carlucci, 1983:13). Therefore, the DOD must find a way to recruit competent young scientists and engineers into the government work force, to retain the technical expertise already committed to government service, and postpone the retirement of at least some of our more experienced personnel.

After a young man or woman receives a scientific or engineering degree, the new graduate usually has high expectations about the first job and associated starting salary. Since the federal government is often perceived as less attractive than the civilian defense industry, the federal government is often the loser in the competition with the civilian sector for this skilled manpower (Carlucci, 1983:16). The federal government appears to have two options. First, it can hire the raw inexperienced scientists and engineers directly after graduation from college, and provide these individuals with on the job training in the areas of design, production, and research. Second, it can recruit experienced scientists and engineers by offering them competitive salaries and the opportunity to obtain advanced degrees while working with the government. In either case, the DOD must find a way to recruit these technically trained individuals to ensure that the Armed Forces have the dedicated and professional people needed to carry on the effort of keeping the peace.

Retention of scientific and engineering specialists is an area of concern. The DOD spends large amounts of resources insuring that the pool of scientists and engineers in the work force gains the necessary experience needed to perform required specialized functions. Private industry knows this fact and is constantly trying to hire the scientific and engineering personnel away from the federal government.

Retirement is a natural phenomenon which will occur in every person's life. Most of the people who are retirement age have accumulated a great deal of specialized knowledge and practical experience, and have built up a good working relationship with their peers. Employees who have reached retirement age may be located in strategic positions within an organization. The DOD should take advantage of the many years of experience these individuals have gathered, and find a way to transfer their valuable information to the younger employees in the organization. If this can be accomplished, an organization will not lose its valuable knowledge when an individual does finally retire.

The period of time between scientific discovery and application of the new knowledge to present and future defense systems can be quite lengthy. The true measure of the successful applications of such knowledge may not be readily apparent for several decades. Given the long lead time and critical role of technology in defense, America's future is in the hands of its present scientific and engineering personnel and it cannot, when the moment of truth arrives, afford to be found wanting (Weinberger, 1983:2). AFLC is a major contributor toward America's future. To meet the challenge, the command is attempting to focus its efforts to attract and retain the highly qualified and motivated scientists and engineers needed at all levels within the organization.

The next chapter will provide a review of literature relevant to the recruitment and retention of scientific and engineering personnel in a variety of organizations.

II. Literature Review

Introduction

Smith and Jones have noted the importance of a new employee's beginning in an organization.

> Launched on the right trajectory, the person is likely to accumulate successes that strengthen the effectiveness of his orientation toward the world while at the same time he acquires the knowledge and skills that make his further success more probable....Off to a bad start, on the other hand, he soon encounters failure that make him hesitant to try....And he falls increasingly behind his fellows in acquiring knowledge and skills that are needed for success on those occasions when he does try (Smith and Jones, 1968: 272).

A relationship exists between what an organization expects from its employees and what the employees want in return from their organization. Most organizations need to be assured that they are receiving a certain quantity and quality of employee participation, and the employees want assurance that they will be able to satisfy personal needs and goals. Thus a linkage exists between the two parties and both agree to some compromise situation in which both the organizational and personal needs and goals are attainable (Steers and Porter, 1983:425).

Scientists and engineers have a strong need to do highly professional, challenging and very technical work (Sherman, 1984:22). It has been suggested that scientists and engineers need to work in an environment that will let them believe they are accomplishing tasks that are important and have a significant impact on organizational goals, and receive recognition from supervisors for significant accomplishments (Sherman, 1984:22).

This literature review will investigate the literature on job and work related attitudes, specifically focusing on studies relating to scientists and engineers in the areas of organizational commitment, turnover, job characteristics, task complexity, job design, goal setting, work goal clarity, goal difficulty, stress, job involvement, job satisfaction, retirement intentions, professional continuing education, and the use of dual path career options for scientists and engineers.

Organizational Commitment

An individual brings to an organization certain basic desires, needs, abilities, skills, and knowledge (Mowday et al., 1982:27). In return, individuals expect to find a suitable work environment where they can use their knowledge and skill, and still satisfy their basic needs and desires. When an individual finds a suitable work environment, they are more committed to that organization than they would be if their desires and needs had not be fulfilled (Mowday et al. ,1982:27).

Mowday, Porter, and Steers (1982) concluded that the meaning of organizational commitment is varied and found ten individual definitions of that single term. They stated that Porter and Smith gave perhaps the most comprehensive definition of organizational commitment, defining organizational commitment as:

> The relative strength of an individuals identification with and involvement in a particular organization. Conceptually, it can be characterized by at lease three factors: (a) a strong belief in and acceptance of the organization's goals and values; (b) a willingness to exert considerable effort on behalf of the organization; and (c) a strong desire to maintain membership in the organization (Mowday et al., 1982: 27].

Mowday, Steers, and Porter (1979) developed a survey instrument that gave researchers a valid and reliable tool to measure the nature and consequences of organizational commitment. The instrument, Organizational Commitment Questionnaire (OCQ), has been used 15 items to investigate the three aspects of organizational commitment defined above. To determine the internal consistency and reliability of the instrument, the OCQ was administered to 2563 employees with various jobs in nine different organizations. Among these employees were 119 scientists and engineers employed by several research laboratories. The means, standard deviations, and reliabilities for the OCQ are shown below in Table 1.

Table 1

Means, Standard Deviations, and Internal Consistencies for the OCQ

	N	Mean	SD	Coefficient Alpha
Public Employees	569	4.5	.90	.90
Classified University Employees (*)	243	4.6	1.30	.90
Hospital Employees (*)	382	5.1	1.18	.88
Bank Employees	411	5.2	1.07	.88
Telephone Company Employees	605	4.7	1.20	.90
Scientists and Engineers (*)	119	4.4	.98	.84
Auto Company Managers	115	5.3	1.05	.90
Psychiatric Technicians	60	4.0/3.5 4.3/3.5 4.3/3.3 4.0/3.0	1.00/1.00 1.10/0.91 0.96/0.88 1.10/0.98	.82-.93
Retail Management Trainees	59	6.1	.64	N/A

(*) A nine item shortened version of the OCQ was used in these studies.

Source: Adapted from Mowday, Steers, and Porter (1979:232)

The study also found that each one of the 15 items had a positive correlation with the total score for the OCQ, with an average correlation ranging from .36 to .72, and a median correlation of .64. Scientists and engineers were rated on the nine positively worded questions, and the range of correlation was from .35 to .67. The results of the research demonstrated strong evidence for the predictive validity of the OCQ in measuring organization commitment (Mowday et al., 1979:232).

Previous research performed on organizational commitment have dealt with variables that are empirically related to commitment, and many of these research studies are correlational in nature. Some of the variables included in these studies are:

1. Age and Tenure
2. Educational Level
3. Gender
4. Turnover
5. Job Characteristics
   a. Variety
   b. Autonomy
   c. Task Identity
   d. Feedback

General Organizational Commitment and Age/Tenure. In a test of the Mobley, Griffeth, Hand, and Meglino Model of organizational commitment, Michaels and Spector (1982) found age and tenure to be significantly related to commitment. The sample data were obtained from 112 employees of a mental health center. Michaels and Spector found that age (r = .28, $p < .05$) and tenure (r = .15, $p < .05$) were significantly and positively correlated with commitment (Michaels and Spector, 1982:56).

Steers and Spencer (1977) also reported similar findings. They sampled 115 managers of manufacturing firms and found age and tenure to be significantly correlated to commitment: age (r = .20, $p < .01$), and tenure (r = .16, $p < .01$) (Steers and Spencer, 1977:475).

Another study, by Graddick and Farr (1983), sampled 1254 research scientists, and found similar correlational results between commitment and age (r = .26, $p < .01$) and tenure(r = .11, $p < .01$). It should be noted that these scientists had negative connotations about government jobs. Graddick and Farr performed regression analysis using organizational commitment as a dependent variable and found that individuals who were highly committed to the organization were less likely to work in government jobs (r = -.09 , $p < .01$) (Graddick and Farr, 1983:642-644).

On the other hand, other studies have shown that age and tenure are not significant correlates of organizational commitment. Steers (1977) surveyed two diverse samples of employees in separate organizations. The first sample consisted of 382 hospital employees, and the second sample consisted of 119 scientists and engineers. Steer's results showed that age and tenure were significantly related to commitment for the hospital employees, but was not significantly related to commitment for the scientists and engineers. The study revealed that as the age and tenure of an individual in an organization increases, individuals were more content to remain with the organization because of limited chances of other alternate employment (Steers, 1977: 52-54).

<u>General Organizational Commitment and Education</u>. Steers and Spencer (1977) sampled 115 managers of manufacturing firms. The data revealed that a majority of those sampled had college degrees and some had advanced degrees. The research concluded that education was found to be inversely related to commitment ($r = -.20$, $p < .05$) (Steers and Spencer, 1977:474-475).

Steers (1977) found a similar pattern in a study of scientists and engineers. Educational levels ranged from bachelor's through doctoral degrees. The scientists and engineers were engaged in both basic and research projects. The results of the multiple regression analysis of education on commitment revealed a beta of -.24 and an F of 11.04 at a significance level of .001 (Steers,1977:52).

The inverse relationship between commitment and education may result from the fact that more highly educated individuals have higher expectations that the organization may be unable to meet. Also, scientists and engineers have been characterized as being more committed toward the profession than toward the organization (Mowday et al., 1982:30).

General Organizational Commitment and Gender. Few studies have examined the sex differences in organizational commitment. Graddick and Farr (1983) researched the question "are women involved in their jobs and committed to the organization to the same extent as their male colleagues?" In examining the responses from 887 scientists, 51 percent of which were males and 49 percent were females, men were found to be more committed to the organization than were women in the sample (Graddick and Farr, 1983:644). "This suggests that females still bear the greater burden of both job and family concerns" (Graddick and Farr, 1983:644). The overall results indicated that professionals are less committed to any given organization and are more committed to their profession. (Graddick and Farr, 1983:644).

General Organizational Commitment and Turnover Research. An individual who strongly identifies with the organization and its goals will exert a high level of group maintenance effort to help maintain the organization, and will be more likely to remain with the organization. Whereas an individual who is unhappy and disillusioned with the organization or dissatisfied with organizational goals or work, is more likely to leave the organization (Blau and Boal, 1987:294).

Porter, Crampon, and Smith (1976) concluded that although people sever ties with the organization when they terminate, they may not necessarily relinquish a set of job duties since they may assume them in some other job in another organization. (Porter and others, 1976:88).

From a sample of 212 management trainees, Porter, Crampon, and Smith (1976) also concluded that commitment for stayers and leavers on the first day of employment differed significantly from one another ($t = 2.30$, $p < .025$), and commitment for stayers and leavers differed significantly from one another during the last two months of employment ($p = 2.93$, $p < .005$). The study showed a decline in commitment just prior to actually leaving the organization. (Porter et al., 1976:94). Another important finding from the study is that:

> ...when a marked decline in commitment starts to occur, it is likely (though obviously *not* invariable) signaling a voluntary termination in the near future (Porter et al., 1976:96).

Porter, Steers, Mowday, and Boulian (1974) concluded that commitment was clearly the most important variable in determining stayers and leavers. This study investigated organizational commitment across time as related to psychiatric technicians. Porter et al concluded that:

> The results clearly indicate that the attitudes held by an individual are predictive of subsequent turnover behavior, with individuals who ultimately leave the organization having less favorable attitudes than individuals who stay. Patterns of attitudes across time suggest that this inverse relationship between favorable attitudes and turnover is stronger as individuals approach the point at which they leave the organization [Porter et al., 1974:607).

In another study, Mowday, Koberg, and McArthur (1981) sampled hospital employees and clerical personnel. Inter-correlations among the study variables indicated that organizational commitment was significantly and inversely related to desire to leave ($r = -.52$, $p < .01$) and intention to search ($r = -.55$, $p < .01$); however, organizational commitment was significantly and positively related to intention to stay ($r = .26$, $p < .01$) (Mowday et al., 1981:87).

Steers (1977) found in a study of scientists and engineers that organizational commitment was significantly and positively related to intent to remain ($r = .38$, $p < .001$) and desire to remain ($r = .36$, $p < .001$) (Steers, 1977:52).

General Organizational Commitment and Job Characteristics. An individual is more likely to contribute more effectively to organizational goals and be more committed if he/she is placed in a job that has specifically defined goals, high autonomy, variety, and feedback mechanisms that are built into the job (Hackman and Lawler, 1971:284).

Steers and Spencer (1977) found organizational commitment to be significantly related to specific aspects of job characteristics: variety ($r = .15$, $p < .01$); autonomy ($r = .32$, $p < .01$); task identity ($r = .25$, $p < .01$); and feedback ($r = .39$, $p < .01$) (Steers and Spencer, 1977:476).

Steers (1977) in a study of scientists and engineers reports similar findings. He found that commitment was significantly related to job characteristics for two diverse samples: hospital employees ($r = .64$, $p < .001$); and research scientists and engineers ($r = .38$, $p < .01$) (Steers, 1977:51).

Turnover

James Price (1977) describes turnover as "the degree of individual movement across the membership boundary of a social system" (Price, 1977:5). Price further explains the definition by outlining three criteria for determining what constitutes membership:

> 1. An individual may be considered a member of a social system if the person defines himself or herself as a member of the system.
>
> 2. There is the criterion of frequency of interaction. The boundary of a social system may be determined by the frequency with which individuals interact with each other. Individuals who interact with each other a great deal are within the boundary. Whereas individuals who interact less often are outside the boundary.
>
> 3. Membership may be determined by whether or not an individual is subject to the official sanction at the disposal of the system. If an individual is subject to the official sanction, the person is considered a member of the system (Price, 1977:5).

Price (1977) distinguishes two types of turnover: voluntary and involuntary. He defines voluntary turnover as an "individual movement across the membership boundary of a social system which is initiated by the individual -

quits or resigns" (Price, 1977:9). Also, Price defines involuntary turnover as the "movement not initiated by the individual - dismissals, layoffs, retirements, and deaths" (Price, 1977:9).

Much of the past research on turnover area focused on the correlates of turnover. Some of these correlates of turnover are:

1. Age
2. Tenure
3. Education
4. Organizational Commitment
5. Job Satisfaction
6. Behavioral Intentions
7. Job Involvement
8. Job Performance

The following paragraphs summarize the literature for each of these variables.

Turnover and Age. In a multivariate analysis of the determinants of job turnover, Arnold and Feldman (1982) found turnover to be significantly influenced by an increase in age ($r = -.22$, $p < .001$) (Arnold and Feldman, 1982:354). Their study indicates that age is significantly related to intention to search for alternatives. The older the employee, the less likely that employee will search for a new job (Arnold and Feldman, 1982:359).

Farris' (1971) research on turnover investigated engineers from two different organizational settings: an electronic firm (organization A), and a pharmaceutical company (organization B). In both organizations, turnover tended to be associated with the younger employees. In organization A, there was a slight tendency for turnover to occur more frequently for those individuals who were better educated. Younger individuals have more opportunities to find other suitable employment than do older ones, especially in the engineering career field (Farris, 1971:320).

Turnover and Tenure. Porter and Steers (1973) summarized the findings of numerous studies on the relationship of increased tenure and turnover (Fleishman and Berniger (1960), Shott et al (1963), Knowles (1964), and Robinson (1972)). They concluded from the previous research that a negative relationship existed between turnover and increased tenure (Porter and Steers, 1973: 168). Porter and Steers state that "increased tenure appears to be strongly related to propensity to remain, and that increases in tenure result in increases in personal investment on the part of the employee in the organization (i.e., after a while, he may not be able to afford to quit)" (Porter and Steers, 1973:167). When an employee remains in the same organization over a period of time, he/she perceives that their investment of time and effort is worthwhile; however, when he/she perceives that they are notreceiving a fair return on their investment, they often seek employment elsewhere (Porter and Steers, 1973: 170-171).

Farris (1971) indicated that scientists and engineers who were early in their career development were more likely to leave the organization because they believed that a change would be more apt to enhance their career development (Farris, 1971:322).

Turnover and Education. Mobley, Griffeth, Hand, and Meglino (1979), in their review of past research involving the relationship between education and turnover, concluded that not enough actual studies had been done to provide an adequate evaluation of the role that education plays in predicting turnover. Most of the studies predicted only a slight positive relationship and found these relationships to be non-significant (Mobley et al., 1979:497).

Turnover and Job Satisfaction. Porter, Steers, Mowday, and Boulian (1974) studied two groups of psychiatric technician trainees employed at a major West coast hospital. The sample group was divided into stayers and leavers. The analysis examined the relationship between turnover and the following set of satisfaction variables over four periods of time: satisfaction with supervision; satisfaction with the work itself; satisfaction with opportunities for promotion; and satisfaction with the co-workers. The results indicate that the strongest relationship between turnover and the satisfaction variables is strongest at points in time closest to when the individual terminates (the latter two periods). As the individual becomes more and more dissatisfied, the relationship between turnover and job satisfaction is significantly and positively related (Porter et al., 1974:606).

Mobley, Horner, and Hollingsworth (1978) collected survey data from 203 hospital employees. They reported that the correlation between overall job satisfaction and intention to search was significantly and inversely related ($r = -.21$, $p < .01$). They also reported that the correlation between overall job satisfaction and thinking of quitting was significantly and inversely related ($r = -.54$, $p < .01$) (Mobley et al., 1978:412). This research indicates that if an individual is satisfied with his or her job, he/she would be less likely to quit that job and search for alternatives. However, if an individual becomes somewhat dissatisfied with his or her work, he/she would be more likely to think about finding a different job and possibly start to search for different job alternatives (Mobley et al., 1978:412-413).

Cotton and Tuttle (1986) found that overall job satisfaction appears to be a better predictor of turnover for professional employees than for non-professional employees (blue collar) (Cotton and Tuttle, 1986:61-63).

Price and Mueller (1981) found seven moderating variables that have an indirect impact on turnover through job satisfaction. The seven variables are:

1. Repetitive work (routinization)
2. Participating in job related decisions (participation)
3. Being informed about job related issues (instrumental communication)
4. Having close friends employed by the same organization (integration)
5. Receiving good pay (pay)
6. Being fairly compensated (distributive justice)
7. Having an opportunity to obtain a better job in the organization (opportunity) (Price and Mueller, 1981:543-545).

Routinization is the only one of the moderating variables that decreases job satisfaction. Routinization, instrumental communication, promotional opportunity, and participation in decision making all have a statistically significant positive influence on turnover (Price and Meuller, 1981:545).

Turnover and Behavioral Intention. According to Mobley (1977), the relationship between job satisfaction and employee turnover has been consistently negative, but the relationship has never been particularly strong. Mobley suggests that after an employee has experienced job dissatisfaction that their next intention toward the organization would be to quit the job. Mobley described the turnover process as a number of intermediate steps between dissatisfaction and actually quitting the job. The steps are presented in order of occurrence as:

A. Evaluation of existing job
B. Experienced job satisfaction or dissatisfaction
C. Thinking of quitting
D. Evaluation of expected utility of search and cost of quitting
E. Intention to search for alternatives
F. Search for alternatives
G. Evaluation of alternatives
H. Comparison of alternatives vs. present job
I. Intention to quit/stay
J. Quit/stay (Mobley, 1977:238).

An individual will determine if he/she is happy with their job by evaluating that job. Upon evaluation, an individual will either experience some level of job satisfaction or some level of job dissatisfaction. If an individual experiences some level of job dissatisfaction in his/her job, they may think about changing jobs. If this occurs, an individual would estimate the chances of finding an alternative to his/her present job, perform some evaluation of the desirability of the alternatives, and estimate the cost of these alternatives (in terms of travel time to and from work, lost work time in searching, etc.). When an individual has become so dissatisfied with his/her present job, he or she experiences an urge to search for new alternatives to that job environment. If an individual finds some interesting and available alternatives, the individual will often evaluate those available alternatives that really appeal to them. If these alternatives compare favorably to their present job, an individual may actually be stimulated to quit his/her job. Once this stage is reached, an individual will then begin to withdraw from his/her present job and move to the more favorable alternative (Mobley, 1977:237-239).

Mowday, Koherg, and McAuthur (1984) reviewed Mobley's (1977) study and concluded, using their own research, that job attitudes actually stimulate withdrawal thoughts and are directly related to eventual turnover. They found that intent to stay was the best predictor of turnover (two samples: $r = -.17$, $p < .01$, and $r = -.32$, $p < .01$) (Mowday et al., 1984:87-88).

Kraut (1975) investigated the job attitudes and intention to remain for 911 salesmen. His results indicate that intent to remain is highly correlated with satisfaction with the work itself ($r = -.34$, $p < .01$) and evaluation of the company as a good place to work ($r = .31$, $p < .01$). Kraut concluded that an employee's intent to remain with an organization is a powerful predictor of the individuals later turnover tendencies (Kraut, 1975:240).

In summary, these studies clearly show that turnover behavior is a function of organizational characteristics. If an organization desires to reduce its turnover rate, then one strategy would be to modify those characteristics most likely to contribute to turnover.

Turnover and Job Involvement. Blau and Boal (1987) define job involvement as "the extent to which the individual identifies psychologically with his/her own job"

(Blau and Boal, 1987:290). Their study concluded that individuals who have high levels of job involvement and organizational commitment were likely to leave the organization when they (1) became unhappy with the organization, (2) felt dissatisfied with their work, or (3) felt that their talents were not being utilized to the maximum extent possible. On the other hand, they found that individuals with low job involvement and organizational commitment were likely to leave their present organization for any number of reasons because this group was low on commitment to their specialized role skills and low on loyalty to their employing organization (Blau and Boal, 1987:293-297).

Farris (1971) found in a study of scientists and engineers that a person's involvement in his/her work was negatively related to turnover. He reported that individuals who were less involved with their jobs were more likely to leave an organization that expected them to perform that particular job (Farris, 1971:314).

Lee and Mowday (1987) found that individuals who were involved with their work and with their organizational goals were less likely to seek employment elsewhere, regardless of the available alternatives (Lee and Mowday, 1987:734-735).

Turnover and Job Characteristics. Steers and Spencer (1977) examined the effect of job scope on 115 managers of manufacturing firms and found that jobs containing more variety, autonomy, feedback, and identity reduced turnover. They concluded that changes in job design do have practical applications for the management of organizations. The extent to which organizations provide these types of jobs increase the likelihood that individuals will develop increased attachments to these organizations (Steers and Spencer, 1977:477).

Farris (1971), in a study of scientists and engineers, found that turnover was negatively associated with the degree to which an individual could influence decisions concerning his/her work goals. He concluded that a scientist or engineer will more likely remain in an organization with a stimulating environment than in one in which he/she has no control over the work goals (Farris, 1971:316).

Porter and Steers (1973) concluded that individuals enter an organization with certain levels of expectations concerning the degree of autonomy that should be present in their work. They found however that leavers experienced significantly less autonomy in their jobs than did stayers (Porter and Steers, 1973:163).

Sherman (1984) suggests several dimensions that are essential to the motivation of scientists and engineers:

1. A reward system related to the attainment of specific objectives;
2. Emphasis given to the individual's performance rather than that of the group;

3. A goal setting procedure that enables each individual to participate in the setting of his own quantified goals in accordance with those of the organization; and

4. Rapid feedback on performance and immediate rewards for successful task fulfillment and relative independence for the individuals from other segments of the organization (Sherman, 1984:17).

Job Characteristics

The recent shift in technological innovations and the growing concerns about technological obsolescence have placed the engineering profession in the spotlight and have brought the engineers performance into focus as a central issue for organizational effectiveness. Kozlowski and Hultz (1986) reported that:

> ... An engineer wanted work that allowed them to explore new technologies, tackle complex technical problems, and be associated with projects stretching their capabilities. Work that provided little opportunity for skill use, learning, creativity, discretion, responsibility, and participation was regarded as demotivating and dissatisfying (Kozlowski and Hultz, 1986:196).

Hackman and Oldham (1975) identified five measurable characteristics of jobs that if present will improve employee motivation, satisfaction, and performance. These characteristics are:

1. Skill variety - the degree to which a job requires a variety of different activities in carrying out the work, which improve the use of a number of different skills and talents of the employee;

2. Task identity - the degree to which the job requires completion of a "whole" and identifiable piece of work - that is, doing a job from beginning to end with a visible outcome;

3. Task significance - the degree to which the job has substantial impact on the lives or work of other people - whether in the immediate organization or in the external environment;

> 4. Autonomy - the degree to which the job provides substantial freedom, independence, and discretion to the employee in scheduling the work and in determining the procedures to be used in carrying it out; and
>
> 5. Feedback - the degree to which carrying out the work activities required by the job results in the employee obtaining direct and clear information about the effectiveness of his or her performance (Hackman and Oldham, 1975:161-162).

Hackman and Lawler (1971) surveyed 208 telephone employees, and found a positive relationship between job characteristics and job satisfaction indicating that the employees had strong higher order need satisfaction. They concluded that when strong higher order need was present, employees felt pressure to take personal responsibility for their work and perform higher work. In fact when jobs are described as high in variety, autonomy, and task identity, employees are rated as doing higher quality work and generally are more effective performers on the job (Hackman and Lawler, 1971:271-273).

In a study of the relationship between job characteristics and job satisfaction, Loher, Noe, Moeller, and Fitzgerald (1985) found the correlation between the two to be .39 . They also investigated the specific relationship between each of the task characteristics and job satisfaction and found a .32 correlation between task identity and job satisfaction, a .38 correlation between task significance and job satisfaction, a .46 correlation between autonomy and job satisfaction, a .41 correlation between feedback and job satisfaction, and a .41

correlation between skill variety and job satisfaction. All of the above Pearson's r-values were significant at $p < .025$. They concluded that the evidence presented offered support that job satisfaction should be increased through enhanced job characteristics (Noe et al., 1985: 286-287).

Stevens and Krochmal (1977) identified some measures of job characteristics which produce positive affects for engineers:

1. Moving forward on projects when he feels it is appropriate, having and maintaining control;
2. Being able to measure his own progress;
3. Having to keep in close tough only with project's progress (that affects him);
4. Communication that is brief and to the point, practical, and somewhat pragmatic;
5. Practical work; and
6. Personal goals, in specific project goals (Stevens and Krochmal, 1977:479).

Task Complexity

Engineers like to feel that they are personally responsible for a meaningful portion of their work, and that they can accomplish their work using their own skills and techniques. They like meaningful feedback. They enjoy very challenging and moderately risky jobs. A routine and uncreative job fatigues the typical engineer. Frustration stifles engineers, and they typically have a hard time adjusting to or understanding others who are not as motivated as themselves (Stevens, 1977:476).

Kozlowski and Hults (1986) examined the engineering performance of 483 engineers. They reported that routine, tightly controlled, and uncreative jobs typically serve to limit the performance of engineers, and that engineers assigned to less complex tasks have typically experienced the lowest levels of job performance. They concluded that perceived task complexity was more important and relevant to engineers in Research and Development (R & D), and the engineer's complexity-performance relationship was very sensitive to time on the job (position tenure). In other words, engineers in R & D work are more sensitive to how they perceive job complexity in their tasks and will become more responsive to that complexity over time. On the other hand, staff engineers are more sensitive to the power, authority, and organizational influence available in their jobs (Kozlowski and Hults, 1986:196-197).

Job Design

According to Umstot, Bell, and Mitchell (1976), job design refers to:

> ... The deliberate, purposeful planning of the job, including any or all of its structural or social aspects. Two major approaches to job design that can be identified are the job enrichment approach - which attempts to make the job more interesting, challenging, and significant by adding dimensions such as variety, autonomy, feedback, and control - and a job engineering approach - which attempts to make jobs more efficient by improving work methods, tools, and task-goal structure through activities such as time-and-motion studies and goal setting (Umstot et al., 1976:379).

Job Enrichment. According to Abdel-Halim (1978), enriched jobs should (1) allow an employee to feel personally responsible for his/her work (autonomy), (2) provide meaningful and challenging outcomes (skill variety and task identity), and (3) provide adequate knowledge of results (feedback) (Abdel-Halim, 1978:563).

Loher, Noe, Moeller, and Fitzgerald (1985) reported that:

> Job enrichment seeks to improve both employee performance and satisfaction by building greater scope for personal achievement and recognition and greater opportunity for individual achievement and growth into employee's jobs. Thus job enrichment can be viewed as an organizational intervention designed to restructure jobs, with the intent of making them more challenging, motivating, and satisfying to the individual (Loher, et al., 1985:280).

Hackman and Lawler (1971) reported that when job designs were high in all five job characteristic dimensions (enriched jobs), employees were more satisfied and had the opportunity to find out (feedback) that they personally (autonomy) had accomplished something meaningful (task variety, task significance, and identity) when they performed well (Hackman and Lawler, 1971:276).

Job Enrichment and Job Satisfaction. Lawler and Hall (1970) collected data from 291 scientists in research and development laboratories. Their analysis revealed that all of the job design characteristics (autonomy, skill variety, task significance, task identity, and feedback) had a significant and positive relationship to job satisfaction. Lawler and Hall reported that these research scientists perceived their jobs to be high in autonomy, performance, and that all of them felt they had a chance to use their valued skills. According to Lawler and Hall, "the data strongly suggest that perceived job characteristics are related to higher order need satisfaction among research and development scientists" (Lawler and Hall, 1970:311). They concluded that scientists received a great deal more satisfaction from jobs that allowed them some say over what goes on, jobs that allowed them to use their skills, and jobs that allowed them to be creative (Lawler and Hall, 1970: 309-311).

Hackman and Lawler (1971) summed up job enrichment by emphasizing that it is not how much enrichment that is put into a job, but rather how much enrichment the employee perceives the job to have. They stated that "the harder and better individuals perform on a job which is perceived as high on these dimensions, the more satisfaction he is likely to feel" (Hackman and Lawler, 1971:264).

Goal Setting

According to Umstot, Bell and Mitchell (1976), a goal is defined simply as what the person is consciously attempting to accomplish (Umstot et al., 1976:381). They go on to define goal setting as:

> The process of developing, negotiating, and formalizing the targets or objectives that an employee is responsible for accomplishing, and ... that effort (and consequently performance) is increased by providing clear targets toward which (employees can) direct their energies (Umstot et al., 1976:381).

Arvey, Dewhirst, and Brown (1978) stated that past research has consistently shown that employees who set hard goals perform at a higher level than employees who use easier, "do your best" goals, or no goals at all as a standard (Arvey et at.,1978:595). Arvey et al. conducted personal interviews with research and development scientists and engineers from a large nuclear research and development center. Their findings indicated that the research scientists perceived their supervisors as not defining goals or setting target goals as often as they thought they should. Arvey et al. also indicated that development scientists and engineers perceived their supervisors as placing more supervisory control over them than they thought they should, giving the development scientists and engineers less perceived freedom to perform their objectives in their own way. When Arvey et al. asked the supervisors to comment on the findings, the research manager expressed the view that the individual research scientist was fully capable of setting his/her own goals and targets, and the manager just thought of himself as a colleague rather than a boss. In contrast, the development manager stated that he purposefully defined specific goals and sets targets for his employees because he thought they needed organizational direction. The research scientists reported less participation in goal setting than was experienced by the development scientists and engineers. However both groups acknowledged that goal setting was important and both believed that they performed better when worked toward established goals (Arvey et al., 1978: 602-604).

Hamner and Harnett (1974) reviewed the past literature on individual task performance and reported that: (1) the higher a person's goals, the better the task performance; (2) the individual who exceeds his goal will be more satisfied than an individual who falls below his expected goal level; (3) an individual who exceeds his opponents outcome will be more satisfied than an individual who fails to exceed his opponents outcome; (4) the closer a person is to his expected goal or to his opponents goal, the less dissatisfied he will be; and (5) once a person has exceeded his own goal or his opponents goal, satisfaction is no longer an increasing function of the difference the goals were exceeded. A key point is that if the goal was accepted by an individual as being attainable, the harder goals consistently increased performance, even when the likelihood of goal attainment decreased. (Hamner and Harnett, 1974:223-227).

Latham and Marshall (1982) studied supervisors in a government agency and randomly assigned them to one of three goal situations (participatively set, self set, and assigned). The results indicate that it is not important how the goal was set, but rather that a goal was set. Neither participation in goal setting nor giving an employee the complete say in decision making appeared to affect productivity (Latham and Marshall, 1982:404).

Kim and Hamner (1976) reviewed past goal setting literature and found that providing employees with feedback serves two functions: "it can act as a guide to keep goal-directed behavior on course, and it can act as an incentive to stimulate greater effort among workers" (Kim and Hamner, 1976:48). They also identified praise as a:

> Specific type of feedback cue that is evaluative in nature, is generally external to the receiver, and is based on knowledge of results concerning the employee's present performance as it relates to the goal set or the employee's previous level of performance (Kim and Hamner, 1976:48).

Kim and Hamner reported also that a superior could look at evidence of past performance and then praise the positive aspects of the employee's performance. They report that giving praise should strengthen the desired performance level, and withholding praise for performance that fell below the acceptable goal level should give the employee the incentive to improve that level of performance (Kim and Hamner, 1976:48-49). Kim and Hamner also investigated the effects of evaluative and non-evaluative feedback and goal setting on performance and satisfaction in a large telephone company. They discovered that:

> ...it is possible for goal setting alone to enhance performance without a formal feedback program, but when self generated knowledge of results plus supervisory generated knowledge of results and praise was added to a formal goal setting program, performance was generally enhanced even more (Kim and Hamner, 1976:56).

Goal Clarity

Latham, Mitchell, and Dossett (1978) state that goal clarity enables the worker "to determine how to translate effort into successful performance by choosing an appropriate action plan" (Latham et al., 1978:170). In a study of scientists and engineers, less than ten scientists and engineers in the assigned goal condition reported that although they did not agree with the rating received from their supervisors, just receiving a clear and specific statement of goal attainment enabled them "to determine for the first time in 15 years what that ****** really expected of me" (Latham et al., 1978:170). The engineers also reported that "they anticipated less difficulty in meeting that expectation (goal) now that he was communicating with them with specifics" (Latham et al., 1978:170).

Arvey, Dewhirst, and Boling (1976) found when studying scientists and engineers that supervisory goal clarity and participation in goal setting had a significant ($p < .05$)

and positive effect on subordinate satisfaction, and resulted in clear and obtainable goals for the scientists and engineers (Arvey et al., 1976:105).

Steers (1976) questioned female supervisors employed in an accounting and customer service department of a major public utility. The major finding in his study was that goal clarity was strongly and consistently related to employee satisfaction, and that employees seem to prefer work situations where they know exactly what is expected of them and how much skill it will take to accomplish the goal (Steers, 1976:13).

Goal Difficulty. Yukl and Latham (1978) state that:

> ...Difficult goals that are clear and specific, if accepted, will result in higher performance than easier goals, non-specific goals, or no goals at all (Yukl and Latham, 1978:305).

They reported that difficult goals require much greater effort than easier goals; as goal difficulty increases, effort will also increase; and the more difficult goals will lead to steadily higher performance if they are not perceived as impossible by the employees (Yukl and Latham, 1978:306-307). In a study using scientists and engineers, Yukl and Latham reported that employee participation led to the upgrading of actual performance standards, and as a general rule, scientists and engineers when allowed to participate in goal setting actually set higher goals and objectives than those set by the supervisors (Yukl and Latham, 1978:167).

Dossett, Latham, and Mitchell (1979) analyzed data collected from 60 female clerical personnel and found that the clerical personnel participatively set goals that they perceived to be difficult but attainable. However, Dossett et al. suggest that the individual abilities of the clerical personnel may have caused them to set such difficult goals. Dossett et al. conclude that assigned goals and participatively set goals can be equally as effective, as long as the difficulty of the two are equal (Dossettet al., 1979:294).

Latham and Steel (1983) interviewed 72 college students, and reported that there was a significant positive linear relationship between goal difficulty and performance. They concluded that participation and assigned goals both can lead to more difficult goal setting, and that in either case, performance will increase (Latham and Steel, 1983:415).

Erez and Zidon (1984) tested 140 technicians and engineers, and concluded that performance in high and medium goal acceptance groups increased continuously with goal difficulty, but in the low acceptance groups, as goals became increasingly more difficult, performance decreased significantly. They therefore concluded that groups with high goal acceptance maintained the highest performance even with extremely difficult goals (Erez and Zidon, 1984:74).

Stress. Motowidlo, Packard, and Manning (1986) define stress as "an unpleasant emotional experience associated with elements of fear, dread, anxiety, irritation, annoyance, anger, sadness, grief, and depression (Motowidlo et al., 1986:618). To these investigators, stress can be attributed to "the frequency with which stressful events occur in an individual and their intensity of stressfulness for the individual" (Motowidlo et al., 1986:618-619).

Role conflict and role ambiguity have been studied as determinants of stress. Miles (1976) defines role conflict as the "degree of incongruity or incompatibility of expectations a focal person experiences in the performance of an assigned role" (Miles, 1976:174). Miles reports that there are two types of role conflict: (1) intersender conflict occurs when a focal person perceives that demands from one role sender oppose demands from one or more other sender; and (2) person role conflict is the perceived incongruence between the role requirements placed on a focal person and his/her orientations, interests, and values (Miles, 1976:174). He also defined role ambiguity as the lack of clarity of role expectations and predictability of role performance outcomes (Miles, 1976:174).

Morris, Steers, and Koch (1979) collected data from non-academic employees of a major university, and reported analysis showing that role conflict is significantly related to participation in decision making, supervisory span of control, the number of supervisor's subordinates report to, and formalization. Role ambiguity was significantly related to all of the above except supervisory span of control. Morris et al. reported that the best way to reduce role conflict and role ambiguity was by increasing employee participation in decision making because employees who were afforded participation were less likely to experience uncertainty about their roles, and they would have more autonomy and increased personal discretion in determining their roles [Morris et al., 1979:69).

Abdel-Halim (1978) collected data from 89 managerial personnel employed at a manufacturing company. The results of his study are as follows:

> 1. Individuals on high enriched jobs seem to acquire greater skills in coping with role ambiguity, and as a result they become more involved in clarifying and defining their own role demands;
> 2. In coping with ambiguous work demands, employees on low enriched jobs probably find themselves compelled sometimes to spend a substantial portion of their work time (in consultation with either) on attempting to resolve role ambiguity;
> 3. Highly involved people might contribute to their organization but at some cost of their own mental and physical health;
> 4. Organizations that wish to reduce the adversive consequences associated with role stress may, therefore, adopt a job redesign strategy aiming at increasing the enrichment in their member's roles; and
> 5. Employees on low enriched jobs should be given a clear, detailed description to guide their behavior on the job [Abdel-Halim, 1978:575-576).

Job Involvement

Lodahl and Kejner (1965) defined job involvement as "the internationalization of values about the goodness of work or the importance of work in the worth of the person" (Lodahl and Kejner, 1965:25). They describe a job involved person as:

> ...one from whom work is a very important part of life, and as one who is affected very much personally by his whole job situation: the work itself, his co-workers, the company, etc. (Lodahl and Kejner, 1965: 25).

They then describe a non-job involved person as one who:

> ...does his living off the job. Work is not as important a part of his psychological life. His interest are elsewhere, and the core of his self-image, the essential part of his identity, is not greatly affected by the kind of work he does or how well he does it (Lodahl and Kejner, 1965:25).

In a study of nurses, students, and engineers, Lodahl and Kejner (1965) found that job involvement is not a trait of the "friendly helper" sort, but rather the sort who likes coordination and administrative type activities. They found that job involved people make good supervisors, and may have higher initiative and intelligence than others. Overall, the engineers and nurses were more involved with their jobs than were the students. For the engineering sample, job involvement was correlated with the number of people contacted per day ($r = .30$, $p < .01$), the interdependence of the job ($r = .34$, $p < .01$), the satisfaction with the work itself ($r = .29$, $p < .01$), promotion potential ($r = .38$, $p < .01$), and co-workers ($r = .37$, $p < .01$) (Lodahl and Kejner, 1965:30-32).

Saleh and Hosek (1976) found that past literature shows four different concepts of job involvement. They concluded that a person is involved when (1) the work to him is a central life interest; (2) he actively participates in his job; (3) he perceives performance as central to his self-esteem; and (4) he perceives performance as consistent with his self concept (Saleh and Hosek, 1976:215).

Ruh, White, and Wood (1975) investigated job involvement and participative decision making and obtained data through questionnaires from employees of manufacturing organizations. They found that personal background, values, and job characteristics all significantly affect job involvement. They also indicated a strong correlation between job involvement and participative decision making ($r = .53$, $p < .01$). Ruh et al. contend that this finding is consistent with other theorists who point out that one's basic work orientation should be strongly related to the characteristics of the job situation (Ruh et al., 1975: 310-311). Ruh et al. are supported by Lawler and Hall's (1970) study of research and development scientists.

Lawler and Hall concluded that the more the job seems to allow the scientists to influence what actually goes on, be creative, and use their skills and abilities, the more they will be involved in their job (Lawler and Hall, 1970: 309-310).

Job Satisfaction

Locke (1976) defined job satisfaction as "a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences" (Locke, 1976: 1300). Locke further explained some individual values and conditions considered to be essential for achieving job satisfaction:

> Job satisfaction results from the attainment of values which are compatible with one's needs. Among the most important values or conditions conductive to job satisfaction are: (1) mentally challenging work with which the individual can cope successfully; (2) personal interest in the work itself; (3) work which is not too physically tiring; (4) rewards for performance which are just, informative, and in line with the individual's personal aspirations; (5) working conditions which are compatible with the individual's physical needs and which facilitate the accomplishment of his work goals; (6) high self-esteem on the part of the employee; (7) agents in the work place who help the employee to attain job values such as interesting work, pay, and promotions, whose basic values are similar to his own, and who minimizes role conflict and role ambiguity (Locke, 1976:1328).

When asked the question "what elements would be found in a satisfying job for you", a group of Defense

Communications Agency (DCA) engineers responded that a satisfying job is one providing:

1. technical challenges
2. significant responsibilities
3. the opportunity to have an impact
4. the opportunity to grow as a professional manager
5. the opportunity to work on the leading edge of technology
6. an environment where one has respect for colleagues and where one is respected by them
7. a sense of accomplishment - accomplishment of something that counts
8. a job where you can use engineering principles to actually implement a system - going beyond the conceptual or architectural phase to bring it to fruition
9. an atmosphere where you can get things done
10. the opportunity to make a contribution (Sherman, 1984:61-63).

Engineers in this sample reported that having an impact makes a difference and is essential to job satisfaction. Of the DCA engineers who terminated their employment, 60 percent of them felt that they had very little impact in influencing the individual who actually had the power to make significant decisions on the mature and course of their work (Sherman, 1884:38). When asked what some of the dissatisfiers and demotivators were on their last jobs, 45 percent responded that organizational policies and rivalries and the overall lack of a team effort on projects were the factors that eventually caused them to leave their jobs. Another 40 percent responded that general frustrations associated with the bureaucratic process was the underlying problem that caused them to separate from the DCA. Other elements which caused the engineers to eventually leave DCA were (1) the lack of a continuing opportunity to broaden and grow professionally (15%); (2) the lack of professional and technical competence among co-workers and managers (15%); (3) being underutilized and unchallenged (15%); and (4) lack of advancement opportunities (10%) (Sherman, 1984:45-46). The data would suggest that turnover would be reduced if managers provide engineers with challenging and interesting work, opportunity for growth, feedback on exactly how they are doing on their jobs, and keep the communication lines open.

Retirement

According to Schmitt and McCune (1981), "retirement has been an automatic process whereby the organization terminated the employment of a worker when she/he reached the age of 65" (Schmitt and McCune, 1981:795). However, recent changes to governmental policy have provided employees with greater flexibility in deciding when they retire. Mandatory retirement for most federal workers is now age 70. In reviewing the retirement literature, Schmitt and McCune found several factors that consistently lowered the retirement age for individuals: (1) poor health; (2) adequate pension benefits; (3) job dissatisfaction; and (4) the individuals perception of being unable to keep up with the demands of work or the changes in work technology (Schmitt and McCune, 1981:796).

In their study of 1000 Michigan civil service employees, Schmitt and McCune (1981) also found that certain job characteristics and certain job attitude variables (i.e., feedback, job satisfaction, job involvement, and desire to work) played an important role in an individual's ultimate decision to retire. They found that employees who were financially able and who viewed their jobs as less involving and challenging usually retired earlier than normal (Schmitt and McCune, 1981:801-802).

Professional Continuing Education

Kaufman (1975) found that the need for continually updating the technical knowledge of engineers was essential in view of the rapid obsolescence of technical knowledge (Kaufman, 1975:405). Large organizations such as AFLC have employed various continuing education approaches that allow engineers to keep up to date with developments in their field.

In a 1978 study of engineers, Kaufman found that in an R & D environment, graduate level courses are needed to maintain the technical proficiency of the individual engineer. On the other hand, in an organization where work is more applied and not as highly technical, in-house courses allow certain individuals to upgrade certain aspects of their jobs, although not at the same rate as a graduate level engineering course would (Kaufman, 1978:250). He notes that engineers who are superior in their professional knowledge and abilities tend to enroll in graduate level courses, whereas those weaker in these attributes are attracted to easier in-house courses (Kaufman, 1975:407).

Dual Path Career Options

Hall and Mansfield (1975) reported that scientists and engineers have a need to establish themselves as a professional early on in their careers. They pointed out that a major mid-career concern of many scientists is getting a promotion to a supervisory rank. This mid-career peak may be seen by scientists as the peak performance years in their careers, and the scientists understand that if they are not promoted to supervisor during these peak performance years that they stand less of a chance in the future of being promoted because their careers are in the declining stages. The idea of wanting to become a supervisor during the mid-career peak holds true with current themes in literature. An individual in this stage of his career tries to extend his youth by trying to stimulate and develop the growth of younger colleagues (Hall and Mansfield, 1975:201-202).

Bailyn and Lynch (1982) state that "to be successful in engineering means to leave it" (Bailyn and Lynch, 1982: 2). They also state that "the engineer who, at 40, can still use a slide rule or logarithmic table, and make a true drawing, is a failure" (Bailyn and Lynch, 1982:2). Bailyn and Lynch investigated 158 MIT engineering graduates some ten years after graduation, and found the least satisfied group was the engineers who had remained staff engineers for the entire period from graduation to the time of the survey. On the other hand, the group that had increased coordinating and supervisory responsibilities and had shifted responsibilities to broader, more complex projects, had greatly increased their satisfaction. Also, Bailyn and Lynch indicated that movement away from specialized projects, toward more complex responsibilities with their organization, had given the engineers a perception of increased recognition from both inside and outside their organization. This group, out of all the other groups, was most optimistic about their career success (Bailyn and Lynch, 1982:11).

Summary of Literature Review

The literature review has shown that, in general, scientists and engineers have a strong desire to perform highly technical and professional work. They want to believe that what they are doing is important and has a significant impact on the organizational goals. They desire to have some say in the setting of their work goals, and prefer an environment where their job has been enriched. When they perceive that they have some influence over decisions made about their jobs, they experience strong satisfaction for that job. They desire to have some idea of what is expected of them and how they should channel their energy into successful completion of what is actually expected of them. In general, scientists and engineers who perceive they have an impact on things that affect them on the job are likely to be more satisfied and remain in that job until they retire.

This literature review has included research on every variable included in the survey. The review provides a comprehensive understanding of the previous research that has focused on scientists and engineers. To gain a better understanding of the scientists and engineers in AFLC, the following investigative questions were designed to analysis specific areas from the literature review and to provide top AFLC management with some information concerning the demographic characteristics and work attitudes of the scientists and engineers in the command.

Investigative Questions and Hypothesis

Investigative Question #1. What are the demographic characteristics of the scientists and engineers working in AFLC?

Investigative Question #2. Is there a significant difference in the degree of job satisfaction experienced by scientists and engineers in AFLC?

Hypothesis 2. There is no difference in the job satisfaction between scientists and engineers in AFLC.

Investigative Question #3. Is there a significant difference in the retirement intentions between scientists and engineers in AFLC?

Hypothesis 3.1. There is no difference in the time to retirement between scientists and engineers in AFLC.

Hypothesis 3.2. There is no difference in the amount of time scientists and engineers in AFLC plan to remain with the government.

Investigative Question # 4. Is there a significant difference in organizational commitment between scientists and engineers in AFLC?

Hypothesis 4. There is no difference among scientists and engineers in AFLC in organizational commitment.

Investigative Question # 5. Is there a significant difference in the perceived participative decision making ability between scientists and engineers in AFLC?

Hypothesis 5. There is no difference in the perceived participative decision making experienced by scientists and engineers in AFLC.

Investigative Question # 6. Is there a significant difference between the way scientists and engineers in AFLC feel about members of their particular work group?

Hypothesis 6. There is no difference in how scientists and engineers in AFLC relate to the members of their particular work group.

Investigative Question # 7. Is there a significant difference in goal clarity between scientists and engineers in AFLC?

Hypothesis 7. There is no difference in goal clarity between scientists and engineers in AFLC.

Investigative Question # 8. Is there a significant difference between scientists and engineers in AFLC in the amount of feedback they receive.

Hypothesis 8. There is no difference between scientists and engineers in AFLC in the amount of feedback received.

Investigative Question # 9. Is there a significant difference between scientists and engineers in AFLC in their ability to do things things their own way in their work?

Hypothesis 9. There is no difference between scientists and engineers in AFLC in the degree of job involvement experienced in their work.

Investigative Question # 10. Is there a significant difference in the importance of professional continuing education between scientists and engineers in AFLC?

Hypothesis 10. There is no difference between scientists and engineers in AFLC in how each group assesses the importance of professional continuing education.

III. Method

Introduction

This chapter describes the methodology used to collect and analyze the data for this research effort. The first part of the chapter discusses the data collection method, and the second part will discuss the sample population with respect to personal characteristics, and a variety of attitudinal variables. The final part of this chapter will describe the steps taken in the data analysis process.

Data Collection Method

The data were collected from the target population using a mail survey. The survey instrument contained 106 questions and was divided into two parts: Part I contained the first 80 questions, and Part II contained the other 26 questions. Each package sent out to the survey population contained one survey, two AFIT Data Collection Forms (AFIT Form 11c), and a cover letter signed by top management within AFLC. A copy of the cover letter and survey can be seen in Appendix A.

AFLC top management requested several additional areas be included in the survey. These areas included questions on respect for scientists and engineers (Part I #66-67), dual path career options (Part II #14-15), and professional continuing education (Part II #16-26). All the other questions were drawn from a larger sample of questions used previously in other studies.

These questions have been previously published and validated, and their internal validity and reliability are already proven.

Sample Population

A total of 4172 surveys were mailed to the following AFLC locations: HQ AFLC, Warner Robins Air Logistics Center, Sacramento Air Logistics Center, Odgen Air Logistics Center, San Antonio Air Logistics Center, and Oklahoma City Air Logistic Center. Each recipient was selected from an internal HQ AFLC personnel data base and the names and addresses were provided to the researcher by a representative of HQ AFLC/MM.

The sample population for this research study was the entire population of Air Force Civil Service scientists and engineers employed at various locations throughout AFLC. The job series targeted were the 08XX series (Engineering and Architecture Group), the 13XX series (Physical Sciences Group), and the 15XX series (Mathematics and Statistics Group).

A total of 2234 surveys had been returned as of 10 June 1988. Six hundred eighty five surveys were returned and destroyed because they were addressed to other individuals not employed by AFLC (AFSC employees working in AFLC and who were mistakenly placed in the AFLC personnel data base). One hundred eighty two surveys were returned because the addressee was unknown, and thirty six were returned due to retirement of the addressee. After controlling for the surveys that were not valid, the response rate was 2234 of 3269 for a 68.3 percent return rate.

Personal Characteristics

Variables included in this category are age, highest educational level obtained, sex, total months in present position of assignment, total years in AFLC, number of people directly supervised, civilian management series, civilian grade level, category of undergraduate degree, four digit civilian job series code, and the number of co-workers who have the same or similar civilian job series code of the respondent.

The current age of the individual was reported by use of an ordinal rating scale ranging from less than 20 to more than 60. Educational level was measured with an ordinal rating scale requesting the highest education level obtained. Total months in the present position provided a measure of the respondent's longevity in his/her current position. Total years in AFLC provided a measure of the respondent's longevity in the greater population within Air Force Logistics Command. The number of people directly supervised provided a measure of the organizational supervisory position of the respondent within AFLC. The civilian series provided a measure of the respondents management grade (GS or GM). The grade level provided a measure of the number of civilians in a particular pay grade and gave a picture of the grade level of the average scientists and engineer within AFLC. The undergraduate degree questions provided a measure of the educational background of the respondents and identified the scientists from the engineers. The civilian occupational series provided specific job category of the respondents. The number of people in the respondents work group (co-workers) with similar civilian occupational series provided a measure of whether the scientists or engineers work with other scientists or engineers or are the only technical individual in their work group.

Job Satisfaction Variable

The individual job satisfaction questions (#15-17) provided a measure of the following three items: job satisfaction; satisfaction with co-workers; and satisfaction with the actual work itself. These three items were combined into one composite variable to give an overall measure of job satisfaction. All three variables were distributed on a 7-point Likert scale, ranging from delighted to terrible. Cronbach's alpha was calculated on the composite variable to be .69 for this sample.

Future Work Plans

Questions about the future work plans of these respondents were added to the survey at the specific request of top management within AFLC. The three retirement variables (#18-20) were not combined and were treated individual questions. The three questions were designed to obtain different information about the respondents: the number of years the respondent has before he/she is eligible for retirement; whether the respondent plans to remain with the government until they retire; and if the respondents plan to remain with AFLC during the next year.

One other question was included in this group of variables at the request of AFLC management. The question (#21) was designed to measure where an individual is likely to seek employment if he or she were to leave AFLC. The answer will assist AFLC in understanding the significant competitors for scientific and engineering talent within the command.

Organizational Information

The organizational questions (#22-36) were designed to provide a measure of an individual's commitment to the organization. The 15 questions were scored on a 7-point Likert scale ranging from strongly disagree to strongly agree. Six of the items required reverse coding (#24, #28, #30, #32, #33, and #36). The fifteen items were combined into one composite variable. The average coefficient alpha of 12 other surveys using the same questions was .90 (Crow, 1987:40). Cronbach's alpha was calculated to be .91 for this sample.

Job Information

The job information questions (#37-50) were designed to provide a measure of an individual's organizational commitment in the following areas: the degree of autonomy the respondents feel they have in their job (participation in work); the degree to which work is of central life interest to the respondents; and the degree to which the job is seen as part of the respondents self-interests. The 14 job information questions were scored on a 7-point Likert scale ranging from strongly disagree to strongly agree, and the individual questions were combined into three separate composite variables. For the participation in work questions (#37, #39, #40, #42, and #43), the average coefficient alpha for the exact same questions in 12 previous studies was .82 (Crow, 1987:41). Cronbach's alpha was calculated to be .84 for this sample. For the central life interest questions (#38, #41, #44, #45, and #46), the average coefficient alpha using the same exact questions for 12 previous samples was .91 (Crow, 1978:43). Cronbach's alpha was calculated to be .90 for this sample. For the self-concept questions (#47-50), the average coefficient alpha using the same exact questions for 12 previous samples was calculated to be .73 (Crow, 1978: 44). Cronbach's alpha was calculated to be .67 for this sample.

Work Role Attitudes

The work role attitude questions were designed to provide measures of participation in decision making, stress, group cohesion, organizational communication, and respect. Questions #51, #52, #54, #55, and #57 addressed the degree to which the respondent participated in decisions about their job. Question #57 was reverse coded. The five questions about participative decision making were combined into a single composite variable. The average coefficient alpha from 12 previous samples using the exact same questions was .87 (Crow, 1987:46). Cronbach's alpha was calculated to be .83 for this sample. Questions #53, #56, and #58 were designed to measure the amount of stress employees experienced on the job; attitudes about their co-workers and supervisors; and respondent attitudes about organizational policies and working conditions. Questions #53, #56, and #58 were reverse coded. The three stress questions were combined into a single composite variable. The average coefficient alpha from 12 previous studies using the exact same questions was .77 (Crow, 1987:47). Cronbach's alpha was calculated to be .71 for this sample. The group cohesion questions (#59-61) were designed to measure cohesion among the respondent's work group. The three group cohesion questions were combined into a single composite variable. The average coefficient alpha from 12 previous samples using the same exact questions was .69 (Crow, 1987:50).

Cronbach's alpha was calculated to be .73 for this sample. Questions #62 - #65 were designed to measure how freely information flows within the respondent's organization. The four organizational communication questions were combined into a single composite variable. The average coefficient alpha from 12 previous samples using the same exact questions was .76 (Crow, 1987:51). Cronbach's alpha was calculated to be .73 for this sample. The two respect questions (#66-67) were included in the survey at the request of top AFLC management. One question obtained a measure of each respondent's perception of the degree to which colleagues in similar civilian job respected his or her work. The other question was designed to measure how much respect co-workers within the same organization have for the respondents. All of the work role attitude questions were measured on a 7-point Likert scale ranging from strongly disagree to strongly agree.

Work Goals

The work goal questions (#68-76) were designed to provide a measure of the clarity and difficulty of goals associated with the respondent's work. The goal clarity questions (#68-71) and the goal difficulty questions (#72-76) were measured on a 7-point Likert scale ranging from strongly disagree to strongly agree. The average coefficient alphas' for 12 previous samples using the same exact questions were .90 for goal clarity and .85 for goal difficulty (Crow, 1987:60-61). Cronbach's alpha was calculated to be .92 for this sample of goal clarity questions and .87 for this sample of goal difficulty questions.

The last four questions of Part I (#77-80) and questions #1 thru #8 of Part II are questions related to job characteristics. These job characteristics questions are expected to provide a measure of skill variety, task identity, task significance, and autonomy experienced by the respondents. Questions #78, #79, Part II #1, and #4 were reverse coded. The skill variety questions (#77, #79, and Part II #7) were designed to provide a measure of the degree to which a job requires a variety of different skills and talents to carry out the job. Two of the skill variety questions were measured on a 7-point Likert scale ranging from very inaccurate to very accurate. The other question was measured on a numbered graphic scale from 1 thru 7 with 1 being very little, 4 being the mid point, and 7 being very much. The three variety questions were combined into a single composite variable. The average coefficient alpha of 12 previous samples using the exact same questions was .70 (Crow, 1987:67). Cronbach's alpha was calculated to be .73 for this sample.

The task identity questions (#78, and Part II #2, and #6) were designed to provide a measure of the extent to which respondents do an entire or whole piece of work. Two of the task identity questions were measured on a 7-point Likert scale ranging from very inaccurate to very accurate. The other question was measured on a numbered graphic scale from 1 thru 7, with 1 being very little, 4 being the midpoint, and 7 being very much. The three task identity variables were combined into a single composite variable. The average coefficient alpha from 12 previous samples using the same exact questions was .65 (Crow, 1987:68). Cronbach's alpha was calculated to be .72 for this sample.

The task significance questions (#80, and Part II #4, and #8) were designed to provide a measure of the respondent's opinion about the significance of their work and how it can affect other people. Two of the task significance questions were measured on a 7-point Likert scale ranging from very inaccurate to very accurate. The other question was measured on a numbered graphics scale from 1 thru 7, with 1 being vary little, 4 being the midpoint, and 7 being very much. The average coefficient alpha from 12 previous samples using the same exact questions was .67 (Crow, 1987:66). Cronbach's alpha was calculated to be .73 for this sample.

The autonomy questions (Part II #1, #3, and #5) were designed to provide a measure of the extent to which respondents have a say in their work activities. Two of the autonomy questions were measured on a 7-point Likert scale ranging from very inaccurate to very accurate. The other questions was measured on a numbered graphics scale from 1 thru 7, with 1 being very little, 4 being the midpoint, and 7 being very much. The three autonomy questions were combined into a single composite variable. The average coefficient alpha from 12 previous samples was .71 (Crow, 1987:69). Cronbach's alpha was calculated to be .73 for this sample.

Feedback

The feedback questions (#9-13) were designed to provide a measure of the degree to which the respondent's report they receive information about how well they are performing on the job. The five feedback questions were measured on a five-point incremental scale ranging from very little to very much, with 3 being a moderate amount. The five feedback questions were combined into a single composite variable. The average coefficient alpha from 12 previous samples was .91 (Crow, 1987:72). Cronbach's alpha was calculated to be .91 for this sample.

Dual Path Career Options

The dual path career option questions (#14-15) were developed at the request of AFLC management and are intended to find out the respondent's opinion about a plan that would allow scientists and engineers to choose one of two career paths. One path would focus on managerial responsibilities and the other path would focus on scientific and technical tasks.

Professional Continuing Education (PCE)

The PCE questions (#16-26) were also included in the survey at the request of top AFLC management. The questions are designed to provide a measure of the respondent's feelings about the following items: amount of professional continuing education needed each year; extent to which the organization supports PCE; extent to which PCE helps keep respondent's informed about latest technological advances in their field; and the degree to which the respondent's feel PCE is important in keeping the them informed about the latest technological advances in their field.

Data Analysis

The analysis of the data was accomplished using the AFIT Academic Support Computer (ASC) and the Statistical Package for the Social Sciences (SPSS). The data from the respondents were input to the ASC via optical scan sheets.

IV. Results and Discussion

Introduction

This chapter consists of two sections. The first section, presents analyses of the differences between the two groups of respondents, scientists and engineers working in Air Force Logistics Command. These analyses will determine if a significant difference exists between the means for such factors as job satisfaction, retirement intentions, organizational commitment, and other job related items. The second section of the chapter presents a discussion of the t-test comparisons.

Section I. Test of Hypotheses

Investigative Question # 1. What are the demographic characteristics of the scientists and engineers working in AFLC? Investigative question #1 does not lead to any hypothesis, but does provide some general information about the civilian scientific and engineering work force in AFLC. For purposes of discussion, the scientific and engineering work force has been separated into three groups: electronics engineers, all other engineers, and scientists. Because a large percentage of the respondents were electronics engineers (47.3%), the engineers were divided into two groups to provide AFLC's upper management with a better picture of the characteristics of the different types of engineers in the work force and to find out if there was any significant differences in the responses between the two different types of AFLC engineers.

Table 2

Demographic Characteristics of Scientists and Engineers in AFLC

Variable	Elect Eng		All Other Eng		Scientists	
	M	SD	M	SD	M	SD
Age	4.75[a]	2.18	5.44[e]	2.39	5.79[g]	1.96
Education Lvl	5.68[a]	0.92	5.80[e]	0.97	5.89[g]	1.16
Sex	1.08[b]	0.27	1.06[d]	0.24	1.17[g]	0.38
Time on Stat.	5.95[b]	1.89	6.07[e]	1.86	6.45[h]	1.98
Yrs. in AFLC	5.56[c]	2.91	6.10[e]	3.09	6.98[g]	2.81
# Supervised	1.48[a]	1.38	1.65[d]	1.48	1.56[g]	1.48
Civ Series	3.11[a]	0.36	3.18[e]	0.42	3.09[g]	0.29
Grade Lvl	6.73[b]	0.97	6.90[d]	1.00	6.30[g]	1.09
# of People w/Similar Job Series In Work Gp.	6.04[c]	1.70	4.52[f]	2.34	4.77[i]	2.37

Number of Respondents: a=1058; b=1057; c=1055; d=1028; e=1027; f=1013; g=117; h=116; i=115

The percentages of each group of respondents were as follows: electronics engineers (47.3%); all other types of engineers (46.0%); and scientists (5.1%). When responding to the survey, 1.6 percent of the respondents (33 individuals) did not classify their job series, and therefore their responses were counted as other than scientist or engineer. The number of respondents, the means, and the standard deviations for the three groups are shown in Table 2.

Age. The average age of electronics engineers is 31 to 35, while for all other types of engineers and scientists, the average age is 36 to 40. The age breakdown of all three groups is shown below in Table 3.

Table 3

Ages of Scientists and Engineers

	Electronics Engineers	All Other Engineers	Scientists	Total
Less Than 20	0	0	0	0
20 to 25	123	86	2	211
26 to 30	292	228	11	531
31 to 35	175	128	24	327
36 to 40	107	96	18	221
41 to 45	114	114	19	247
46 to 50	86	115	19	220
51 to 55	86	126	14	226
56 to 60	49	90	4	143
More Than 60	25	43	4	72
TOTAL	1057	1026	117	2200

Four different t-tests were performed to determine if there was a significant difference between the following groups: all scientists vs. all engineers; all scientists vs. only electronics engineers; all scientists vs. all other engineers; and only electronics engineers vs. all other engineers. The results of the t-tests are presented in Table 4. The findings indicate that scientists were significantly older than all engineers combined. When scientists were compared to different types of engineers, scientists were significantly older than electronics engineers, but they were not significantly older than all other types of engineers. All other types of engineers were significantly older than electronics engineers. Overall, the scientists were the oldest group, and the electronics engineers were the youngest group.

Table 4

Age

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	5.10	2.31	0.05				
Scientists	117	5.80	1.96	0.18	1.39	-3.71	2198	0.00
Elect Engrs	1057	4.75	2.18	0.07				
Scientists	117	5.80	1.96	0.18	1.32	-5.39	1172	0.00
Other Engrs	1026	5.44	2.39	0.07				
Scientists	117	5.80	1.96	0.18	1.48	1.79	1141	0.08
Elect Engrs	1057	4.75	2.18	0.07				
Other Engrs	1026	5.44	2.39	0.07	1.20	-6.91	2081	0.00

Education Level. The average educational level for all three groups was a bachelor's degree, with some graduate work. A breakout of the educational level of the three groups shows that: 555 electronics engineers have a B.S. degree (52.5%), while 321 have some graduate work (30.4%); 476 of all other engineers have a B.S. degree (46.4%), while 332 have some graduate work (32.4%); and 52 scientists have a B.S. degree (44.4%), while 35 have some graduate work (29.9%). Four different t-tests were used to determine if there was a significant difference between the different groups. The results of the t-tests are presented in Table 5. The t-tests indicate that there was no significant difference in educational level between scientists and engineers. When the scientists were compared to the different types of engineers, there was a significant difference in the level of education between scientists and electronics engineers, but not a significant difference in level of education between scientists and all other types of engineers. When electronics engineers were compared to all other types of engineers, there was a significant difference in the level of education between the two groups. Overall, scientists have the highest level of formal education and electronics engineers have the lowest level of formal education.

Table 5

Education Level

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	5.74	0.95	0.02				
Scientists	117	5.89	1.16	0.11	1.50	-1.62	2198	0.11
Elect Engrs	1057	5.68	0.92	0.03				
Scientists	117	5.89	1.16	0.11	1.58	-2.26	1172	0.02
Other Engrs	1026	5.80	0.97	0.03				
Scientists	117	5.89	1.16	0.11	1.43	0.89	1141	0.37
Elect Engrs	1057	5.68	0.92	0.03				
Other Engrs	1026	5.80	0.97	0.03	1.10	-2.97	2081	0.00

Sex. The percentage of males responding to the survey was 92.7, and the percentage of females was 7.3. This percentage remained constant for all three types of groups that were studied. A breakout of the respondents sex shows that: 973 electronics engineers were males (92.1%), while 83 were females (7.9%); 967 of all other engineers were males (94.2%), while 60 were females (5.8%); and 97 scientists were males (82.9%), while 20 were females (17.1%). Four different t-tests were used to determine if there was a significant difference between the groups with respect to the percentages of females that work in each group. The results of the t-tests are presented in Table 6. There was a significant difference in the percentage of females in each group between the scientists and the engineers. When the scientists were compared to different types of engineers, the scientific career field contains a larger percentage of females than do both electronics engineers and all other types of engineers. No significant difference was noted between the electronics engineers and all other types of engineers. Overall, the scientific career field contains the largest percentage of females and all other types of engineers contains the smallest percentage of females.

Table 6

Percentage of Females

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	1.07	0.25	0.01				
Scientists	117	1.17	0.38	0.04	2.24	-4.13	2198	0.00
Elect Engrs	1057	1.08	0.27	0.01				
Scientists	117	1.17	0.38	0.04	1.97	-3.36	1172	0.01
Other Engrs	1026	1.06	0.24	0.01				
Scientists	117	1.17	0.38	0.04	2.60	4.56	1141	0.00
Elect Engrs	1057	1.08	0.27	0.01				
Other Engrs	1026	1.06	0.24	0.01	1.32	1.82	2081	0.07

Time on Station. For the combined groups of scientists and engineers in AFLC, the average time on station was more than 24 months but less than 36 months. For the electronics engineers, the average time on station was almost 24 months. For all other types of engineers, the average time on station was a little over 24 months. For the scientists, the average time on station was almost 36 months. T-tests were used to determine if there was a significant difference between the groups with respect to the length of time on station. The results of the t-tests are presented in Table 7. The results of the t-tests are that there was a significant difference between scientists and engineers for time on station. Scientists had been on station longer than had the engineers. When the scientists were compared to the different types of engineers, the scientists had been on station longer than both the electronics engineers and all other types of engineers. No significant difference was noted between electronics engineers and all other types of engineers with respect to the amount of time on station.

Table 7

Time on Station

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	6.01	1.88	0.04				
Scientists	116	6.45	1.98	0.18	1.12	-2.44	2197	0.02
Elect Engrs	1057	5.95	1.89	0.06				
Scientists	116	6.45	1.98	0.18	1.10	-2.70	1171	0.01
Other Engrs	1026	6.07	1.86	0.06				
Scientists	116	6.45	1.98	0.18	1.14	2.04	1140	0.04
Elect Engrs	1057	5.95	1.89	0.06				
Other Engrs	1026	6.07	1.86	0.06	1.03	-1.55	2081	0.12

Years in AFLC. When all respondents were combined, 46.3 percent of the respondents had been with AFLC less than five years, but 21.6 percent of the respondents had been with AFLC for 16 or more years. The average tenure of the electronics engineers was more than four years but less than five years. The average tenure of all other types of engineers was five years but less than six years. The average tenure of the scientists was almost six to eight years. T-tests were used to determine if there was a significant difference between the groups, and the results of the t-tests are presented in Table 8. The findings indicate that scientists have been in AFLC longer than have the engineers. Scientists have been in AFLC longer than have the electronics engineers or all other types of engineers. A significant difference was also noted between the electronics engineers and all other types of engineers, indicating that all other types of engineers have been in AFLC longer than the electronics engineers. Overall, the scientists have been in AFLC the longest time and the electronics engineers have been in AFLC the shortest time.

Table 8

Years in AFLC

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2082	5.88	3.01	0.07				
Scientists	117	6.98	2.81	0.26	1.14	-3.88	2197	0.00
Elect Engrs	1055	5.65	2.91	0.09				
Scientists	117	6.98	2.81	0.26	1.07	-4.72	1170	0.00
Other Engrs	1027	6.10	3.09	0.10				
Scientists	117	6.98	2.81	0.26	1.21	2.94	1142	0.00
Elect Engrs	1055	5.65	2.91	0.09				
Other Engrs	1027	6.10	3.09	0.10	1.13	-3.43	2080	0.00

Number of People Supervised. The scientific and engineering work force in AFLC reported almost no supervisory activity; 84.4 percent all respondents reported that they supervise no one. A breakout of the supervisory activity shows that: 922 electronics engineers supervised no one (87.2%), 11 supervised 2 or less (1%), and 124 supervised 3 or more (11.8%); 841 other types of engineers supervised no one (81.9%), 6 supervised 2 or less (0.6%), and 180 supervised 3 or more (17.5%); and 99 scientists supervised no one (84.6%), 2 supervised 2 or less (1.7%), and 16 supervised 3 or more (13.7%). T-tests were used to determine if there was a significant difference between the groups. Detailed results of the t-tests are presented in Table 9. No significant difference in supervisory activity was noted between scientists and all engineers, between scientists and electronics engineers, and between scientists and all other types of engineers. However, a significant difference in supervisory activity was noted between the electronics engineers and all other types of engineers. Overall, the non-electronics engineers have the most supervisory responsibility and the electronics engineers have the least supervisory responsibility.

Table 9

Supervision

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	1.57	1.44	0.03				
Scientists	117	1.56	1.48	0.14	1.06	0.04	2198	0.97
Elect Engrs	1057	1.48	1.38	0.04				
Scientists	117	1.56	1.48	0.14	1.16	-0.59	1172	0.56
Other Engrs	1026	1.65	1.48	0.05				
Scientists	117	1.56	1.48	0.14	1.00	-0.58	1141	0.56
Elect Engrs	1057	1.48	1.38	0.04				
Other Engrs	1026	1.65	1.48	0.05	1.16	-2.60	2081	0.01

Grade Level. The average grade level for the combined scientists and engineers in AFLC ranged between GS-11 and a GS-12. A list of the grade levels for scientists and engineers in AFLC is shown in Table 10. T-tests were used to determine if there was a significant difference between the groups. The results of the t-tests are presented in Table 11. Engineers have significantly higher grade levels than do scientists. When the scientists are compared to the different types of engineers, the electronics engineers and all other types of engineers had a significantly higher grade level than did the scientists. The results indicate that all other types of engineers had a significantly higher grade level than did the electronics engineers. Overall, the non-electronics engineers have the highest grade level and the scientists have the lowest grade level.

Table 10

Grade Level of Scientists and Engineers in AFLC

Grade	Electronics Engineers	All Other Engineers	Scientists	Total
1-2	0	0	0	0
3-4	1	0	1	2
5-6	2	4	1	7
7-8	19	19	6	44
9-10	88	44	10	142
11	230	229	47	506
12	548	497	41	1086
13	143	180	10	333
14-15	26	52	1	79
SES	0	1	0	1
TOTAL	1057	1026	117	2200

Table 11

Grade Level

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	6.82	0.99	0.02				
Scientists	117	6.30	1.09	0.10	1.23	5.49	2198	0.00
Elect Engrs	1057	6.73	0.97	0.03				
Scientists	117	6.30	1.09	0.10	1.28	4.56	1172	0.00
Other Engrs	1026	6.90	1.00	0.03				
Scientists	117	6.30	1.09	0.10	1.19	-6.09	1141	0.00
Elect Engrs	1057	6.73	0.97	0.03				
Other Engrs	1026	6.90	1.00	0.03	1.07	-3.85	2081	0.00

Number of Co-workers With Similar Job Series. When all respondents were combined, 51.8 percent of the total population reported that six or more of their co-workers had similar job series, while 10.1 percent of the respondents reported that no one in their work group had a similar job series to their own. Approximately 68 percent of the electronics engineers reported having more than 6 co-workers in their work group who had a similar job series to themselves, while only 4.1 percent reported having no one in their work group with a similar job series. For all other types of engineers, approximately 37 percent reported having more than 6 co-workers with similar job series to themselves, while 15.7 percent reported having no one in their work group with a similar job series. For the scientists, approximately 42 percent reported having more than 6 co-workers with similar job series to themselves, while 17.4 percent reported having no one in their work group with a similar job series. T-tests were used to determine if there was a significant difference between the different groups.

The results of the t-tests are presented in Table 12. There is a significant difference between scientists and engineers in the number of co-workers who have similar job series. The results indicate that there is a significant difference between the scientists and electronics engineers, but not a significant difference between scientists and all other types of engineers. Electronics engineers work with more people who have a similar job series than do all other types of engineers. Overall, electronics engineers work with the largest group of similar co-workers and all other engineers work with the smallest group of co-workers with a similar job series.

Table 12

Work Group With Similar Job Series

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2068	5.30	2.17	0.05				
Scientists	115	4.77	2.37	0.22	1.19	2.54	2181	0.01
Elect Engrs	1055	6.04	1.70	0.05				
Scientists	115	4.77	2.37	0.22	1.93	7.28	1168	0.00
Other Engrs	1013	4.52	2.34	0.07				
Scientists	115	4.77	2.37	0.22	1.02	1.05	1126	0.30
Elect Engrs	1055	6.04	1.70	0.05				
Other Engrs	1013	4.52	2.34	0.07	1.88	16.86	2066	0.00

Investigative Question #2. This investigative question led to Hypothesis 2, which stated that there is no difference in the job satisfaction between scientists and engineers within AFLC. A t-test was used to investigate Hypothesis 2. The results of the t-test are presented in Table 13. The findings support Hypothesis 2. Therefore, the conclusion is that there is no difference in the job satisfaction of scientists and engineers in AFLC.

Note that the results also indicate that scientists and engineers reported having generally positive levels of job satisfaction.

Table 13

Job Satisfaction

Hypothesis 2 - Job Satisfaction

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	4.80	0.98	0.02				
Scientists	117	4.76	1.01	0.09	1.06	0.44	2198	0.66

<u>Investigative Question #3</u>. This investigative question produced two hypotheses. The first hypothesis, Hypothesis 3.1, was that there is no difference in the time to retirement between scientists and engineers within AFLC. A t-test was used to investigate this hypothesis. The results of the t-tests are presented in Table 14 and the results of the analysis confirms Hypothesis 3.1. Therefore, we conclude that there is no difference in the time until retirement between scientists and engineers in AFLC.

The second hypothesis, Hypothesis 3.2, stated that there is no difference in the amount of time scientists and engineers within AFLC plan to remain with the government. A t-test was used to investigate this hypothesis, and the results are presented in Table 14. The results of the statistical test do not allow rejection. Therefore, one can conclude that there is no significant difference in the amount of time scientists and engineers in AFLC plan to remain in government service.

Table 14

Retirement Intentions

Hypothesis 3.1 - Number of Years Before Retirement

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2081	8.75	2.63	0.06				
Scientists	116	8.59	2.67	0.25	1.03	0.65	2195	0.52

Hypothesis 3.2 - Do You Plan To Stay In AFLC Until Retirement

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	1.72	0.75	0.02				
Scientists	117	1.53	0.68	0.06	1.06	0.44	2198	0.66

Investigative Question #4. This investigative question provided a basis for the hypothesis that there is no difference among scientists and engineers within AFLC in organizational commitment. A t-test was performed to test this hypothesis, and the results, presented in Table 15, do not permit rejection of Hypothesis 4. We therefore conclude that there is no difference in organizational commitment between scientists and engineers in AFLC.

Table 15

Organizational Commitment

Hypothesis 5 -Organizational Commitment

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	4.05	1.22	0.03				
Scientists	117	3.95	1.30	0.12	1.13	0.81	2198	0.42

Investigative Question #5. This investigative question provides a basis for Hypothesis 5, which states that there is no difference in the perceived participative decision making experienced by scientists and engineers in AFLC. A t-test was used to test this hypothesis, and the results, presented in Table 16, provide marginal support for Hypothesis 5. One may therefore conclude that there is no significant difference in the perceived participative decision making activity experienced by scientists and engineers in AFLC.

Table 16

Participative Decision Making

Hypothesis 5 - Participative Decision Making Opportunity

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	5.46	1.84	0.04				
Scientists	117	5.13	1.84	0.17	1.00	1.88	2198	0.06

Investigative Question #6. This investigative question generated a basis for Hypothesis 6, which states that there is no difference in how scientists and engineers in AFLC relate to members of their particular work group. A t-test was performed to test the hypothesis, and the results, presented in Table 17, do allow rejection of Hypothesis 6.

Table 17

Work Group Cohesion

Hypothesis 6 - Feelings About Co-workers

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	4.53	1.47	0.03				
Scientists	117	4.07	1.61	0.15	1.23	3.25	2198	0.00

Investigative Question #7. This investigative question produced Hypothesis 7, which states that there is no difference in goal clarity between scientists and engineers in AFLC. A t-test was performed to test this hypothesis, and the results, presented in Table 18, do permit rejection of the hypothesis statement. Therefore, there is a significant difference in the degree of goal clarity experienced by scientists compared to the goal clarity reported by engineers in AFLC.

Table 18

Goal Clarity

Hypothesis 7 - Goal Clarity

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	4.53	1.69	0.04				
Scientists	117	5.04	1.61	0.15	1.10	-3.16	2198	0.00

Investigative Question #8. This investigative question provides the basis for Hypothesis 8, which states that there is no difference between scientists and engineers in AFLC in the amount of feedback they receive. A t-test was used to test this hypothesis, and the results, presented in Table 19, do not permit rejection of Hypothesis 8. Therefore, we can conclude that there is no significant difference between scientists and engineers in AFLC in the amount of feedback they receive.

Table 19

Feedback

Hypothesis 8 - Feedback

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	2.73	0.95	0.02				
Scientists	117	2.90	1.01	0.09	1.13	-1.89	2198	0.06

Investigative Question #9. This investigative question provides the basis for Hypothesis 9, which states that there is no difference between scientists and engineers in AFLC in the degree of job involvement experienced in their work. A t-test was used to test this hypothesis. The results, presented in Table 20, do allow rejection of the hypothesis. We therefore conclude that there is a significant difference between scientists and engineers in AFLC in the degree of job involvement experienced from their work.

Table 20

Job Involvement
(Participation in Work)

Hypothesis 9 - Job Involvement

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	2083	4.32	1.47	0.03				
Scientists	117	4.59	1.58	0.15	1.15	-1.94	2198	0.05

Investigative Question #10. This investigative question formed the basis for Hypothesis 10, which states that there is no difference between scientists and engineers in AFLC in how each group asseses the importance of professional continuing education. A t-test was used to test this hypothesis. The results, presented in Table 21, do not support rejection of Hypothesis 10 at a probability level of at least 95 percent. We conclude therefore that there is no significant difference between scientists and engineers in AFLC in how each group assesses the importance of professional continuing education.

Table 21

PCE Importance

Hypothesis 10 - Importance of PCE

	N	MEAN	SD	SE	F	t	df	PROB
Engineers	1641	1.89	1.14	0.03				
Scientists	96	2.15	1.44	0.15	1.58	-1.69	1735	0.09

Section II. Discussion of Findings

Investigative Question #1.

Age. When the responses from all the scientists and engineers were combined, 58.7 percent of the respondents were found to be under 40 years of age. Previous analysis (see Table 4) revealed that electronics engineers were the youngest group and the scientists were the oldest group. Table 22 provides the percentages of males and females by job series of all the respondents. Analyses of these data reveal that: (1) 621 (63.8 percent) male electronics engineers are 40 years of age or less, while 75 (90.4 percent) females in the same category are 40 years of age or less; (2) 482 (49.9 percent) all other types of male engineers are 40 years of age or less, while 56 (93.3

percent) females in the same category are 40 years of age or less; and (3) 42 (43.3 percent) male scientists are 40 years of age or less, while 13 (65 percent) females in the same category are 40 years old or less. There is a larger percentage of females who are 40 years of age or younger in the scientific and engineering work force in AFLC than there are males in the same category.

When focusing on older employees, the data indicate that: (1) 158 (16.2 percent) male electronics engineers are over 50 years of age, while 2 (2.4 percent) females in the same category are over 50 years of age; (2) 256 (26.5 percent) all other types of male engineers are over 50 years of age, while 3 (5.0 percent) females in the same category are over 50 years of age; and (3) 20 (20.6 percent) male scientists are over 50 years of age, while 4 (20.0 percent) females in the same category are over 50 years of age. If AFLC desires a more equitable distribution of sexes across the various categories, this analysis would support a policy of hiring females in the scientific career field.

Table 22

The Scientific and Engineering Work Force
(By Job Series, By Age, and By Sex)

Age Groups	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
20 to 30	361 (37.1%)	53 (63.9%)	270 (28.0%)	44 (73.3%)	7 (7.2%)	6 (30.0%)
30 to 40	260 (26.7%)	22 (26.5%)	212 (21.9%)	12 (20.0%)	35 (36.1%)	7 (35.0%)
40 to 50	194 (19.9%)	6 (7.2%)	228 (23.6%)	1 (1.7%)	35 (36.1%)	3 (15.0%)
50 to 60	134 (13.8%)	3 (3.6%)	214 (22.2%)	2 (3.3%)	16 (16.5%)	2 (10.0%)
More Than 60	24 (2.5%)	1 (1.2%)	42 (4.3%)	1 (1.7%)	4 (4.1%)	2 (40.0%)

Education Level. Recall that scientists have the highest level of formal education and electronics engineers have the lowest level of formal education. Table 23 provides a display of the educational level of the scientific and engineering work force in AFLC with respect to job series and sex. Female electronics engineers and other types of female engineers have a higher percentage of B. S. degrees than do their male counterpart. The female scientists have accured more graduate course work towards an M. S. degree than do have their other male and female counterparts. The male scientists have the highest percentage of M. S. and PhD degrees.

Table 23

The Educational Level
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

Educational Level	Electronics Engineers M	Electronics Engineers F	All Other Engineers M	All Other Engineers F	Scientists M	Scientists F
HS	1 (0.1%)	0 (0.0%)	1 (0.1%)	1 (1.7%)	0 (0.0%)	0 (0.0%)
HS+	4 (0.4%)	0 (0.0%)	2 (0.2%)	0 (0.0%)	1 (1.0%)	0 (0.0%)
Assoc	3 (0.3%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	1 (5.0%)
BS/BA	503 (50.7%)	51 (61.4%)	442 (45.8%)	34 (56.7%)	44 (45.4%)	8 (40.0%)
BS/BA+	299 (30.7%)	22 (26.5%)	319 (33.0%)	13 (21.7%)	26 (26.8%)	9 (45.0%)
MS/MA	107 (11.0%)	7 (8.4%)	139 (14.4%)	9 (15.0%)	17 (17.5%)	1 (5.0%)
MS/MA+	50 (5.1%)	3 (3.6%)	51 (5.3%)	3 (5.0%)	5 (5.2%)	1 (5.0%)
PhD	5 (0.5%)	0 (0.0%)	10 (1.0%)	0 (0.0%)	2 (2.1%)	0 (0.0%)
PhD+	1 (0.1%)	0 (0.0%)	1 (0.1%)	0 (0.0%)	2 (2.1%)	0 (0.0%)

Sex. Previous analysis reported that 92.7 percent of the respondents were males, 7.3 percent were females, and that the scientific career field contains the largest percentage of females while the smallest percentage of females were in the other than electronics engineering group. Table 22 presents a distribution of the male and female scientists and engineers by job series and age groups. Table 23 portrays the number of the males and females compared across level of education and job series.

Time on Station. Electronics engineers have been in their present assignment almost 24 months; all other types of engineers have been in their present assignment a little over 24 months; and the scientists have been in their present positions of assignment almost 36 months. As shown in Table 24, a larger percentage of male engineers, regardless of type, have been on station longer than their female counterparts; male scientists have been on station slightly longer than their female counterparts; and male and female scientists have been on station longer than their male and female engineering counterparts.

Table 24

Total Months in Present Position of Assignment
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

Time In Months	Electronics Engineers M	Electronics Engineers F	All Other Engineers M	All Other Engineers F	Scientists M	Scientists F
Less Than 1	9 (0.9%)	0 (0.0%)	2 (0.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
> 1 - < 6	44 (4.5%)	4 (4.8%)	44 (4.6%)	5 (8.3%)	4 (4.2%)	1 (5.0%)
> 6 - < 12	98 (10.1%)	8 (9.6%)	90 (9.3%)	7 (11.7%)	9 (9.5%)	2 (10.0%)
> 12 - < 18	55 (5.7%)	6 (7.2%)	56 (5.8%)	7 (11.7%)	6 (6.3%)	3 (15.0%)
> 18 - < 24	132 (13.6%)	20 (24.1%)	90 (9.3%)	12 (20.0%)	6 (6.3%)	0 (0.0%)
> 24 - < 36	215 (22.1%)	19 (22.9%)	234 (24.2%)	17 (28.3%)	11 (11.6%)	5 (25.0%)
> 36 - < 48	107 (11.0%)	10 (12.0%)	120 (12.4%)	5 (8.3%)	8 (8.4%)	3 (15.0%)
More than 48 Months	312 (32.1%)	16 (19.3%)	329 (34.1%)	7 (11.7%)	51 (53.7%)	6 (30.0%)

Years in AFLC. The average tenure of the electronics engineers is more than 4 years but less than 5 years; the average tenure of all other types of engineers is more than 5 years but less than 6 years; and the average tenure for the scientists is almost 6 to 8 years. Table 25 shows how the amount of time that scientists and engineers have been in AFLC is distributed across job series for each sex.

Table 25

Total Years in AFLC
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

Time In Years	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Less Than 1	45 (4.6%)	5 (6.1%)	43 (4.5%)	2 (3.3%)	4 (4.1%)	0 (0.0%)
1 But < 2	119 (12.3%)	14 (17.1%)	68 (7.0%)	19 (31.7%)	4 (4.1%)	1 (5.0%)
2 But < 3	149 (16.3%)	18 (22.0%)	167 (17.3%)	13 (21.7%)	6 (6.2%)	3 (15.0%)
3 But < 4	78 (8.0%)	10 (12.2%)	96 (9.9%)	7 (11.7%)	9 (9.3%)	4 (20.0%)
4 But < 5	66 (6.8%)	8 (9.8%)	52 (5.4%)	4 (6.7%)	1 (1.0%)	0 (0.0%)
5 But < 6	71 (7.3%)	11 (13.4%)	62 (6.4%)	7 (11.7%)	8 (8.2%)	2 (10.0%)
6 TO 8	133 (13.7%)	12 (14.6%)	94 (9.7%)	3 (5.0%)	19 (19.6%)	5 (25.0%)
9 TO 10	75 (7.7%)	2 (2.4%)	48 (5.0%)	2 (2.3%)	4 (4.1%)	1 (5.0%)
11 TO 16	78 (8.0%)	0 (0.0%)	72 (7.5%)	1 (1.7%)	7 (7.2%)	2 (10.0%)
16 Or More	157 (16.2%)	2 (2.4%)	264 (27.3%)	2 (3.3%)	35 (36.1%)	2 (10.0%)

Table 25 is consistent with the data in Table 8. That is, male and female scientists have been in AFLC longer than their engineering counterparts, and male and female electronics engineers have been in AFLC the shortest amount of time.

Number of People Supervised and Grade Level. Previous analysis showed how the average grade level for the scientific and engineering work force in AFLC was a GS-12 (see Table 10). In a typical federal government organization, a GS-12 will usually have supervisory responsibility. In AFLC however, 98.2 percent of the GS-12 electronics engineers, 95.2 percent of all other types of GS-12 engineers, and 87.8 percent of the GS-12 scientists do not supervise anyone. When the scientists and engineers in AFLC reach the GS-13 grade level, the number who report having supervisory responsibilities increases substantially. Of the 333 scientists and engineers who are presently in the grade of GS-13, 59.4 percent of the electronics engineers, 60.6 percent of all other types of engineers, and 100 percent of the scientists supervise one or more individuals. Scientists in grades of GS-12 and above, have the most supervisory responsibility and the largest percentage (47.3 percent) of AFLC's engineering population, electronics engineers, have the least supervisory responsibility.

Number of Co-workers With Similar Job Series. Electronics engineers appeared to work with the largest number of co-workers who have similar job series. Other types of engineers have the smallest number of co-workers with a similar job series.

Investigative Question #2. In earlier analyses, we did not reject Hypothesis 2 and we concluded that there is no difference in job satisfaction between scientists and engineers in AFLC. Further investigation, reported in Table 26, indicates that there is a significant difference between electronics engineers and all other types of engineers with respect to job satisfaction, and that all other types of engineers experience higher job satisfaction than do electronics engineers. Table 27 provides a composite view of how the different types of scientists and engineers in AFLC actually perceived their jobs, their co-workers, and the work itself (overall job satisfaction). Overall, 65.8 percent of the entire work force reported being satisfied with their job. The results indicate that 64.0 percent of the electronics engineers expressed positive feelings about overall job satisfaction, while 67.3 percent of all other types of engineers reported having varying amounts of overall job satisfaction. When the three questions on job satisfaction were viewed separately, the individual responses indicate that the scientists and engineers were more satisfied with their job and the work itself than with their co-workers. This is an interesting finding because the literature indicates that scientists and engineers usually do not like working alone or being the "token" scientist or engineer in a work place. In general, scientists and engineers are more satisfied when their work group is made up of other scientists and engineers.

Table 26

Job Satisfaction

Hypothesis 2 - Job Satisfaction

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	4.75	0.99	0.03				
Scientists	117	4.76	1.01	0.09	1.04	-0.15	1172	0.88
Other Engrs	1026	4.86	0.97	0.03				
Scientists	117	4.76	1.01	0.09	1.08	-1.01	1141	0.31
Elect Engrs	1057	4.75	0.99	0.03				
Other Engrs	1026	4.86	0.97	0.03	1.04	-2.58	2081	0.01

Table 27

Overall Job Satisfaction
for the Scientific and Engineering Work Force
(By Job Series)

Job Satisfaction Rating	Electronics Engineers	All Other Engineers	Scientists
Terrible	4	2	0
Unhappy	27	16	3
Mostly Dissatisfied	77	71	12
Mixed	273	246	27
Mostly Satisfied	450	407	52
Pleased	203	256	19
Delighted	23	29	4
TOTAL	1057	1027	11

Investigative Question #3. Investigative question # 3 produced two hypotheses. Previous analyses could not support rejection of Hypothesis 3.1. Therefore, we can say that there is no difference in the time until retirement between scientists and engineers in AFLC. However, further investigation, presented in Table 28, reveals that there is a significant difference in the time until retirement between scientists and electronics engineers and between the different types of engineers. The indication is that all other types of engineers will retire earlier than scientists or electronics engineers. Table 29 provides a detailed assessment of the number of years remaining before male and female scientists and engineers in the AFLC work force are eligible to retire.

The support for Hypothesis 3.2 confirms there is no significant difference in the amount of time that scientists and engineers in AFLC plan to remain with the government. However further investigation, presented in Table 28, reveals that there is a significant difference in the amount of time that scientists and electronics engineers in AFLC plan to remain with the government. There is also a significant difference in the amount of time that different types of engineers in AFLC plan to remain with the government. Table 30 provides the actual retirement intentions of the male and female scientists and engineers in AFLC. These data indicate that scientists plan to remain with the government until they are eligible to retire and that electronics engineers do not plan to remain with government service until they are eligible to retire. Female scientists and engineers plan to leave government service earlier than their male counterparts. These results suggest that personnel managers in AFLC may want to consider implementing policies that would cause more females to remain in the scientific and engineering work force.

Table 28

Retirement Intentions

Hypothesis 3.1 - Number of Years Before Retirement

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1055	9.11	2.24	0.07				
Scientists	116	8.59	2.67	0.25	1.41	2.04	1169	0.02
Other Engrs	1026	8.38	2.92	0.09				
Scientists	116	8.59	2.67	0.25	1.20	0.71	1140	0.48
Elect Engrs	1055	9.11	2.24	0.07				
Other Engrs	1026	8.38	2.92	0.09	1.70	6.35	2079	0.00

Hypothesis 3.2 - Do You Plan To Stay In AFLC Until Retirement

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	1.81	0.77	0.02				
Scientists	117	1.53	0.68	0.06	1.28	4.23	1172	0.00
Other Engrs	1026	1.62	0.72	0.06				
Scientists	117	1.53	0.68	0.06	1.14	-1.30	1141	0.19
Elect Engrs	1057	1.81	0.77	0.02				
Other Engrs	1026	1.62	0.72	0.06	1.12	5.86	2081	0.00

Table 29

Number Of Years Before Eligible to Retire
for the Scientific and Engineering Work Force
(By Job Series and By Sex)

Time In Years	Electronics Engineers M	Electronics Engineers F	All Other Engineers M	All Other Engineers F	Scientists M	Scientists F
Less Than 1	37 (3.8%)	1 (1.2%)	72 (7.5%)	2 (3.3%)	4 (4.2%)	2 (10.0%)
1 But < 2	2 (0.2%)	1 (1.2%)	18 (1.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
2 But < 3	22 (2.3%)	1 (1.2%)	32 (3.3%)	0 (0.0%)	6 (6.3%)	0 (0.0%)
3 But < 4	19 (2.0%)	1 (1.2%)	29 (3.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)
4 But < 5	12 (1.2%)	1 (1.2%)	22 (2.3%)	0 (0.0%)	3 (3.1%)	0 (0.0%)
5 But < 6	27 (2.8%)	0 (0.0%)	45 (4.7%)	0 (0.0%)	8 (8.3%)	0 (0.0%)
6 But < 7	19 (2.0%)	0 (0.0%)	31 (3.2%)	0 (0.0%)	2 (2.1%)	0 (0.0%)
7 But < 8	22 (2.3%)	0 (0.0%)	19 (2.0%)	1 (1.7%)	2 (2.1%)	0 (0.0%)
8 But < 9	20 (2.1%)	1 (1.2%)	23 (2.4%)	2 (3.3%)	5 (5.2%)	0 (0.0%)
9 Or More	790 (81.4%)	78 (94.0%)	674 (69.8%)	55 (91.7%)	65 (67.7%)	18 (90.0%)

Table 30

Retirement Intentions
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Do You Plan to Remain In Government Service Until Eligible To Retire?						
Yes	392 (40.4%)	20 (24.1%)	518 (53.6%)	18 (30.0%)	61 (62.9%)	6 (30.0%)
Not Sure	182 (18.7%)	26 (31.3%)	134 (13.9%)	13 (21.7%)	6 (6.2%)	6 (30.0%)
No	397 (40.9%)	37 (44.6%)	315 (32.6%)	29 (48.3%)	30 (30.9%)	8 (40.0%)

Investigative Question #4. The support for Hypothesis 4 means that there is no difference in organizational commitment among scientists and engineers in AFLC. Further analysis, presented in Table 31, revealed there is a significant difference in organizational commitment between electronics engineers and all other types of the engineers. Overall, electronics engineers experience less organizational commitment than all other types of engineers. Table 32 provides a composite view of the 15 different individual organizational commitment questions asked of the male and female scientists and engineers in AFLC.

In summary, a large percentage (40.7 percent for males and 46.7 percent for females) of all other types of engineers had positive attitudes toward organizational commitment, and a somewhat smaller percentage (35.2 percent for males and only 26.5 percent for females) of electronics engineers also reported positive feelings toward organizational commitment. Female electronics engineers had the least amount of organizational commitment. AFLC may therefore want to examine current goals and organizational policies to determine whether or not these goals and policies encourage retention of electronics engineers, both male and female, in the organization.

Table 31

Organizational Commitment

Hypothesis 5 -Organizational Commitment

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	4.00	1.21	0.04				
Scientists	117	3.95	1.30	0.12	1.15	0.36	1172	0.72
Other Engrs	1026	4.10	1.23	0.04				
Scientists	117	3.95	1.30	0.12	1.11	-1.22	1141	0.22
Elect Engrs	1057	4.00	1.21	0.04				
Other Engrs	1026	4.10	1.23	0.04	1.03	-1.95	2081	0.05

Table 32

Overall Organizational Commitment
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

Scale	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Strongly Disagree	15 (1.5%)	3 (3.6%)	11 (1.1%)	0 (0.0%)	3 (3.1%)	1 (5.0%)
Moderately Disagree	100 (10.3%)	8 (9.6%)	113 (11.7%)	5 (8.3%)	14 (14.4%)	3 (15.0%)
Slightly Disagree	206 (21.2%)	23 (27.8%)	188 (19.4%)	15 (25.0%)	19 (19.6%)	2 (10.0%)
Neutral	308 (31.8%)	27 (32.5%)	261 (27.1%)	12 (20.0%)	22 (22.7%)	6 (30.0%)
Slightly Agree	230 (23.6%)	12 (14.5%)	264 (27.4%)	18 (30.0%)	25 (25.8%)	4 (20.0%)
Moderately Agree	105 (10.8%)	9 (10.8%)	122 (12.6%)	9 (15.0%)	14 (14.4%)	4 (20.0%)
Strongly Agree	8 (0.8%)	1 (1.2%)	7 (0.7%)	1 (1.7%)	0 (0.0%)	0 (0.0%)

Investigative Question #5. The support for Hypothesis 5 suggests that there is no difference in the level of perceived participative decision making experienced by scientists and engineers in AFLC. Further investigation, presented in Table 33, indicates that there is a significant difference between scientists and all other types of engineers and between electronics engineers and all other types of engineers in the extent to which each group is allowed to participate in decisions about their jobs. Table 34 shows whether or not the male and female scientists and engineers in AFLC think they have the opportunity to participate freely in making the decisions which directly affects their work group or their job. Analysis of the table indicates that the other types of engineers perceive that they are allowed to participate more frequently in the decisions regarding their jobs, while scientists report having the least opportunity to participate in the decisions directly impacting their jobs. Overall, both the scientists and engineers agree that members of their work groups are allowed to participate freely in making decisions. They believe that they have a significant influence in making the decisions which most affect them and agree that there is a great deal of opportunity to be involved in resolving problems which affect their work groups.

Table 33

Participative Decision Making

Hypothesis 5 - Participative Decision Making Opportunity

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	5.32	1.80	0.06				
Scientists	117	5.13	1.84	0.17	1.05	1.05	1172	0.29
Other Engrs	1026	5.61	1.88	0.06				
Scientists	117	5.13	1.84	0.17	1.04	-2.61	1141	0.01
Elect Engrs	1057	5.32	1.80	0.06				
Other Engrs	1026	5.61	1.88	0.06	1.09	-3.63	2081	0.00

Table 34

Extent of Perceived Participative Decision Making Experienced by the Scientific and Engineering Work Force (By Job Series and By Sex)

Scale	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Strongly Disagree	24 (2.5%)	3 (3.6%)	22 (2.3%)	1 (1.7%)	2 (2.1%)	1 (5.0%)
Moderately Disagree	47 (4.8%)	6 (7.2%)	38 (3.9%)	3 (5.0%)	6 (6.2%)	1 (5.0%)
Slightly Disagree	80 (8.2%)	9 (10.8%)	73 (7.5%)	6 (10.0%)	12 (12.4%)	2 (10.0%)
Neutral	124 (12.7%)	8 (9.6%)	135 (14.0%)	5 (8.3%)	15 (15.5%)	5 (25.0%)
Slightly Agree	173 (17.8%)	16 (19.3%)	135 (14.0%)	6 (10.0%)	12 (12.4%)	3 (15.0%)
Moderately Agree	210 (21.6%)	19 (22.9%)	183 (18.9%)	11 (18.3%)	19 (19.6%)	3 (15.0%)
Strongly Agree	315 (32.4%)	22 (26.6%)	381 (39.4%)	28 (46.7%)	31 (32.0%)	5 (25.0%)

Investigative Question #6. Because the tests did not support Hypothesis 6, there is a significant difference in how scientists and engineers in AFLC relate to the members of their particular work group. Table 35 describes the degree to which the male and female scientists and engineers in AFLC report experiencing group cohesion. A review of the table indicates that: (1) 24.1 percent of the male electronics engineers and 27.7 percent of the female electronics engineers reported having little or no work group cohesion, 20.8 percent of the males and 26.5 percent of the females gave neutral responses, and 55.1 percent of the males and 45.8 percent of their female counterparts reported experiencing some degree of group cohesion; (2) 23.2 percent of all other types of male engineers and 14.9 percent of all other types of female engineers reported having little work group cohesion, 20.1 percent of the males and 18.3 percent of their female counterparts gave neutral answers to work group cohesion, and 56.6 of the males and 66.7 percent of their female counterparts experience work group cohesion; and (3) 34.0 percent of the male scientists and 35.0 percent of the female scientists 56 reported having little or no work group cohesion, 25.8 percent of the males and 15.0 percent of their female counterparts gave neutral responses to work group cohesion, and 40.3 percent of the males and 50.0 percent of their female counterparts reported experiencing some level of work group cohesion. Females in general, with the exception of female electronics engineers, reported having experienced more work group cohesion than their male counterparts, and all other types of male and female engineers reported having experienced the highest degree of work group cohesion.

Table 35

Extent of Work Group Cohesion Experienced by the Scientific and Engineering Work Force (By Job Series and By Sex)

Scale	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Strongly Disagree	27 (2.8%)	3 (3.6%)	37 (3.8%)	5 (8.3%)	8 (8.2%)	3 (15.0%)
Moderately Disagree	84 (8.6%)	9 (10.8%)	61 (6.3%)	2 (3.3%)	10 (10.3%)	2 (10.0%)
Slightly Disagree	124 (12.7%)	11 (13.3%)	127 (13.1%)	2 (3.3%)	15 (15.5%)	2 (10.0%)
Neutral	202 (20.8%)	22 (26.5%)	194 (20.1%)	11 (18.3%)	25 (25.8%)	3 (15.0%)
Slightly Agree	258 (26.5%)	15 (18.1%)	274 (28.3%)	19 (31.7%)	18 (18.6%)	2 (10.0%)
Moderately Agree	223 (22.9%)	17 (20.5%)	219 (22.6%)	11 (18.3%)	19 (19.6%)	6 (30.0%)
Strongly Agree	55 (5.7%)	6 (7.2%)	55 (5.7%)	10 (16.7%)	2 (2.1%)	2 (10.0%)

Investigative Question #7. Previous analysis did not support Hypothesis 7. From Table 36, one can also infer that scientists expressed having more goal clarity in their jobs than did both the electronics engineers and all other types of engineers ($p \le .05$). Table 37 provides an actual account of how clear the work goals were for male and female scientists and engineers in AFLC. Using this table, one can infer that scientists, both male and female, experienced more work goal clarity than do their engineering counterparts, and that electronics engineers, females more so than males, experience the least amount of work goal clarity in their jobs.

Table 36

Goal Clarity

Hypothesis 7 - Goal Clarity

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	4.48	1.70	0.05				
Scientists	117	5.04	1.61	0.15	1.10	-3.39	1172	0.00
Other Engrs	1026	4.58	1.69	0.05				
Scientists	117	5.04	1.61	0.15	1.09	2.89	1141	0.00
Elect Engrs	1057	4.48	1.70	0.05				
Other Engrs	1026	4.58	1.69	0.05	1.02	-1.37	2081	0.17

Table 37

Work Goal Clarity
of the Scientific and Engineering Work Force
(By Job Series and By Sex)

Scale	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Strongly Disagree	47 (5.4%)	5 (6.0%)	56 (5.8%)	1 (1.7%)	3 (3.1%)	0 (0.0%)
Moderately Disagree	96 (9.9%)	8 (9.6%)	90 (9.3%)	2 (3.3%)	5 (5.2%)	2 (10.0%)
Slightly Disagree	121 (12.4%)	14 (16.9%)	104 (10.8%)	7 (11.7%)	11 (11.3%)	1 (5.0%)
Neutral	129 (13.3%)	19 (22.9%)	127 (13.1%)	8 (13.3%)	9 (9.3%)	1 (5.0%)
Slightly Agree	198 (20.3%)	10 (12.0%)	197 (20.4%)	12 (20.0%)	23 (23.7%)	4 (20.0%)
Moderately Agree	272 (28.0%)	18 (21.7%)	289 (29.9%)	21 (35.0%)	26 (26.8%)	6 (30.0%)
Strongly Agree	104 (10.7%)	9 (10.8%)	104 (10.8%)	9 (15.0%)	20 (20.6%)	6 (30.0%)

<u>Investigative Question #8</u>. Hypothesis 8 was supported. Further analysis, presented in Table 38, indicates that there is a significant difference in the amount of feedback received between the scientists and electronics engineers. The t-tests confirmed that there were no other differences between other groups. Table 39 describes the job feedback received by the male and female

scientists and engineers in AFLC. Data in the table reveal that scientists, both male and female, received the most feedback while electronics engineers, both male and female, received the least.

Table 38

Feedback

Hypothesis 8 - Feedback

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	2.72	0.95	0.03				
Scientists	117	2.90	1.01	0.09	1.13	-2.01	1172	0.05
Other Engrs	1026	2.75	0.95	0.09				
Scientists	117	2.90	1.01	0.09	1.13	1.66	1141	0.10
Elect Engrs	1057	2.72	0.95	0.03				
Other Engrs	1026	2.75	0.95	0.09	1.00	-0.77	2081	0.44

Table 39

Extent of Job Feedback for
the Scientific and Engineering Work Force
(By Job Series and By Sex)

Scale	Electronics Engineers		All Other Engineers		Scientists	
	M	F	M	F	M	F
Very Little	104 (10.7%)	14 (16.9%)	98 (10.1%)	5 (8.3%)	9 (9.3%)	3 (15.0%)
Little	298 (30.6%)	24 (28.9%)	293 (30.3%)	15 (25.0%)	23 (23.7%)	6 (30.0%)
Moderate Amount	380 (30.1%)	33 (39.8%)	379 (39.2%)	27 (45.0%)	34 (35.1%)	7 (35.0%)
Much	153 (15.7%)	8 (9.6%)	164 (17.0%)	11 (18.3%)	25 (25.8%)	3 (15.0%)
Very Much	38 (3.9%)	4 (4.8%)	33 (3.4%)	2 (3.3%)	6 (6.2%)	1 (5.0%)

<u>Investigative Question #9</u>. Hypothesis 9 was rejected. Further investigations, presented in Table 40, revealed that there is also a significant difference between electronics engineers and scientists in the degree of job involvement experienced in their work. Table 41 potrays the degree of participation in work experienced by the male and female scientists and engineers in AFLC. From this table, one can see that scientists, both male and

female, believe that they most often have an opportunity to try out their own ideas and have a chance to do things their own way. Electronics engineers, in constrast, experience the least job involvement of any group.

Table 40

Job Involvement
(Participation in Work)

Hypothesis 9 - Job Involvement

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	1057	4.23	1.46	0.05				
Scientists	117	4.59	1.58	0.15	1.17	-2.50	1172	0.02
Other Engrs	1026	4.40	1.47	0.05				
Scientists	117	4.59	1.58	0.15	1.15	1.29	1141	0.23
Elect Engrs	1057	4.23	1.46	0.05				
Other Engrs	1026	4.40	1.47	0.05	1.02	-2.68	2081	0.01

Table 41

Job Involvement (Participation in Work) of the Scientific and Engineering Work Force (By Job Series and By Sex)

	Electronics Engineers		All Other Engineers		Scientists	
Scale	M	F	M	F	M	F
Strongly Disagree	39 (4.0%)	24 (2.5%)	30 (3.1%)	22 (2.3%)	2 (2.1%)	2 (2.1%)
Moderately Disagree	92 (9.5%)	8 (9.6%)	95 (9.8%)	3 (5.0%)	10 (10.3%)	3 (15.0%)
Slightly Disagree	175 (18.0%)	18 (21.7%)	152 (15.7%)	9 (15.0%)	9 (9.3%)	2 (10.0%)
Neutral	208 (21.4%)	20 (24.1%)	207 (21.4%)	17 (28.3%)	23 (23.7%)	4 (20.0%)
Slightly Agree	243 (25.0%)	17 (20.5%)	231 (16.7%)	10 (16.7%)	22 (22.7%)	2 (10.0%)
Moderately Agree	176 (18.1%)	15 (18.1%)	192 (19.9%)	19 (31.7%)	20 (20.6%)	5 (25.0%)
Strongly Agree	40 (4.1%)	2 (2.4%)	60 (6.2%)	1 (1.7%)	11 (11.3%)	3 (15.0%)

Investigative Question #10. Hypothesis 10 was confirmed meaning that there is no significant difference between scientists and engineers in AFLC in how each group assesses of the importance of professional continuing education (PCE), with respect to keeping them informed on the latest technological advances in their career field. Additional analyses, presented in Table 42, confirmed that there is also a significant difference between scientists and all other types of engineers. Scientists believe that PCE was not as important to them as it apparently is to all the other types of engineers. Additionally, 92.6 percent of the male electronics engineers and 98.3 percent of the female electronics engineers believe PCE to be very important; 93.6 percent of all other types of male engineers and 97.9 percent of their female counterparts perceived PCE to be equally as important. There were also 87.6 percent of the male scientists and 81.3 percent of their female counterparts who thought that PCE was also very important. Overall, the female engineers thought PCE was more important than did their male counterparts.

Table 42

PCE Importance

Hypothesis 10 - Importance of PCE

	N	MEAN	SD	SE	F	t	df	PROB
Elect Engrs	836	1.92	1.19	0.04				
Scientists	96	2.15	1.44	0.15	1.47	-1.46	930	0.15
Other Engrs	805	1.86	1.10	0.04				
Scientists	96	2.15	1.44	0.15	1.71	2.30	899	0.02
Elect Engrs	836	1.92	1.19	0.04				
Other Engrs	805	1.86	1.10	0.04	1.17	1.06	1639	0.29

V. Conclusions and Recommendations

Overview

The chapter will present conclusions about each of the investigative questions, and offer appropriate recommendations for future research in this area.

Conclusion for Investigative Question #1

Almost 60 percent of the scientific and engineering work force in AFLC is 40 years of age or younger, and approximately 20 percent of the work force is 50 years of age or older.

A typical electronics engineer is: a male; less than 36 years old; has a B.S. degree in electrical engineering with some graduate level courses; has been in his present of assignment less than 24 months; has been with AFLC less than 5 years; has a grade level of GS-11/12; works with an average of five other electronics engineers; and does not supervise anyone.

The group of all other types of engineers is composed of the following: general engineers, engineering technicians, safety engineers, materials engineers, landscape architects, civil engineers, environmental engineers, mechanical engineers, nuclear engineers, aerospace engineers, ceramic engineers, chemical engineers, and industrial engineers. A typical engineer in this category is: a male; 36 to 40 years of age; has a B.S.

degree in mechanical engineering, electrical engineering, aeronautical engineering, chemical engineering, other engineering fields, or other technical areas; has been in his present position of assignment more than 24 months but less than 36 months; has been with AFLC more than five years but less than six years; has a grade level of GS-11/12; works with an average of 3 other engineers with job series like themselves; and does not supervise anyone.

In contrast, the typical scientists is; a male; almost 40 years of age; has a B.S. degree with some graduate level courses in a scientific area; has been in his current position of assignment almost 36 months; has been with AFLC between six to eight years; has a grade level of GS-11; works with an average of four other scientists; and does not supervise anyone.

Conclusion for Investigative Question #2

Overall, the scientists and engineers in AFLC expressed positive feelings about job satisfaction, with actual responses ranging from delighted to terrible about how they felt about their jobs, how they felt about their co-workers, and how they felt about the work itself. Overall, 76.8 percent reported having a positive attitude toward job satisfaction. Neither the scientists nor the engineers expressed more job satisfaction than the other, but rather both groups expressed the same general level of positive satisfaction for their jobs in AFLC.

Approximately 53 percent of all respondents expressed satisfaction with their jobs; approximately 80 percent expressed satisfaction with their co-workers; and approximately 61 percent expressed satisfaction with the work itself.

<u>Conclusion for Investigative Question #3</u>

Approximately 76 percent of the total scientific and engineering work force in AFLC have nine or more years remaining in government service before they are eligible to retire, and approximately 50 percent of the total work force plans to remain in government service until they are eligible to retire. More importantly for AFLC policies, approximately 50 percent of the total population have either expressed feelings of uncertainty about future employment intentions or have indicated that they would definitely not remain in government service until they were eligible to retire.

Even though the scientific work force will retire sooner than the engineering work force, a larger percentage of the scientists compared to the engineers plan to remain in government service until they are eligible to retire.

<u>Conclusion for Investigative Question #4</u>

Scientists and engineers in AFLC express generally neutral commitment to the organization. This level of commitment is unexpected given the large percentage (63.7

percent) who reported feeling loyalty to AFLC and 77.7 percent were willing to put in a great deal of effort beyond that normally expected of them in order to help AFLC be successful. A possible explanation for this inconsistency is that engineers and scientists have been shown by other studies to have a greater commitment towards their profession than to the organization where presently working.

Conclusion for Investigative Question #5

Overall, engineers perceived their degree of participative decision making (the degree they participated freely in making decisions affecting their jobs) to be slightly higher than that of the scientists; however, both groups felt they were allowed to participate in decisions regarding their jobs. Approximately 70 percent of all respondents gave an affirmative answer when asked if they were allowed to participate in decisions regarding their job.

Conclusion for Investigative Question #6

Engineers other than electronics engineers reported that they were somewhat closer to their co-workers than did electronics engineers or scientists. Non-electronics engineers also felt a higher spirit of teamwork and group cohesiveness among their co-workers than did electronics engineers.

Conclusion for Investigative Question #7

Scientists experienced more goal clarity in their work than did non-electronics engineers or electronics engineers, and they knew more of what was expected of them in performing their jobs. Scientific jobs when compared to engineering jobs were more clearly defined with respect to exactly how the job was to be performed.

Conclusion for Investigative Question #8

Scientists received more feedback than engineers about job performance and other job related items. Overall, the scientists and engineers in AFLC reported experiencing some degree of job feedback. Approximately 70 percent of all responses ranged from a moderate amount to receiving very much feedback.

Conclusion for Investigative Question #9

Scientists experience a greater degree of job involvement in their jobs than engineers. Both groups agreed that they experienced some degree of job autonomy in their current positions. In general when scientists and engineers in AFLC were asked if they had a chance to use the skills they had learned to perform their job, approximately 60 percent responded in the affirmative. Approximately 64 percent of the scientists and engineers in AFLC reported that they often had a chance to do things their own way when performing their jobs. This is important because the literature suggests that scientists and engineers desire a job that provides them substantial freedom, independence, and discretion in determinating the procedures to be used in performing that job.

Conclusion for Investigative Question #10

Both engineers and scientists believe that professional continuing education is very important in keeping them informed on the latest technological advances in their field. Support for PCE is expected, given how quickly engineering and scientific knowledge can become obsolete. The scientists and engineers are concerned, however, that AFLC management does not support PCE, in terms of quotas and TDY dollars, at the level desired by the respondents.

Recommendations

This study was an initial research investigation into the demographic characteristics and the work attitudes of the civil service scientists and engineers in AFLC.

Areas of Future Research.

1. Replicate this study and determine whether or not scientists and engineers from other commands when compared to scientists and engineers from AFLC have the same or different work attitudes toward job satisfaction, organizational commitment, retirement, and other related items.

2. The results of this investigations suggests that scientists and engineers in AFLC have little or no organizational commitment. Suggest further investigation to determine the reasons for the lack of organizational commitment.

3. Approximately 65 percent of the scientific and engineering work force have expressed uncertainty or have indicated that they definitely will not remain in government service until they are eligible to retire. Of all the engineers in AFLC, electronics engineers, both male and female, make up the greatest percentage of this group (males - 59.6 percent and females - 75.9 percent). This investigation suggests that a larger percentage of female scientists and engineers than of male scientists and engineers do not plan to stay in government service. Suggest further investigation be done to determine the reasons why females are more likely to leave government service before retirement than are their male counterparts.

Appendix: Cover Letter and Survey Instrument

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE LOGISTICS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-5001

1 7 MAR 1988

REPLY TO ATTN OF: CCN

SUBJECT: Survey of AFLC Scientists and Engineers

TO: All AFLC Engineers or Scientists

1. As AFLC's first chief scientist and engineer, I plan to implement a civilian career enhancement program that will allow the command to program education and training to help you stay current in your career fields. Before I can implement such a program, I need some information from you about your current needs and concerns as scientists and engineers. In order to gather the necessary information, I have asked the Air Force Institute of Technology to develop and administer the attached survey. Please take time out of your busy schedule to complete and return the survey and response sheets in the envelopes provided.

2. Your anonymous responses will be mailed directly to AFIT who will then perform data analysis and write a final report that will be provided to me. At no time will anyone associated with AFLC or AFIT be able to identify individual responses.

3. Please respond to this survey and return it to AFIT. Thank you for your time and cooperation.

EARL W. BRIESCH
AFLC Chief Scientist/Engineer

1 Atch
AFLC Scientists and Engineers Survey

AFLC COMBAT STRENGTH THROUGH LOGISTICS

Survey Instrument -USAF SCN 85-30

PRIVACY ACT

In accordance with paragraph 30, AFR 12-35, the following information is provided as required by the Privacy Act of 1974:

a. Authority:

(1) 5 U.S.C. 301, Departmental Regulations; and

(2) 10 U.S.C. 8012, Secretary of the Air Force, Powers, Duties, Delegation by Compensation; and

(3) EO 9397, 22 Nov 43, Numbering System for Federal Accounts Relating to Individual Persons; and

(4) DOD Instruction 1100.13, 17 Apr 68, Surveys of Department of Defense Personnel; and

(5) AFR 30-23, 22 Sep 76, Air Force Personnel Survey Program.

b. Principal purposes. The survey is being conducted to collect information to be used in research aimed at illuminating and providing inputs to the solution of problems of interest to the Air Force and DOD.

c. Routine uses. The survey data will be converted to information for use in research of management related problems. Results of the research, based on the data provided, will be included in a written master's thesis and may also be included in published articles, reports, or texts.

d. Participation in this survey is entirely voluntary.

e. No adverse action of any kind may be taken against any individual who elects not to participate in any or all of this survey.

KEYWORDS

The following are definitions of key works that recur throughout the questionnaire:

1. Supervisor: The person to whom you report directly.

2. Work Group: All persons who report to the same supervisor that you do. (If you are a supervisor, your work group is the group of employees that report directly to you).

3. Organization: Your unit of assignment; e.g. Sacramento ALC.

INSTRUCTIONS

This questionnaire contains 106 items (individual "questions"). The questionnaire booklet is broken into two parts. Part I contains the first 80 items in this booklet, and Part II contains the remaining 26 items. All items must be answered by filling in the appropriate spaces on the machine-scored response sheets provided. If for any item you do not find a response that fits your situation exactly, use the one that is the closest to the way you feel.

Please use a "soft-lead" (No. 2) pencil, and observe the following:

1. Make heavy black marks that fill in the space (of the response you select).

2. Erase cleanly any responses you wish to change.

3. Do not staple, fold or tear the response sheet.

Please mark all your responses in the survey booklet and then transfer them to the answer sheet(s). You have been provided with two answer sheets. Please use one of the answer sheets to respond to Part I questions only. When you begin Part II, use the first 26 response blocks on the other answer sheet to answer these questions. Do not fill in your name on either sheet so that your responses will be anonymous.

Each response block has 10 spaces (numbered 1 through 10) or a 1-10 scale. The questionnaire items normally require a response from 1-7 only, therefore, you will rarely need to fill in a space numbered 8, 9, or 10. Questionnaire items are responded to by circling the appropriate responses or by putting the number of the scale beside the appropriate question in the survey booklet and then transferring the responses by marking the appropriate space on the answer sheet as in the following example:

<u>SCALE</u>:

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree or disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree

<u>Sample item 1</u>:

The guidance you receive in your job from your supervisor is frequently unclear. _______

(If you "moderately agree" with sample item #1, you would write the number 6 in the blank space provided after the statement and then you would "blacken in" the corresponding number of that statement (moderately agree = 6) on the answer sheet for the item numbered "sample item 1.")

<u>Sample response</u>: 1 2 3 4 5 6 7 8 9 10

PART 1

First put your answers on the survey, then put them on the answer sheet when directed.

BACKGROUND INFORMATION

This section of the survey contains several items dealing with personal characteristics. This information will be used to obtain a picture of the "typical employee."

1. Your age is:

    1. Less than 20
    2. 20 to 25
    3. 26 to 30
    4. 31 to 35
    5. 36 to 40
    6. 41 to 45
    7. 46 to 50
    8. 51 to 55
    9. 56 to 60
    10. More than 60

2. Your highest educational level obtained is:

    1. Non high school graduate
    2. High school graduate or GED
    3. Some college work
    4. Associate degree or LPN
    5. Bachelor's degree or RN
    6. Some graduate work
    7. Master's degree
    8. Some work beyond master's degree
    9. Doctoral degree
    10. Post doctoral degree

3. Your sex is:

    1. Male
    2. Female

4. Total months in present position of assignment is:

    1. Less than 1 month
    2. More than 1 month, less than 6 months
    3. More than 6 months, less than 12 months
    4. More than 12 months, less than 18 months
    5. More than 18 months, less than 24 months
    6. More than 24 months, less than 36 months
    7. More than 36 months, less than 48 months
    8. More than 48 months

5. Total years in Air Force Logistics Command:

   1. less than 1 year.
   2. 1 year but less than 2 years.
   3. 2 years but less than 3 years.
   4. 3 years but less than 4 years.
   5. 4 years but less than 5 years.
   6. 5 years but less than 6 years.
   7. 6 to 8 years.
   8. 9 to 10 years.
   9. 11 to 16 years.
   10. 16 or more years.

6. How many people do you directly supervise (i.e., those for which you write performance reports)?

   1. None
   2. 1 to 2
   3. 3 to 5
   4. 6 to 8
   5. 9 to 12
   6. 13 to 20
   7. 21 or more

7. You are a (an):

   1. Officer
   2. Enlisted
   3. Civilian (GS)
   4. Civilian (GM)
   5. Civilian (WB/WG)
   6. Civilian (WS/WL)
   7. Non-appropriated Fund (NAF employee)
   8. Other

8. Your grade level is:

   1. 1-2
   2. 3-4
   3. 5-6
   4. 7-8
   5. 9-10
   6. 11
   7. 12
   8. 13
   9. 14-15
   10. SES

9. In what general category is your undergraduate degree?

1. Mechanical engineering
2. Electrical engineering
3. Aeronautical engineering
4. Chemical engineering
5. Other engineering (Please specify) ____________
6. Computer sciences
7. Mathematics
8. Physics
9. Other scientific/technical field (Please specify)

____

10. Use the next four item responses (10 - 13) to enter your four digit civilian occupational series. For example, a mechanical engineer has the code "0830" and would leave item 10 blank, put an "8" in item 11, a "3" in item 12, and leave item 13 blank.

<ON THE ANSWER SHEETS, PLEASE LEAVE ALL "0" RESPONSES BLANK>

10. _____

11. _____

12. _____

13. _____

14. How many people in your work group are in a civilian occupational series similar to you?

1. None
2. 1
3. 2
4. 3
5. 4
6. 5
7. 6 or more

JOB SATISFACTION

Below are 3 items which relate to the degree to which you are satisfied with various aspects of your job. Read each item carefully and choose the statement below which best represents your opinion.

1 = Delighted
2 = Pleased
3 = Mostly satisfied
4 = Mixed (about equally satisfied and dissatisfied)
5 = Mostly dissatisfied
6 = Unhappy
7 = Terrible

15. How do you feel about your job? _____

16. How do you feel about the people you work with -- your co-workers? _____

17. How do you feel about the work you do on your job -- the work itself? _____

FUTURE WORK PLANS

Use the rating scale below to indicate your future work plans.

18. How many more years do you have in government service before you are eligible for retirement?

    1. Less than 1 year
    2. 1 year
    3. 2 years
    4. 3 years
    5. 4 years
    6. 5 years
    7. 6 years
    8. 7 years
    9. 8 years
    10. 9 or more years

19. Do you plan to remain in government service until you are eligible to retire?

    1. Yes
    2. No
    3. Not sure

20. Within the coming year, if I have my own way:

1 = I definitely intend to remain with AFLC.
2 = I probably will remain with AFLC.
3 = I have not decided whether I will remain with AFLC.
4 = I probably will not remain with AFLC.
5 = I definitely intend to separate from AFLC.

21. If I were to leave my present job in AFLC, I would most likely accept other employment with:

1. Air Force Systems Command
2. Other Major Commands
3. Some other DOD organization other than the Air Force
4. Another Federal Agency
5. Academic Institution
6. Private sector company
7. Self-employment

ORGANIZATIONAL INFORMATION

Listed below are a series of statements that represent possible feelings that individuals might have about the company or organization for which they work. Use the following rating scale to indicate your own feelings about the particular organization for which you are now working.

1 = Means you strongly disagree with the statement.
2 = Means you moderately disagree with the statement.
3 = Means you slightly disagree with the statement.
4 = Means you neither agree nor disagree with the statement.
5 = Means you slightly agree with the statement.
6 = Means you moderately agree with the statement.
7 = Means you strongly agree with the statement.

22. I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful. _____

23. I talk up this organization to my friends as a great organization to work for. _____

24. I feel very little loyalty to this organization. _____

1 = Means you <u>strongly disagree</u> with the statement.
2 = Means you <u>moderately disagree</u> with the statement.
3 = Means you <u>slightly disagree</u> with the statement.
4 = Means you <u>neither agree nor disagree</u> with the statement.
5 = Means you <u>slightly agree</u> with the statement.
6 = Means you <u>moderately agree</u> with the statement.
7 = Means you <u>strongly agree</u> with the statement.

25. I would accept almost any type of job assignment in order to keep working for this organization. _____

26. I find that my values and the organization's values are very similar. _____

27. I am proud to tell others that I am part of this organization. _____

28. I could just as well be working for a different organization as long as the type of work was similar. _____

29. This organization really inspires the very best in me in the way of job performance. _____

30. It would take very little change in my present circumstances to cause me to leave this organization. _____

31. I am extremely glad that I chose this organization to work for over others I was considering at the time I joined. _____

32. There is not too much to be gained by sticking with this organization indefinitely. _____

33. Often, I find it difficult to agree with this organization's policies on important matters relating to its employees. _____

34. I really care about the fate of this organization. _____

35. For me this is the best of all possible organizations for which to work. _____

36. Deciding to work for this organization was a definite mistake on my part. _____

JOB INFORMATION

Use the following rating scale to express your own feelings about your present job or work.

1 = Means you strongly disagree with the statement.
2 = Means you moderately disagree with the statement.
3 = Means you slightly disagree with the statement.
4 = Means you neither agree nor disagree with the statement.
5 = Means you slightly agree with the statement.
6 = Means you moderately agree with the statement.
7 = Means you strongly agree with the statement.

37. I often have to use the skills I learned for my job. _____

38. The most important things I do involve my work. _____

39. I do not often have a chance to try out my own ideas. _____

40. I often have a chance to do things my own way. _____

41. The major satisfaction in my life comes from my job. _____

42. I often have a chance to do the kinds of things that I am best at. _____

43. I often feel at the end of the day I've accomplished something. _____

44. The most important things that happen to me involve my work. _____

45. The activities which give me the greatest pleasure and personal satisfaction involve my job. _____

46. I live, eat, and breathe my job. _____

47. How well I perform on my job is extremely important to me. _____

48. I am very personally involved in my work. ____

49. I avoid taking on extra duties and responsibilities. ____

50. I feel badly if I don't perform well on my job. _____

WORK ROLE ATTITUDES

This section contains a number of statements that relate to feelings about your work group, the demands on your job, and the supervision you receive. Use the following rating scale to indicate the extent to which you agree or disagree with the statements shown below.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree

51. In my work-group there is a great deal of opportunity to be involved in resolving problems which affect the group. _____

52. I am allowed to participate in decisions regarding my job. _____

53. My job (e.g., the type of work, amount of responsibility, etc.) causes me a great deal of personal stress and anxiety. _____

54. Within my work-group the people most affected by decisions frequently participate in making the decisions. _____

55. My supervisor usually asks for my opinions and thoughts in decisions regarding my work. _____

56. Relations with the people I work with (e.g., co-workers, supervisor, subordinates) cause me a great deal of stress and anxiety. _____

57. I am not allowed a significant degree of influence in decisions regarding my work. _____

58. General aspects of the organization I work for (e.g., policies and procedures, general working conditions) tend to cause me a great deal of stress and anxiety. _____

59. There is a high spirit of teamwork among my co-workers. _____

60. Members of my work group take a personal interest in one another. _____

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree

61. If I had a chance to do the same kind of work for the same pay in another work group, I would still stay here in this work group. _____

62. My organization provides all the necessary information for me to do my job effectively. _____

63. My work group is usually aware of important events and situations. _____

64. The people I work with make my job easier by sharing their ideas and opinions with me. _____

65. People in my work group are never afraid to speak their minds about issues and problems that affect them. _____

66. I feel that my colleagues in civilian jobs similar to mine have little respect for the type work that I am typically required to perform. _____

67. Within my own organization, I feel that I get a great deal of respect from by co-workers because of my job performance. _____

WORK GOALS

The following statements deal with your perceptions of the nature of goals and objectives that guide your work. Use the rating scale given below to indicate the extent to which your work goals have the characteristics described.

1 = Strongly disagree
2 = Moderately disagree
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree

68. I know exactly what is expected of me in performing my job. _____

69. I understand clearly what my supervisor expects me to accomplish on the job. _____

70. What I am expected to do at work is clear and unambiguous. _____

71. I understand the priorities associated with what I am expected to accomplish on the job. _____

72. It takes a high degree of technical skill on my part to attain the results expected for my work. _____

73. Results expected in my job are very difficult to achieve. _____

74. It takes a lot effort on my part to attain the results expected for my work. _____

75. I must work hard to accomplish what is expected of me for my work. _____

76. I must exert a significant amount of effort to attain the results expected of me in my job. _____

Listed below are a number of statements which could be used to describe a job. You are to indicate whether each statement is an accurate or an inaccurate description of your job. Please try to be as objective as you can in describing how accurately each statement describes your job -- regardless of whether you like or dislike your job.

How accurately is the statement in describing your job?

1 = Very inaccurate
2 = Mostly inaccurate
3 = Slightly inaccurate
4 = Uncertain
5 = Slightly accurate
6 = Mostly accurate
7 = Very accurate

77. The job requires me to use a number of complex or high-level skills. _____

78. The job is arranged so that I do not have a chance to do an entire piece of work from beginning to end. _____

79. The job is quite simple and repetitive. _____

80. This job is one where a lot of other people can be affected by how well the work gets done. _____

****
****

Please take your responses from the booklet and fill in the first answer sheet now. Your first answer sheet should be completely filled. If it is not completely filled, go back and check the sequencing of your answers. You may have skipped an item. Use the second answer sheet to respond to the remaining items in the questionnaire (those in Part II).

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****

Part II

How accurately is the statement in describing your job?

1 = Very inaccurate
2 = Mostly inaccurate
3 = Slightly inaccurate
4 = Uncertain
5 = Slightly accurate
6 = Mostly accurate
7 = Very accurate

1. The job denies me any chance to use my personal initiatives or judgment in carrying out the work. _____

2. The job provides me the chance to completely finish the pieces of work I begin. _____

3. The job gives me considerable opportunity for independence and freedom in how I do my work. _____

4. The job itself is not very significant or important in the broader scheme of things. _____

This part of the questionnaire asks you to describe your job, as objectively as you can.

Please do not use this part of the questionnaire to show how much you like or dislike your job. Questions about that will come later. Instead, try to make your descriptions as accurate and as objective as you possibly can.

JOB CHARACTERISTICS

5. How much automony is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing your work? _______

1---------2---------3---------4---------5--------6--------7

Very little; the job gives me almost no personal "say" about how and when the work is done.	Moderate automony; many things are standardized and not under my control, but I can make some decisions about the work.	Very much; the job gives almost complete responsibility for deciding how and when the work is done.

6. To what extent does your job involve doing a "whole and identifiable piece of work? That is, is the job a complete piece of work that has an obvious beginning and end? Or is it only a small part of the overall piece of work, which is finished by other people or by automatic machines? _____

1--------2--------3---------4--------5--------6--------7

My job is only a tiny part of the overall piece of work; the results of my activities cannot be seen in in the final product or services.	My job is a moderately sized "chunk" of the overall piece of work; my own contribution can be seen in the final outcome.	My job involves doing the whole piece of work; from start to finish; the results of my activities are easily seen in the final product or service.

7. How much variety is there in your job? That is, to what extent does the job require you to do many different things at work, using a variety of your skills and talents? _____

1---------2--------3--------4--------5--------6-------7

Very little; the job requires me to do the same routine things over and over again.	Moderate variety	Very much; the job requires me to do many different things, using a number of different skills and talents.

8. In general, how <u>significant or important</u> is your job? That is, are the results of your work likely to significantly affect the lives or well-being of other people? ______

1--------2--------3---------4--------5---------6--------7

Not very significant; the outcomes of my work are <u>not</u> likely to have important effects on other people.	Moderately significant.	Highly significant; the outcomes of my work can affect other people in very important ways.

JOB FEEDBACK

Use the rating scale below to indicate <u>how you feel about</u> the following two questions.

1 = Very little
2 = Little
3 = A moderate amount
4 = Much
5 = Very much

9. To what extent do you find out how well you are doing on the job as you are working? _____

10. To what extent do you receive information from your superior on your job performance? _____

Use the same rating scale to indicate <u>how much job feedback</u> is present in your job.

11. The feedback from my supervisor about how well I am doing. _____

12. The opportunity to find out how well I am doing in my job. ______

13. The feeling that I know whether I am performing my job well or poorly. _____

DUAL PATH CAREER OPTIONS

14. Air Force Systems Command permits scientists and engineering personnel to select among two career paths. One path focuses on managerial responsibilities while the other path focuses on the scientific and technical tasks. If AFLC were to implement a dual path career option similar to AFSC's, how would that affect your career opportunities?

    1. Would greatly enhance my career opportunities.
    2. Would slightly enhance my career opportunities.
    3. Would neither enhance nor detract from my career opportunities.
    4. Would slightly detract from my career opportunities.
    5. Would greatly detract from my career opportunities.

15. If AFLC were to implement the dual career path concept, what effect would it have on your AFLC career plans?

    1. I would be more likely to stay in AFLC.
    2. I would be more likely to leave AFLC.
    3. It would have no effect on my AFLC career plans.

PROFESSIONAL CONTINUING EDUCATION

16. Does your job require that you must take professional continuing education (PCE) classes to be promoted?

    1. Yes
    2. No
    3. Not sure

17. About how many PCE classes do you need each year?

    1. 1
    2. 2
    3. 3
    4. 4
    5. 5
    6. 6 to 8
    7. 8 to 10
    8. 10 or more

18. How many PCE courses have you taken since receiving your <u>Bachelor's Degree</u>?

1. None
2. 1 to 2
3. 3 to 4
4. 5 to 6
5. 7 to 8
6. 9 to 10
7. 10 or more

19. Identify the most common source of PCE courses that you have used most often?

1. Air Force Institute of Technology
2. Local colleges/universities
3. Federal government
4. Contractors with the Federal Government
5. Professional associations
6. Private companies
7. Others not shown
8. Have not taken any PCE courses

20. Using the source you reported in the previous question, what was the method of course presentation?

1. Attended class at a location on my base.
2. Attended class at a location not on my base.
3. Correspondence.
4. Have not taken any PCE courses.

21. What is the extent to which your organization supports PCE courses for you?

1. I can take all the courses I require.
2. I can take most of the courses I require.
3. I have to compete with others for the courses that I require.
4. My organization provides only minimum PCE support for me.
5. My organization does not support PCE for me.

22. If you believe your organization does not provide PCE for your profession, what is the primary reason?

< MARK THE ONE REASON THAT APPLIES OR SKIP TO NEXT QUESTION.>

1. Management does not support PCE.
2. Constraints on TDY dollars.
3. Organization does not request any quotas for courses.
4. Organization does not request enough quotas for PCE courses.
5. Organization does not distribute PCE quotas fairly.
6. My organization supports PCE but does not seem to get enough quotas in enough courses.

23. Who has paid for most of the PCE courses that you have taken?

1. Air Force funded.
2. I paid for the course but was reimbursed by the Air Force.
3. I paid for the course and was not reimbursed by anyone.
4. Private corporation funded.

24. As a scientist or engineer in AFLC, do you feel that PCE helps keep you informed on the latest technological advances in your field?

1. Yes
2. No
3. Not sure

25. If yes, to what extent is PCE important?

1. Extremely important
2. Moderately important
3. Slightly important
4. Neither important nor unimportant
5. Slightly unimportant
6. Moderately unimportant
7. Extremely unimportant

26. What one type of PCE course would most likely enhance your promotion opportunities in AFLC?

1. Courses related to my specific degree area.
2. Courses related to my specific discipline.
3. General management courses.
4. Continuing education courses on the operation of computers.
5. Mathematics courses.
6. Computer programming courses.
7. Communication courses - written or oral.
8. Computer assisted drafting courses.
9. Other type of course - Please Specify.

____

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****

Please <u>take your responses from the booklet</u> and <u>fill in the second answer sheet now.</u>

Now <u>place the two answer sheets</u> and the <u>survey booklet</u> in the <u>pre-addressed envelope</u>. <u>Please mail your responses as soon as possible</u>. Thank you.

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Vita

Captain John T. Breed, Jr. [redacted] He then joined the United States Air Force in July of 1965, and was honorably discharged in January 1969. In September 1977, he enrolled in ROTC at Auburn University, Auburn Alabama. In December 1979, he graduated and received the degree of Bachelor of Science in Industrial Management. Upon graduation, he received a commission in the USAF through the ROTC program, and he entered active duty two days after graduation in December 1979. Prior to entering AFIT in June 1987, his previous assignments include duties as a Weapons Systems Acquisition Staff Officer at HQ Air Force Systems Command and as a Program Control Officer in the B-1B SPO at Wright-Patterson AFB. Upon graduation from AFIT, he will go to the Standard Systems Center, Air Force Communications Command, as a Contracting Officer.

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Abstract

This research focused on identifying the demographic characteristics and current work attitudes of the civilian scientists and engineers in AFLC. The research was done at the request of the AFLC's Chief Scientist and Engineer.

A 106-question survey was administered to each of the scientists and engineers in AFLC with the objective of measuring such job related areas as job satisfaction, future work plans, job involvement, and professional continuing education (PCE).

Statistical analyses were performed to determine if there were significant differences between scientists and engineers in AFLC. → Keywords →

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