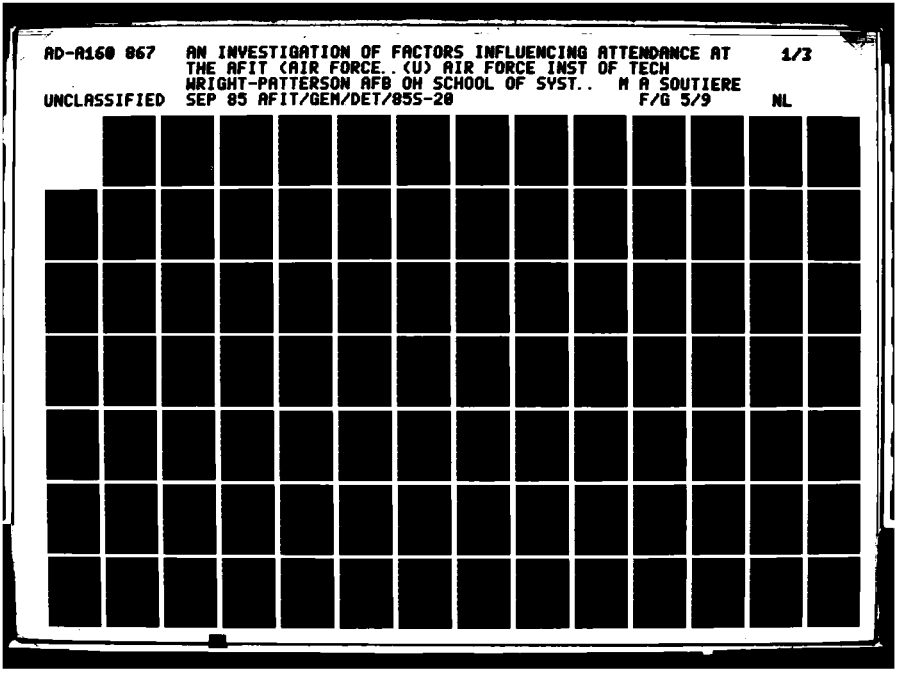
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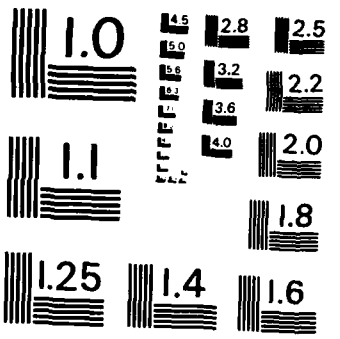

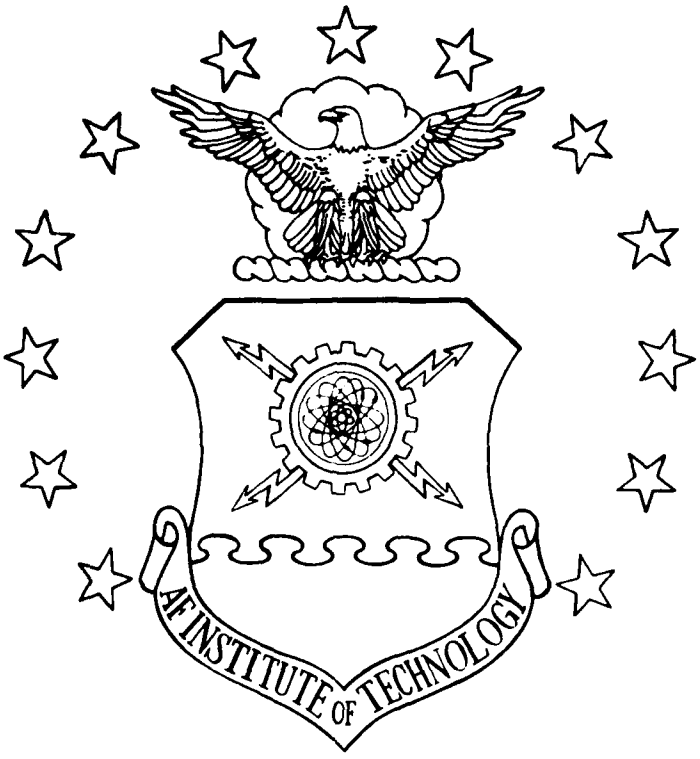

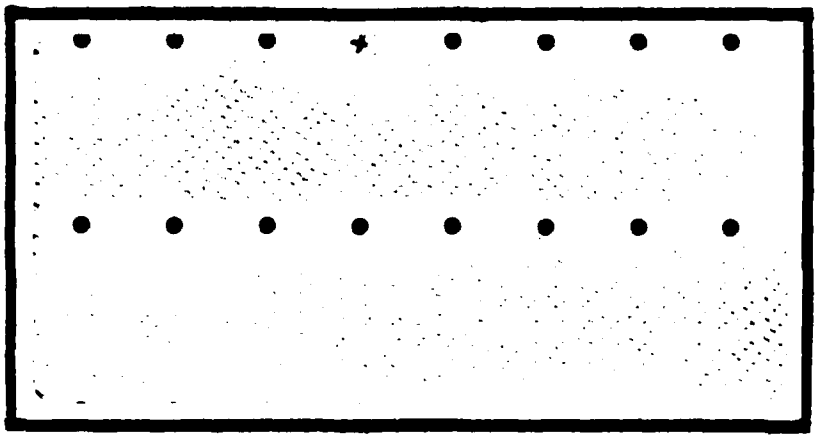

DEPARTMENT OF THE AIR FORCE

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Wright-Patterson Air Force Base, Ohio

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AFIT/GEM/DET/85

AN INVESTIGATION OF FACTORS INFLUENCING ATTENDANCE AT THE AFIT SCHOOL OF CIVIL ENGINEERING PROFESSIONAL CONTINUING EDUCATION PROGRAM

THESIS

Marc A. Soutiere
Captain, USAF

AFIT/GEM/DET/85S-20

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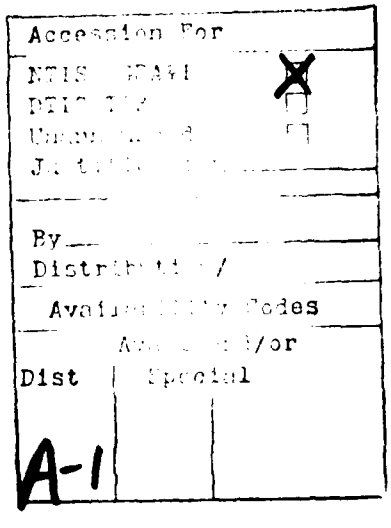

AFIT/GEM/DET/85S-20

AN INVESTIGATION OF FACTORS INFLUENCING ATTENDANCE AT THE AFIT SCHOOL OF CIVIL ENGINEERING PROFESSIONAL CONTINUING EDUCATION PROGRAM

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the Requirements for the
Degree of Master of Science in Engineering Management

Marc A. Soutiere, B.S.C.E.
Captain, USAF

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Abstract

The AFIT School of Civil Engineering (SOCE) conducts a wide range of resident Professional Continuing Education (PCE) courses for the Air Force civil engineering (CE) functional field. This study surveyed 500 CE officers examining factors influencing both the access of civil engineers to resident programs and factors influencing their motivation to attend. Descriptive statistics and nonparametric tests were used to investigate factors influencing access. Motivation factors were determined using factor analysis and examined with linear regression techniques. Results showed that workload significantly constrained PCE attendance. Additionally, engineers who do not work in base level CE organizations do not hear about the SOCE program as much as base level engineers. Factors influencing motivation to attend SOCE PCE courses included supervisory support for the program, perceived usefulness of the courses, engineers' attitudes towards TDY, preferred type of PCE course, and academic degree held by the engineer. Engineers whose latest degree is over eight years old or who have not participated periodically in formal continuing education were less motivated to attend SOCE PCE courses.

AN INVESTIGATION OF FACTORS INFLUENCING ATTENDANCE AT THE AFIT SCHOOL OF CIVIL ENGINEERING PROFESSIONAL CONTINUING EDUCATION PROGRAM

I. Introduction

Overview

Chapter one begins with a brief background concerning Professional Continuing Education (PCE) followed by the general problem statement. The two research objectives will then identify the areas in which various attendance factors were investigated. Finally, a justification for proceeding with this research is discussed, along with the scope and limitations of the research.

Background

Most professionals complete formal education in their early years, culminating in the granting of a degree by an institution of higher learning. They then proceed into the work place to ply their chosen profession. The pace of technological and managerial innovation, however, can soon render the knowledge gained during formal schooling obsolete. The term "half-life" (analogous to radioactive decay) has been used to describe that obsolescence experienced by

professionals. Various authors identify a half-life of between 4 and 10 years as being the span over which a practicing engineer or scientist becomes half as knowledgeable in his field as he was at graduation (1,2,3). Professor P.E. Barker, chairman of a working group on continuing and post-graduate education, notes that this half-life is rapidly decreasing as the pace of scientific innovation expands exponentially (1:49).

Because of this rapid pace of engineering, scientific, and managerial development, professional continuing education (PCE) becomes of vital importance. Professional continuing education is the vehicle by which professionals keep abreast of current developments in their chosen field. B.R. Harris, Chairman of the Continuing Education Sub-committee for the Institute of Chemical Engineers warns against professional complacency. He states:

> Practising scientists and engineers have a responsibility for maintaining and developing their knowledge so that their professional contributions to their employment and to society are consistently of high standard. Hence the need for continuing education. (4:71)

The term "technically obsolete" is being used to brand those engineers and scientists who do not make the effort to stay abreast of changes in their profession (5:387).

The role of continuing education has become more and more important to professionals in all fields from social work to medicine to civil engineering. Numerous continuing education programs to meet the needs of the professions are

now sponsored by universities, industry, and all types of professional societies and associations. Mandatory continuing education in some states and countries exists as a pre-condition for re-licensure or reaccreditation (6,7).

Industry has been taking the lead in recognizing the deficiency in continuing education because the success of a technological company depends in large part on the ability of their engineers and managers to keep pace with new developments. A recent conference at the Massachusetts Institute of Technology (MIT) brought academia and industry together to discuss the situation. Robert M. Fano, an MIT professor, noted that "both sectors [industry and universities] must put to rest the vestiges of their traditional view of education as a process largely confined to the young and largely carried out on the university campus" (8:76). Industries are now beginning to see that their engineers need "preventative maintenance" periodically just like all valuable equipment and that PCE is the way to refresh and refurbish the engineer. (8:77) An IBM vice-president noted that "industry needs to turn inward to its own technical population and bring it and keep it up-to-date by making life-long continuing education mandatory" (9:845). IBM urges its technical engineering and management staffs to attend 40 hours of PCE per year at universities or through professional societies (9:845).

For a PCE program to flourish, there must be a shift

from traditional attitudes to ones in which

1. engineers must be committed to the idea of uninterrupted formal education.

2. employers must whole-heartedly support the belief that study and teaching are necessary components of productive work.

3. engineering universities must devote increased attention to educational needs of engineers of all ages. (5:387)

The net result of this discussion indicates that "the clear committment of the employer is to provide an opportunity for each individual to realize his or her full potential" (10:13).

The United States Air Force is no less concerned than the civilian sector about possible professional obsolescence of its scientific and technical personnel. The Air Force either oversees or conducts numerous PCE programs in fields such as medicine, logistics, supply, and various engineering disciplines (11). These educational endeavors can take place at a variety of civilian and military locales. The School of Civil Engineering (SOCE), a branch of the Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base, Ohio, conducts a wide array of PCE classes for Air Force and Department of Defense personnel who work in the Civil Engineering functional field. This research project focuses on the resident PCE program at AFIT's School of Civil Engineering.

Problem Statement

What are some factors that affect attendance at the Professional Continuing Education program provided by the AFIT School of Civil Engineering? This question guided efforts to identify factors that constrain attendance at SOCE PCE and influence the desire of Air Force civil engineers to enroll in these continuing education courses.

Research Objectives

This research effort will investigate two separate topics that influence attendance at the SOCE. The first area concerns factors that could constrain engineers from attending the 2-4 week resident courses offered at the Ohio location. The second topic addresses factors that impact on civil engineers' desire to attend resident PCE courses to supplement their formal engineering education.

Objective #1. The first objective is to investigate what factors influence a Civil Engineer's access to resident PCE programs at the SOCE. The following four Research Questions guided efforts to achieve this objective.

1A. What influence does a civil engineer's duty assignment have on ability to attend SOCE resident PCE courses?

1B. To what extent is knowledge about the SOCE resident PCE program disseminated to Air Force civil engineers?

1C. What supervisory factors influence attendance at SOCE resident PCE courses?

1D. Do civil engineers feel SOCE application procedures influence attendance?

A detailed discussion of these questions and how they could influence access to SOCE PCE is provided later in Chapter 3.

Objective #2. This objective is to investigate what factors influence a Civil Engineer's motivation and intent to attend SOCE PCE in residence at AFIT. The following seven factors that may influence engineers' desire to attend the SOCE will be investigated:

a) previous academic background

b) supervisor's attitude about PCE and the SOCE

c) the graded/credit course structure at the SOCE

d) attitudes about temporary duty (TDY)

e) increasing rank and responsibilities

f) a perceived relationship between PCE and enhanced advancement potential

g) the perceived usefulness and applicability of SOCE PCE courses

Again, Chapter 3 expands upon each factor listed here and discusses how they might influence an engineers' desire to attend a SOCE PCE course.

Justification

In the Fiscal Year 1985 budget of the School of Civil Engineering, 2.2 million dollars was allocated to fund travel (and per diem) of students from their home stations to Wright-Patterson for class attendence (12). The mere

existence of the school and the amount of money allocated to fund its program is an indication of the importance placed on continuing education by the Air Force in general and the USAF Engineering and Services deputate in particular. And, like any organization in austere times, the maximum benefit per dollar spent is the goal. Information about factors influencing both access and desire to attend the resident PCE program can help make the program responsive to the needs and desires of the career field and insure that funds are well spent. Factors that appear to encourage participation can be enhanced, while any stumbling blocks that discourage PCE can be removed.

A large scale study provides a good overview of how the career field perceives both the SOCE and PCE in general. Opinions from a broad cross-section of Air Force civil engineers may provide a more complete picture than is available by other means, such as selective polling of only SOCE attendees.

Scope and Limitations

Continuing education can take on a variety of forms, and many people can benefit from PCE attendance. The Air Force Civil Engineering functional field is comprised of people of many different ranks, grades, and affiliations. Additionally, the School of Civil Engineering PCE program consists of a number of courses that vary by length, location, or teaching method. Because PCE is comprised of so

many different facets, the scope and limitations placed on of this research must be specified.

Only USAF civil engineering officers participated in this research. Although the CE career field includes civilian employees, survey approval time limitations prevented including them as part of the survey population. The results of this research, however, may give an insight into factors affecting all CE employees.

Only officers presently assigned to bases in the Continental United States (CONUS) were surveyed. In FY 85, only about 15% of the students at the SOCE attended from their overseas assignments (12). The longer travel time involved in coming from overseas is a factor in reducing attendance from these locations. Funding, however, is provided by AFIT for overseas travel just as it is for CONUS-based engineers (12).

Continuing education could include formal academic classes (both credit and non-credit) as well as seminars or conventions where relevant professional information is discussed. While AF civil engineers do participate in a wide range of PCE programs, this investigation limits consideration to the School of Civil Engineering resident PCE programs. Additionally, for purposes of this study, Professional Military Education (PME) courses accomplished by military officers, while covering many management topics germane to their duties, will not be considered PCE.

The measurement instrument used was tailored so that previous attendance at a SOCE resident PCE program was not required to provide a majority of the information. All but a few of the survey questions solicited the respondent's opinion or attitude about the SOCE or PCE in general and did not require first-hand experience at a SOCE program.

The following chapter will review research conducted concerning continuing education, discuss the role of continuing education in the Air Force, and present an overview of AFIT and the School of Civil Engineering.

II. Background

Introduction

As noted in Chapter I, the need for technical and managerial professionals to "update" their skills periodically is an acknowledged fact in our rapidly changing society. Some of the research accomplished in the field of continuing education and adult learning will be discussed in this chapter. This research analyzes some motivations people have for pursuing additional education and examines some of the hinderances and constraints they face. The final section of this chapter discusses PCE in the Air Force and specifically presents information about the AFIT School of Civil Engineering (SOCE) PCE program.

Continuing Education Research

What Dr. Cyril O. Houle, Professor Emeritus of Education at the University of Chicago, calls the "zest for learning" (13:124) is the focus of some studies that examine why people engage in adult learning while others do not. An extensive survey on adult learning (as opposed to PCE specifically) was conducted by the Educational Testing Service in 1972. When asked their motivations for pursuing additional education, individuals whose occupation can be classed as "professional" cited "help to advance in present job" and "meet requirements of employer and profession" as two of the top three responses (13:134). The same study also compiled

a list of reasons respondents felt were barriers to learning. The top five responses were: 1) not enough time 2) job responsibilities 3) cost 4) no desire to attend full time 5) home responsibilities (13:149). Another survey of 427 doctors in 1968 indicated similar reasons (13:126).

Two other extensive studies reported by Houle provide further insight into the learning process. A 1971 survey was able to determine seven "orientations" for engaging in learning activities. These orientations were synthesized from a vast list of possible reasons developed by the author. The seven were:

1. Desire to know
2. Desire to reach a personal goal.
3. Desire to reach a social goal.
4. Desire to reach a religious goal.
5. Desire to take part in social activity.
6. Desire to escape.
7. Desire to comply with formal requirements. (13:149)

Houle cautions, however, that these "orientations" at present only constitute "lists of observable and testable categories" (13:150). In a doctoral dissertion at the University of Chicago, M.N. Dao developed nine clusters of reasons for non-participation in learning. The most influential reasons were demands on time and unawareness of available opportunities. Next in significance was the feeling that results of educational activities were not valued. Other reasons highlighted were individual/personal problems, negative feelings towards the institution offering the instruction, and indifference to educational activities (13:151).

As reported earlier, engineers must take conscious steps to avoid becoming technically obsolete in their chosen field. The results of the 1981 National Engineer Career Development Survey indicate that most engineering graduates certainly do not intend to let their skills lapse. The survey gathered information from 2700 engineers who belonged to nine major engineering societies and eight major colleges. The results showed that "engineers clearly have a commitment to furthering their education" with 80% noting they planned some form of additional education beyond the B.S. degree (14:662). In general, therefore, the B.S. degree was not considered a "terminal" degree and the respondents viewed "continuing and graduate education as an integral part of their careers" (14:663). A surprising result noted by the authors was that age was not a major factor in responses. Fifty-nine percent of engineers who had been in the field 15-20 years and 60% of PhDs surveyed said they planned further education (14:662-663). Finally, when asked about preferred degree programs, engineers whose B.S. was relatively recent stated they would prefer a technical follow-on degree. If a longer time had elapsed since the first degree, engineers leaned towards a management-oriented degree to be more in line with their current responsibilities (14:663).

Another research project was directed towards the attitudes of individuals in the technical professions. Profes-

sor H.G. Kaufmann, Polytechnic Institute of New York, took a systems approach to investigating the important factors that create technical obsolescence among engineers. He cited four broad factors that were linked to obsolescence among professionals and attempted to resolve which were of greater importance. These factors were:

> 1. Rapid environmental change, such as advances in technical knowledge and the information explosion.
>
> 2. The organizational climate in which engineers work, which is determined largely by management policies and practices--especially those related to the organizational reward system.
>
> 3. The nature of the work that engineers are assigned, particularly the use of their technical knowledge and skills.
>
> 4. Individual characteristics of the engineer that are generally psychlogical in nature and involve cognitive, motivational and personality dimensions. (3:826)

Using 404 engineers in a high technology firm, his analyses determined that the nature of the work and organizational climate were the most important factors in producing out-of-date engineers. Like the earlier study, Kaufmann noted that age was not an influencing factor in the obsolescence of engineers; rather, that obsolescence "was a consequence of organizational practices and policies, especially as they are reflected in the nature of the work that engineers are assigned" (3:828).

The two ways to combat this obsolescence, Kaufmann says, are to change jobs or attend formal PCE. His research showed that this formal PCE is effective in updating engi-

neers' skills. The most critical factor to keeping employees updated was top-management's commitment to providing challenging jobs requiring a high degree of technical knowledge and skill and to creating an environment that stimulates learning through self-study or formal coursework. Kaufmann notes:

> The effectiveness of such learning can be even further enhanced if it is encouraged and tangibly recognized by the organizational reward system. However, unless such management interventions are introduced from the very start of the engineer's career, they may have limited effects at later career stages. (3:830)

Kaufmann's position that top management commitment is a critical factor in combatting technical obsolescence is bolstered by a study done by Dr. Benjaming J. Luberhoff, editor of ChemTech magazine, for a seminar entitled "Learning for Life." (15) Luberhoff examined the relationship between the importance placed on PCE by a company and the amount actually being accomplished by employees. He developed a measure called "level of corporate encouragement" that indicated how much a company actively promoted and encouraged participation in PCE. He found that the number of employees taking courses was directly related to the encouragement provided. He says, "To me this indicates that there is a response when the employee recognizes that the company is serious enough about continuing education" (15:17).

Another study that agrees with Kaufmann's findings

about the benefits of PCE is one conducted by Albert J. Morris, president of Genesys Systems, with a grant from the National Science Foundation. Using a sample of 396 engineers from four large Bay Area companies, Morris attempted to find an association between PCE and improved on-the-job performance. He feels the results convincingly showed such a causal relationship (16:836). He noted that participation in PCE produced positive feelings about themselves in 80% of the engineers surveyed (16:836). Four other findings of interest came out of Morris' work.

> 1. Non-credit technical continuing education [informal education, seminars, etc.] was significantly more effective than credit technical continuing education (CE).
>
> 2. Non-academic instructors are capable of doing an effective job of teaching.
>
> 3. Non-credit technical CE [continuing education] courses offered away from the place of employment can successfully affect performance.
>
> 4. The effects of CE [continuing education] participation may be cumulative over time. (16:837)

With regard to the last point above, Morris notes that "this may explain why engineers who participate in continuing education only rarely and sporadically may find that the expected benefits of such participation are illusory" (16:837). Finally, Morris makes an interesting observation about "job-related" PCE.

> The findings also suggest that "mental stimulation," provided by exposure to non-job-related courses, may be an improtant factor. If so, organizational policies for CE [continuing education] support, which require the CE to be job-

> related, might be worthy of review. This view is further supported by the attitudes of the engineers surveyed about what policies they would establish in support of CE (16:837).

Morris noted that sometimes less formal PCE courses can be effective. A survey of electrical engineers (EE) conducted by the Institute of Electrical and Electronics Engineers (IEEE) found that 60% of EE's considered "live" discussion classes with and instructor present to be the most effective type of course (17:198). The preferable PCE course of the future, in the eyes of EE's, is "a discussion class in the engineer's technical specialty that would last from 1-3 days, be be given by a university, and cost less than $150" (17:198).

The studies discussed above present a variety of views about engineers' attitudes and motivations to pursue additional education. There can be many factors that stimulate or hinder that pursuit. Cyril Houle sums up some of these results.

> . . . people do not necessarily reject specific learning activities only for simple or transitory reasons. Failure to participate may be caused by a deeply ingrained attitude or group of attitudes that effectively prevents positive action. . . . The task of securing participation in a particular activity may involve not only wide-spread promotion but also the exploration of deep-seated resistance among the target audiences and the discovery of ways to minimize it. To the extent that these negative orientations exist in a profession, they will systematically impede its capacity to provide a wholly satisfactory program of continuing education (13:152).

Air Force Professional Continuing Education

Like its counterparts in the civilian community, the USAF has established programs to provide PCE for personnel in professional fields. The purpose of Air Force sponsored PCE is "to provide concentrated instruction in specialized subjects needed to improve the performance of Air Force and Department of Defense (DOD) personnel in their present duties or to prepare them to assume greater responsibilities" (11:4-23). The PCE for Air Force employees can take place not only at AF/DOD locations but at civilian education institutions and other civilian locations (11:4-23).

The Air Force provides professionals the opportunity to engage in PCE in a variety of fields. The Scientist and Engineer Education Program is designed for personnel filling billets in selected AF Specialty Codes (including 55XX-Civil Engineer). Each year, these personnel are authorized to attend one course of 3 to 7 days duration at government expense. This time can be used to attend a formal academic course offered by a civilian institution or professional society. Alternatively, personnel may attend meetings of technical, scientific, professional, or similar organizations (11:4-26, 18:1). In either case, the attendance of the course or meeting must contribute to furthering the capabilities of the individual to perform his USAF duties.

In addition to attendance at formal courses and meetings presented by non-DOD organizations, USAF personnel

can attend courses managed under the USAF Professional Continuing Education (Short Course) Program. This program provides PCE courses of "less than 20 weeks in length, to meet validated educational requirements of AF personnel in specific functional areas" (19:1). Courses of particular interest to scientific, engineering, and management personnel are conducted by the Air Force Institute of Technology (AFIT).

Role of AFIT

AFIT is one component of the USAF Major Command (MAJCOM) called Air University. The mission of the Institute is:

> to provide education and training to meet the requirements of the AF in scientific, technological, and managerial areas . . . This mission requires the Institute to identify, conduct, and evaluate . . . the academic and professional education necessary to satisfy the stated needs of the AF for the continued effectiveness of aerospace power as an instrument of US policy. It continuously analyzes the resources of higher education and the educational requirements of the AF to assure a continuing effective articulation between academic means and existing and anticipated requirements and applications. (20:1)

AFIT accomplishes its mission by providing resident/non-resident degree level programs as well as a wide variety of PCE.

The PCE programs managed by AFIT have 3 key functions. The first is to prepare people for entry into a career field by giving specialized knowledge needed to begin professional

duties. The second function is to combat technical and professional obsolescence by constantly updating personnel about new state-of-the-art in their field. Lastly, the PCE program is designed to transfer new knowledge and "bring practicing professionals the latest forefront knowledge in their field" (20:1, 21:1). Various components of AFIT are charged with conducting the PCE program. This report will concentrate on the School of Civil Engineering.

School of Civil Engineering (SOCE).

Located at Wright-Patterson AFB, the mission of the SOCE is "to provide PCE for the Air Force Civil Engineering (AFCE) functional field" (22:2). The SOCE curriculum is divided into two academic departments. The Technical Applications department offers course work designed to update and broaden the professional/technical knowledge of civil, electrical, mechanical, industrial, and general engineers and architects working in AFCE. The Department of Management Applications provides courses in management doctrine and applications to career professionals as they rise in the AFCE structure from entry level to top management (23:240). The SOCE catalog notes that "each of the school's programs satisfies a specific and integrated career need of the students; . . . taken as a group, the school's programs provide the education that an officer/civilian would need over a typical career in AFCE for 20-35 years" (23:240). Additionally, the PCE offered at the SOCE is described as

TABLE 1

PCE Courses (FY 85)
Department of Management Applications

Course #	Title	Credit Hrs
MGT 001	Base Civil Engineering	None
MGT 002	Commanders Civil Engineering Orientation	None
MGT 004	Environmental Protection Committee Members	None
MGT 023	Project Programming	None
MGT 400	Base CE Staff Officer	2.0
MGT 403	Industrial Engineering Management Applications	2.0
MGT 406	Family Housing Management Applications	2.0
MGT 416	Financial Management Applications	2.0
MGT 420	Engineering & Environmental Planning Mgt. Applications	2.0
MGT 427	Fire Protection Management Applications	None
MGT 430	Operations Mgt. Applications	2.0
MGT 424	Real Property Management	None
MGT 425	Contract Preparation and Management	2.0
MGT 438	Readiness & Logistics Mgt.	None
MGT 520	Environmental and Contract Planning (22:13-19)	3.0

"generally AF unique and not available at civilian institutions.. . .The fundamental objective is to return the student to his assignment better prepared to do his job both specifically and generally" (20:44).

SOCE Curriculum. The SOCE began offering some PCE courses for academic credit in 1974. The SOCE courses, however, were given on a credit/no credit basis until 1979 when all courses above the orientation level were offered for undergraduate or graduate level credit (20:45). Tables 1 and 2

TABLE 2

PCE Courses (FY 85)
Department of Technical Applications

Course #	Title	Credit Hrs
ENG 400	Construction Cost Estimating	2.0
ENG 440	Built-Up Roofing	pending
ENG 460	Mechanical Engineering for Supervisors	2.0
ENG 470	Electrical Engineering for Supervisors	2.0
ENG 472	Engineering for Energy Mgt. and Control Systems	2.0
ENG 480	Building Systems	3.0
ENG 485	Contingency Engineering	2.0
ENG 490	Architectural Planning	2.0
ENG 500	Environmental/Sanitary Eng.	3.0
ENG 550	Pavement Engineering	3.0
ENG 561	Heating, Ventilation, and Air Conditioning Design	4.0
ENG 563	Facility Energy Systems	4.0
ENG 571	Electrical Engineering	4.0
ENG 590	Corrosion Control	2.0
ENG 595	Industrial Water Treatment	3.0

(22:20-27)

depict the course offerings and credit hours for FY 85.

Non-Resident PCE Programs. In addition to the resident program, the SOCE provides three non-resident programs. The Civil Engineering Management Applications Regional Seminar (CEMARS) is conducted at pre-determined regional sites so that several bases' CE personnel in relative proximity can attend. The two one-week sessions are designed primarily for first and second line supervisors. Subjects include an overview of base civil engineering branch and section responsibilities, and various management skills needed by the supervisors. Seminars at three locations were planned for

FY 85 (22:30). The second nonresident program is the On-Site Seminar program, involving 1-5 day courses (no academic credit) covering any of 14 different subjects. The courses can be tailored to meet the special needs of the requesting base (22:31). The Teleteach program is the third non-resident method of receiving instruction from the SOCE. Forty one-hour video-tape or slide/tape programs have been developed for use at individual bases. The SOCE provides an instructor to discuss the program via telephone hook-up once they have viewed the course (22:34).

Faculty Selection and Credentials. The faculty of the SOCE consists of both military officers and civilian educators. Traditionally, the faculty had been 90% military and 10% civilian educators (20:46). The FY 85 school brochure showed the current teaching staff to have 31 military faculty and 3 civilians (22:4-7). The current teaching faculty includes 33 instructors with Master's degrees and one with a PhD. The Dean and Vice-Dean also hold PhD degrees (22:3).

A Faculty Review Board of five members, chaired by the Dean of the SOCE is convened to review recommendations made by faculty members in order to fill vacancies. General criteria used to determine eligibility for appointment to faculty duty are:

1. Be a volunteer
2. Have at least a Master's degree
3. Served in Base Level positions for at least three years
4. Have a good military record with a potential for promotion

5. Be a Captain (8-9 years) or Major (11-12 years)
6. Attended Squadron Officers School in residence
7. Be an excellent communicator (27:Atch 1).

The Dean of the SOCE has final approving authority for appointments to the faculty. Military faculty are assigned for four-year tours.

The AFIT Self-Study report accomplished for reaccreditation review identified "currency" as a faculty strength. The report noted "military faculty are carefully selected and come to the school directly from assignments in the mainstream of Air Force civil engineering at base and MAJCOM level . . . [bringing] fresh enthusiasm, new ideas, and current real world-wide problems and solutions" (20:46). There has been some concern, however, that the 25% per year turnover of military faculty presents some continuity and stability problems that might be ameliorated by a greater civilian/military mix at the expense of current field expertise (20:46).

Curriculum Review. The SOCE curriculum is reviewed periodically by both external and internal processes.

External review is provided annually by the Program Review Committee (PRC) convened at the direction of the USAF Deputy Chief of Staff for Engineering and Services (E & S). Committee members include the directors of E & S for all USAF MAJCOMS and Separate Operating Agencies as well as AFIT and SOCE faculty and staff. The PRC provides:

> periodic, intense review of courses and program offerings . . . [by addressing] the content, quality, and primary thrust of each SOCE continuing education course. The group proposes course deletions and additions and addresses how best to meet the requirments [of USAF] agencies (24:12).

Maj Gen Stuart Sherman, former Commandant of AFIT, notes that the feedback from the actual using field agencies allows the SOCE to adapt courses to meet the changing requirements and be responsive to the needs of the entire CE community (24:12-13).

Internal review of each SOCE course is accomplished by the formal Curriculum Review Board (CRB) and informal End-of-Course surveys. The CRB annually reviews the course material and schedule to "insure the latest state-of-the-art advances in technology and changes in functional operations and management of AFCE are incorporated in each directed course" (25:3).

Course Availability/Quotas/Student Applications. The size and scope of PCE offerings provided by the SOCE are contingent upon funding authorized in the DOD budget each year (24:12). The Program Review Committee each year prioritizes the courses offered by the school and determines the number of course offerings consistent with funding levels and manpower available (24:12). The courses approved for presentation during a fiscal year determine the student slots needing to be filled. Available slots are divided into quotas provided to each MAJCOM/Separate Operating Agency (SOA) through the HQ USAF Pipeline Management System

(PMS). The training and classification officers at MAJCOM/SOA level are responsible for filling class rosters (11:4-24). If MAJCOM's have not filled quotas with approved students by approximately 35 days prior to class start, quotas can be reallocated to other MAJCOM/SOA's who have additional students.

Air Force Regulation 50-5, Formal Schools Catalog, is the regulation describing procedures for application to SOCE courses. The recommended procedure begins 90-45 days prior to class start date. The applicant completes a DD Form 1556 requesting the training and routes it to his MAJCOM through his local base Personnel Office. The recommendation is that "supervisors, training personnel, and the MAJCOM's closely screen the qualifications of the students they send . . . [because] *maximum* benefit accrues to those students who meet established prerequistes" (22:40). The School of Civil Engineering is the approving authority for all applications and individuals are notified of approval through the PMS (22:40).

Dissemination of Course Information. Five methods exist for civil engineers in the field to receive information about available PCE programs offered by the SOCE.

1. Numerous regulations/directives contain information about PCE available. Among them are: AFR 50-5, Formal Schools Catalog; AFR 53-7, USAF PCE Program (Short Course); AFR 53-11, AFIT; and AFR 30-9, Meetings of Technical, Scientific, Professional, or Similar Organizations.

2. AFIT periodically issues a catalog similar to ones

published by large universities (23).

3. Each AFIT school including the SOCE publishes a brochure each FY highlighting its PCE program. The brochure includes listings and schedules of each course offering and instructions for applying for courses (21,22). The School of Civil Engineering prints about one brochure for each three engineers (military and civilian) in the career field (26). These brochures are distributed primarily through MAJCOM training coordinators or via mail directly from the SOCE (26).

4. Official publications such as the Engineering and Services Quarterly periodically publish PCE information. (28:31)

5. Word of mouth at all levels disseminates information about the SOCE and what it offers.

Career Management Guidance. To ensure that qualified officers are available to take on responsibilities in the defense establishment, the Air Force must "provide for the intellectual and professional growth of all officers" (29:1-1). A variety of career development programs are available to fill the experience gaps to improve performance and encourage advancement (29:1-1). Professional Continuing Education is one of those programs.

Air Force Regulation 36-23 contains "Career Progression Guides" for the civil engineering functional area that delineate appropriate jobs and education for officers during

their careers. SOCE PCE short courses figure prominently in the recommendations made for civil engineers in all career phases from commissioning to senior management levels (29:25-5). "Technical training courses serve a variety of needs . . . and must be considered as a prime means for improving job performance" (29:4-1).

The supervisor's role in officer career management is emphasized. While career development is ultimately the responsibility of the individual officer, "management must provide guidance and opportunities for career development, and create a climate that engenders growth" (29:1-1). Supervisors and commanders are encouraged to:

> 1. Counsel subordinates on career objectives and career-broadening programs.
>
> 2. Advise the immediate commander what formal training would further enhance the subordinate's capabilities to perform future duties of increasing complexity and scope. (Such training need not be directly related to the job at hand or immediate unit effectiveness).
>
> 3. Provide the subordinate sufficient opportunity and time for self-development in his or her chosen utilization field and as a professional officer. (29:4-4)

The supervisor, therefore, can be a vital force in the professional development of young officers.

Summary

This chapter first discussed some research conducted in the field of adult learning and continuing education. The research centered on some of the individual and organiza-

tional constraints individuals face and some of their attitudes and motivations to pursue additional education. The focus then shifted to the Air Force and its Professional Continuing Education programs. The AFIT School of Civil Engineering was highlighted and information provided covering the school's curriculum, faculty, and operating procedures.

The following chapter will discuss the methodology employed in this research project.

III. Methodology

Introduction

This chapter describes the process undertaken to answer the research objectives posed in Chapter I. The relevant population to be studied and the sample chosen are discussed first. Then, a description of data collection is presented. The factors that were assumed to affect engineers' access or desire to attend AFIT PCE are next explained. Applicable statistical analysis techniques used in this project are covered, followed by a discussion of how these techniques were used to answer the research objectives.

Population and Sample

A population can be defined as a group consisting of all individuals or objects of a particular type (30:1). It is often impractical to survey every person if the size is very large. A sample of that population is instead chosen, and from the characteristics of the sample, inferences are made about the population.

As stated in Chapter I, this research would be limited to data gathered from only one group in the Air Force Civil Engineering functional field--active duty officers. These officers hold the Air Force Specialty Code (AFSC) 55XX. Possible AFSC's in this career field include entry level engineers holding 5521 codes, fully qualified individuals

identified by a 5525 code, and civil engineers in leadership and staff positions with the 5516 identification. Officers holding these AFSC's range in rank from 2nd Lieutenant (Lt) through Major General. Approximately 2400 civil engineering officers are on active duty in the following ranks: 2nd Lt (22%), 1st Lt (23%), Captain (30%), Major (12%), Lt Colonel (8%), Colonel (5%), General officer (4 individuals) (31). Approximately 600 overseas billets are filled by civil engineers, a fact which reduces the survey population to 1800 (31). A sample size of 500, or 28% of the population, was chosen after discussion with statistician Lt. Col Joseph Coleman, instructor of Operations Research, about the requirements of the statistical procedures to be used (32).

Because of the impracticality of surveying the entire population, a decision was made to sample the above population. Parten describes the optimum sample as one which "fulfills the requirements of efficiency, representativeness, reliability, and flexibility" (33:293). No matter what type of sample is used, it is important to insure that the sample is representative of the population. The aim of this research was to gather information from a cross-section of the civil engineering career field. Demographic questions in the survey allowed the researcher to group respondents (by rank or engineering experience, for instance) after return of the surveys. A simple random sample of the population was therefore used in hopes of garnering a repre-

sentative cross-section of the career field. Randomization occurs when "each population element has an equal chance of being selected into the sample" (U:150). A sample of civil engineers was chosen by computer search of all officers meeting the population criteria. That search identified possible respondents by using four randomly chosen digits between 0 and 9 and matching those numbers to the last digit of officer's Social Security number. The computer output contained 54 individuals excluded by the researcher because of computer data masking (no address given), they were current AFIT instructors or students, or because current duties took individuals out of the "mainstream" of the career field. Examples include current AFIT instructors and students and individuals pursuing academic degrees at civilian institutions.

A representative random sample should, in theory, mirror the characteristics of the whole population. One factor that might bias this sample (in addition to the exclusions cited above) is the "CONUS-based" constraint. Most officers who transfer to overseas billets are experienced engineers on their second or later assignment. Surveying only CONUS based officers could result in a greater percentage of 2nd and 1st Lieutenant respondents than are present in the career field. It is not expected that this bias will significantly affect results.

Data Collection

There are two ways to collect information from a population--through direct observation or by asking questions. While observation is adequate, indeed preferred, for many types of research, "we can learn little about what a person knows or believes except by asking. How one thinks can seldom be demonstrated by overt behavior" (34:213). An instrument that "asks" questions is indicated for this project.

Where the population or sample to be studied is relatively small or the manpower available for research is plentiful, personal contact with respondents is an option for data collection. Both personal and telephone interviews have the advantage of quick response and allow the researcher to expand and clarify answers given. However, funding and time constraints are negative factors when many people must be interviewed at widely dispersed locations. A third technique to gather data is the mail survey. Advantages of a mail survey include: lower cost, wider dissemination, one person job, and convenience for the respondent. (33:94) Additionally, it is likely that answers more representative of true feelings are elicited when the respondent is given more time to "mull over" responses. Emory identifies two major drawbacks to mail surveys. Excessive length and/or disinterest in the survey topic can lower response rate significantly (34:302). The mail survey was chosen as more practical in this case to survey the requi-

site number of civil engineers at many Air Force bases around the country.

Survey Instrument. The survey developed for this project contained 67 questions divided into three sections. Appendix A includes a copy of the survey sent to 500 civil engineers.

Part I of the survey solicited demographic information by which respondents can be separated by information such as rank, experience, duty assignment, academic background, and marital status. Part II asks respondents to answer questions and react to a series of statements about AFIT and PCE. The final section contains three open-end response questions that allow the respondents to offer their own opinions about the important factors they feel affect attendance at AFIT.

The majority of questions in Parts I and II were multiple choice questions requiring a circled response on the survey. Blanks were provided for written responses in a few cases. In Part II, most questions requested participants' reaction to a given statement by using a familiar Likert scale like the one presented below.

SD	D	N	A	SA
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

No computer scan sheet was included because the researcher felt that scan sheets would increase survey completion time

and significantly reduce the response rate.

Prior to mailing, the survey was pre-tested by asking 22 Air Force civil engineers in AFIT's Graduate Engineering Management program to complete the survey and comment on its format and content. Eighteen were returned with generally favorable response. Some students pointed out some confusing areas or ambiguities and suggested ways to clarify some wording. After some revision to rectify those problems, the survey was submitted to the Air Force Military Personnel Center (AFMPC) for approval.

Once approved by AFMPC (Survey Control Number 85-49 was assigned), survey packages were prepared and mailed on 17 May 1985. Each mailing contained a cover letter, the survey and instructions, and a pre-addressed return envelope.

Factors Affecting Attendance

In developing the research objectives, some possible factors affecting both the access and motivation of Air Force civil engineers were hypothesized by the researcher. The survey instrument was then structured to gather data about these factors and their relationship to AFIT attendance. This section presents those possible factors and explains the rationale behind their selection and relationship to PCE attendance.

Access. The following four factors may have a bearing on AFIT attendance.

1. Duty Assignment: Air Force civil engineers hold a

variety of jobs at many levels of command. They can work at base level, on various headquarters staffs, or at research laboratories. Depending on experience and expertise, they will hold staff and leadership positions that vary considerably in terms of workload and criticality of manning. Some of these assignments may be more conducive to AFIT attendance than others.

2. Knowledge of AFIT Programs: One of AFIT's responsibilities is to insure the dissemination of information about its programs. How well they do this and how well it is done at unit level could affect attendance, especially among officers new to the career field.

3. Supervisory Factors: Most potential attendees must request approval from their supervisors for AFIT attendance. The supervisors must balance the career development needs of the individual with the needs of the organization to do its job in his or her absence. Future inspections, adequate manning, and supervisor-subordinate relationships could affect access to PCE.

4. Application Procedures: Procedures for applying to AFIT are set down in both Air Force regulations and AFIT publications. Difficulties in finding this information could affect attendance. Other factors that could affect attendance are the lead times and pre-planning needed to schedule and coordinate a TDY for PCE activities.

Motivation and Intent. Assuming that individuals are not otherwise constrained from attending AFIT, each has a particular desire, high or low, to take advantage of AFIT's program. Some factors that might influence this desire are presented here.

1. Academic Background: Engineers' desire to take PCE classes could be affected by the number and types of degrees already attained, performance and experiences during that previous education, and the time since the officers last updated those degrees with follow-on courses.

2. Supervisor Attitudes--AFIT and PCE: Just as supervisors might affect a subordinate's access to continuing education, their attitudes about the SOCE or PCE in general may come into play. Discussions between the two individuals will no doubt reveal the supervisor's opinion, either positive or negative, about the SOCE. With younger officers especially, supervisor attitude may be particularly influential.

3. PCE Course Structure: The majority of SOCE PCE courses are taught for academic credit, with students receiving letter grades upon completion. This formal structure could influence desire to attend, possibly among those who are not interested in the credit hours or prefer a less rigid learning environment.

4. Attitudes About TDY: Most resident PCE courses at the SOCE are 2-4 weeks in length. Marital status, number of children, child supervision in one-parent families, or

amount of other TDY commitments may influence a desire to travel and be away from home.

5. Increasing Rank/Responsibilities: Just as senior officers may feel that workload constrains attendance at SOCE, they must consider what benefits may accrue from that attendance. Engineers progressing through the ranks may be less inclined to attend AFIT if the program does not offer material they feel is helpful.

6. PCE and Advancement Potential: Whether individuals perceive that PCE enhances their promotion potential may be related to their efforts towards continuing education. Some may see PCE as a vehicle to prepare them for increased responsibilities and feel their chances for promotion may be increased by attending the SOCE program.

7. Usefulness/Applicability of PCE: The aim of continuing education is to further professional knowledge and improve ability to perform a present or future job. The perceived success or failure of that objective may influence a student's desire and intent to take PCE courses. A potential attendee's opinion about this usefulness may stem from either his own experience at other courses or from word-of-mouth from colleagues.

Summary. The factors discussed here are by no means an exhaustive list. Other factors may influence SOCE attendance. Respondents are given the opportunity in Part III of the survey to state what factors they feel are most important.

Data Analysis

Types of Data. The first step in analyzing data using statistical tests is to determine the type of data available. Four common classifications of data are nominal, ordinal, interval, and ratio (34:121). This research deals with all but the ratio scale.

Nominal data is measured on a scale that is purely classificatory in nature. A nominal scale partitions a set or population into subsets or categories that are mutually exclusive and collectively exhaustive (34:121) meaning that no categories overlap and that each object can be placed in at least one of the categories. These categories are simply used to classify an object, person, or characteristic. Any number assigned to each category is simply an aid to identification rather than a value for use in a mathematical expression. Examples of nominal scales in this research include questions about a respondent's MAJCOM, academic specialty, duty section, marital status, or supervisor status.

Ordinal data adds the concept of relatedness to nominally scaled data (35:24). The categories of data can be ordered in some way that demonstrates a relationship such as "greater than," "more difficult," "higher than," or "less preferred." In other words, a comparison can be made between the categories and they can be placed in a particular order along a continuum. The difference between each cate-

gory, however, cannot be determined with certainty. Numbers again can represent each category but must always reflect the underlying ranking of each class (35:25). Much of the data in this research is ordinal. The familiar Likert scale described earlier represent ordinal data because responses can be ranked from strongly disagree to strongly agree. Demographic questions such as rank, academic achievement, years of service, or how often a respondent hears about SOCE PCE are other examples of ordinal data.

The last type of data used in this study is interval data. Unlike ordinal data, the distance between points on the interval scale is known.

> An interval scale is characterized by a common and constant unit of measurement. . . . In this sort of measurement, the ratio of any two intervals is independent of the unit of measurement and of the zero point. In an interval scale, the zero point and the unit of measurement are arbitrary (35:26).

The factor analysis technique discussed later will produce data that is a measure of strength of various factors (motivation, for example). While the differences between two pairs of data can be compared, the scales have no zero point. Zero motivation, for instance, is not defined.

Descriptive Statistics. Descriptive statistical methods are some of the simplest methods to analyze data using the basic distributional characteristics of the data. Frequency counts for questions answered in discrete categories show the number of times a particular answer was selected. The percentage of the total response that each answer com-

prises provides an overall picture of the response pattern for each question. For ordinal data, where a measure of central tendency would be instructive, the median is the appropriate statistic. "The median is the numerical value of the middle case lying exactly on the 50th percentile, once all the cases have been rank ordered from the highest to lowest" (37:183). The median is analogous to the mean of interval or ratio data. For analysis of Likert scale data, responses were coded from 1 (strongly disagree) to 5 (strongly agree). If, for example, the median response for a particular question is 4, the prevailing opinion was to "agree" with the statement given. The mean and the variance computed for each question will also be presented to give the reader more information about the overall distribution of responses. For nominal data, the mode indicates the category that had the most responses and is the appropriate measure of central tendency.

Hypothesis Testing. Statistical tests are performed on samples drawn from a population in order to make inferences about the whole population. Using this classical or sampling-theory approach (34:406), the investigator makes a hypothesis about the population and uses statistical methods to test this hypothesis. The null hypothesis (H_o) is the hypothesis tested against another alternate hypothesis (H_a). For example, the null hypothesis that the mean age of men and women in the U.S. is equal could be tested against an

alternate hypothesis that the mean of one group is greater than, less than, or simply not equal to the mean of the other group.

> . . .[T]he null hypothesis will be the favored claim. The burden of proof will rest with the alternate hypothesis in the sense that we shall continue to believe in the null hypothesis unless the experimental evidence strongly contradicts it. In scientific investigations the null hypothesis is often the "status quo" claim, stating that previously accepted theory remains valid, while the alternate hypothesis is the "research" hypothesis which contradicts or extends in a new manner the accepted theory (30:100).

The "evidence" cited above usually takes the form of a test statistic that is computed using the data from the sample. "An extreme value of the test statistic means that . . . the null hypothesis is false. A probability value (p-value), or the observed level of significance, expresses the probability of obtaining a test statistic as extreme as the one observed, when the null hypothesis is true" (37:42).

A critical value must be selected to determine how stringent the requirements will be to reject H_o in favor of H_a. If a five percent possibility of rejecting H_o when it is actually true (a Type I error) is acceptable to the researcher, the critical value is set at 0.05 (30:101). The p-value for a test is compared to the critical value chosen. A p-value less than or equal to the critical value indicates that H_o should be rejected. A p-value greater than the critical value indicates the statistical evidence is not sufficient and H_o is not rejected.

Types of Tests. Statistical tests are usually classified as parametric and non-parametric. Which type to use is traditionally determined by the nature of the data involved. Parametric tests are appropriate for data at least on the interval scale and require more rigorous assumptions about the underlying population distribution. Non-parametrics, however, require the data only be nominal or ordinal and have less stringent distribution requirements; hence, they are often called "distribution-free" statistics (38:45). The decision about which type to use has become less "cut and dried" recently as parametrics are increasingly used for social research on less than interval data. Indeed, resulting differences are often negligible with larger sample sizes (35:31). This research sides with the traditionalists and employs non-parametrical techniques because the data is primarily nominal and ordinal and not as well-suited to parametric tests.

All tests for this project were completed with the aid of a statistical computer package, the Statistical Package for the Social Sciences (SPSS), Release 9. This extensive program provides a variety of statistical procedures and utilities, of which the following were used in this study.

Mann-Whitney Test. The Mann-Whitney (M-W) test was used to compare responses of two independent populations or groups to determine if those responses were significantly different between groups. "This is one of the most powerful

of the non-parametric tests and is a most useful alternative to the parametric T-test. . ." (35:116). In general, the M-W test ranks all responses in order from lowest to highest and determines a mean or average rank for the responses of each group. This average rank for each group is then tested for significant differences. For example, the null hypothesis could be that there is no difference between how often field grade officers and company grade officers hear about SOCE programs. The alternate hypothesis would be that there is a difference. The SPSS computer program ranks the data, computes the test statistic (corrected for any ties), and determines the level of significance (p-value) for the result. The critical value used for this study is 0.05, but a p-value will be presented to give the reader an indication of the strength of any differences. If the difference is significant at the critical level, a comparison of the mean rank for both groups will indicate how their answers differed. The large number of ties encountered in analyzing Likert scale data does not significantly affect results of this test, and its efficiency approaches 95% that of the powerful T-test (35:126).

Kruskal-Wallis Test. The Kruskal-Wallis (K-W) test is similar to the M-W test except that it attempts to identify differences among more than two groups. Its parametric counterpart is the oneway analysis of variance (ANOVA). The mean ranks of each group under consideration

are compared in the form of a test statistic, K. The alternate hypothesis in this ANOVA test is that the response of at least one pair among the groups tested differs. A p-value less than the chosen critical value, therefore, merely tells the researcher that one or more differences do exist. The SPSS package again computes the needed test statistic, corrects for ties, and determines a level of significance. A critical value of 0.05 was again be used. The efficiency of this test is also reported to approach 95.5% when compared to parametric ANOVA (35:193). Once the K-W test rejects the null hypothesis, the researcher must determine which pairs in the group are significantly different.

Two methods of performing multiple comparisons were found in the literature. One author proposes performing the M-W test on each pair once the K-W test indicates a significant result (38:163), while other experts suggest a formula proposed by Dunn in 1964 (30:498, 39:124). Preliminary calculations indicated that both methods give similar results, so the M-W method was chosen primarily due to the SPSS support for that particular test. References consulted indicated, however, that the critical value for the comparisons should not be set at the same level as for the original K-W test. "If we are concerned to keep the per experiment error rate at a particular value, say $\underline{a}$ (alpha), then if we are carrying out c comparisons, each comparison should be tested using a significance level of $\underline{a}$/c" (38:161). This

can, however, be conservative.

> [I]f we reject the null hypothesis using the Kruskal-Wallis Test with alpha=0.05, it may be acceptable to set alpha as high as 0.20 when carrying out a large number of multiple comparisons. Values of alpha between 0.05 and 0.20 are frequently used for this purpose. (38:162)

Devore mentions an $\underline{a}$ of 0.10 to be common (30:598). Because some results will necessitate a larger number of comparisons, the $\underline{a}$ for the overall comparison tests will be 0.15. For example, for six categories on which comparisons must be done, there are 15 pairs to test. The p-value (significance level) to use for the comparisons would be 0.15/15 = 0.01 for a one-tailed test and 0.005 for a two-tailed test.

Factor Analysis. The term "factor analysis" describes a collection of techniques used to examine the underlying structure of a set of variables on which data has been gathered (40:6-1). The objective of the analysis is to identify a smaller number of underlying factors, or dimensions, from the larger set of variables. Factor analysis in this project will be used to develop "motivation" and "motivation-influencing" variables to be used in a regression analysis. Readers unfamiliar with factor analysis are encouraged to consult Appendix C for a fuller explanation and an example of factor analysis techniques.

Multiple Linear Regression. Regression is a common statistical technique used to examine the relationships

between a dependent variable and a set of independent variables. Appendix D presents a brief explanation of regression analysis and its use in this project.

Applied Analysis

This final section discusses the procedures employed to analyze the survey data and achieve the research objectives.

Two different approaches were taken to answer Research Objectives 1 and 2. The reason for this two-faceted approach was the nature of the dependent variable.

For Objective 1, an exploration of factors affecting the access of civil engineers to SOCE PCE was undertaken. Four factors that could constrain or encourage PCE attendance were hypothesized. However, the research did not develop a measure of access against which the hypothesized factors could be compared and tested. Such a measure would be difficult to establish given the many variables that influence access. Instead, the survey asked specific questions that related to each of the four factors. The answers to these questions could then be analyzed individually and inferences made about the strength of that factor upon an engineer's access.

Objective 2 related to factors influencing an engineer's motivation to attend SOCE PCE. A different method was used in this case. This method involved the development of a measure of individuals' motivation through use of the factor analysis technique. This "motivation score" was used

as the dependent variable in a regression problem. The independent variables used were developed by a factor analysis of other survey questions. The aim was to determine which of the independent variables (factors) seemed to have the most influence on an individual's motivation to attend SOCE.

Objective 1. The procedures used to analyze the four hypothesized factors that influence SOCE access are discussed below.

> 1A. What influence does a civil engineer's duty assignment have on ability to attend SOCE resident PCE courses?

Survey questions 24 and 25 asked respondents about how their duties, responsibilities, and workload affected SOCE attendance. Descriptive statistics were used to help answer this question by noting the median responses. As a further step, answers to these questions were broken down by responses in the following demographic categories and subcategories.

Question	Variable
1	Rank
3	MAJCOM
4	Job Level
5	Base CE Job Level
6	Base Level Section
9	Time in Current Job
10	Supervisor Status

The areas noted above involve the duty assignment of civil engineers, and any differences in responses indicated where

that assignment affected access to SOCE PCE. Kruskal-Wallis and Mann-Whitney tests were conducted as appropriate to detect significant differences in responses to Q24 and Q25.

1B. To what extent is knowledge about the SOCE resident PCE program disseminated to Air Force civil engineers?

The degree to which SOCE programs are "advertised" and information made available to the career field was tested by a number of questions. Q18 asked how often respondents heard about the SOCE, while Q19 attempted to determine the methods by which that information is disseminated. The SOCE produces a comprehensive brochure about its resident PCE program each year, and Q20 measured the extent of circulation of the FY85 brochure. Likert response questions 27 and 28 were designed to see if lack of knowledge about SOCE programs was adversely affecting attendance.

The median response for questions 18, 20, 27, and 28 gave an overall view of the extent to which word of SOCE programs is disseminated. Q18 and Q20 were evaluated to see whether rank (Q1), job level (Q4), supervisor status (Q10), or base level job (Q5) was significant in predicting responses. Questions 27 and 28 were analyzed by rank (Q1), job level (Q4,Q5), and supervisor status (Q10) to determine if these factors appeared significant in influencing attendance. Question 19 concerning how engineers heard about SOCE allowed respondents to mark as many answers as applied. The

percentage of the sample that marked each method was noted to determine the most prevalent methods.

1C. What supervisory factors influence attendance at SOCE resident PCE courses?

Four Likert scale questions elicited responses about supervisors' influence on potential attendees' access to PCE. Question 30 asks whether a respondent's supervisor approves attendance on the basis of who will benefit most or, alternately, who can be "spared." Question 31 attempts to determine if upcoming inspections influence supervisor's decisions to approve an SOCE TDY. Whether home station duty or SOCE attendance took priority in supervisors' views was asked in Question 32. Question 33 looked at whether supervisors felt that either military or civilian engineers could benefit more than the other from SOCE PCE.

Each of the above questions was analyzed with descriptive statistics. Next, nonparametric tests (K-W, M-W) were performed to see if responses varied among supervisors and non-supervisors (Q10) and by those working at the base or headquarters level (Q4). Additionally, the responses of those officers who had been turned down for attendance on at least one occasion were analyzed separately to see these officers differed in their opinion from the entire sample. Question 21 allowed respondents to state the various reasons their supervisor had stated as justification for denying an

application for SOCE attendance. Those responses were tallied, grouped, and presented in Chapter IV.

1D. Do civil engineers feel SOCE application procedures influence attendance?

Question 34 asked if respondents felt the SOCE application process was too complicated. The median response shows the overall view of the career field. A look at responses by experience level (Q2) determined whether experience in the career field changes that attitude. To determine the feelings of respondents who have not attended and/or applied for SOCE PCE, the median responses for these individuals were compared to the career field as a whole.

Question 35 asked if the 45-60 day lead time for applications prescribed by regulation was reasonable in the respondent's opinion. These responses were grouped by rank (Q1), supervisory status (Q10), base versus headquarters job (Q4), and base level job (Q5) to determine how opinions differed on this subject.

Question 36 determined if respondents were familiar with application procedures. This question was analyzed by rank (Q1) and base job level (Q5) to again see how experience affected, if at all, perceptions about the difficulty of application procedures. Responses of individuals who had not applied or attended the SOCE were also checked against median scores of the entire sample.

Open-end Response. Part III contained an open ended response question that asked officers to list areas they thought were major factors affecting access to SOCE PCE. The intent of the question was twofold. The first aim was to confirm or reject the selection of the four factors that were tested by the research. Second, it served to identify factors not specifically covered by the research but considered important by respondents. Answers provided were grouped into similar categories and ranked by the number of respondents who identified a particular factor.

Objective 2. A multiple regression approach was taken to determine if the hypothesized factors discussed earlier are significant in predicting an engineer's desire to attend SOCE PCE. The only exception is the factor called perceived usefulness and applicability of SOCE PCE courses. Because only respondents who had attended SOCE courses answered questions dealing with that topic, this factor was analyzed in a manner similar to the manner for Objective 1, using descriptive statistics and non-parametric tests.

Determination of Regression Variables. Using survey questions relating to Objective 2, a factor analysis was performed using the SPSS program FACTOR. The initial analysis included all the relevant questions in an attempt to see if the survey questions (manifestation variables) could be reduced into fewer explainable categories (factors) corresponding to motivation and the hypothesized variables.

This validation run included the following survey questions and the topic to which they pertained.

Factor	Applicable Questions
Motivation	26,29,37,42,52 54,58,59
Supervisor attitude about PCE	38,39,40,41,53
SOCE graded/credit course structure	43,44,45,46
Attitudes about TDY	47,48,49
Increasing rank/responsibilities	50,51
PCE and enhanced promotion potential	55,56,57

Two subsequent factor analyses were performed. The factor(s) comprising manifestation variables related to an individual's motivation were analyzed separately. The intent was to determine if the survey questions elicited simply a one-dimensional "motivation score" or if more than one facet of motivation appeared to be measured. The remaining questions related to the independent variables were then analyzed to define factors that could influence motivation. Standardized factor scores for both the motivation and influencing factors were computed using the factor score coefficients calculated by the FACTOR program. These scores form the data base for the regression problem.

The dependent variable for the multiple regression is the "motivation score" calculated for each individual. The independent variables are the scores measuring individual

factors produced by the factor analysis, as well as responses to Questions 11 through 15. These questions ask the engineer's degree, specialty, year of degree, undergraduate grade point average (GPA), and time since a credit course was taken. Using the SPSS program NEW REGRESSION, the factors affecting motivation can be ranked and the contribution of each to predicting motivation to attend SOCE can be determined.

Research Question 2G. The perceived usefulness and applicability of SOCE PCE courses may also influence desire to attend other courses. Question 60 asked how many courses respondents had attended and Questions 61-63 ascertained their opinions about the applicability, currency, and relevancy of the course material to their jobs. The median response indicated the sample's overall opinion of the courses they had taken. To see if previous SOCE experiences had affected their motivation, the K-W test was run to evaluate the average motivation score for respondents answering in each of the five Likert scale categories (SD, D, N, A, SA) for questions 61-63. A significantly lower motivation score by those with unfavorable opinions about their SOCE experience would indicate that usefulness or applicability of course material does influence motivation.

Open-response Question. Question 67 allowed respondents to comment about what they perceived to be important motivation factors. Again, responses were tallied and

grouped according to subject area and ranked by number of times each was mentioned.

The following chapter presents the results of the survey and of the statistical procedures described in this chapter.

IV. Results

Introduction

This chapter presents the information gathered from the survey instrument and results of the analyses described in Chapter III. Five hundred surveys were mailed from Wright-Patterson AFB on 17 May 1985. The cut-off date for tabulating responses was 8 July 1985. There were 387 surveys returned prior to that date for a return rate of 77.4%.

Demographic Information

Part I of the survey was comprised of demographic questions for use in the data analysis. Question 1 determined the rank of each respondent. Table 3 presents the breakdown of survey respondents by rank and also shows the estimated percentages of civil engineering officers as reported by the Air Force Military Personnel Center (31).

TABLE 3

Ranks of Survey Respondents

Rank	Sample N	Sample %	Actual %
2nd Lt	108	27.9	22.0
1st Lt	103	26.6	23.0
Capt	83	21.4	30.0
Maj	44	11.4	12.0
Lt Col	32	8.3	8.0
Col	16	4.1	5.0
No Response	1	.3	-

A random sample of the career field should include officers whose ranks are in approximately the same proportion as exists in the entire population. Table A indicates that the sample distribution is approximately the same as for the actual population.

Appendix E summarizes the results of the other demographic questions in Part I of the survey. Listed below are the topics of those questions.

Q2.	Years experience in CE career field	Q10.	Supervisor status
Q3.	MAJCOM	Q11.	Academic degree
Q4.	Job level	Q12.	Academic specialty
Q5.	Base CE job level	Q13.	Year of degree
Q6.	Base CE section	Q14.	Undergraduate GPA
Q8.	Rated supplement	Q15.	Last credit course
Q9.	Time in current job	Q16.	Marital status
		Q17.	Children living at home

The discussion of data analysis to follow will address the specific results of questions in Part II and III of the survey. Appendix E presents answer distributions and descriptive statistics for survey questions covered in this chapter.

Data Analysis--Objective #1

Results of the data analysis will be presented in the same manner as in Chapter 3 by covering each research objective and question in sequence. Much of the analysis results is presented in tabular form and placed in Appendix F.

Research Question 1A. What influence does a civil engineer's duty assignment have on ability to attend SOCE resident PCE courses? Survey questions 24 and 25 were used to evaluate this research question. Table 48 in Appendix F presents complete results of the statistical tests performed to analyze this question. Results from each question will be discussed separately.

> Q24. My duties and responsibilities in my current job prevent my attendance at resident AFIT PCE courses.

The median response to question 24 was two (disagree). Fifty-seven percent (57%) of respondents either disagreed or strongly disagreed, 31% agreed or strongly agreed, and 12% were neutral. This question was analyzed using a number of demographic categories as explained in Chapter III. Responses to this question were significantly different ($p=.034$) using the Mann-Whitney (M-W) test only between supervisors and non-supervisors. (To be statistically significant, the computed level of significance, or p-value, must be less than the pre-determined critical value, .05.) Among non-supervisors, 17% strongly disagreed and 42.9% disagreed. Ten percent (10%) of supervisors strongly disagreed and 41% disagreed with the statement. The next question specifically asked respondents about their workload.

Q25. I would attend more PCE courses at AFIT if my workload allowed.

The median response to Q25 fell in the neutral range (median=3). Forty-seven percent (47%) of respondents, however, agreed to some extent with the statement, while 28% disagreed.

The rank of respondents produced significant differences in answers to Q25 when all six ranks were tested with the Kruskal-Wallis (K-W) test (p=.006) and when broken down into company grade (2nd Lt-Capt) and field grade (Maj-Col) categories using the M-W test (p=.0058). In the latter case, 52.8% of company grade officers agreed that workload affected their attendance while only 33.0% of field grade officers agreed with the statement.

Since the K-W test that compared responses of all six ranks was significant at p=.006, multiple comparison tests were accomplished to determine what ranks differed significantly in their responses. Table 4 presents the results of the multiple comparison tests on the 15 pairs of officer ranks. As explained in Chapter III, each pair is compared using a M-W test. The category farthest to the left in the top row (Colonel in this case) had the lowest "average" responses to the question while the category farthest right (1st Lt) had the highest. Therefore, moving from left to right in the top row indicates a greater agreement to the statement from Colonel to 1st Lieutenant. Logically,

TABLE 4

Levels of Significance
Multiple Comparisons--Q25 By Q1

	Disagree <---------- Col	LtCol	2 Lt	Maj	Capt	1 Lt ----------> Agree
Col	-					
LtCol	.3173	-				
2 Lt	.2334	.1125	-			
Maj	.2482	.1129	.5595	-		
Capt	.0263	.0473	.2778	.2322	-	
1 Lt	.0040*	.0035*	.0204	.0870	.6799	-

* Significant at critical level

the most likely candidates to show "significant" differences are those categories that are at different ends of the spectrum. The level of significance for this test was .005. As noted by the asteriks, the responses of colonels and Lt Colonels are significantly lower than responses of 1st Lieutenants. Percentages of responses for these three groups are shown below.

	Disagree	Neutral	Agree
1st Lt	19.8	17.8	62.3
Lt Col	34.4	34.4	31.2
Col	56.3	18.8	25.1

Table 4 shows significant levels for all 15 comparisons. In the rest of this report, tables showing comparison tests will be presented in Appendix F.

When analyzed by squadron section, the K-W test detected a significant difference (p=.024) in Q25 responses

TABLE 5

Analysis Summary-Objective 1A

Dep Var	Median	Indep Var	Group Differences
Q24	2	Supervisor Status	Super./Non-Super.
Q25	3	Rank	1st Lt/Col 1st Lt/Lt Col Company grd/Field grd
		Base Section	Programming/Readiness Programming/Design

between one or more sections. Multiple comparisons (Table 49, Appendix F) showed that officers in Programming disagreed with the statement to a greater extent than did officers in the Readiness and Design sections. The percentages for their responses are shown below.

	Disagree	Neutral	Agree
Programming	50.0	25.0	25.0
Design	22.1	21.1	56.8
Readiness	11.8	17.6	70.5

The sample sizes for both the Programming and Readiness sections were small compared to the entire sample size with 20 and 17 respondents in each category respectively. Ninety-five individuals stated they worked in Design. A summary of results for Research Question 1A follows.

Questions 24 and 25 were analyzed using various demographic variables to answer Reaseach Question 1A. Table 5 presents a summary of the statistically significant results. The following section discusses the dissemination of PCE

information to Air Force civil engineers.

Research Question 1B. To what extent is knowledge about the SOCE resident PCE program disseminated to Air Force civil engineers? Survey questions 18 through 20, 27, and 28 were used to answer this objective. Table 50 in Appendix F contains complete results of all statistical tests. Analysis begins with responses to Question 18.

> Q18. I hear about the AFIT PCE program: 1) at least once a month, 2) about once every 3 months, 3) about once each 6 months, 4) about once a year, 5) never

Fifty-two percent (52%) of respondents heard of SOCE PCE programs at least once in each three month period, 20% heard about once every six months, 22% only hear about once a year, and 5% never hear of SOCE PCE on their jobs. Engineers at base level heard about SOCE PCE significantly more (M-W, p=.000) than officers not in a base level CE organization. Almost 60% of base level engineers were exposed to information about the SOCE once each three months. On the other hand, only 37% of the non-base level personnel heard about SOCE that often.

In terms of rank, the K-W test detected a statistically significant (p=.000) difference between at least one pair of ranks. Multiple comparisons showed that 2nd Lieutenants heard about SOCE PCE more often than did either captains or majors (Table 51, Appendix F). The responses for these

TABLE 6

Dissemination of SOCE PCE Information

Method	Percentage of Respondents
Conversation/Word of Mouth	62.3
SOCE catalogs/brochures	42.1
Engineering & Services Quarterly	24.8
Commander's/Officer's Call	11.9
Other methods	5.9
Never hear about SOCE	4.4

three groups are shown below.

	1/month	1/3 months	1/6 months	1/year	never
2nd Lt	38.9	26.9	19.4	8.3	6.5
Capt	17.1	24.4	19.5	32.9	6.1
Maj	13.6	20.5	25.0	34.1	6.8

colonels generally heard about the SOCE more often than did 2nd lieutenants (75.1% heard at least once each 3 months) but tests did not indicate a statistically significant difference perhaps due to the small sample size for colonels. How officers hear about PCE is the next subject for analysis.

Q19. If you hear about AFIT PCE, it is usually from what method(s)?

Table 6 shows how officers hear about the SOCE. Respondents could mark more than one answer to Q19 and the total percentage is more than 100%. Word-of-mouth is the most likely way civil engineers hear about programs. "Other methods" noted by respondents include training officers and NCOs, visits to the SOCE to lecture or attend courses, or

through subordinates asking approval for course attendance. Additionally, some officers noted that they had dealings with AFIT or with SOCE issues as a normal part of their jobs.

A PCE brochure is a major method used by the SOCE to advertise its courses. The next question asks about that brochure.

Q20. I have seen the FY 85 AFIT School of Civil Engineering brochure?

Sixty-three percent (63%) of respondents had seen the brochure, 32.8% had not, and 4.0% were unsure.

Officers in base level CE jobs saw the brochure significantly more (M-W, p=.000) than officers not in base level jobs. While over 71% of base level respondents had seen the current PCE brochure, only 43% of officers not at base level had seen it.

A K-W test detected that rank was also a statistically significant factor (p=.031) in predicting who had seen the brochure. Multiple comparisons (Table 52, Appendix F) showed that 2nd lieutenants saw the brochure significantly more than either captains or majors. The percentages for those three groups are presented below.

	Yes	No	Unsure
2nd Lt	75.0	22.2	2.8
Capt	53.0	42.2	4.8
Maj	52.3	38.6	9.1

Question 27 investigates whether lack of knowledge about PCE courses affects attendance.

Q27. I would be more interested in AFIT resident PCE courses if I knew more about them.

Responses to this question were generally mixed (median=3, neutral), with 30% disagreeing, 29% being neutral, and 41% agreeing with the statement.

Analysis by rank, however, detected some differences in responses. The K-W test had a level of significance of .031 when all ranks were compared. The pairwise comparison of ranks showed a statistically significant difference (p=.0019) between responses of 2nd lieutenants and lieutenant colonels (Table 53, App. F) whose answers were at differing ends of the spectrum. 2nd lieutenants agreed to a greater extent than did lieutenants colonels. The responses for both groups are shown below.

	Disagree	Neutral	Agree
2nd Lt	24.0	25.0	50.9
Lt Col	43.8	31.3	25.0

The responses were analyzed by company grade rank versus field grade rank. The M-W test was significant (p=.002) and tabulation by category showed that 44% of company grade officers agreed with the statement and 27% disagreed. In the upper three ranks, the percentages were nearly reversed, with 30 % agreeing and 41% disagreeing. In each case neu-

tral answers comprised about 30% of the sample. The next question finishes up discussion about Research Objective 1B.

> Q28. I am familiar with the full program of resident PCE courses offered by the AFIT School of Civil Engineering.

The median response for Q28 was four (agree). Fifty-four percent (54%) of respondents agreed or strongly agreed, 14% were neutral, and 32% disagreed or strongly disagreed. Further analysis showed that responses to this question were significant when tested against three of the demographic variables.

The first significant result (p=.036) occurred when responses were compared by rank using the K-W test. Comparisons among the six ranks (Table 54, Appendix F), however, did not reveal any significance levels below the critical level of .005 despite the significant K-W test. When placed on a continuum from disagree to agree, the six ranks can be ordered using the "mean rank" as computed by the K-W test. That order is 1) Major, 2) 2nd Lt, 3) 1st Lt, 4) Capt, 5) Col, and 6) Lt Col. In most cases the groups at differing ends of the spectrum are most likely to differ significantly. The responses for all six ranks are given below.

	Disagree	Neutral	Agree
Maj	45.5	11.4	43.2
2nd Lt	39.2	16.8	43.9
1st Lt	23.3	18.4	58.2
Capt	31.3	6.0	62.7
Col	18.1	0.0	75.1
Lt Col	18.8	18.8	62.5

TABLE 7

Analysis Summary--Objective 1B

Dep Var	Median	Indep Var	Group Differences
Q18	2	Rank	2nd Lt/Capt 2nd Lt/Maj Company/Field
		Job Level	Base/HQ
Q20	1	Rank	2nd Lt/Capt 2nd Lt/Maj
		Job Level	Base/HQ
Q27	3	Rank	2nd Lt/Lt Col
		Job Level	Base/HQ
		Super. Status	Super./Non-super.
Q28	4	Rank	None detected
		Base Job	Sect Ch + above/ Below Sect Ch.
		Super. Status	Super./Non-super.

From top to bottom in the chart, there is less disagreement and more agreement with the statement in Q28.

Familiarity with the SOCE PCE program also was statistically significant when compared by base level jobs. The M-W test showed officers working below the section chief level were less familiar than more senior officers at the section chief level or above (p=.008). Responses by both groups are shown below.

	Disagree	Neutral	Agree
Below Sect Ch.	33.8	16.6	49.6
Sect Ch + above	24.3	12.9	62.9

Similarly, supervisors were more familiar with the SOCE's PCE program than non-supervisors (M-W, p=.011). Among supervisors, 62.7% agreed with the statement and 25.4% disagreed. Non-supervisors agreed to a lesser extent--50.0% agreed with Q28 and 35.8% disagreed.

Questions 18, 19, 20, 27, and 28 were used to evaluate Reseach Objective 1B concerning dissemination of information about the SOCE PCE program. Table 7 summarizes the statistically significant findings.

Research Question 1C. What supervisory factors influence attendance at SOCE resident PCE courses? Four questions were analyzed to answer this question. Table 55 in Appendix F presents results of all statistical tests performed. Each of the four questions is analyzed separately.

> Q30. My current supervisor often selects for AFIT PCE those people who can be "spared" rather than those who might benefit most.

The median response for Q30 was two (disagree). Twenty percent (20%) strongly disagreed with the statement, 31% disagreed, 12% agreed, and 8% strongly agreed. Two other response distributions were studied to glean further information. Responses of the 88 officers (22.7% of sample) who had been denied supervisor approval for SOCE attendance on at least one occasion were studied separately. While 20% of the whole sample agreed with the statement, 49.4% of this

group agreed. Additionally, of the 46 officers (11.9% of sample) indicating in Q64 that they had been sent to AFIT as a non-volunteer at least once, 30.4% agreed with the statement and 52.2% disagreed.

While the job level of respondents was not significant in their answers to this question, the M-W test did detect that supervisors and non-supervisors differed in their opinions ($p=.0473$). The percentages for each group are shown below.

	Disagree	Neutral	Agree
Supervisors	53.8	31.3	14.9
Non-Supervisors	50.6	27.1	22.3

Another supervisory factor is covered in Question 31.

> 31. My current supervisor discourages planned AFIT attendance if a Higher Headquarters inspection is anticipated.

There was a mixed response (median=3, neutral) to this statement as 39% of the sample disagreed, 32% were neutral, and 29% agreed. Individuals who had previously encountered supervisor disapproval of their SOCE application agreed to a greater extent than did the whole sample. Forty-eight percent (48%) of these individuals disagreed while only 14.7% agreed with the statement. The individuals who had been SOCE "non-volunteers" at one time answered in approximately the same percentages as the entire sample.

Unlike the analysis for Q30, a M-W test comparing

responses by job level was significant (p=.000). Almost 48% of officers not performing base level CE jobs disagreed with the statement and only 8% agreed. On the other hand, base level civil engineers were almost evenly split with 36% disagreeing, 27% neutral, and 37% agreeing. No significant differences were detected (M-W test) when Q31 was analyzed by supervisor status. A third facet of supervisor influence on attendance is investigated in Q32.

> Q32. My supervisor feels that my duties at home station take precedence over attendance at AFIT resident PCE courses.

Similar to Q31, responses were mixed (median=3, neutral) to this question with 35% disagreeing, 26% being neutral, and 38% agreeing. Those who had been denied supervisor approval at one time, however, agreed to a much greater extent with 71.6% marking "agree" or "strongly agree". Again, past non-volunteers had the same answer distribution as the entire sample.

The M-W test again was significant (p=.001) when respondents' job levels were analyzed. Forty-three percent (43%) of base level civil engineers agreed that their supervisor's priorities lay with home station duties, while only 26% of non-base level personnel also agreed. A final question under this research question looks at a possible bias supervisors might have.

Q33. My supervisors feel that military personnel in Civil Engineering can benefit most from AFIT resident PCE.

The largest number of respondents (42%) marked 3 (neutral). 26% disagreed with the statement and 31% agreed. The tabulation for the 88 officers who had had an SOCE application rejected by a supervisor had an almost identical distribution, with 21.6% disagreeing, 47.7% neutral, and 29.5% agreeing. The 46 respondents who had been non-volunteers disagreed 39.2% of the time, 43.5% were neutral, and 17.4% agreed.

Again analyzed by supervisor status and job level using M-W tests, only the latter category proved statistically significant (p=.0239). Percentages in each category are shown below.

	Disagree	Neutral	Agree
Base Level CE	24.7	39.9	35.5
Non-base level	29.6	49.1	21.3

The following paragraph examines responses to an open-end question supervisory actions concering PCE.

Those officers who had been denied approval for SOCE attendance were asked to note reasons given by their supervisors for that denial. Those reasons have been grouped and are presented in Table 8.

Questions 30-33 were used to meet Question 1C concerning supervisory factors affecting access to SOCE PCE. Table 9 summarizes the statistically significant findings.

TABLE 8

Supervisor Disapproval of SOCE Attendance

Reason Given	Times noted
1. Cannot release for SOCE -Workload -conflicts w/ "Hot" projects -course too long -too much responsibility	56
2. Not applicable to current job -no "benefit" from PCE	11
3. Inspection in progress/ anticipated	9
4. Manpower shortage	4
5. Restricted # of SOCE TDY/yr	4

TABLE 9

Analysis Summary--Objective 1C

Dep Var	Median	Indep Var	Group Differences
Q30	2	Super. Status	Super/Non-super
Q31	3	Job Level	Base Level/HQ
Q32	3	Job Level	Base Level/HQ
Q33	3	Job Level	Base Level/HQ

Research Question 1D. Do civil engineers feel SOCE application procedures influence attendance? This research question was analyzed using survey questions 34-36. Analysis performed for each question is presented below. Table 55 in Appendix F presents complete results of the statistical tests. The complexity of the application process is investigated first.

> Q34. The application process for AFIT PCE courses is too complicated.

Twenty-seven percent (27%) of respondents agreed that the application process is too complicated, 31% were neutral, and 42% disagreed with the statement. The median response was 3 (neutral). Responses to this question were also tabulated for the 65 officers who had not yet attended an SOCE PCE course. Neutral answers comprised 48% of this group's answers, while 25% agreed and 27% disagreed.

In an effort to determine if engineers' experience in the career field affected answers to this question, an analysis of responses to Q2 was performed. The K-W test was not statistically significant (p=.238). Question 35 addresses one of the planning factors in the application process.

> Q35. The regulation governing applications for AFIT PCE requires that paperwork be submitted 45-60 days prior to class start date. It is unreasonable to commit oneself to attending an AFIT PCE course that far in advance.

The majority of respondents (56%) either disagreed or strongly disagreed with this statement, while 27% of the respondents agreed and 17% were neutral. The median response was two (disagree).

When responses were compared by rank, the K-W test detected a significant difference in at least one pair of the six ranks (p=.049). Multiple comparisons indicated that 2nd lieutenants agreed with the statement significantly more (p=.0019) than did lieutenant colonels (Table 57, App. F). The responses of those 2 groups are shown below.

	Disagree	Neutral	Agree
2nd Lt	38.0	13.9	48.2
Lt Col	9.4	21.9	68.8

To further examine the effect of rank on answers to this question, a M-W test comparing answers of company and field grade officers was accomplished. Results showed that company grade officers agreed significantly more with the statement than did field grade officers (p=.005) although the majority of both groups generally disagreed with the statement. The responses of both groups are shown below.

	Disagree	Neutral	Agree
Company Grade	53.3	17.2	29.5
Field Grade	67.0	15.4	17.6

Another significant comparison involved answers to Q35 given by supervisors and non-supervisors (M-W, p=.022). As

with the previous test, both groups generally disagreed with the statement with over 50% of respondents marking either "disagree" or "strongly disagree". However, non-supervisors showed slightly more agreement than non-supervisors. The answer distributions are shown below.

	Disagree	Neutral	Agree
Supervisors	66.9	11.8	21.3
Non-Supervisors	50.6	19.6	29.8

Question 36 finishes analysis under Research Question 1D.

> Q36. I am unsure how to apply for or obtain information about AFIT resident PCE courses.

The median response to this question was two, indicating *some disagreement* with the statement. Sixty-nine percent (69%) of respondents disagreed or strongly disagreed, only 18% agreed, and 13% were neutral.

A M-W test showed that base level respondents filling positions below section chief agreed with the statement slightly more than did their counterparts in other base level jobs (p=.032). The breakdown for each group is presented below.

	Disagree	Neutral	Agree
Sect Ch + above	76.3	14.5	9.2
Below Sect Ch	68.5	11.6	19.2

A summary of results for this research question follows.

TABLE 10

Analysis Summary--Objective 1D

Dep Var	Median	Indep Var	Group Differences
Q34	3	No significant tests	
Q35	2	Rank	2nd Lt-Lt Col
		Super. Status	Super/Non-super
Q36	2	Base Job Level	Sect Ch + above/ Below Sect Ch

Objective 1D concerning SOCE PCE application procedures was analyzed using survey questions 34-36 and a variety of demographic variables. A summary of the statistically significant tests is presented in Table 10.

Open-end Responses. Question 65 in Part III of the survey asked respondents what major factors they saw affecting civil engineers' ability to attend SOCE PCE courses assuming an engineer wants to attend a particular course. The answers were grouped by subject area and presented in Table 11. Under each numbered factor in Table 11 are some of the responses grouped together to form that factor.

Data Analysis--Objective #2

A series of factor analyses were performed as explained in Chapter III for two purposes. The first was to confirm that the responses to questions in the survey could be broken down into a few known dimensions that closely approximate some hypothesized variables. Secondly, the analyses

TABLE 11

Factors Affecting Access to SOCE PCE
Responses to Question 65

Factors	Times Noted
1. Workload -perceived by officer -perceived by superior -courses too long -level of responsibility	196
2. Availability of Course Openings -too few MAJCOM quotas -too few course offerings/yr -difficult to anticipate requirements far in advance	105
3. Supervisors Attitude/Policy -Immediate use/applicability? -Degree of support for PCE -Restrictions on # SOCE TDY/yr	83
4. Manpower Shortages -Under-staffed offices -one man offices	39
5. Knowledge of Course Offerings -Get information soon enough -Get enough information	16
6. Anticipated inspections/exercises	15
7. Family Poblems/Commitments -1 parent families -both parents work	13
8. Eligibility Restrictions	7
9. Poor Scheduling/Planning/ Procedures -By squadron trng. monitor -By MAJCOM coordinators -By SOCE	7

TABLE 12

Factors Retained--Initial Factor Analysis

Factor	Dimension	Questions
1	Motivation to attend SOCE	26,37,42,52, 54,58,59
2	Perceived supervisor attitude towards SOCE PCE	38,39,40,41
3	Opinion about SOCE course structure	44,45,46
4	Opinion about the effect of PCE on promotability	55,56
5	Perceived benefits of PCE as rank/responsibilities increase	50,51
6	Attitude towards TDY	47,48
7	[NO DISCERNIBLE RELATIONSHIP]	29,49

was used to obtain a measure of both motivation and "motivation-influencing" variables for use in a regression analysis. The results of the factor analyses will be discussed, followed by an explanation of findings from the regression procedure.

Factor Analysis--All Variables. The primary purpose of this initial factor analysis using all relevant variables was to determine if the questions thought to comprise the dimension called "motivation" would actually be grouped together by the analysis procedure. Should that grouping occur, it would lend credance to the use of these variables to compute a motivation score for each individual.

Appendix G displays the results of this initial analy-

sis giving Varimax-rotated factor loadings and communalities for each variable. The appendix also includes tables giving the eigenvalues and percent of explained variance for each factor.

Seven factors that had eigenvalues greater than 1 were extracted during this initial analysis. These factors explained 60.3% of the variance. Communalities for the 25 manifestation variables ranged from 79.3% to 40.9%. Table 12 on page 77 shows the questions grouped together based on their factor loadings to make the dimensionality decision for each factor. Of the questions initially designed to measure an engineers' motivation to attend AFIT, all but Q29 were grouped together in Factor 1. Factors 2-6 and their resultant dimensionalities closely approximated the factors that guided survey development. This fact generally confirmed the hypotheses that those factors could be used to develop measures that might affect motivation and intent to attend SOCE PCE. Interpretation of Factor 7 and the disposition of Q29 deserve a more detailed examination.

Question 29 stated "I have not taken all the AFIT PCE courses I want to," and was expected to load primarily with the other motivation variables in Factor 1. Instead, Q29 had a factor weights of .31864 on Factor 1 and .44529 on Factor 7. Factor 7 did not have any variable loadings greater than Q29's, indicating weak dimensionality. Because Q29 was not as highly associated with the "motivation" vari-

ables as was expected, some further analysis was undertaken. Another factor analysis was completed using all the original manifestation variables except the seven closely associated with with Factor 1--the "motiviation" variables (Q26, Q37, Q42, Q52, Q54, Q58, Q59). The purpose of this additional analysis was to see if Q29 demonstrated a stong association with one of the "motivation-influencing" factors. The factor matrix produced from this run is also presented in Appendix G. This analysis retained six factors. Question 29 did not load on any of the six factors greater than the relatively low value of -.21549. This result confirms that Q29 is not highly correlated with any of the independent variables and it will be included, instead, among the seven previously identified motivation variables in Factor 1. Question 29's second highest loading in the initial analysis was on Factor 1.

Factor Analysis-Motivation Variables. The eight variables used to develop a measure of motivation for each officer were analyzed separately. The purpose of this analysis was to determine if the eight variables were so closely related that they measured only one facet or dimension of motivation. Appendix G includes the complete results of this analysis.

Two separate "motivation" factors were retained in this analysis. Only the first factor had an eigenvalue over one. However, because the second factor had an eigenvalue

TABLE 13

Motivation Factors

Factor	Dimension	Questions
1	Opinion about benefits of SOCE PCE for civil engineers	37,42,52,54, 58,59
2	Personal desire to attend SOCE PCE	26,29

so close to 1 (.99644) and an explained variance of almost 13%, this factor was also retained. The factor matrix developed from this analysis contained somewhat high loadings for some variables on both factors (Q26, Q37, and Q59 in particular). However, two distinct dimensions were derived from the factor matrix. Table 13 identifies the questions used to identify both dimensions. Examination of the relevant questions for each factor showed that two slightly different dimensions could be derived. The six questions related to Factor 1 gathered respondent's opinion about the role and importance of SOCE PCE to civil engineers in general terms. On the other hand, Factor 2 that loaded highly on Q26 and Q29 was more specific and personal. Question 26 stated, "Periodic AFIT PCE courses are important to my development as an engineer and manager." Question 29 stated, "I have not taken all the AFIT PCE courses I want to". The use of the pronouns "my" and "I" made these questions more specific than the others, forcing the officer to make a decision about his personal attitude towards at-

tending SOCE PCE. This second factor may more closely approximate the intended result of the analysis: that is, to ascertain the individual's personal feeling or motivation towards attending PCE. However, Factor 1 can also be useful for providing another indication of motivation. The assumption to be made in this case is that an individual who believes AFIT and the School of Civil Engineering is important to Air Force civil engineers would be more highly motivated to attend than one who thought otherwise.

In order to investigate both these facets of motivation, regression analyses will be performed with both factors acting as the dependent variable. The results of the runs can then be compared to identify any interpretable differences.

Factor Analysis--Independent Variables. The final step in synthesizing data for the regression analysis was to determine what factors to use as independant or "motivation-influencing" variables. Just as the motivation variables were subjected to a separate analysis, so were the remaining manifestation variables to determine what dimensions they might represent. Appendix G presents complete results of this analysis. Five factors were retained by the analysis and are summarized in Table 14 on page 82. The five factors indicate that they measure five of the variables initially thought to affect engineers' motivation to attend SOCE PCE. As explained in Chapter III, variables relating to respon

TABLE 14

Motivation-Influencing Factors

Factor	Dimension	Questions
1	Perceived supervisor attitude towards SOCE PCE	38,39,40, 41,53
2	Opinion about SOCE course structure	43,44,45, 46
3	Opinion about the effect of PCE on promotability	55,56
4	Perceived benefits of PCE as rank/responsibilities increase	50,51
5	Attitude towards TDY	47,48,49

dents' academic achievement (type degree, GPA, year of degree, etc.) will be included in the regression analysis using raw scores. The seventh hypothesized variable, perceived usefulness and applicablility of PCE courses will be analyzed separately because not all respondents had attended SOCE PCE courses in the past.

Generation of Factor Scores. Using the SPSS facility called COMPUTE, values for the two motivation variables and the five "motivation-influencing" variables were calculated as part of the regression problem. The factor score coefficients used to compute the factor scores are shown in Appendix G. As noted in Chap III, the values calculated for each factor are standardized values that, when added together, have a mean of zero and variance of one. The statistics for each factor are presented in Appendix G. While the mean of

TABLE 15

Regression Analysis--Independent Variables

Variable & Dimension	Range (High/Low)
FACT1 Supervisor support for SOCE PCE	H strong support L weak support
FACT2 Preferred PCE course structure	H prefer pass/fail no academic credit L prefer graded/tested courses w/credit
FACT3 Percieved career enhancement resulting from SOCE PCE	H PCE not important L PCE is important
FACT4 Percieved importance of PCE as rank/responsibilities increase	H PCE less important L PCE more important
FACT5 Attitudes about TDY	H TDY inconvenient/ unwanted L TDY acceptable

all variables is near zero, the variances are slightly below one due to computer round-off error. These slight deviations will not affect results of the regression problem (32).

Results of Regression Analyses. Regression analyses were performed using the SPSS program NEW REGRESSION. Analyses were performed for each dependent variable representing the two dimensions of motivation to attend SOCE PCE courses (MOT1 and MOT2) derived from the factor analysis. The independent variables for each analysis included values for the five factors determined by

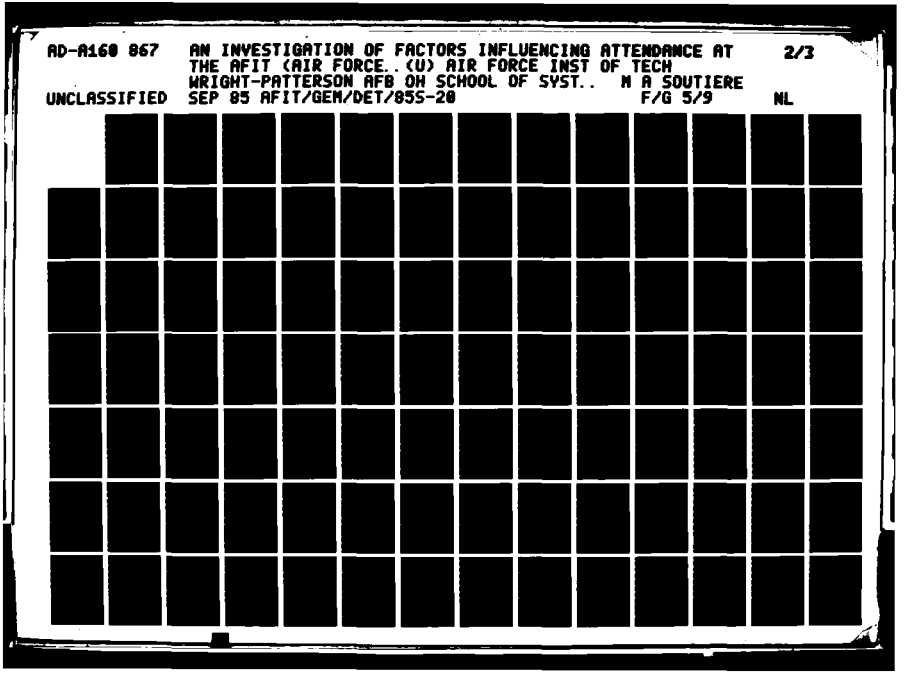
TABLE 16

Regression Analysis--Dummy Independent Variables

Variables	Meaning
DEG1-DEG5 Highest level of academic achievement	1) B.S. 2) B.S. plus 3) M.S. 4) M.S plus 5) PhD.
SPEC1-SPEC6 Primary academic background	1) Civil 2) Mechanical 3) Electrical 4) Architecture 5) Industrial 6) Other
YR1-YR5 Year highest degree attained	1) 83-85 2) 80-82 3) 77-79 4) 74-76 5) before 74
GPA1-GPA5 Undergraduate GPA	1) below 2.0 2) 2.00-2.5 3) 2.51-3.0 4) 3.01-3.5 5) 3.51-4.0
CRS1-CRS5 Time since last academic course for credit	1) 0-6 months 2) 7-12 months 3) 13-24 months 4) 25-36 months 5) over 36 months

factor analysis (Table 15) and the 26 variables representing various facets of the respondent's academic achievement (Table 16). These variables were tested to determine if they significantly affect MOT1 and MOT2 representing engineers' motivation to attend SOCE PCE.

Because the data for the five variables about academic


AD-A160 867
AN INVESTIGATION OF FACTORS INFLUENCING ATTENDANCE AT THE AFIT (AIR FORCE..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. M A SOUTIERE
2/3
UNCLASSIFIED
SEP 85 AFIT/GEM/DET/85S-20
F/G 5/9
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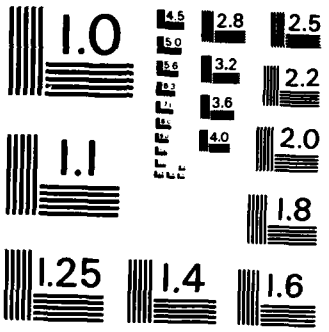

achievement is ordinal rather than interval data, a procedure using dummy variables had to be employed. Each possible answer to survey questions 11-15 has a dummy variable. For each case, the dummy variable takes on the value of 1 when the respondent answers in that particular category. For example, dummy variables DEG1 to DEG5 represent the five answers to Q11. If a respondent marked "c", indicating a Master's degree, the variable DEG3 is 1.0 and the other four DEG variables are zero. These dummy variables are treated in the regression procedure in the same manner as variables represented by interval data. Readers can consult the SPSS user's manual (36:373) for further information about dummy variables.

The values of the dependent variables, MOT1 and MOT2, range from approximately -3.0 to 3.0. Values less than zero do not indicate negative motivation, just as positive values do not indicate positive motivation. Rather, a proper interpretation is that a higher score indicates a higher motivation to attend PCE.

Dependent Variable-MOT1. Three of the independent variables (IV) tested entered the regression equation when MOT1 was used as the dependent variable. Appendix H contains complete results of the analysis. Table 17 on page 86 shows the significant variables, B coefficents, level of significance for B (from T-test), and R-Squared for each variable. These three variables "explain" 23.2% of the total

TABLE 17

Regression Summary-Variable MOT1

Variable	Beta	p-value	R-Sq
FACT1	.32153	.0000	.117
FACT4	-.30379	.0000	.103
FACT5	-.14984	.0009	.022
Constant	-.00355	.9255	

variance of the MOT1 dependent variable. The linear equation derived from the regression is:

$$MOT1 = 0 + .32153(FACT1) - .30379(FACT4) - .14984(FACT5)$$

The general linear equation presented in Appendix D included an error term. If included in the above equation, such a term would represent the "error" between an individual's actual motivation and the value predicted by the equation. The constant term (B_o) is zero (p=.9255) as expected because FACT1, 4, 5 and MOT1 are standardized variables. When none of the IV's are significant, the expected value of the DV is equal to the constant term. Since MOT1 is standardized with a mean or expected value of zero, B_o should be zero.

Because this research is primarily exploratory rather than predicatory, the signs of the coefficients are of great interest. The coefficent for FACT1 is positive. As the value of FACT1 increases, so does the value of MOT1. The negative coefficents for FACT4 and FACT5 mean that as values for these variables increase, MOT1 decreases.

TABLE 18

Regression Summary--Variable MOT2

Variable	Beta	p-value	R-sq
FACT4	-.19943	.0000	.067
FACT2	-.18466	.0000	.047
FACT1	.21436	.0000	.047
CRS5	-.15605	.0013	.029
DEG5	-.12381	.0070	.015
YR4	-.09553	.0440	.008
Constant	.08840	.0368	

Dependent Variable--MOT2. This dependent variable can be equated to a personal desire to attend SOCE PCE courses. This variable was regressed against the same IV's as in the previous procedure. Appendix H contains full results of the regression. Table 18 above presents a summary of this procedure. Three "dummy" variables entered the regression equation. CRS5 corresponds to a response to Q15 denoting it has been over 36 months since the respondent had last taken a course for academic credit. DEG5 denotes respondents who had a PhD degree, and YR4 indicates respondent's highest degree was attained between 1974 and 1976. The total variance explained by this regression equation, R-squared, is 21.4% of the total variance.

The linear equation derived is:

$$MOT2 = .08840 - .19943(FACT4) - .18466(FACT2) + .21436(FACT1) - .15625(CRS5) - .12381(DEG5) - .09553(YR4)$$

All the coefficients except FACT1 are negative, indicating that as those other five variables increase, MOT2 decreases.

TABLE 19

Regression Summary--Variable MOT2 (w/o DEG5)

Variable	Beta	p-value	R-sq
FACT4	-.19876	.0000	.0665
FACT2	-.18307	.0001	.0472
FACT1	.21460	.0000	.0470
CRS5	-.14695	.0026	.0296
YR4	-.09712	.0416	.0083
FACT5	-.09295	.0445	.0084
Constant	.07982		.0598

The dummy variables that are in the equation only affect MOT2 when an individual has the characteristic described by the variable. For example, the value (-.15625)(DEG5) will be zero unless the respondent has a PhD degree and DEG5 takes on the value of 1. Again, the constant term, Bo, is very close to zero.

Closer examination of the results above prompted one further analysis. Only one survey respondent had a Phd degree. Though the entry of variable DEG5 into the equation was statistically significant, more than one data point to test this variable would be preferable. Therefore, one further analysis was completed without DEG5 as an IV. Table 19 shows the results of this analysis. In this case, FACT5, attitude about TDY, replaced DEG5. The negative coefficient indicates that a poor attitude about TDY decreases personal desire to attend SOCE PCE. The beta coefficients and total R-squared values in this analysis closely resemble those in earlier analyses.

Research Question 2G. What influence does perceived usefulness and applicability of SOCE PCE courses have on engineers' desire to attend?

A series of M-W tests were accomplished to determine the effect of past SOCE experience upon officers' motivation to attend courses in the future. The dependent variables for the M-W tests were the two motivation scores calculated from the factor analysis. The independent variables were survey questions 61-63 that asked officers who had previously attended at least one SOCE course about their opinions of the usefulness, currency, and applicablilty of those courses. The vast majority of respondents (at least 82%) to Q61-Q63 agreed or strongly agreed with the statements indicating a wide approval of their SOCE experience. Because the sample was skewed so much to the "agree" opinion, the respondents were grouped in the following manner to achieve an adequate sample size in each of the two groups. Officers who agreed or strongly agreed comprised one group and those who strongly disagreed, disagreed, or were neutral comprised the second group. This grouping was done to achieve an adequate sample size in both groups. Table 58 in Appendix F contains complete results of the tests conducted to answer this objective. The first question asks respondents about the usefulness of previous PCE courses.

Q61. In general, the AFIT courses I have attended have helped me do my job better.

Ninety-three percent (93%) of respondents agreed or strongly agreed with the statement above while only 6% were neutral and 3% disagreed.

Mann-Whitney tests against both motivation variables resulted in a significant difference (p=.000) in motivation levels for the two respondent groups. The first motivation variable measured respondent's general attitude about the importance of PCE to Air Force civil engineers. The average value on this variable (MOT1) for the "disagree" group was -.934, while the mean for the "agree" group was .181. The mean scores for the second motivation variable (Mot 2) that measured personal motivation were -.623 for the "disagree" group and .093 for the "agree" group. These scores cannot be equated with any particular motivation level but the difference and direction of the difference does indicate differing motivation levels. Currency of course materials is the topic of Q62.

Q62. The material taught in the AFIT courses I've attended was always current and up-to-date.

Eighty-two percent (82%) of officers agreed with this statement while 9% disagreed and 10% were neutral.

Again, the M-W tests using both motivation variables were statistically significant (Mot1, p=.000, Mot2, p=.016).

The mean scores for both groups are tabulated below.

	Mot 1	Mot2
Disagree/Neutral	-.503	-.176
Agree	.228	.086

Question 63 concludes investigation of the Research Question 2G.

> Q63. The subject matter in the AFIT PCE courses I've attended was always relevant to the Air Force civil engineering mission.

Responses to Q63 were divided as follows: 88% agreed, 5% disagreed, and 7% were neutral.

Both M-W tests had a level of significance of .000 indicating strong differences in motivation between the two groups. The mean motivation scores are shown below:

	Mot 1	Mot 2
Disagree/Neutral	-.505	-.389
Agree	.177	.096

Open Response Question. Question 67 in Part III of the survey asked respondents "What major factors do you see affecting civil engineers' desire to attend resident SOCE PCE courses (assuming there are no other constraints to their attending)?" Many officers provided one or more responses. Their answers were tabulated and grouped by major area and presented in Table 20 on pages 92 and 93.

TABLE 20

Factors Affecting Desire To Attend SOCE PCE
Responses To Question 67

Factors Noted	Frequency
1. Course Material -Availability of relevant courses -Quality of courses -Currency of topics -Variety of topics	74
2. Applicability to Current/ Future Jobs	50
3. Course Administration -Length of courses -Grading policies -Amount of homework -Too much material in courses -Appropriate academic credit -Scheduling	47
4. TDY to WPAFB/Dayton -Base Facilities (VOQ, Transp.) -No auto/isolation -Weather in winter months	42
5. Effects of Missed Work -Work piles up -Suspenses missed	38
6. Time Away From Family -Care of children	37
7. Perceived Benefits -Recognition -Promotion Enhancement	30
8. Dissemination of SOCE PCE Info. -By SOCE -By MAJCOM -By Base	22

TABLE 20 (Cont.)
Factors Affecting Desire To Attend SOCE PCE
Responses to Question 67

Factors Noted	Frequency
9. Thirst For Knowledge -Apathy -Enthusiasm	18
10. Graduate Courses/PME @ Home Station	17
11. Quality of Instruction/Instructors	13
12. Word-of-mouth About Courses	13
13. Supervisor Support/Attitude About SOCE PCE -Civilian Supervisors -Military Supervisors	12
14. Other -Get away from "grind" -Career Objectives -Additional Commitment	17

This chapter has presented the results of the survey and the analyses performed to answer the two research objectives. Chapter V will present a discussion of these results.

V. Discussion

Introduction

This chapter discusses the research results presented in Chapter IV. Again a step-by-step approach is used. Each research question will be covered in order.

Sample Validation

The sample of 387 Air Force civil engineering officers included officers in approximately the same proportion as exists in the entire population. As expected, however, the proportion of 2nd and 1st lieutenants was slightly higher and the proportion of captains slightly lower than actual figures due to the sampling from CONUS bases only. These small deviations, it is felt, do not significantly bias the survey results.

Research Objective #1

Research Question 1A. What influence does a civil engineers' duty assignment have on ability to attend SOCE resident PCE courses?

The general feeling of engineers surveyed was that their duty assignments did not prevent their attendance at SOCE PCE courses. They felt that if the need or their desire to attend a course was sufficiently high, an absence from their duty stations could be arranged. As might be expected, supervisors felt their positions inhibited at-

tendance to a slightly greater extent than did subordinates.

While most officers felt their jobs did not prevent attendance, many did feel that their workload put definite constraints upon their attendance. The most significant differences in opinion were evident between lower and higher ranking officers. Company grade officers felt their workload affected their PCE attendance significantly more than did field grade officers. More specifically, a breakdown by each rank showed that 1st lieutenants hold the strongest opinions that their workload negatively influences attendance while senior officers, colonels and lieutenant colonels, were less inclined to agree.

Results showing senior officers less constrained by workload than junior officers must also be evaluated in another light. Workload may not be the primary influence on senior officers' attendance at PCE courses. The findings must be tempered by the possibility that senior officers' motivation to attend may be significantly less than for junior officers and workload/duty assignment may not be the operative factor.

An effort was also made to determine if some squadron sections at base level felt that workload particularly affected PCE attendance. Individuals stating they worked in the readiness and design sections felt that they would take more PCE courses if not for the work they were expected to accomplish. Individuals in Resources & Requirments and the

Contract/Environmental Planning sections had a similar opinion. Officers in Programming and Industrial Engineering, on the other hand, did not feel as constrained by their current duties.

When asked in the open-end question what major factors affected ability to attend PCE courses, over half of the respondents noted that "workload" was a significant constraint. Other reasons relating to work or duty assignment included the perception that PCE courses were too long (work accumulates while away) or that the potential attendee held "too important" a job to be released for PCE. Many individuals noted that "manpower shortages" were significant constraints in that officers in "one-man shops" or from understaffed sections could not attend PCE as often as they would like.

Research Question 1B. To what extent is knowledge about the SOCE resident PCE program disseminated to Air Force civil engineers?

"Getting the word out" is an important function for any organization. A majority of civil engineers surveyed hear about AFIT programs at least once each three months by a variety of methods. Only 5% stated they never hear about PCE in their jobs.

As expected, "word-of-mouth" is the most prevalent way that AF civil engineers hear about SOCE PCE in their day-to-day jobs. The next most popular means is through AFIT and

SOCE catalogs and brochures. Over 63% of engineers surveyed had seen the FY 85 SOCE PCE brochure. This is a significant number in that the brochure is published on the basis of one per each three CE officers. This indicates that the brochure is circulated throughout some offices. A quarter of the engineers noted they often see PCE information published in the Engineering and Services Quarterly. A somewhat surprising figure of only 11% of respondents said they heard PCE information at commander's/ officer's calls.

A significant discrepancy was evident between the dissemination of PCE information between base-level CE organizations and other organizations at Headquarters level. Base CE offices heard about PCE programs and had seen the FY 85 brochure much more often than had Headquarters level officers. This trend is backed up by results showing majors, captains, and lieutenant colonels heard about SOCE PCE less often than did lieutenants or colonels. Similarly, 2nd lieutenants had seen the FY 85 brochure significantly more than captains or majors. One explanation for these results could be that most billets at headquarters level are filled by captains, majors, and lieutenant colonels while many base level jobs are filled by lieutenants.

Survey Question 28 asked how familiar respondents were with the SOCE PCE program. Over half of the officers surveyed felt they were familiar with the program. It appears, however, that experience in the career field is a major

contributing factor to this familiarity. When responses were broken down by rank, colonels, lieutenant colonels, and captains were more familar than were lieutenants or majors. It is not known why majors reported such an unfamiliarity with the SOCE's program. This fact may be a function of duty assignments at Headquarters level where information does not appear to be as plentiful. Additionally, supervisors and officers at the section chief level or above were more familiar with the SOCE program than their subordinates.

In the open-end response section of the survey, 16 respondents felt that inadequate knowledge about course offerings was a constraint upon attendance. Some specifically cited the inability to get information soon enough to apply for courses.

Research Question 1C. What supervisory factors influence attendance at SOCE resident PCE courses?

Survey questions 30-33 were directed at four facets of possible supervisor "behavior" that could influence subordinate's attendance at the SOCE. The predominant reaction to these four questions was one of neutrality. Perhaps explaining this reaction is the suggestion that many of the respondents did not know enough about their supervisor's feelings or policies to make a definitive judgment in either direction.

The only question eliciting strong opinions was Q30 asking if supervisors merely send to AFIT those who can be

"spared" rather than those who might benefit most from the training. A majority of respondents disagreed with this assertion. However, individuals who had been denied supervisor approval for AFIT attendance on at least one occasion had a differing opinion. Half of these officers agreed with the statement indicating that the denial of an AFIT application does alter perceptions. Individuals stating they had been sent to the SOCE as "non-volunteers" at least once also agreed to the statement slightly more than did the sample as a whole. Investigation of responses to this question by job level (base/HQ) did not reveal any significant differences, but non-supervisory personnel did agree slightly more than did supervisors. Although the question was worded for respondents to think of their own supervisor, that some were supervisors themselves may have affected answers to this question and others.

Question 31 asked if current supervisors discouraged PCE attendance if a higher headquarters (HHQ) inspection was in progress or anticipated. This question did not elicit any strong opinions from the sample as a whole. However, those officers who had at least once been denied supervisor approval again agreed more strongly with the statement indicating they had faced the situation before.

A significant difference was detected, however, between responses of base level officers and those at headquarters level. Base level officers agree to this statement more

than their headquarters counterparts. This fact may be a function of who are the "inspectors" and who are the "inspectees." Base level organizations are primarily the ones that face periodic exercises and inspections from the headquarters level staffs. Since base level officers face more inspections, they are more likely to have seen an occasion when supervisors altered some PCE plans.

Question 32 asked if current supervisors felt duties at home station took precedence over attendance at SOCE PCE courses. One's duties are indeed important and performance of an organizations's mission is critical. However, as Morris noted (see Chapter II), PCE can often measureably improve that job performance. The intent of the question was to see if supervisors were willing to look beyond the time a subordinate was to be away to the improved job performance that could possibly result.

The overall response, however, was neutral. Not surprising, though, are responses by officers who had been denied supervisor approval. Seventy percent (70%) of those officers agreed with the statement. When compared by job level, base level CE officers again agreed with the statement more often than did officers at the headquarters level. One possible bias present in this response, however, is the general tendency of officers on headquarters staffs to deal with matters away from home station more often. These jobs often involve temporary duty at other locations.

Question 33 attempted to determine if respondents felt supervisors preferred to send military or civilian engineers to the SOCE. The entire sample, officers who had been denied approval, and past non-volunteers all showed a neutral feeling about this question. However, base level officers once more agreed to a greater extent than did officers not in base level jobs.

The officers who had been denied supervisor approval for SOCE attendance were able to note the reason(s) given by their supervisor(s) for that disapproval. The vast majority of officers noted that their supervisors could not release them because of workload ("hot" projects), the length of time they would be away, or because the officer had too much responsibility to be able to attend. This response mirrors the response to Q30, where 50% of these individuals agreed that their supervisors often send only individuals who can be "spared." Some officers noted that their supervisor felt the PCE course applied for must be related to the current job. Other reasons noted include manpower shortages, inspections anticipated, and restrictions levied by commanders on the number of PCE TDY's allowed per year.

Many of the responses to open-end survey question 65 dealt with supervisory effects on the ability to attend PCE courses and were similar to those noted above. In the general category of supervisor attitude/policy, respondents noted that many supervisors insist a PCE course be directly

applicable to an officer's current job. Others percieved their supervisor does not support the PCE program or said that the number of courses per year they could attend is limited.

Research Question 1D. Do civil engineers feel SOCE application procedures influence attendance?

In any large organization, many procedures tend to be very complicated and involve many levels of the bureaucracy. The application procedure for SOCE PCE courses include many levels of the Air Force organization. This research question was designed to determine if civil engineers felt application procedures significantly affected their ability to attend.

When asked directly if they thought the application process for SOCE PCE was too complicated, most respondents disagreed. To see if seniority measurably affected this opinion, responses were tabulated by years of service. Experience level, however, was not a factor in the officers' opinion.

A majority of respondents also disagreed that a requirement to submit applications 45-60 days prior to class start date was unreasonable. While all respondents generally disagreed, the lower three ranks felt more strongly that the 45-60 day requirement was excessive. majors, lieutenant colonels, and colonels felt more strongly that a SOCE TDY could be planned that far in advance. Similarly,

non-supervisors (who generally comprise the lower ranks) agreed slightly more than supervisors that the time period was too long.

Over 70% of respondents stated they were aware of how to apply for SOCE PCE courses. This is not surprising because only 17% of respondents had never attended a SOCE course. Only one significant comparison of reponses was noted. Similar to responses to the previous question, lower ranking officers at base level below section chief were slightly more unsure of how to apply for PCE. Many officers new to the service and civil engineering are likely to be in this group, so again this result is not totally unexpected.

Open-end Responses. A major purpose of including open response questions in the survey was to highlight some factors affecting access to SOCE PCE thought to be important by respondents but not directly investigated by the survey questions. Four areas not discussed earlier are worthy of note.

One quarter of the respondents cited availability of course openings to be a major constraint to their attendance at PCE courses. They noted that their base received too few quotas from the MAJCOM to accomodate all the officers who wanted to attend. Many felt that an increase in the number of course offerings or an increase in class size would be beneficial. Others felt that some of the problem stemmed from the need to anticipate requirements for PCE slots (to

tell MAJCOM coordinators) too far in advance. They felt that unanticipated requirement could not be accomodated on short notice.

Another area of concern was the planning and scheduling procedures used at all levels. Some officers attribute many problems they have had to poor work by squadron training monitors who often hold that job as an additional duty and approach their tasks with varying degrees of enthusiasm and expertise. Others criticized the MAJCOM's and the SOCE for being inflexible by often not allowing last minute substitutions or by waiting too long to fill out class rosters.

A third area of note was that some officers felt that prerequisites for some courses should be lessened. The primary concern was that some courses required an individual be performing (or soon will perform) a particular job. These officers felt that they could benefit from some courses even though the subject matter was not directly related to their current job.

Finally, some officers noted that family concerns often hindered their access to SOCE PCE courses. Noted especially were those who were the only parent or in families where both parents worked. Concern for child care and the added expenses of paying for that extra care while away were cited as constraints.

Research Objective #2

What factors influence a civil engineer's motivation and intent to attend SOCE PCE in residence at AFIT?

Independent Variable-MOT1. Regression analyses were performed using the two "motivation" variables developed through factor analysis. The first of these variables (MOT1) represented motivation derived from "perceived benefits of SOCE PCE for civil engineers." Three of the independent variables were statistically significant in explaining an individual's level of this motivation factor. When combined, these three variables explained 23.6% of the total variance in the sample.

The first important factor derived by the analysis was perceived supervisor support for SOCE PCE. As engineers realize that their supervisors at both base and headquarters level are strong supporters of SOCE PCE, their view about the benefits of the courses also increases. Supervisors who hold the SOCE program in low esteem and who do not avidly promote the program by both word and action will lower subordinate's opinion of the program.

The second significant "motivation-influencing" factor was the perceived importance of PCE as rank and responsibilities increase. The data showed when engineers feel PCE is no longer valuable to them, their motivation also decreased. This result is not surprising. Some officers feel that job experience and dealing with day-to-day problems can

be a better learning tool than academic courses taken at the SOCE. If they hold this view, their perceptions about the benefits of the SOCE courses will be lowered.

The last of the significant factors dealt with attitudes about TDY. Individual's outlook about leaving their home station for temporary duties elsewhere can be influenced by a number of factors. The regression analysis showed that engineers' opinions about the benefits of PCE were affected by their outlook on TDY. Officers who find TDY inconvenient and unwanted see fewer benefits accruing from PCE. Their attitude about the good that can come out of attendance is colored by the family separation and inconveniences of TDY.

Independent Variable--MOT2. Another analysis was performed using the second motivation variable derived from the factor analysis. This variable measured an officer's personal desire to attend SOCE PCE. Four factors derived from the factor analysis and three variables representing some facet of academic achievement were statistically significant in predicting personal desire to attend SOCE courses.

The factors dealing with supervisor support of AFIT, importance of PCE as rank/responsibilities increase, and attitudes about TDY were significant in this analysis as well as in the previous regression. The signs of the coefficients for these independent variables were the same as in the first regression indicating that the factors affect MOT2

in a similar manner as MOT1.

In this analysis, the FACT2 variable was also significant. This factor measured preferred PCE course structure and included perceptions about the importance of giving grades, tests, and academic credit for PCE courses. The results indicated that as individual's preference for pass/fail classes without formal academic credit increased, so did their desire to attend PCE at the SOCE. At present, the majority of SOCE PCE courses are offered for credit and evaluations and letter grades are given.

Three variables relating to engineer's academic achievement also were significant "predictors" of personal desire to attend SOCE short courses. Individuals who have not taken an academic course for credit in the last 36 months have a lower desire to attend PCE. Engineers who have been out of school for some years and have not recently taken any PCE or graduate courses fall into this group.

Another significant variable concerned the year an engineer's highest degree was attained. Individuals whose highest degree was attained in the 1974-1976 time frame were less motivated to attend PCE. Similar to the previous variable, engineers who appear to have been away from the academic world do not care to pursue PCE programs as much as younger officers.

The significant variable DEG5 indicated that individuals holding a PhD degree were less motivated to attend

SOCE PCE. Unfortunately, the sample of 387 engineers only included one officer with a PhD degree. While the inclusion of this variable is not unexpected, a larger sample size would have been preferred. It is interesting to note, however, that the variable representing officers with a Master's degree had a T-test level of significance less than .10 in the same regression problem (See Appendix H). This low value, while not statistically significant, gives an indication that the M.S. degree did have an influence on motivation. The B coefficent for this variable was negative, indicating that the M.S. (or M.B.A.) also had a negative effect on motivation.

Research Question 2G. How does perceived usefulness/ applicability of SOCE PCE courses influence motivation to attend? This objective was not analyzed using regression but rather using descriptive statistics and non-parametrics as with Research Objective #1.

Survey questions 61-63 asked respondents about the usefulness, currency, and relvancy of SOCE courses they had taken. The overwhelming majority of past attendees were pleased with the material presented and felt the experience was worthwhile. The motivation scores for engineers who said they had not been pleased with the courses were compared with scores of engineers who were more enthusiastic. Mann-Whitney tests for all three questions indicated that poor experiences at PCE courses definitely lowered motiva-

tion. Both "motivation" variables were significantly lower in the group displeased with the SOCE courses.

Open-end Responses. Table 20 in Chapter IV presents a summary of responses to survey question 67 that asked respondents to note factors they felt influenced engineers' desire to attend resident SOCE PCE courses. Once again, the purpose of this question was to highlight some areas not specifically investigated by the research but felt important by engineers in the field.

Many of the engineer's responses can be grouped in categories that correspond to "factors" investigated in this project. Among these are usefulness/applicablilty of the course material, course administration procedures (testing, grading, and length), supervisor support for PCE, and attitudes about TDY.

One facet in the latter category was not addressed specifically in the survey but was important to PCE students. The base facilities at Wright-Patterson (especially billeting and transportation) were singled out for being poor. Engineers commented about the relative isolation they feel when TDY without a vehicle and many noted the winter weather in Ohio was a deterrent to attendance.

The effects of missing work (work piling up, suspenses missed) was felt by some to deter attendance. Some officers noted more people would want to come to the SOCE if information was disseminated more effectively. Finally, officers

pursuing a graduate degree or Professional Military Education (PME) at their home station noted their desire to attend PCE courses was lower because of these other commitments.

The final chapter presents conclusions that can be drawn from the results presented and gives some recommendations for further research.

VI. Conclusions and Recommendations

Introduction

This project investigated factors that influence the access of civil engineers to SOCE PCE courses and the motivation of those engineers to attend those courses. Conclusions reached in each of these two areas are presented in this chapter, along with recommedations to improve current practices. The final section presents recommendations for further research on these topics.

Research Objective #1

To investigate what factors influence civil engineers' access to resident Professional Continuing Education programs at AFIT's School of Civil Engineering.

Finding #1. The duty assignment of civil engineers and the associated workload can be a definite constraint upon attendance at SOCE PCE courses. The research showed that engineers realize that their duties at home station take priority and often do not feel they can afford the 2-4 weeks away that a resident PCE course entails. Manpower shortages can exacerbate this situation. The data also indicated younger officers feel more constrained by their workload than do senior officers. Finally, as a result of increased emphasis on Prime BEEF contingency training as well as liberal funding in the budget, engineers in Readiness and Design sections at base level feel particularly constrained

by their duties.

Recommendation. Because many officers and supervisors feel that a resident PCE course of 2-4 week duration has a detrimental effect on immediate mission accomplishment, some alteration in the structure of SOCE PCE may be worth investigating. Examples include shorter classes at the SOCE and more seminars/classes conducted away from the SOCE at base/regional sites (similar to CEMARS). By shortening the time officers are away from their primary duties, there would be less reluctance on the part of engineers and their supervisors to attend. These points will be discussed further in recommendations made in conjunction with Objective #2.

Finding #2. Information about the SOCE PCE program is being adequately disseminated to Air Force CE officers. The SOCE brochure, containing information about the PCE program, is reaching a majority of civil engineers. However, there are areas where improvements are needed. Engineers who do not work in base-level CE positions are not receiving the information as often as their base-level counterparts. This finding is not surprising because CE officers work in many different and widely dispersed organizations from headquarters positions to joint service assignments to regional civil engineering offices to small specialized detachments.

Recommendation. The SOCE may be able to institute some changes to insure that more AF civil engineering officers are apprised of the course offerings at the SOCE. Steps could be taken to insure that information is disseminated particularly to officers who do not work at base level and often find themselves out of the "mainstream" of AF civil engineering. Often, these officers can benefit from courses that "refresh" their knowledge about current state-of-the-art in civil engineering. One method that can provide information to all 55XX officers is a once-a-year direct mail campaign. While the annual brochure provides complete information about courses, applications, faculty, non-resident programs, and related topics, a small leaflet (one/two pages) could be sent to all civil engineers prior to the fiscal year. The short flyer could simply present a list of courses and a schedule for the coming year and be designed to pique the interest of engineers. For many officers, this leaflet would likely be the only PCE information that they would get during the year.

Additionally, steps should be taken to widen the dissemination of the current brochure to the many non-base level organizations where civil engineers work. Presently, MAJCOM training coordinators are responsible for distribution of brochures to civil engineers in their command. It is possible that the major bases in each command get a majority of the brochures, while smaller sites or even head-

quarters personnel are sometimes missed. A letter from the SOCE to each MAJCOM coordinator with their allotment might stress the need to insure dissemination to all areas in the command where 55XX officers are stationed. Additionally, the SOCE must insure that organizations not under a specific MAJCOM (such as Regional Civil Engineering offices) are sent the current PCE course information.

Finding #3. Commanders and supervisors are not making PCE a topic for discussion at commanders' and officers' calls. Discussion of PCE opportunities in these forums could serve to spread the word to the vast majority of AF civil engineers.

Recommendation. Commanders should be encouraged to show their support for the SOCE program by using opportunities such as commander's calls to "push" the program. The Engineering and Services leadership and Deputy Chiefs of Staff at the MAJCOM level could provide that encouragement by including PCE as an "interest item" to be briefed during staff meetings and occasions when the commander addresses the squadron's engineers. This emphasis by commanders keep engineers aware of the available PCE opportunities and, as will soon be discussed, does much to motivate individuals to attend SOCE courses.

Finding #4. The research shows that most supervisors do try to match the right PCE course with the right officer. In this way, the engineer and organization are getting the

most for the money and time invested. However, the findings indicate that subordinates feel unexpected or anticipated events do affect the way supervisors perceive PCE and cause them to often alter plans of their subordinates to attend. Supervisors at base level sometimes discourage planned PCE attendance when a headquarters inspection is in progress or even anticipated. Preparations for these inspections and other "hot" projects that unexpectedly arise result in lost opportunites for potential attendees when the supervisor cancels the TDY. These findings, however, are based on engineers' perceptions about their supervisor. A survey of supervisors themselves could determine if the subordinates' perceptions are indeed correct.

Recommendation. Once the engineer and his or her supervisor have decided that a particular PCE course will be beneficial, they should do everything possible not to let short term requirements and "crises" interfere with the planned attendance. The aim of PCE is to ultimately improve performance on the job, develop well-rounded AF engineers and managers, and provide a stimulus that encourages new approaches and ideas. When short term crises disrupt this long term outlook, the result is lost opportunities.

Finding #5. Though an application for SOCE PCE must be processed at many organizational levels, its complexity does not hinder attendance. Most officers are aware of how to apply for SOCE short courses or where to get information

about applying. The exception is among lower ranking base level officers. These officers, relatively new to the Air Force, are probably not being informed at the very early stages of their career about PCE opportunities. Additionally, new officers who attend the introductory Base Civil Engineering course may have had their application submitted prior to their arrival at their initial assignment and are not familiar with the application process.

Recommendation. To spread the word about the SOCE program, a short letter or leaflet similar to the one described earlier could be sent to officers entering the 55XX career field. This letter would "advertise" the SOCE and immediately acquaint the new officer with the opportunities at the SOCE. The information could reach the new engineer at their first duty assignment or be routed through the appropriate ROTC, OTS, or Academy commissioning source.

Finding #6. Engineers generally feel the lead time specified by regulation for submission of application for SOCE PCE is not an obstacle to attendance. However, officers in the lower three ranks do feel that the 45-60 day lead time required should be shortened. These officers may be subject to many short notice taskings and "hot" projects and feel that they are unable to project their duties far enough in advance to confidently schedule a PCE course.

Objective #2

To investigate what factors influence civil engineers' motivation and intent to attend Professional Continuing Education courses in residence at the School of Civil Engineering.

Finding #1. The degree of support for the SOCE PCE program shown by commanders and supervisors at all levels has a direct influence on engineers' motivation to attend the SOCE. When engineers hear their bosses (and the Engineering & Services leadership) promoting the benefits of the PCE program, their desire to attend is measureably increased.

Finding #2. The research indicates that engineers' attitudes and outlook about the TDY experience influences motivation and desire to attend. Many individuals do not care to interrupt activities at their home stations, be separated from loved ones, or endure some of the inconveniances associated with temporary duty. It is possible that for some engineers, the aversion to going on an essentially "voluntary" TDY such as PCE becomes the overriding factor in creating an overall desire not to attend.

Recommendation. Shorter courses taught at base or regional sites would remove some of the "workload" constraints that engineers now feel and mitigate some of the influence "TDY attitude" has on desire to attend resident PCE. From a dollars and cents viewpoint, should more aus-

tere budgets be on the horizon, it is more cost effective to send a few instructors to the students than to send many students to the instructors.

Finding #3. Engineers' personal desire to attend SOCE PCE courses is also negatively influenced by the highly structured, academically rigorous environment at the SOCE. Engineers apparently feel that evaluations and grades are not required as an incentive to learn. The academic credit received for many of the SOCE PCE courses may be unimportant to engineers not enrolled in a formal engineering or management degree program. It was noted in Chapter II that a survey of electrical engineers preferred PCE courses to be less structured and only 1-3 days in length. The results in this project may indicate a similar feeling among AF civil engineers who would be more enthusiastic about shorter and less academically rigorous PCE courses. This feeling may be related to the earlier conclusion that length of courses had a negative influence on access to PCE.

Recommendation. The present highly structured environment should be investigated to see if some shorter, less formal, seminar courses for which no credit is awarded would be beneficial and well received by engineers in the career field. Access and motivation to attend PCE might be significantly improved by changing to a shorter and less structured program. These shorter seminars could take an orientation approach where the aim is to acquaint engineers

with new developments rather than teach them as in a formal course. Information and sources would be provided for engineers to delve further into topics of particular interest to them.

Finding #4. Engineers who have been away from formal academics for awhile or who have already gained a higher level of academic achievement (in terms of advanced degrees) are less inclined to attend SOCE PCE. The data also indicated that once engineers feel that PCE has outlived its usefulness, their opinion about its benefits is lowered and personal desire to attend diminishes. The program at the SOCE, therefore, may not include the type of courses that are needed or wanted by the experienced civil engineering leader or manager. As noted in Chapter II, engineers progressing up the ranks prefer more management oriented courses. The current SOCE program is skewed toward technical applications aimed primarily at younger engineers, and most courses are given for formal credit. Senior civil engineers may not desire to reenter this rigorous academic environment. These senior officers may be satisfying their current educational desires through means other than the SOCE such as PME, journals, and discussions with other individuals in similar positions.

Recommendation. The needs of middle and upper level civil engineering managers may not be met by the present PCE program. Shorter seminar courses covering cur-

rent topics in engineering and management could be beneficial to all civil engineering managers and present an alternative to the formal structured courses that apparently are in disfavor. Periodic attendance at seminars such as these have the secondary benefit of maintaining the "stimulation and enthusiasm" Morris (16:837) feels so important to engineers of all ages and in all jobs. The annual Program Review Committee meeting would be an excellent forum to discuss the PCE needs of senior civil engineering managers.

Finding #5. Past experience at SOCE PCE courses has a direct effect on motivation to attend again. Most civil engineers have been pleased at the quality, currency, and relevancy of the material taught at the SOCE in the past. As a result, the motivation of these individuals to attend again is significantly greater than for officers who were not pleased by their SOCE PCE experience. The positive feelings engendered by SOCE PCE courses is a tribute to the excellent work by faculty and staff but also says that unless high standards are maintained, the popularity of the program will certainly decline.

Recommendations For Further Research

1. Additional investigation is needed to more fully document the opinions and attitudes of upper echelon civil engineering officers (Major-Colonel) with respect to how the SOCE PCE program is meeting their educational needs and what role, if any, the school should have in meeting these needs.

2. This report focused only on CE officers. Since AF Civil Engineering also includes many civilian engineers, a study should be undertaken to determine if similar factors influence attendance and motivation to attend the SOCE. Additionally, civilian CE supervisors should be surveyed to see if their attitudes about PCE mirror those of military supervisors.

3. Many civil engineers were often unable to attend courses due to limited quotas assigned to their base/MAJCOM. A study of current procedures for determining quotas, forecasting requirements, and assigning slots is needed to see if procedures need to be improved. The study should also investigate if the problem lies in the limited course offerings each year.

4. As suggested earlier, the present formal structure of the PCE program does have some drawbacks. Further research might investigate ways that the structure could be altered (shorter courses, differing sites, etc.) to make PCE available to more civil engineers while still meeting the needs of both the individuals and the Air Force.

Appendix A: Survey Instrument

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

9 MAY 1985

LSG (GEM 85-S/Capt Soutiere/AUTOVON 785-4437)

Civil Engineering Professional Continuing Education Questionnaire (USAF Survey Control Number 85-49)

USAF Civil Engineers

1. Please take the time to complete the attached questionnaire and return in the enclosed envelope within five working days.

2. This questionnaire was designed to gather information concerning your feelings about the Professional Continuing Education (PCE) program offered by the School of Civil Engineering at the Air Force Institute of Technology (AFIT), Wright-Patterson AFB OH. The information collected will help identify some of the factors affecting participation in the resident PCE program. The questionnaire was prepared as part of a research project conducted by a graduate student attending AFIT. Your responses will directly help the School of Civil Engineering in its commitment to meet the Air Force mission.

3. Your responses will be held in the strictest confidence. No attempt will be made to attribute responses to specific individuals. Your participation is completely voluntary but we would certainly appreciate your help.

Larry D. Smith

LARRY D. SMITH, Colonel, USAF
Dean
School of Systems and Logistics

2 Atch
1. Survey
2. Return Envelope

Civil Engineering
Professional Continuing Education
Survey
(USAF SCN 85-49)

GENERAL INSTRUCTIONS

1. Definition. This survey pertains to the resident Professional Continuing Education (PCE) program offered by the School of Civil Engineering at Wright-Patterson AFB, Ohio. Students attending the Civil Engineering School will come to Wright-Patterson in TDY status for the duration of their course. This survey DOES NOT pertain to courses that may be taught at your home station by instructors from the Civil Engineering School or to audio-visual materials prepared by the school. Throughout this survey the abbreviation "PCE" will be used to mean "Professional Continuing Education" as defined above.

2. We need your response whether or not you have attended resident PCE courses at AFIT School of Civil Engineering. The 67 questions on the survey require only about 20 minutes to answer.

3. Please provide your answers in the blank provided or, for multiple choice questions, circle the letter indicating your response. Some of the multiple choice questions use a scale of responses to determine your agreement or disagreement with a particular statement. Please circle the letter that BEST describes your feelings about the given statement.

PART I--DEMOGRAPHIC INFORMATION

Circle the letter corresponding to your answer or fill in the blank.

1. What is your rank (grade)?

a. 2nd Lieutenant (O-1)
b. 1st Lieutenant (O-2)
c. Captain (O-3)
d. Major (O-4)
e. Lt Col (O-5)
f. Col (O-6)

2. How many years (to the nearest year) have you worked in the Air Force Civil Engineering career field?

a. 0-2
b. 3-5
c. 6-8
d. 9-11
e. 12-14
f. 15-17
g. 18 or more

3. To what MAJCOM are you presently assigned?

a. ATC
b. MAC
c. SAC
d. TAC
e. AFLC
f. AFSC
g. ESC
h. Other (specify _____)

4. At what job level are you presently working?

a. Base Level Civil Engineering
b. Major Command (MAJCOM) Headquarters
c. HQ USAF
d. Laboratory
e. Other (Please Specify _____)

IF YOU DO NOT WORK IN BASE LEVEL CIVIL ENGINEERING, PLEASE SKIP TO QUESTION 7.

5. What is your present job in the CE squadron?

a. BCE/Deputy BCE
b. Branch Chief
c. Section Chief
d. Below Section Chief

BCE/DEPUTY BCE/BRANCH CHIEFS, PLEASE SKIP TO QUESTION 6.

6. In what Section are you presently assigned?

a. Readiness
b. Resources and Requirements
c. Design
d. Programming
e. Environmental Planning
f. Industrial Engineering
g. Other

7. Respondents working outside a Base Civil Engineering organization please indicate your general job title.

_____

8. Are you a rated officer in a rated supplement position?

a. Yes
b. No

9. How long have you held your current job?

a. 0-3 months
b. 4-6 months
c. 7-9 months
d. 10-12 months
e. over 1 year

10. In your present job, do you supervise other CE officers/civilian equivalents (write OERs/performance evaluations)?

a. yes
b. no

11. What is your highest level of academic achievement?

a. Bachelor's degree
b. Bachelor's degree plus graduate hours
c. Master's degree
d. Master's degree plus graduate hours
e. PhD

12. In what specialty is your primary educational background?

a. Civil Engineering
b. Mechanical Engineering
c. Electrical Engineering
d. Architecture
e. Industrial Engineering
f. Other
Specify_____

13. In what year was your highest degree attained?

a. 1983-1985
b. 1980-1982
c. 1977-1979
d. 1974-1976
e. before 1974

14. What was your undergraduate GPA? (Based on 4-point scale: 2.0=C 3.0=B 4.0=A)

a. Below 2.0
b. 2.0 to 2.5
c. 2.51 to 3.0
d. 3.01 to 3.5
e. 3.51 to 4.0

15. How long ago did you last complete an academic course for which you received academic credit hours?

a. 0 to 6 months
b. 7 to 12 months
c. 13-24 months
d. 25-36 months
e. over 36 months

16. What is your current marital status?

a. Single
b. Married

17. How many children do you have living with you at home?

a. none
b. 1
c. 2
d. 3
e. 4 or more

PART II--PROFESSIONAL CONTINUING EDUCATION (PCE)

Please circle the letter corresponding to your answer.

18. I hear about the AFIT PCE program:

a. At least once a month
b. About once every 3 months
c. About once each 6 months
d. About once a year
e. Never

19. If you hear about AFIT PCE, it is usually from: (circle as many as applicable)

a. casual conversation/word of mouth
b. commander's/officer's calls
c. AFIT catalogs/brochures
d. Engineering and Services Quarterly
e. Other (Please specify _____)
f. Never hear about AFIT PCE

20. I have seen the FY 85 AFIT School of Civil Engineering brochure.

a. Yes
b. No
c. Not sure

21. Have you ever been denied supervisor approval for attendance at an AFIT PCE course? If so, how often and for what reasons?

a. Yes, _____time(s). Reasons: _____
b. No _____
c. Have not applied _____
for AFIT attendance.

22. What are your current intentions towards making the Air Force a career?

a. Definitely will
b. Probably will
c. Not sure/undecided
d. Probably will not
e. Definitely will not

23. Assuming there were no other constraints upon you, how would you rate your present desire to attend one or more AFIT resident PCE courses?

a. Very strong desire
b. Strong desire
c. Neutral
d. Weak desire
e. Very weak desire

Questions 24-63 ask you to indicate the degree to which you agree or disagree with a given statement about PCE. Read each statement carefully and then circle your answer according to the following scale:

SD---Strongly Disagree--I strongly disagree with the statement
D---Disagree--I disagree with the statement, but not strongly so.
N---Neutral--I am neutral toward the statement, or, I just don't know enough about it.
A---Agree--I agree with the statement, but not strongly so.
SA---Strongly Agree--I strongly agree with the statement.

For your convenience, this scale will be presented on each page.

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24. My duties and responsibilities in my current job prevent my attendance at resident AFIT PCE courses.	SD	D	N	A	SA
25. I would attend more PCE courses at AFIT if my workload allowed.	SD	D	N	A	SA
26. Periodic AFIT PCE courses are important to my development as an engineer and manager.	SD	D	N	A	SA
27. I would be more interested in AFIT resident PCE courses if I knew more about them.	SD	D	N	A	SA
28. I am familiar with the full program of resident PCE courses offered by the AFIT School of Civil Engineering.	SD	D	N	A	SA
29. I have not taken all the AFIT PCE courses I want to.	SD	D	N	A	SA
30. My current supervisor often selects for AFIT PCE those people who can be "spared" rather than those who might benefit most.	SD	D	N	A	SA
31. My current supervisor discourages planned AFIT PCE attendance if a Higher Headquarters inspection is anticipated.	SD	D	N	A	SA
32. My supervisor feels that my duties at home station take precedence over attendence at AFIT resident PCE courses.	SD	D	N	A	SA

SD=Strongly Disagree D=Disagree N=Neutral A=Agree SA=Strongly Agree

33. My supervisors feel that military personnel in Civil Engineering can benefit most from AFIT resident PCE.	SD	D	N	A	SA
34. The application process for AFIT PCE courses is too complicated.	SD	D	N	A	SA
35. The regulation governing applications for AFIT PCE requires that paperwork be submitted 45-60 days prior to class start date. It is unreasonable to commit oneself to attending an AFIT PCE course that far in advance.	SD	D	N	A	SA
36. I am unsure how to apply for or obtain information about AFIT resident PCE courses.	SD	D	N	A	SA
37. AFIT PCE is an excellent way to keep up-to-date about what is happening in the Air Force civil engineering career field.	SD	D	N	A	SA
38. My supervisor believes that PCE is important for my development as an engineer and manager.	SD	D	N	A	SA
39. My supervisor strongly supports the AFIT resident PCE program.	SD	D	N	A	SA
40. My supervisor does not think that attendance at AFIT PCE courses helps me do my job better.	SD	D	N	A	SA
41. The chain of command in my organization strongly supports the AFIT resident PCE program.	SD	D	N	A	SA
42. I can get the same information as AFIT teaches from civil engineering journals and magazines.	SD	D	N	A	SA
43. I prefer PCE courses that are graded on a pass/fail basis.	SD	D	N	A	SA

SD=Strongly Disagree D=Disagree N=Neutral A=Agree SA=Strongly Agree

44. I learn more from a course when I know I will be tested on the material.	SD	D	N	A	SA
45. It is generally <u>less</u> important to give tests and letter grades in continuing education courses than it is in a degree program.	SD	D	N	A	SA
46. It is important to me to receive formal academic credit for the PCE courses I attend at AFIT.	SD	D	N	A	SA
47. My current marital status makes it inconvenient for me to go TDY.	SD	D	N	A	SA
48. My job-related TDY takes me away from home too much.	SD	D	N	A	SA
49. I would try to attend more PCE courses if they were at civilian institutions instead of at AFIT.	SD	D	N	A	SA
50. AFIT PCE becomes less important as one progresses upward through the ranks to top management positions.	SD	D	N	A	SA
51. Job experience can substitute for formal continuing education as one increases in rank.	SD	D	N	A	SA
52. Effective PCE courses prepare CE officers to assume increased responsibilities and leadership positions.	SD	D	N	A	SA
53. The Engineering and Services leadership supports and encourages AFIT PCE attendence.	SD	D	N	A	SA
54. The AFIT School of Civil Engineering PCE program has an important role in the education of AF civil engineers.	SD	D	N	A	SA

SD=Strongly Disagree D=Disagree N=Neutral A=Agree SA=Strongly Agree

55. AFIT PCE attendance on a service record is a positive influence on promotability and job selection. SD D N A SA

56. Promotion boards are more interested in PME activities than PCE activities. SD D N A SA

57. The AFIT PCE program is primarily oriented to the entry level and middle management positions in Civil Engineering. SD D N A SA

58. PCE courses taught at AFIT keep the career field abreast of current issues and technologies. SD D N A SA

59. AFIT PCE combined with on the job experience is a must for all sucessful Air Force civil engineers. SD D N A SA

IF YOU HAVE NOT ATTENDED A RESIDENT PCE COURSE AT AFIT, PLEASE SKIP TO PART III.

60. How many resident AFIT PCE courses have you attended in your career.

_____courses

61. In general, the AFIT courses I have attended have helped me do my job better. SD D N A SA

62. The material taught in the AFIT courses I've attended was always current and up-to-date. SD D N A SA

63. The subject matter in the AFIT PCE courses I've attended was always relevant to the Air Force Civil Engineering mission. SD D N A SA

64. Of the times you have attended PCE courses in residence, how many times were you a "non-volunteer"--instructed to attend rather than wanting to attend?

_____times

PART III----OPEN-ENDED QUESTIONS

Please use the back of the sheet if you need additional space.

65. What major factors do you see affecting civil engineers' ability to attend PCE courses in residence at AFIT (assuming that they want to attend a particular course).

66. Is the availability of TDY funds at your base a major constraint on attendance at AFIT resident PCE?

67. What major factors do you see affecting civil engineers' desire to attend resident AFIT PCE courses (assuming there are no other constraints to their attending).

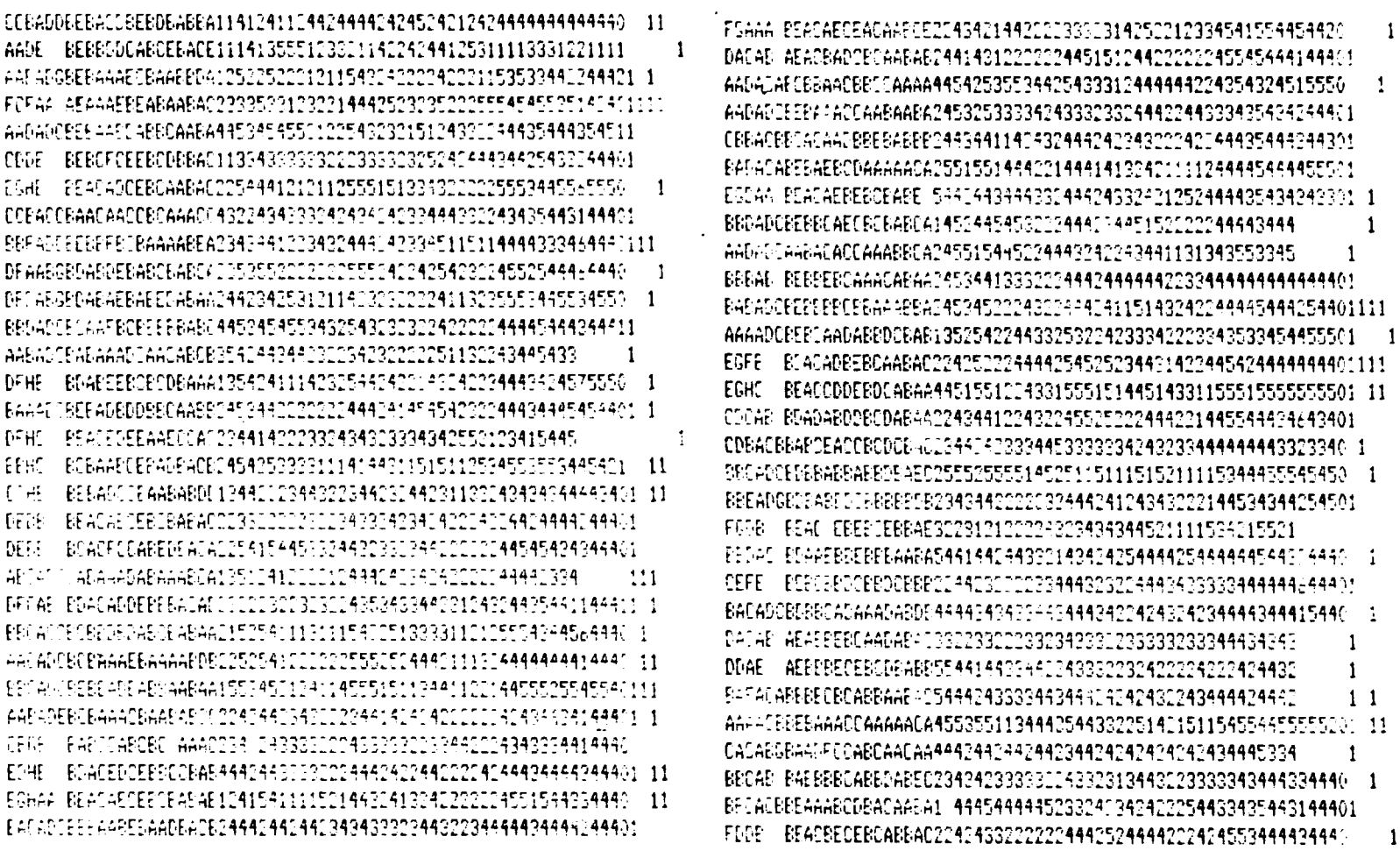
THANK YOU FOR YOUR PARTICIPATION.
PLEASE PLACE THE COMPLETED QUESTIONNAIRE IN THE ENVELOPE PROVIDED AND SEND VIA OFFICIAL MAIL.

Appendix B: Data Base and Computer Code

The following pages contain the data base used in this project. The data is arranged in 68 columns in the manner described below.

Column(s)	Survey Question(s)
1-6	1-6
7-17	8-18
18-62	20-64
63-68	19A-19F

The answers for the first 23 survey questions (except Q7) were coded as alphanumeric characters as they appeared in the survey. The SPSS RECODE function was used to change these alphanumeric characters to numbers for subsequent analysis. Survey questions answered on the scale from "Strongly Disagree" to "Strongly Agree" were coded from "1" to "5". Question 19 allowed respondents to answer in more than one category. A one (1) in columns 63-68 indicated that the respondent marked the corresponding answer in Question 19. A blank space in the data base indicates missing data or that the respondent was instructed not to answer that particular question. The data base on the following pages contains 387 entries. Included following the data base is some of the computer code used in this project and examples of some of the SPSS sub-programs used.



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BEDACCEEEBABBABBAABAA115444112412155515124251113255553355355550 1
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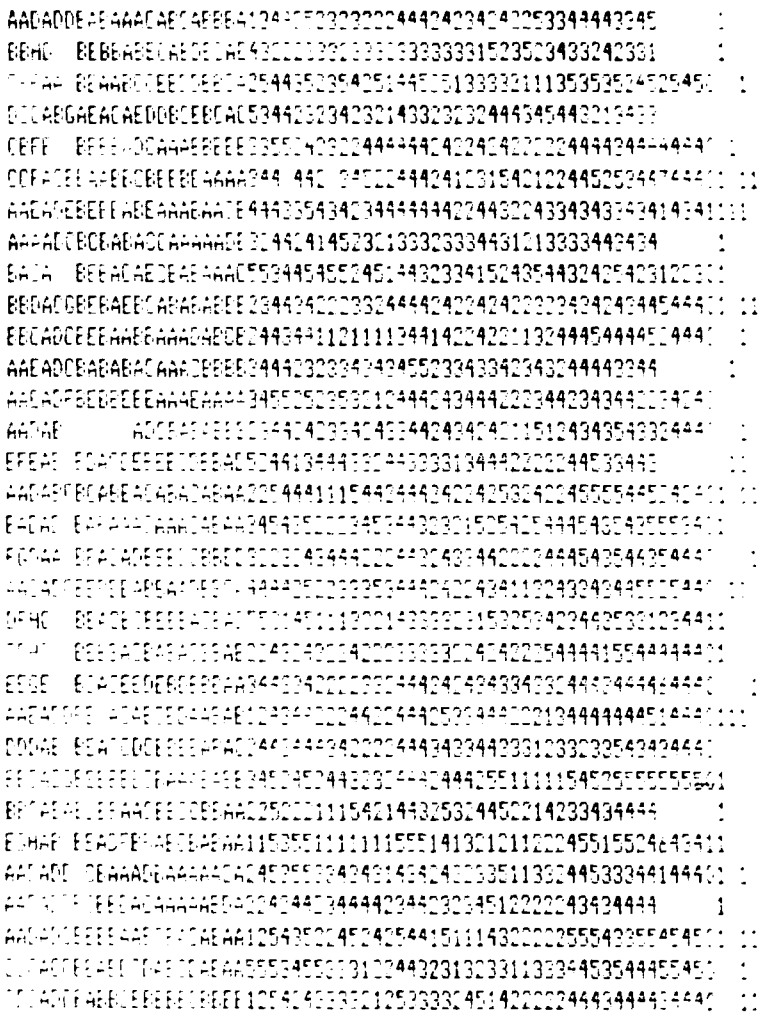

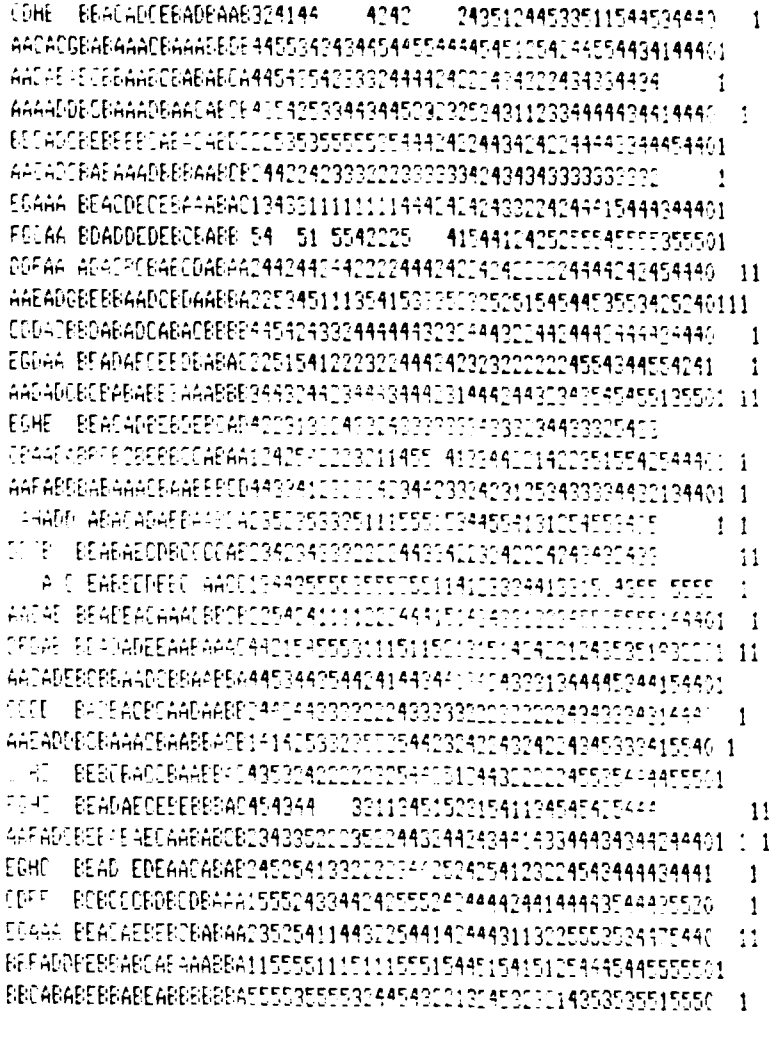

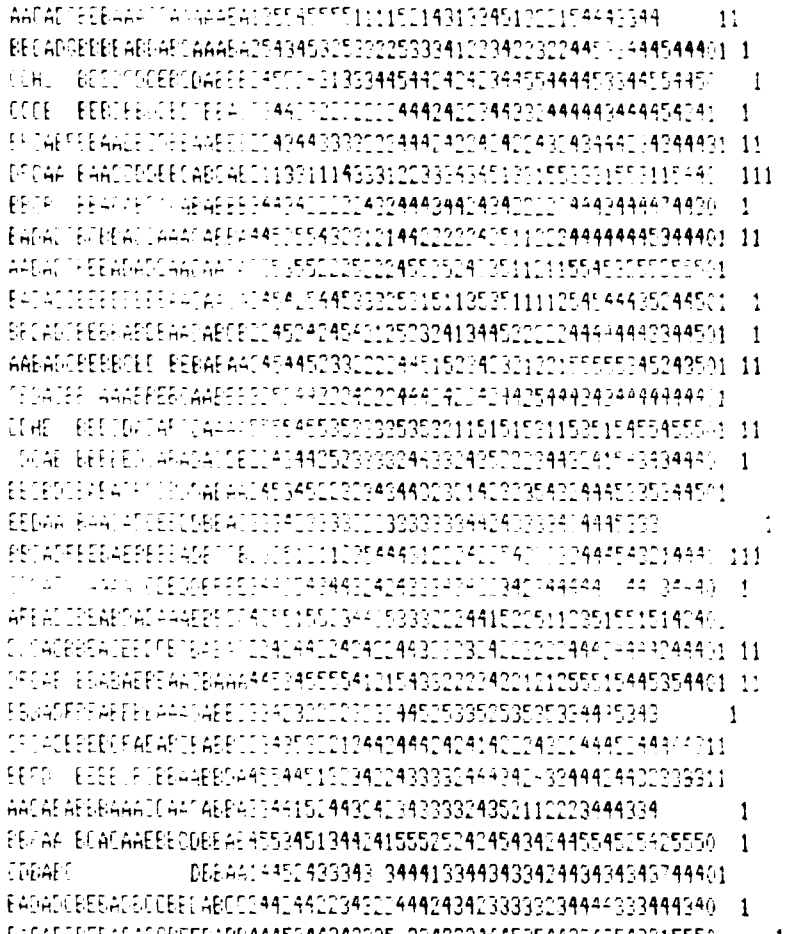

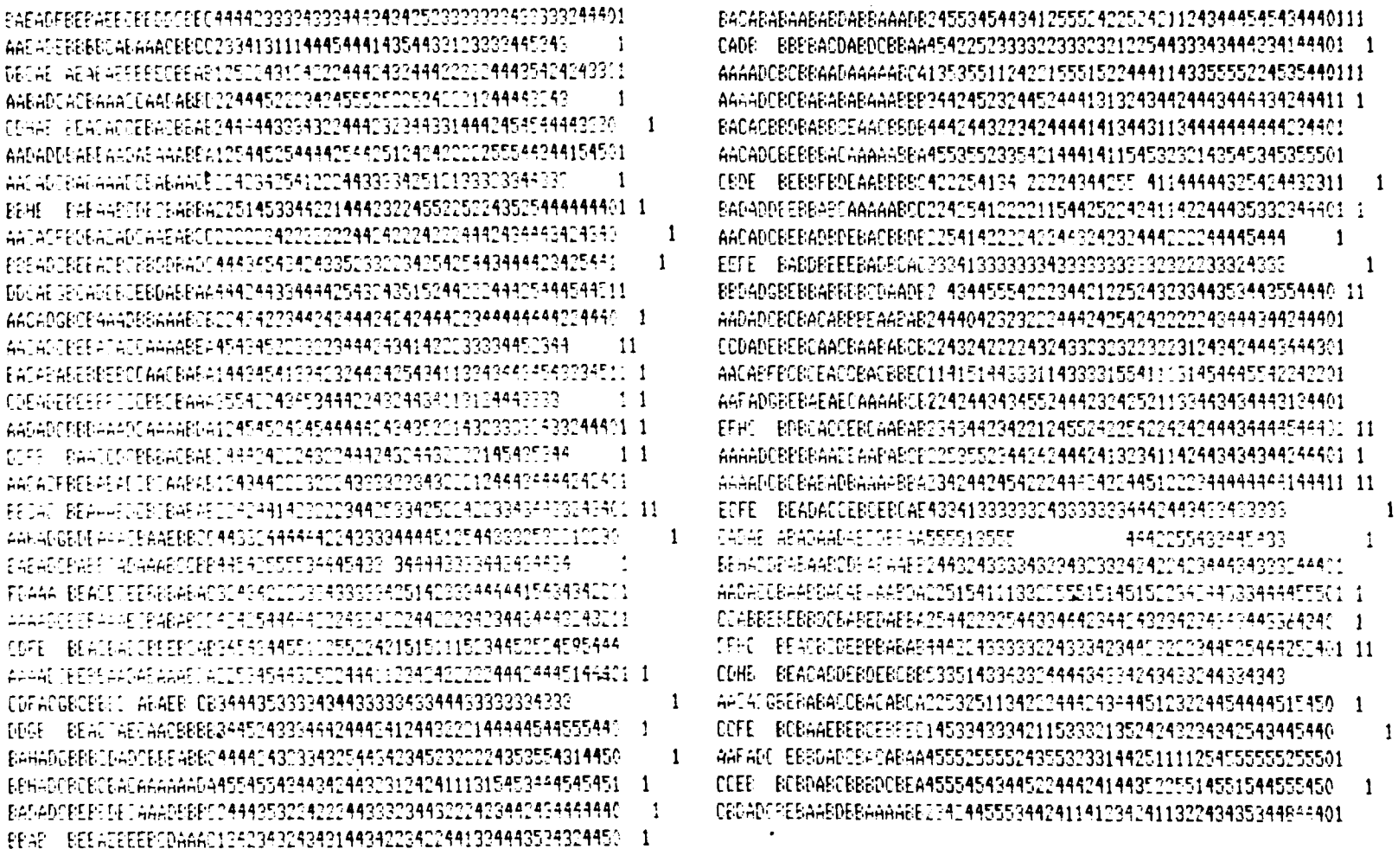

Baseline Computer Code (SPSS package on ASD Cyber Computer*)

```
RUN NAME        THESIS PROGRAM
PRINT BACK      CONTROL
VARIABLE LIST   Q1 TO Q6,Q8 TO Q13,Q20 TO Q64,Q19A,Q19B,Q19C,Q19D,Q19E,Q19F
INPUT MEDIUM    CARD
N OF CASES      387
INPUT FORMAT    FIXED (21A1,47T1.0)
RECODE          Q1,Q12 ('A'=1)('B'=2)('C'=3)('D'=4)('E'=5)('F'=6)
                (ELSE=0)/Q2,Q6 ('A'=1)('B'=2)('C'=3)('D'=4)('E'=5)
                ('F'=6)('G'=7)(ELSE=0)/Q3 ('A'=1 ('B'=2)('C'=3)('D'=4)
                ('E'=5)('F'=6)('G'=7)('H'=8)(ELSE=0)/Q4,Q9,Q11,
                Q13 TO Q15,Q17,Q18,Q22,Q23
                ('A'=1)('B'=2)('C'=3)('D'=4)('E'=5)(ELSE=0)/Q5 ('A'=1)
                ('B'=2)('C'=3)('D'=4)(ELSE=0)/Q8,Q10,Q16 ('A'=1)('B'=2)
                (ELSE=0)/Q20,Q21 ('A'=1)('B'=2)('C'=3)(ELSE=0)/
MISSING VALUES  ALL (0)
VAR LABELS      Q1,RANK/Q2,YRS EXPERIENCE/Q3,MAJCOM/Q4,JOB LEVEL/
                Q5,SQDN JOB/Q6,SQDN SECTION/Q8,RATED SUPP?/Q9,CURRENT JOB EXP/
                Q10,SUPERVISOR?/Q11,ACADEMIC DEGREE/Q12,PRIMARY SPECIALTY/
                Q13,YR DEGREE/Q14,UNDERGRAD GPA/Q15,LAST CREDIT COURSE/
                Q16,MARITAL STATUS/Q17,CHILDREN @ HOME/
                Q18,HEAR ABOUT AFIT/Q20,SEEN AFIT BROCHURE/
                Q21,DENIED SUPER APPROVAL/Q22,CAREER INTENT/Q23,PCE DESIRE/
                Q19A,WORD-OF-MOUTH/Q19B,CC CALLS/Q19C,AFIT BROCHURES/
                Q19D,E & S QUARTERLY/Q19E,OTHER MEANS/Q19F, NEVER HEAR/
                Q60,# COURSES ATTENDED/Q64,NON-VOLUNTEER/
VALUE LABELS    Q1 (1)2ND LT (2)1ST LT (3)CAPT (4)MAJOR (5)LT COL (6)COL/
                Q3 (1)ATC (2)MAC (3)SAC (4)TAC (5)AFLC (6)AFSC (7)ESC
                (8)OTHER/Q4 (1)BASE LEVEL (2)HEADQUARTERS-MAJCOM
                (3)HQ USAF (4)LAB (5)OTHER/Q5 (1)BCE (2)BRANCH CH
                (3)SECTION CH (4)BELOW SECT CH/Q6 (1)READINESS (2)R & R
                (3)DESIGN (4)PROGRAMMING (5)ENVIRONMENTAL (6)IND ENG
                (7)OTHER/Q8,Q10 (1)YES (2)NO Q9 (1)0-3 MOS (2)4-6 MOS
                (3)7-9 MOS (4)10-12 MOS (5)OVER 1 YEAR/Q11 (1)BACH DEG
                (2)BACH DEG PLUS (3)MASTERS DEG (4)MASTERS PLUS (5)PHD/
                Q12 (1)CIVIL (2)MECH (3)EE (4)ARCH (5)IE (6)OTHER/
                Q16 (1)SINGLE (2)MARRIED/Q17 (1)NONE (2)ONE (3)TWO
                (4)THREE (5)FOUR PLUS/Q18 (1)EACH MONTH (2)EACH 3 MOS
                (3)EACH 6 MOS (4)EACH YEAR (5)NEVER/Q20 (1)YES (2)NO
                (3)NOT SURE/Q21 (1)YES (2)NO (3)NEVER APPLIED/
                Q22 (1)DEF WILL (2)PROB WILL (3)UNDECIDED (4)PROB WON'T
                (5)DEF WON'T/Q23 (1)VERY STRONG DESIRE (2)STRONG DESIRE (3)
                NEUTRAL (4)WEAK DESIRE (5)VERY WEAK DESIRE Q24 TO Q59,
                Q61 TO Q63 (1)STRONGLY DISAGREE (2)DISAGREE
                (3)NEUTRAL-DON'T KNOW (4)AGREE (5)STRONGLY AGREE
                Q19A,Q19B,Q19C,Q19D,Q19E,Q19F (1)YES.
```

*SPSS packages on other computer systems may require other control cards.

Examples of SPSS Subprograms Utilized

```
FREQUENCIES     GENERAL=Q1 TO Q6,Q8 TO Q64
```

FREQUENCIES produces a listing of the answers (and percentages) in each answer category for the named variables and calculates summary statistics for those variables.

```
NPAR TESTS      M-W=Q24 BY Q10(1,2)/K-W=Q24 BY Q1(1 6)
```

NPAR TESTS performs the requested nonparametric statistical tests. In the example above, the first test is a Mann-Whitney (M-W) test in which the dependent variable (DV) is Q24 and the independent variable (IV) is Q10. The two groups compared by the test are those designated by Q10, answer 1 (Yes) and Q10, answer 2 (No). The second requested test is a Kruskal-Wallis (K-W) test. The groups compared are represented by answers 1 (2nd Lt) through 6 (colonel).

```
CROSSTABS       TABLES=Q24 BY Q1
```

Subprogram CROSSTABS produces a contingency table that displays the number and percentages of answers in a n x m matrix where n is the number of categories in the first variable (Q24) and m is the number of possible answers in the second variable (Q1). This utility can be used to determine the answer distributions for each category of independent variable. For example, the number of colonels (Q1, answer f) that "disagreed" with Q24 (answer 2) can be determined using CROSSTABS.

```
FACTOR          VARIABLES=Q26,Q29,Q42,Q52,Q54,Q58 TO Q59/
                TYPE=PA2/ROTATE=VARIMAX/
```

The factor utility performs a factor analysis using the variables named after the "=" sign. SPSS performs various factoring methods. In this example, TYPE=PA2, specifies the method to be used. If no rotation method is specified like above, a VARIMAX rotation is completed.

```
NEW REGRESSION DESCRIPTIVES/VARIABLES=MOT1,MOT2,FACT1 TO
               FACT5,DEG1 TO DEG4,SPEC1 TO SPEC5,YR2 TO YR5,
               GPA2 TO GPA5,CRS2 TO CRS5/STATISTICS=DEFAULTS,
               CHA,HISTORY/DEPENDENT=MOT1,MOT2/STEPWISE/
               RESIDUALS=DEFAULTS,SMALL/
               SCATTERPLOT (*RESID,*PRED)/
```

The subprogram NEW REGRESSION performs the linear regression using the variables specified by the "VARIABLES=" code. The dependent variable(s) are specified by the "DEPENDENT=" code. Other codes such as DESCRIPTIVE, STEPWISE, STATISTICS, RESIDUALS, and SCATTERPLOT direct the program to perform various tests on the data or specify the format of the output.

Interested readers should consult the two SPSS manuals (36,41) for further information.

Appendix C: Factor Analysis

In many kinds of research it is difficult to get an exact measure of a variable. This is especially true in social research when one tries to measure individuals' attitudes or perceptions. One method that can be used to help alleviate this problem is factor analysis.

Factor analysis techniques attempt to determine if the correlations between a large number of observed variables (called manifestation variables) can be broken down into a smaller number of underlying or latent variables called factors.

> Factor analysis assumes that the observed (measured) variables are linear combinations of some underlying source variables (or factors). That is, it assumes the existence of a system of underlying factors and a system of observed variables. There is a certain correspondence between these two systems and factor analysis "exploits" this correspondence to arrive at conclusions about the factors. (42:13)

These factors will more simply explain the different dimensions of the topic being studied.

There are three major uses of factor analysis techniques. In most social research, the major use is exploratory; the researcher is attempting to determine what and how many latent factors underlie a set a data. The techniques can also be confirmatory where hypotheses about the dimensionality of the data are made and tested with factor analy-

TABLE 21

Correlation Matrix

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1.000	.560	.480	.224	.192	.160
X_2	.560	1.000	.420	.196	.168	.140
X_3	.480	.420	1.000	.168	.144	.120
X_4	.224	.196	.168	1.000	.420	.350
X_5	.192	.168	.144	.420	1.000	.300
X_6	.160	.140	.120	.350	.300	1.000

sis. Finally, factor analysis can be used as a measuring device to construct new variables for use in other analysis. (36:469) This project will make use of the latter two applications.

The factor analysis problem can be divided into four basic steps (42:46). This discussion of factor analysis will use those four steps as a guide for further discussion.

Step 1: Data Collection/Preparation of Correlation Matrix. Data collection usually takes the form of a survey in which scores for certain questions (variables) are tabulated prior to analysis. The data is reduced into a correlation matrix that displays a measure of association between each relevant variable. Table 21 is an example of such a matrix. Correlations vary from 1.0 to -1.0 with values nearer those extremes indicating strong interdependance between pairs of variables.

TABLE 22

Unrotated Factor Matrix

Variable	Factors F1	Factors F2	Communalities
X_1	.766	-.232	.640
X_2	.670	-.203	.490
X_3	.574	-.174	.360
X_4	.454	.533	.490
X_5	.389	.457	.360
X_6	.324	.381	.250
Eigenvalues		1.827	.763
Variance Explained		30.5%	12.7%
Cumulative Variance		30.5%	43.2%

Step 2: Extracting Initial Factors. Factor analysis techniques then attempt to extract information about the interrelationship between the manifestation variables to define factors. These factors are, in effect, new variables that are uncorrelated or independent of each other and are linear combinations of the manifestation variables (36:470). For instance, if two factors were extracted from among four variables, the following relationship may occur:

$$F1 = a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + a_{14}x_4$$
$$F2 = a_{21}x_1 + a_{22}x_2 + a_{23}x_3 + a_{24}x_4$$

where x_i represents the values of the observed variables and a_{ij} are coefficients derived by the mathematical manipulation of the correlation matrix. These coefficients that form the initial factor matrix like the one presented in Table 22 on page 146.

Each factor extracted "explains" a certain amount of the information contained in the original data. A number of factors equal to the number of original variables could be developed--in that case, those factors would explain 100% of the information or variance in all the variables. Unfortunately, the majority of those factors would contribute little more than a small percentage of the variance and it would be difficult to determine any underlying dimensions or "common thread" to each. Therefore, only a few factors are extracted for use. There are a number of rules of thumb to determine how many factors to retain (43:42). The one used for this project is the "eigenvalue specification". This rule states that factors are retained when their eigenvalue is one or greater. An eigenvalue is an indication how much of the total variance is captured by a particular factor. For example, if there are 10 original variables, a factor with an eigenvalue of 3 would explain 3/10 or 30% of the variance. The rule of thumb retains factors that explain at least 1/x% of the total variance where x is the number of manifestation variables.

One other important term can help explain the process.

Just as the eigenvalue defined how much of the total variance was explained by each factor, the communality of a variable defines how much of the variance of each variable is explained by the extracted factors. Looking back at Table 22, we note first the factor loadings for each variable and their two related factors. Some simple mathematics will show that the eigenvalues, 1.827 and .763, do indeed represent a total of 43.2% of the total variance. (NOTE: Factor 2 was retained despite having an eigenvalue less than one.) The communalities for each variable are shown and we see that for the first variable, 64% of its information is included in the two factors.

Step 3: Rotation To A Terminal Solution. The factor loadings shown on the initial factor matrix (Table 2) do not lend themselves to easy interpretation. The loadings on some of the variables are nearly the same for both factors--it is difficult to make any dimensionality decision with this information. In order to simplify the structure of the matrix and render it more interpretable, a mathematical "rotation" is performed that simply changes the matrix without any gain or loss of information already inherent in the structure (42:50). "One factor solution can be transformed into another without violating the basic assumptions or mathematical properties of a given solution. In other words, there are many statistically equivalent ways to define the underlying dimensions of a set of data" (36:472).

TABLE 23

Varimax-rotated Factor Matrix

Variables	F1	F2
x_1	.783	.163
x_2	.685	.143
x_3	.587	.123
x_4	.143	.685
x_5	.123	.587
x_6	.102	.489

The primary aim, then, of matrix rotation is simplification and interpretability.

There are many types of rotation possible but the one used here will be the VARIMAX orthogonal rotation that maximizes the variance of a column in the initial factor matrix (42:79). Table 23 shows the matrix from Table 22 after a VARIMAX rotation. A glance at Table 23 shows the loadings to be much more interpretable than was the case before. It is evident that variables x_1, x_2, and x_3 load heavily on Factor 1 while x_4, x_5, and x_6 can be related to Factor 2.

The subjective judgment of the researcher comes into play at this point. The dimensionality decision must be made by attempting to define what underlying characteristics variables $x_1 \text{-->} x_3$ and $x_4 \text{-->} x_6$ have in common. Factors 1 and 2 then are "new variables" representing these dimensions. For instance, the first three variables may concern job satisfaction. That factor might itself then be called a

TABLE 24

Factor Coefficient Matrix

	Factor 1	Factor 2
Var 1	.83200	-.23168
Var 2	.22120	.00193
Var 3	.10000	.52354
Var 4	-.21267	.62138
Var 5	.00389	.82124

measure of job satisfaction. For a confirmatory project such as this thesis, the researcher will check to see if the expected hypotheses about the nature of the inherent factors is validated by the data.

In Table 23 it was easy to determine which variables were related to each factor. In some cases, it is not so apparent. Other rotation methods could be used to attempt to get a more interpretable presentation (40:6-41). A rule of thumb is to consider significant loadings greater than 0.4. The ideal situation would be to have each variable correlate strongly with only one factor. When real world data is used, however, it is common for some variables to exhibit some complexity; the researcher must use judgment in the final analysis (32).

Step 4: Constuction of Factor Scales. A third factor analysis was used to produce variables for use in further analysis. This fourth step accomplishes that operation. If the rotated factor matrix is multiplied by the original correlation matrix, a factor score coefficient

matrix is the result. These coefficients can be used to compute each factor score for each case in the study. Table 24 on page 150 is an example of a factor score coefficient matrix. A case's factor score for Factor 1 could be calculated using the following formula:

$$F1 = .83200z_1 + .22120z_2 + .10000z_3 - .21267z_4 + .00389z_5$$

where z_i is the standardized value of the variables x_1 to x_5. That is, z_i is computed by

$$z_i = \frac{(x_i - \bar{x}_i)}{SD_{x_i}}$$

x_i = raw variable score

$\bar{x}_i$ = mean of all responses for variable x_i

SD_{x_i} = std deviation of raw scores for variable x_i

Sometimes factor scores are created using only variables on which that factor had high loadings. While appropriate in certain cases, experts note that using all the manifestation variable scores retains the original meaning of the underlying factor dimensions and avoids introducing error into the process (36:488,42:51).

Use of a computer to make the caluculations for a large factor analysis makes a tedious process very fast and simple. The SPSS program, FACTOR, was used to accomplish the steps described above. Chapter 4 presents more specific information about the exact procedures used and the results.

Appendix D: Multiple Linear Regression

Regression is a very common statistical method to investigate relationships between two or more variables. The purpose of this section is not to acquaint the reader with all the intracacies of this technique, but to provide an overview of the method along with some information about the statistical computer package used in this research.

Linear regression techniques attempt to identify if any linear relationship exists between a dependent variable (DV) and one or more independent variables (IV). The general form of this linear equation is:

$$Y = B_o + B_1 X_1 + B_2 X_2 + \ldots + B_i X_i + e_i$$

where Y =dependent variable
X_i =independent variable
B^o =constant term
B_i =coefficent of IV
e_i =error term.

Using the correlations (a measure of association between the variables), the regression procedure determines 1) what IV's can be used to help predict the value of the dependent variable and 2) how much of the total variance in the data does that equation explain.

Determining Significant Independent Variables. The null and alternate hypotheses shown below indicate the statistical approach taken to determine what IV significantly

help predict values of the DV.

$$H_o : B_1 = B_2 = B_3 = . . . = B_i = 0$$
$$H_a : \text{at least one } B_i \neq 0$$

If any $B_i \neq 0$, a linear relationship exists between the DV and the associated IV, X_i. Once H_o above is rejected in favor of H_a, further statistical tests are performed to determine which of the B_i are not equal to zero. The null and alternative hypotheses for each B_i is:

$$H_o : B_i = 0$$
$$H_a : B_i \neq 0$$

When H_o is rejected, the IV, X_i, associated with the particular B_i is statistically significant as a predictor for the dependent variable.

The SPSS program NEW REGRESSION calculates the regression values, B_i, and performs the statistical tests mentioned above. An analysis of variance (ANOVA) test using the F statistic determines if a linear relationship is present among the variables. Once such a relationship is determined, an F-test or T-test can be used to check if the *coefficients are significantly greater than zero.* The SPSS procedure performs both tests and the results of each test are exactly equal. The level of significance, $\underline{a}$ (alpha),

for all tests will be 0.05 meaning there is a 5% chance of rejecting H_o when it is actually true. The researcher specifies in the SPSS control statements which of thevariables is to be the DV and which ones are to be the IV's. The program will then begin "picking" IV's to "enter" the regression equation in order of decreasing significance (the STEPWISE criteria). The ANOVA and F/T tests will be performed after each iteration to confirm the significance of that variable to the regression equation. When one of the B_i is not statistically different from zero at the .05 level, the procedure stops. The variables that "entered" the regression equation are said to be significant predictors of the IV.

Explained Variance. While an equation to help predict values of the DV can be developed, it is important to also determine the explanatory power of that model. That is, how much of the variance in all the data can be explained using the regression model. Sometimes referred to as the "goodness of fit", the coefficient of multiple determination, R-squared (R^2), is just such a measure. Varying from 0 to 1.0, the value of R^2 indicates what percentage of the total variance is explained by the regression model. Values nearer to 1.0 indicate a high predictive power. The SPSS program calculates the R^2 for each variable placed in the regression equation and the cumulative value for all variables.

Analysis of Residuals. In a perfect regression analysis, the regression equation would exactly predict the value of the DV. This cannot be the case and there is always a difference between the actual value of the DV and the value predicted by the regression equation. This difference is the error or residual. The e_i in the general linear equation shown earlier represents this residual. Residuals are examined to help determine if the underlying assumptions of the regression model have been violated.

> In regression analysis, it is assumed that the error components (1) are independent, (2) have a mean of zero, and (3) have the same variance throughout the range of Y values. Serious violations of the foregoing assumptions are usually detectable through an examination of residuals. (36:341)

The SPSS program provides plots of residuals to investigate the validity of these assumptions. The plots for the regressions performed in this project will be presented as part of the results.

Goals of Regression Analysis. Two goals are possible when performing a regression analysis on some data. One goal is that of prediction. The researcher wishes to develop an equation that can be used to predict with accuracy the value of another variable or characteristic. A second goal is primarily exploratory. The research, in this case, can be used to investigate if certain IV's influence the DV to any extent. This particular research falls in the latter case. It attempts to determine if any relationship

exists between motivation and the hypothesized factors and identify the direction of that relationship. The intent is not to be able to predict exactly the motivation of an individual to attend SOCE PCE.

Appendix E: Descriptive Statistics

TABLE 25

Experience in CE Career Field (Q2)

Years	N	%
0-2	147	38.0
3-5	89	23.0
6-8	40	10.3
9-11	35	9.0
12-14	21	5.4
15-17	24	6.2
18 or more	30	7.8
No Response	1	.3

TABLE 26

MAJCOM of Respondents (Q3)

MAJCOM	N	%
ATC	43	11.1
MAC	35	9.0
SAC	103	26.6
TAC	82	21.2
AFLC	29	7.5
AFSC	39	10.1
ESC	3	.8
Other*	53	13.7

* The majority of the responses marked "Other" indicated officers assigned to Headquarters USAF, Space Command, or assignments not reporting directly to a MAJCOM Headquarters.

TABLE 27

Rated Supplement Civil Engineers (Q8)

Supplement	N	%
No	366	94.5
Yes	15	3.9
No Response	6	1.6

TABLE 28

Respondent Job Level (Q4)

Job Level	N	%
Base Level CE	277	71.6
MAJCOM Hq	52	13.4
Hq USAF	21	5.4
Laboratory	4	1.0
Other*	33	8.5

* Responses classified as "Other" included officers working at assignments such as Site Activation Teams, Systems Project Offices, or Regional Civil Engineering Offices.

TABLE 29

Base CE Job Level (Q5)

Job Level	N	Rel %
BCE/Deputy BCE	25	9.0
Branch Chief	54	19.4
Section Chief	53	19.1
Below Sect Ch	146	52.5

TABLE 30

Base Level CE Section (Q6)

Section	N	Rel %
Readiness	17	7.8
Res/Rqmts	22	10.0
Design	95	43.4
Programming	20	9.1
Environmental	14	6.4
Industrial Eng	13	5.9
Other	38	17.4

NOTE: Discrepancies between the number of respondents in Tables 35 and 36 are a result primarily of differing designations of "branch" and "section" at some bases. Additionally, some bases combine some of the sections shown in Question 6 of the survey. Finally, some of the respondents who marked "Other" were BCEs/branch chiefs who were instructed to skip Question 6.

TABLE 31

Time in Current Job (Q9)

Time	N	%
0-3 months	51	13.2
4-6 months	35	9.0
7-9 months	57	14.7
10-12 months	48	12.4
over 1 year	194	50.1
No Response	2	.5

TABLE 32

Supervisor Status (Q10)

Supervisor?	N	%
Yes	137	35.4
No	247	63.8
No Response	3	0.8

TABLE 33

Academic Degree (Q11)

Degree	N	%
Bachelor's deg.	126	32.6
Bachelor's plus*	127	32.8
Master's deg.	101	26.2
Master's plus*	30	7.8
PhD	1	.3
No Response	2	.5

* The term "plus" indicates credit hours towards a higher degree.

TABLE 34

Academic Specialty (Q12)

Specialty	N	%
Civil Eng	195	50.4
Mechanical Eng	49	12.7
Electrical Eng	36	9.3
Architecture	32	8.3
Industrial Eng	45	11.6
Other	25	6.5
No Response	5	1.3

TABLE 35

Year of Highest Degree (Q13)

Year	N	%
1983-1985	142	36.7
1980-1982	119	30.7
1977-1979	46	11.9
1974-1976	35	9.0
Before 1974	44	11.4
No Response	1	.3

TABLE 36

Undergraduate GPA (Q14)

GPA	N	%
Below 2.0	1	.3
2.00-2.50	80	20.7
2.51-3.00	160	41.3
3.01-3.50	108	27.9
3.51-4.00	36	9.3
No Response	2	.5

TABLE 37

Time Since Credit Course (Q15)

Time Period	N	%
0-6 months	98	25.3
7-12 months	74	19.1
13-24 months	83	21.4
25-36 months	38	9.8
over 36 months	92	23.8
No Response	2	.5

TABLE 38

Marital Status (Q16)

Status	N	%
Single	111	28.7
Married	275	71.1
No Response	1	0.2

TABLE 39

Children Living At Home (Q17)

Children	N	%
none	194	50.1
1	52	13.4
2	89	23.0
3	35	9.0
4 or more	16	4.1
No Response	1	0.3

TABLE 40

Hear About AFIT Programs (Q18)

	Response	N	%
1	Once a month	104	26.9
2	Once each 3 months	99	25.6
3	Once each 6 months	76	19.6
4	Once each year	85	22.0
5	Never hear	21	5.4
	No response	2	0.5

Median: 2
Mean: 2.53
Variance: 1.56

TABLE 41

FY 85 SOCE Brochure (Q20)

	Seen Brochure	N	%
1	Yes	244	63.0
2	No	127	32.8
3	Not Sure	16	4.1

Median: 1
Mean: 1.41
Variance: 0.326

TABLE 42

Denied Supervisor Approval For Attendance (Q21)

Denied Approval?		N	%
1	Yes	88	22.7
2	No	272	70.3
3	Never Applied	26	6.7
	No resp.	1	0.3

Median: 2
Mean: 1.839
Variance: .270

TABLE 43

Career Intentions (Q22)

Intent to Stay	N	%
1 Definitely	161	41.6
2 Probably will	91	23.5
3 Not sure	82	21.2
4 Probably won't	38	9.8
5 Definitely won't	15	3.9

Median: 2
Mean: 2.109
Variance: 1.361

TABLE 44

Desire for SOCE PCE (Q23)

Desire	N	%
1 Very Strong	138	35.7
2 Strong	133	34.4
3 Neutral	83	21.4
4 Weak	19	4.9
5 Very Weak	12	3.1
No response	2	0.5

Median: 2 Mean: 2.049 Var: 1.052

TABLE 45

SOCE Courses Attended (Q60)

Number	N	%	Number	N	%
0	65	16.8	5	38	9.8
1	56	14.5	6	19	4.9
2	81	20.9	7	9	2.3
3	60	15.5	8	2	0.5
4	52	13.4	9+	5	1.3

Mean: 3.22 Variance: 3.24

TABLE 46

Non-Volunteer SOCE Attendance (Q64)

Number	N	%
0	341	88.1
1	38	9.8
2	4	1.0
3	2	0.5
4	1	0.3
5	1	0.3

Mean: .158

TABLE 47

Descriptive Statistics
Likert Scale Questions

Question	Median	Percent* SD(1)	D(2)	N(3)	A(4)	SA(5)	Mean	Variance
24	2	15	42	12	24	7	2.66	1.43
25	3	4	24	24	34	13	3.29	1.20
26	4	1	3	8	46	41	4.23	0.69
27	3	7	23	29	31	10	3.13	1.21
28	4	7	25	14	40	14	3.30	1.40
29	4	2	6	10	49	33	4.05	0.84
30	2	20	31	28	12	8	2.55	1.35
31	3	13	26	32	18	11	2.88	1.38
32	3	8	27	26	25	13	3.07	1.37
33	3	6	20	42	27	4	3.04	0.87
34	3	7	35	31	22	5	2.83	1.00
35	2	10	46	17	22	5	2.66	1.15
36	2	19	50	13	15	3	2.32	1.08
37	4	1	4	15	56	25	4.00	0.62
38	4	2	5	25	56	11	3.70	0.63
39	4	2	6	35	41	14	3.59	0.79
40	2	13	52	27	5	2	2.30	0.69
41	4	2	9	30	44	14	3.60	0.83
42	2	23	54	19	4	0	2.04	0.59
43	3	6	29	32	27	5	2.96	1.03
44	4	5	28	12	44	10	3.25	1.28
45	4	5	21	15	47	11	3.36	1.20
46	4	5	22	21	34	18	3.38	1.34
47	2	22	47	11	18	1	2.29	1.09
48	2	25	50	13	9	3	2.17	1.02
49	3	8	32	29	22	10	2.94	1.25
50	2	13	39	23	20	4	2.63	1.16
51	2	10	41	23	25	2	2.68	1.02
52	4	2	5	15	64	13	3.81	0.66
53	4	1	2	28	54	15	3.81	0.53
54	4	1	1	6	62	30	4.19	0.45
55	3	9	18	39	29	5	3.04	1.02
56	4	0	2	16	38	43	4.23	0.63
57	4	0	6	25	62	8	3.72	0.47
58	4	1	3	26	59	11	3.76	0.52
59	4	2	7	17	49	25	3.89	0.85
61	4	1	2	6	63	30	4.19	0.43
62	4	1	8	10	65	17	3.90	0.63
63	4	1	4	7	65	23	4.05	0.55

* Percentages rounded off to nearest whole number

Appendix F: Nonparametric Test Results

TABLE 48

Statistical Tests
Research Question 1A

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
Q24	Q1-Rank			
	-all	K-W	3.425	.635
	-company/field	M-W	-.846	.397
	Q3-MAJCOM	K-W	5.555	.593
	Q4-Job level			
	-all	K-W	1.696	.791
	-base/HHQ	M-W	-.846	.397
	Q5-Base job			
	-all	K-W	3.004	.391
	-above sect. ch/ below sect. ch	M-W	-1.690	.091
	Q6-Base section	K-W	9.671	.139
	Q9-Time in job	K-W	6.405	.171
	Q10-Supervisor?	M-W	-2.119	.034*
Q25	Q1-Rank			
	-all	K-W	16.520	.006*
	-company/field	M-W	-2.760	.0058*
	Q3-MAJCOM	K-W	4.716	.695
	Q4-Job level			
	-all	K-W	1.755	.781
	-base/HHQ	M-W	-1.327	.185
	Q5-Base job			
	-all	K-W	6.177	.103
	-above sect. ch/ below sect. ch	M-W	.3004	.764

TABLE 48 (Cont.)

Statistical Tests
Research Question 1A

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
Q25	Q6-Base section	K-W	14.587	.024*
	Q9-Time in job	K-W	1.919	.751
	Q10-Supervisor?	M-W	-.445	.6561

* indicates significant at .05 level

TABLE 49

Multiple Comparisons-Q25 by Q6
Levels of Significance

	Disagree <---------- Prgrm	IE	Other	Design	Envmnt	R&R	Agree Readnss
Prgrm	-						
Ind Eng	.3913	-					
Other	.0163	.2050	-				
Design	.0031	.0886	.5598	-			
Envmnt	.0312	.1680	.5828	.7889	-		
R & R	.0095	.0760	.3820	.6300	.9439	-	
Readnss	.0034*	.0307	.1703	.3096	.6333	.6547	-

*Significant at .0035 level

TABLE 50

Statistical Tests
Research Question 1B

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
Q18	Q1-Rank			
	-all	K-W	24.115	.000*
	Q4-Job level			
	-base/HHQ	M-W	-4.334	.000*
	Q5-Base job			
	-above sect. ch/ below sect. ch	M-W	-1.467	.142
	Q10-Supervisor?	M-W	-.155	.877
Q20	Q1-Rank			
	-all	K-W	12.302	.031*
	Q4-Job level			
	-base/HHQ	M-W	-5.189	.000*
	Q5-Base job			
	-all	K-W	2.187	.535
	-above sect. ch/ below sect. ch	M-W	-.047	.963
	Q10-Supervisor?	M-W	-0.489	.625
Q27	Q1-Rank			
	-all	K-W	12.307	.031*
	-company/field	M-W	-3.031	.002*
	Q4-Job level			
	-base/HHQ	M-W	-0.105	.917
	Q5-Base job			
	-above sect. ch/ below sect. ch	M-W	-1.860	.063
	Q10-Supervisor?	M-W	-0.283	.777
Q28	Q1-Rank			
	-all	K-W	11.740	.039*
	-company/field	M-W	-0.063	.950
	Q4-Job level			
	-base/HHQ	M-W	-1.794	.097
	Q5-Base job			
	-above sect ch/ below sect ch	M-W	-2.623	.008*
	Q10-Supervisor?	M-W	-2.530	.011*

*Significant at .05 level

TABLE 51

Multiple Comparisons-Q18 By Q1
Levels of Significance

	Hear often <----------				Hear seldom
	Col	2 Lt	1 Lt	LtCol	Capt	Maj
Col	-					
2 Lt	.1259	-				
1 Lt	.1891	.0609	-			
LtCol	.1278	.0565	.2209	-		
Capt	.0182	.0001*	.1114	.1639	-	
Maj	.0107	.0001*	.1467	.1742	.4925	-

*Significant at .005 level

TABLE 52

Multiple Comparisons--Q20 By Q1
Levels of Significance

	Seen brochure <----------				Seen seldom
	2 Lt	1 Lt	Col	LtCol	Capt	Maj
2 Lt	-					
1 Lt	.0941	-				
Col	.2692	.8500	-			
LtCol	.0803	.5606	.8424	-		
Capt	.0018*	.1203	.5365	.6169	-	
Maj	.0049*	.1265	.5063	.5721	.8630	-

*Significant at .005 level

TABLE 53

Multiple Comparisons--Q27 By Q1
Levels of Significance

	Disagree <----------					Agree
	LtCol	Col	Maj	1 Lt	Capt	2 Lt
LtCol	-					
Col	.5995	-				
Maj	.3124	.8316	-			
1 Lt	.0380	.2724	.3285	-		
Capt	.0253	.2296	.2693	.7436	-	
2 Lt	.0019*	.0526	.0348	.0986	.2891	-

*Significant at .005 level

TABLE 54

Multiple Comparisons--Q28 By Q1
Levels of Significance

	Disagree <----------					Agree
	Maj	2 Lt	1 Lt	Capt	Col	LtCol
Maj	-					
2 Lt	.7435	-				
1 Lt	.0340	.0153	-			
Capt	.0693	.0618	.8449	-		
Col	.0787	.0839	.6503	.7925	-	
LtCol	.0380	.0313	.3532	.4760	.8012	-

*Significant at .005 level

TABLE 55

Test Results-Research Question 1C

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
Q30	Q4-Job level -base/HHQ	M-W	-1.659	.0971
	Q10-Supervisor?	M-W	-1.984	.0473*
Q31	Q4-Job level -base/HHQ	M-W	-4.202	.000*
	Q10-Supervisor?	M-W	-.712	.4763
Q32	Q4-Job level -base/HHQ	M-W	-3.347	.001*
	Q10-Supervisor?	M-W	-1.367	.172
Q33	Q4-Job level -base/HHQ	M-W	-2.259	.0239*
	Q10-Supervisor?	M-W	-1.732	.0833

*Significant at .05 level

TABLE 56

Test Results-Research Question 1D

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
Q34	Q2-Experience	K-W	7.997	.238
Q35	Q1-Rank -all	K-W	11.127	.049*
	Q4-Job level -base/HHQ	M-W	-1.096	.273
	Q5-Base job -above sect ch/ below sect ch	M-W	-1.518	.129
	Q10-Supervisor?	M-W	-2.296	.022*
Q36	Q1-Rank -all	K-W	6.698	.244
	Q5-Base job -above sect ch/ below sect ch	M-W	-2.147	.032*

*Significant at .05 level

TABLE 57

Multiple Comparisons--Q35 By Q1
Levels of Significance

	Disagree <----------					> Agree
	LtCol	Col	Maj	Capt	1 Lt	2 Lt
LtCol	-					
Col	.6300	-				
Maj	.1505	.5454	-			
Capt	.0609	.3395	.5970	-		
1 Lt	.0396	.2832	.5345	.9468	-	
2 Lt	.0019*	.0728	.0526	.1153	.0977	-

*Significant at .005 level

TABLE 58

Test Results--Research Question 2G

Dep. Var.	Indep. Var.	Test	Test Statistic	Sig. Level
MOT1	Q61	M-W	-5.234	.000
	Q62	M-W	-5.550	.000
	Q63	M-W	-4.161	.000
MOT2	Q61	M-W	-4.525	.000
	Q62	M-W	-2.526	.012
	Q63	M-W	-4.090	.000

Appendix G: Factor Analysis Results

Page

Analysis I 174

All manifestation variables

Analysis II 176

All variables except Q26,Q37,Q42,Q52,Q54,Q58,Q59

Analysis III 177

"Motivation" variables

Analysis IV 178

"Motivation-influencing" variables

TABLE 59

Descriptive Statistics
Motivation and Factor Variables

Variable	Mean	Standard Deviation	Maximum	Minimum
MOT1	-.010	.852	2.298	-4.188
MOT2	-.013	.794	1.791	-4.085
FACT1	-.026	.970	1.883	-3.290
FACT2	-.005	.849	2.174	-2.251
FACT3	-.004	.769	1.897	-2.373
FACT4	-.002	.764	2.049	-2.326
FACT5	.000	.740	2.306	-1.682

FACTOR ANALYSIS--ANALYSIS I

VARIABLE	EST COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
Q36	.55014	1	5.22659	20.9	20.9
Q37	.25441	2	2.63536	10.5	31.5
Q37	.49301	3	2.02296	8.1	39.6
Q38	.60929	4	1.59975	6.4	45.7
Q39	.67116	5	1.40746	5.7	51.5
Q40	.52767	6	1.18592	4.7	56.0
Q41	.52864	7	1.06937	4.3	60.3
Q42	.51194	8	.90731	3.6	64.0
Q43	.31652	9	.86610	3.5	67.5
Q44	.36794	10	.76734	3.1	70.6
Q45	.39025	11	.74610	3.0	73.6
Q46	.38492	12	.68703	2.8	76.3
Q47	.31651	13	.65462	2.6	78.9
Q48	.31312	14	.61328	2.5	81.4
Q49	.34777	15	.59871	2.4	83.8
Q50	.30312	16	.55185	2.2	86.1
Q51	.29538	17	.50095	2.0	88.0
Q52	.43107	18	.48658	1.9	89.9
Q53	.38263	19	.46501	1.9	91.8
Q54	.52077	20	.42466	1.7	93.5
Q55	.27913	21	.39043	1.6	95.1
Q56	.33385	22	.35530	1.4	96.5
Q57	.20694	23	.34769	1.4	97.9
Q58	.37333	24	.31430	1.3	99.1
Q59	.46911	25	.21700	.9	100.0

FACTOR ANALYSIS--ANALYSIS I (CONT.)

VARIMAX ROTATED FACTOR MATRIX
AFTER ROTATION WITH KAISER NORMALIZATION

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7
Q26	.65711	.17652	.16123	.04016	-.07507	-.15746	.28676
Q29	.70164	-.01113	.12140	.12119	-.19875	-.07598	.44729
Q31	.65868	.08641	-.01330	.14460	-.15249	.09684	-.00224
Q35	.67991	.73650	-.00136	.07985	-.06729	-.01311	.15461
Q39	.08517	.87645	.04243	.03324	-.02438	-.02231	-.04586
Q40	-.13112	-.74252	-.04758	-.01219	.02691	.01388	-.06070
Q41	.19335	.69948	-.04704	.06537	.06294	.02619	-.16113
Q42	-.46512	.00030	-.05352	.13669	.11188	.59152	.04876
Q43	-.12538	-.03985	-.39427	.01101	.12467	.00207	-.06394
Q44	.04945	.01682	.61227	.04455	.13555	-.07718	.01875
Q45	-.05798	.01366	-.74045	-.06131	.14799	.03812	.02182
Q46	.10239	.00065	.65405	.22230	-.05808	.01850	.10761
Q47	-.02880	.03735	-.04169	-.03847	.12122	.60848	.09816
Q48	-.10909	-.04483	-.04664	-.05869	-.01462	.59325	-.03887
Q49	-.21370	-.02742	.08265	.02549	.05023	.19283	.36648
Q50	-.34275	-.03481	-.08337	-.11444	.48402	.13647	.03816
Q51	-.28306	.01688	-.14815	-.06435	.58171	.12922	-.00796
Q52	.63235	.14180	.07661	.10846	-.08800	-.04956	-.10047
Q53	.42296	.38243	.00464	-.08310	.15454	-.05329	-.19386
Q54	.72171	.17214	.11073	-.07729	-.02467	-.05939	.12900
Q55	.10446	.08913	.18522	.67041	.02658	-.09440	.07479
Q56	.06400	-.02639	-.08277	-.54126	.12553	.06617	.00781
Q57	.02045	-.00196	.02182	-.34975	.35018	-.10238	-.09802
Q58	.59789	.13236	.06011	-.01075	-.05876	-.00400	-.14692
Q59	.60084	.17290	.22672	.01594	-.10926	-.10340	.17644

FACTOR ANALYSIS--ANALYSIS II

VARIABLE	EST COMMUNALITY	FACTOR	EIGENVALUE	PCT OF VAR	CUM PCT
Q29	.13290	1	3.29660	18.3	18.3
Q38	.59134	2	2.53147	14.1	32.4
Q39	.67110	3	1.60575	8.9	41.3
Q40	.52591	4	1.44041	8.0	49.3
Q41	.51927	5	1.20750	6.7	56.0
Q42	.16556	6	1.03750	5.8	61.8
Q44	.24567	7	.87394	4.9	66.6
Q45	.37139	8	.84712	4.7	71.3
Q46	.35938	9	.80841	4.5	75.8
Q47	.19769	10	.65360	3.6	79.5
Q48	.19518	11	.61631	3.4	82.9
Q49	.11224	12	.60451	3.4	86.2
Q50	.25553	13	.56646	3.1	89.4
Q51	.16834	14	.49355	2.7	92.1
Q53	.29268	15	.46497	2.6	94.7
Q55	.17328	16	.38073	2.1	96.8
Q56	.20037	17	.34667	1.9	98.8
Q57	.17484	18	.22449	1.2	100.0

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6
Q29	.07502	.18408	-.21599	-.11847	-.03119	-.05749
Q38	.83509	.02337	-.09548	-.08271	-.01122	-.00835
Q39	.85527	.03757	-.01029	-.01612	-.04065	.11830
Q40	-.76044	-.05184	.04511	.02309	.00565	-.05744
Q41	.66487	-.04072	-.00205	-.06276	.01430	.45687
Q43	-.05615	-.39288	.16037	.01933	-.02418	.02256
Q44	.01454	.53888	.11107	-.01149	-.09783	-.02465
Q45	.02550	-.71926	.16879	.05216	.03125	-.02333
Q46	-.00834	.66139	-.10814	-.22913	.04950	.02274
Q47	.04290	-.02115	.12653	.04782	.58926	-.02058
Q48	-.05495	-.08022	.04261	.07484	.57936	-.01953
Q49	-.03434	.09491	.10207	-.06406	.24865	-.21023
Q50	-.05757	-.08964	.58142	.09025	.16808	-.09814
Q51	-.01314	-.14172	.66271	.06321	.13736	-.01571
Q53	.35190	.03621	-.01364	.10069	-.10082	.56841
Q55	.10292	.20749	-.02017	-.68485	-.10247	.04660
Q56	-.01588	-.07582	.07970	.50395	.07141	.08023
Q57	.00797	.04083	.31266	.39396	-.12988	.05163

FACTOR ANALYSIS--ANALYSIS III

VARIABLE	EST COMMUNALITY	FACTOR	EIGENVALUE	PCT	CUM PCT
Q26	.49749	1	3.62414	45.3	45.3
Q29	.13009	2	.99644	12.5	57.8
Q37	.39224	3	.78480	9.8	67.6
Q42	.18455	4	.65364	8.2	75.7
Q52	.30700	5	.58514	7.3	83.1
Q54	.45241	6	.51541	6.4	89.5
Q58	.32953	7	.45874	5.7	95.2
Q59	.40325	8	.38169	4.8	100.0

VARIMAX ROTATED FACTOR MATRIX
AFTER ROTATION WITH KAISER NORMALIZATION

	FACTOR 1	FACTOR 2
Q26	.45125	.68776
Q29	.09596	.54935
Q37	.58584	.30080
Q42	-.42549	-.14125
Q52	.55113	.23549
Q54	.62967	.58254
Q58	.68338	.08748
Q59	.51308	.42988

FACTOR SCORE COEFFICIENTS

	FACTOR 1	FACTOR 2
Q26	-.02842	.56543
Q29	-.12817	.29681
Q37	.20318	-.00942
Q42	-.12514	.04635
Q52	.16432	.01374
Q54	.24700	.04775
Q58	.35811	-.20488
Q59	.11403	.11048

FACTOR ANALYSIS--ANALYSIS IV

VARIABLE	EST COMMUNALITY
Q38	.58508
Q39	.67010
Q40	.52591
Q41	.51719
Q42	.15199
Q43	.24562
Q45	.37111
Q46	.25646
Q47	.19654
Q48	.18743
Q49	.10068
Q50	.24998
Q51	.26309
Q53	.29079
Q55	.26589
Q56	.19880
Q57	.17444

FACTOR	EIGENVALUE	PCT	CUM PCT
1	3.26307	19.2	19.2
2	2.45829	14.5	33.7
3	1.60574	9.4	43.1
4	1.48703	8.5	51.6
5	1.19179	7.0	58.6
6	.99078	5.8	64.4
7	.85657	5.0	69.4
8	.81197	4.8	74.2
9	.67761	4.0	77.9
10	.65305	3.8	81.7
11	.61289	3.6	85.3
12	.56648	3.3	88.7
13	.49768	2.9	91.6
14	.46504	2.7	94.3
15	.38482	2.3	96.6
16	.35231	2.1	98.7
17	.22499	1.3	100.0

VARIMAX ROTATED FACTOR MATRIX

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Q38	.78426	-.01739	-.12888	-.06111	.02055
Q39	.86389	-.03573	-.04701	-.00550	-.01929
Q40	-.74913	.04630	.06079	.02746	-.01815
Q41	.74658	.03532	-.10927	-.02236	-.04608
Q43	-.04988	.38633	.03340	.13660	-.02975
Q44	.00946	-.53795	-.01027	.12114	-.09570
Q45	.01453	.73636	.05489	.16333	.02930
Q46	.00132	-.65904	-.22400	-.08866	.04245
Q47	.03861	.02956	.06853	.11913	.58030
Q48	-.05476	.07304	.08525	.01227	.56971
Q49	-.09122	-.08206	-.08736	.12982	.27722
Q50	-.08496	.10225	.09362	.57560	.18843
Q51	-.01944	.15531	.09123	.64896	.14277
Q53	.46744	-.02384	.15726	-.03697	-.16567
Q55	.10990	-.20946	-.61537	-.00352	-.10829
Q56	.00971	.08121	.54762	.05918	.06100
Q57	.02223	-.03576	.41808	.30276	-.13336

FACTOR ANALYSIS--ANALYSIS IV (CONT.)

FACTOR SCORE COEFFICIENTS

	FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
Q38	.23011	.01496	-.08663	-.02661	.06899
Q39	.40573	-.01726	.02455	.04928	.00167
Q40	-.18861	.01183	.00835	-.00285	-.04055
Q41	.21757	.02648	.03586	-.01316	-.02742
Q43	-.01104	.11410	-.00307	.04173	-.03045
Q44	-.01638	-.02725	.04906	.12441	-.05598
Q45	.01479	.45197	-.08679	.06137	-.02063
Q46	-.00301	-.32197	-.08915	.01740	.07792
Q47	.03817	-.02213	.02662	.00859	.39213
Q48	-.00670	.01218	.12724	-.06957	.38130
Q49	-.01399	-.02443	-.05084	.04819	.12964
Q50	.06595	-.02009	-.01529	.35147	.06689
Q51	.00905	.00887	-.02476	.46266	.03099
Q53	.08806	-.00966	.11497	-.01295	-.09532
Q55	.00783	-.03004	-.46147	.09790	-.06747
Q56	.02445	-.03139	.31703	-.02207	.02309
Q57	.02567	-.07953	.02665	.15913	-.12468

Appendix H: Regression Analysis Results

Page

Analysis I 181

Dependent Variable - MOT1

Analysis II 184

Dependent Variable - MOT2

Analysis III 187

Dependent Variable - MOT2
Independent Variable DEG5 excluded

AD-A160 867 AN INVESTIGATION OF FACTORS INFLUENCING ATTENDANCE AT THE AFIT (AIR FORCE..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. M A SOUTIERE 3/3

UNCLASSIFIED SEP 85 AFIT/GEM/DET/85S-20 F/G 5/9 NL

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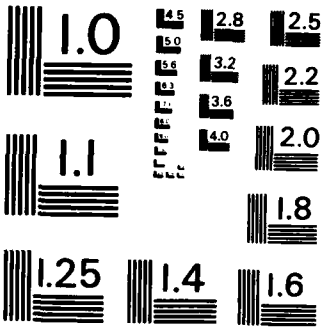


REGRESSION--ANALYSIS I

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	SE B	BETA	T	SIG T
FACT1	.28254	.03915	.32153	7.216	.0000
FACT4	-.33891	.05004	-.30379	-6.772	.0000
FACT5	-.17248	.05161	-.14994	-3.342	.0009
(CONSTANT)	-.00355	.03788		-.094	.9255

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	MIN TOLER	T	SIG T
FACT2	-.06635	-.09948	.97339	-1.954	.0514
FACT3	.07544	.07459	.97163	1.462	.1446
DEG1	-.07245	-.08174	.97962	-1.603	.1095
DEG2	.01056	.02356	.98020	.462	.6443
DEG3	.03499	.08542	.97394	1.673	.0949
DEG4	-.02595	-.05073	.98007	-.991	.3218
SPEC1	.01139	.03079	.98213	.603	.5467
SPEC2	.03633	.07592	.98075	1.488	.1375
SPEC3	-.01203	-.01975	.98325	-.387	.6988
SPEC4	-.02080	-.02368	.96795	-.463	.6437
SPEC5	-.02403	-.03721	.98145	-.730	.4650
YR1	-.00667	-.00765	.98178	-.150	.8812
YR2	.01673	.01900	.98255	.375	.7076
YR3	-.07393	-.07235	.98214	-1.426	.1514
YR4	.7245-03	.00090	.98232	.018	.9860
GPA2	.07196	.08253	.98297	1.618	.1064
GPA3	-.02372	-.02716	.97336	-.531	.5957
GPA4	-.00253	-.00290	.98092	-.057	.9548
GPA5	-.03973	-.04492	.95579	-.879	.3800
CRS1	.05434	.06215	.98249	1.217	.2243
CRS2	-.05509	-.06306	.98041	-1.235	.2176
CRS3	-.04481	-.05132	.98040	-1.004	.3158
CRS4	-.01922	-.02202	.98297	-.430	.6671

SUMMARY TABLE

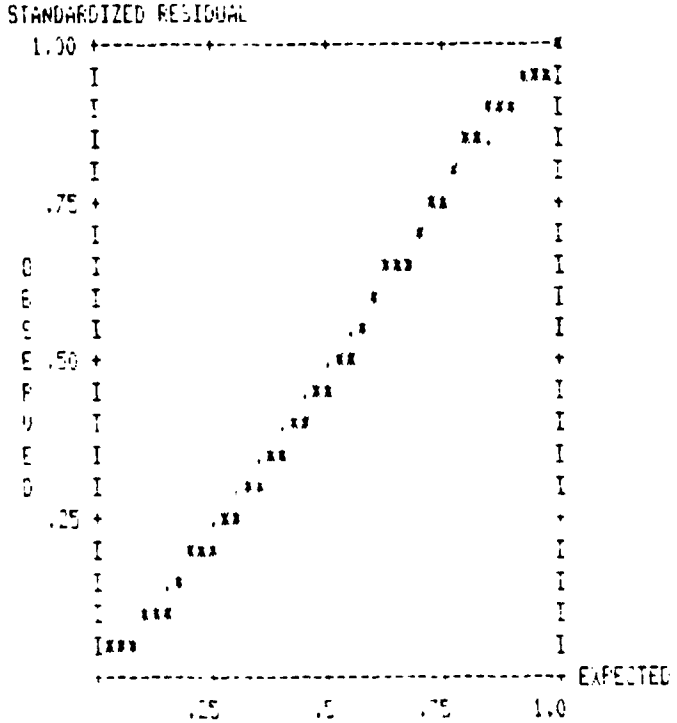
STEP	MULTR	RSQ	ADJRSQ	F(EQU)	SIGF	RSQCH	FCH	SIGCH		VARIABLE	BETAIN	CORREL
1	.3417	.1168	.1145	50.898	.000	.1168	50.898	.000	IN%	FACT1	.3417	.3417
2	.4691	.2201	.2160	54.180	.000	.1033	50.868	.000	IN%	FACT4	-.3216	-.3375
3	.4921	.2422	.2362	40.799	.000	.0221	11.168	.001	IN%	FACT5	-.1498	-.1998

REGRESSION--ANALYSIS I (CONT.)

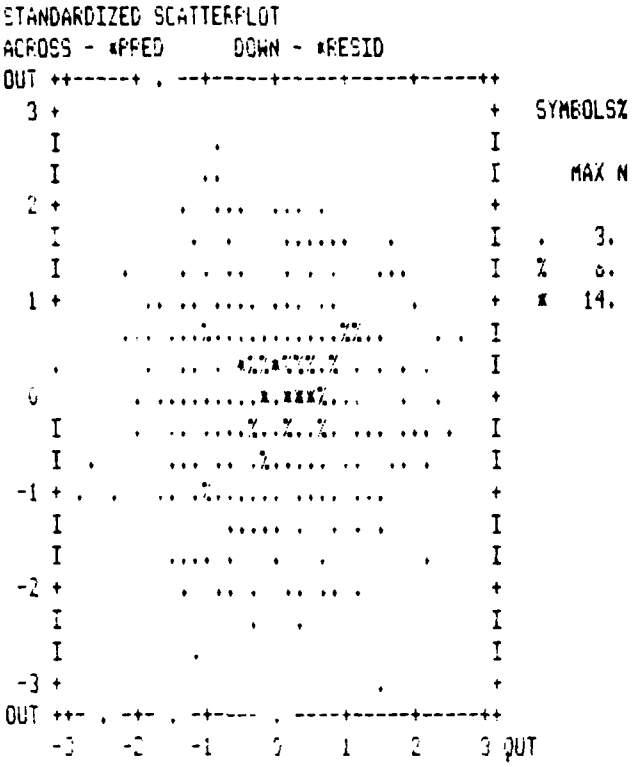
HISTOGRAM
STANDARDIZED RESIDUAL

```
 N EXP N     ( * = 1 CASES,    . % = NORMAL CURVE)
 1   .30   OUT *
 0   .59  3.00 .
 1  1.51  2.66 *.
 2  3.45  2.33 **.
 8  7.06  2.00 *******%*
10 12.94  1.66 **********  .
14 21.23  1.33 **************      .
26 31.21  1.00 ************************************    .
56 41.10  0.66 ****************************************************%****************
55 48.48  0.33 ***************************************************%********
60 51.52  0.00 ***************************************************%**********
51 48.48 -0.33 ***************************************************%**********
31 41.10 -0.66 ***************************************  .
32 31.21 -1.00 *********************************%*
15 21.23 -1.33 ***********      .
 8 12.94 -1.66 ********    .
10  7.06 -2.00 ******%***
 2  3.45 -2.33 **.
 1  1.51 -2.66 *.
 1   .59 -3.00 *
 3   .30   OUT ***
```

NORMAL PROBABILITY (P-P) PLOT
STANDARDIZED RESIDUAL



REGRESSION--ANALYSIS I (CONT.)



REGRESSION--ANALYSIS II

---------- VARIABLES IN THE EQUATION ----------

VARIABLE	B	SE B	BETA	T	SIG T
FACT4	-.20730	.04804	-.19943	-4.315	.0000
FACT2	-.17280	.04224	-.18466	-3.987	.0001
FACT1	.17552	.03732	.21436	4.703	.0000
[illegible]35	-.19075	.05009	-.15605	-3.331	.0013
DEG5	-1.93439	.71351	-.10391	-2.711	.0070
[illegible]R4	-.16418	.13075	-.09553	-1.021	.1440
(CONSTANT)	.08840	.04218		2.096	.0368

---------- VARIABLES NOT IN THE EQUATION ----------

VARIABLE	BETA IN	PARTIAL	MIN TOLER	T	SIG T
FACT3	-.03696	-.03959	.97595	-.765	.4445
FACT5	-.08800	-.09813	.98483	-1.922	.0554
DEG2	.03335	.03736	.80569	.699	.4849
DEG3	-.06472	-.06951	.78967	-1.371	.1706
DEG4	-.02134	-.02315	.96153	-.451	.6523
SPEC1	.04810	.05247	.89419	1.043	.2979
SPEC2	-.01950	-.02199	.98536	-.432	.6703
SPEC3	.02260	.03184	.97369	.620	.5355
SPEC4	-.02530	-.02814	.98244	-.548	.5840
SPEC5	-.03528	-.03896	.98673	-.759	.4483
[illegible]R2	.05186	.05643	.93618	1.100	.2716
[illegible]R3	.00458	.00502	.85714	.098	.9221
[illegible]R5	-.06737	-.06737	.71845	-1.315	.1895
GPA2	-.06685	-.07477	.88508	-1.460	.1452
GPA3	.05907	.06636	.89690	1.295	.1962
GPA4	-.00361	-.00415	.98387	-.079	.9372
GPA5	-.00558	-.00620	.98481	-.121	.9039
CRS2	.00244	.00264	.82209	.051	.9591
CRS3	-.07050	-.07448	.82061	-1.454	.1468
[illegible]534	.03656	.04033	.86035	.786	.4324

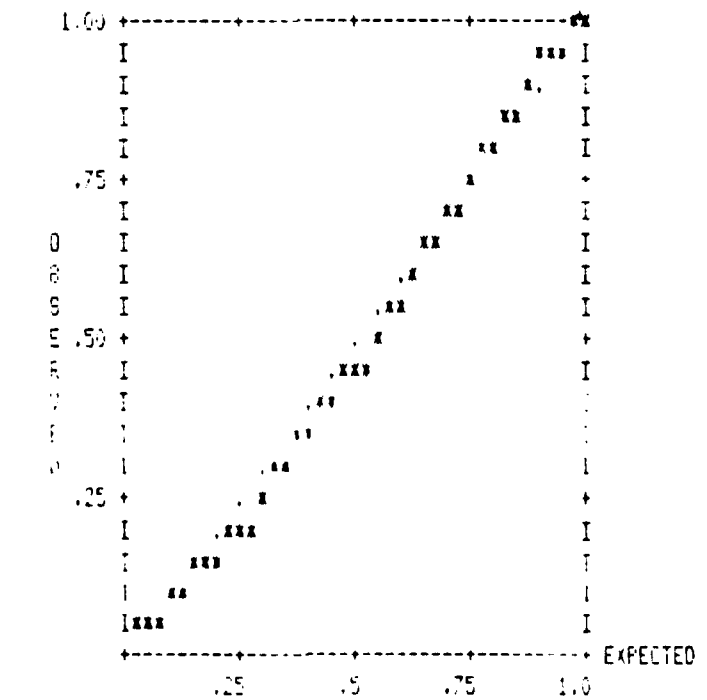
SUMMARY TABLE

STEP	MULTR	RSQ	ADJRSQ	F EQU	SIGF	RSQCH	FCH	SIGCH		VARIABLE	BETAIN	CORREL
1	.2578	.0665	.0640	27.407	.000	.0665	27.407	.000	IN%	FACT4	-.2578	-.2578
2	[illegible]	.1137	.1091	24.642	.000	.0473	20.490	.000	IN%	FACT2	-.2181	-.2358
3	.4009	.1607	.1541	24.446	.000	.0470	21.432	.000	IN%	FACT1	.2170	.2294
4	.4362	.1903	.1818	22.447	.000	.0296	13.965	.000	IN%	CRS5	-.1764	-.2369
5	.4531	.2053	.1949	19.688	.000	.0150	7.196	.008	IN%	DEG5	-.1230	-.1385

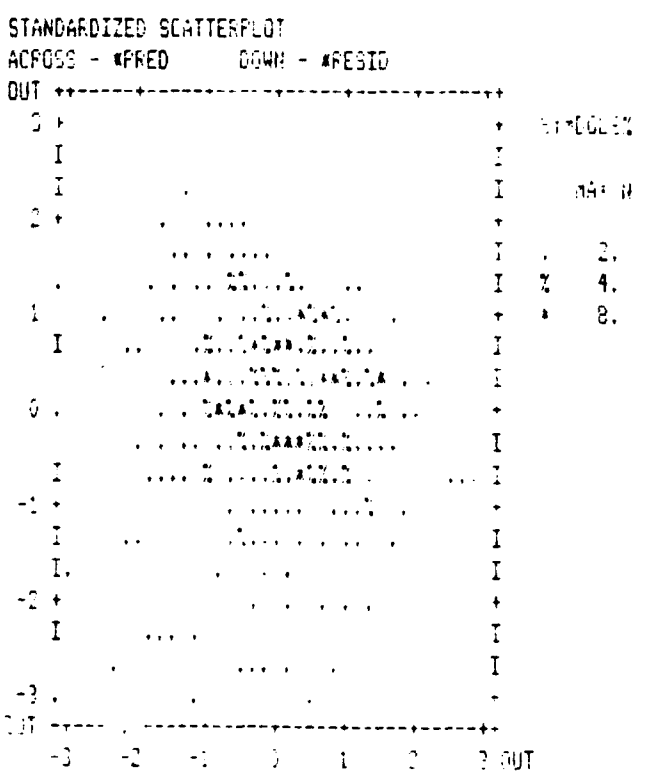
REGRESSION--ANALYSIS II (CONT.)

```
HISTOGRAM
STANDARDIZED RESIDUAL
 N EXP N     ( * = 1 CASES,     . % = NORMAL CURVE)
 1   .30   OUT
 0   .59  3.00 .
 0  1.51  2.66  .
 1  3.45  2.33 * .
 6  7.06  2.00 ******.
 8 12.94  1.66 ********    .
23 21.23  1.33 ************************%**
37 31.21  1.00 ********************************%*****.*
47 41.10  0.66 ***********************************************%******
64 48.48  0.33 ****************************************************%*****************
49 51.23  0.00 ************************************************** .
50 48.48 -0.33 ****************************************************%**
40 41.10 -0.66 ***********************************************.
18 31.21 -1.00 *****************          .
16 21.23 -1.33 ****************    .
 8 12.94 -1.66 ********    .
 6  7.06 -2.00 ******.
 4  3.45 -2.33 **%*
 2  1.51 -2.66 *%****
 3   .59 -3.00 %**
 1   .30   OUT *
```

NORMAL PROBABILITY (P-P) PLOT
STANDARDIZED RESIDUAL



REGRESSION--ANALYSIS II (CONT.)



REGRESSION--ANALYSIS III

------------------ VARIABLES IN THE EQUATION ------------------

VARIABLE	B	SE B	BETA	T	SIG T
FACT4	[illegible]	[illegible]	[illegible]	-4.269	.0000
FACT2	-.17131	.04353	-.18307	[illegible]	.0001
FACT1	[illegible]	.03749	[illegible]	[illegible]	[illegible]
CRS5	[illegible]	[illegible]	-.14695	-3.028	.0026
YR4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FACT5	[illegible]	.04946	[illegible]	[illegible]	.0445
(CONSTANT)	[illegible]	[illegible]		1.888	.0598

------------- VARIABLES NOT IN THE EQUATION -------------

VARIABLE	BETA IN	PARTIAL	MIN TOLER	T	SIG T
FACT3	[illegible]	-.05268	[illegible]	[illegible]	[illegible]
SEC1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SEC2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SEC3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SEC4	-.01946	[illegible]	[illegible]	[illegible]	[illegible]
SPEC1	.04274	[illegible]	[illegible]	[illegible]	.3566
SPEC2	-.01297	[illegible]	[illegible]	-.292	[illegible]
SPEC3	.03216	[illegible]	[illegible]	.695	.4877
SPEC4	-.02397	[illegible]	[illegible]	[illegible]	[illegible]
SPEC5	-.02969	[illegible]	[illegible]	-.636	.5252
YR2	.05986	[illegible]	[illegible]	[illegible]	[illegible]
YR3	.00960	[illegible]	.65652	.204	[illegible]
YR5	-.07834	[illegible]	[illegible]	-1.515	[illegible]
GPA2	[illegible]	-.07477	[illegible]	[illegible]	[illegible]
GPA3	[illegible]	.05335	[illegible]	1.040	.2990
GPA4	[illegible]	-.00500	[illegible]	-.097	[illegible]
GPA5	.01224	[illegible]	.98445	.260	.7948
CRS2	.00192	.00196	[illegible]	.038	.9697
CRS3	-.08371	-.08845	.81926	[illegible]	.0847
CRS4	.04295	.04663	[illegible]	.909	.3640

SUMMARY TABLE

STEP	MULTR	RSQ	F(EQU)	SIGF		VARIABLE	BETAIN
1	.2578	.0665	[illegible]	.000	IN:	FACT4	-.2578
2	.3373	.1137	[illegible]	.000	IN:	FACT2	-.2181
3	.4009	.1607	[illegible]	.000	IN:	FACT1	.2170
4	.4362	.1903	[illegible]	.000	IN:	CRS5	-.1769
5	.4456	.1986	[illegible]	.000	IN:	YR4	-.0944
6	.4550	.2070	[illegible]	.000	IN:	FACT5	-.0930

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Vita

Captain Marc A. Soutiere grew up in Sacramento, California where he graduated from Rancho Cordova Senior High School in 1972. Upon graduation from the U.S. Air Force Academy in 1976 with B.S. degree in Civil Engineering, he attended Undergraduate Navigator Training at Mather AFB, CA. After receiving his wings, Captain Soutiere flew KC-135's at Plattsburgh AFB, NY from 1977 to 1980. In September 1980, he joined the 38th Strategic Reconnaissance Squadron (SRS) at Offutt AFB, NE, flying the RC-135 reconnaissance aircraft and becoming an instructor navigator in July 1982. Captain Soutiere joined the 24th SRS, 6th Stategic Wing (SW), Eielson AFB, Alaska flying the RC-135S reconnaissance platform. With the 6th SW, he served as a flight instructor, senior evaluator navigator, and Training Flight instructor. He entered the AFIT Graduate Engineering Management program in May 1984 and upon graduation was assigned to the 97th Civil Engineering Squadron at Blytheville AFB, Arkansas.

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The Air Force Institute of Technology School of Civil Engineering (SOCE) conducts a wide range of resident Professional Continuing Education (PCE) courses for the Air Force civil engineering (CE) functional field. This study surveyed 500 CE officers examining factors influencing both the access of civil engineers to resident programs and factors influencing their motivation to attend. Descriptive statistics and nonparametric tests were used to investigate factors influencing access. Motivation factors were determined using factor analysis and examined with linear regression techniques.

Results showed that workload significantly constrained PCE attendance. Additionally, engineers who do not work in base level CE organizations do not hear about the SOCE program as much as base level engineers. Factors influencing motivation to attend SOCE PCE courses included supervisory support for the program, perceived usefulness of the courses, engineers' attitudes towards TDY, preferred type of PCE course, and academic degree held by the engineer. Engineers whose latest degree is over eight years old or who have not participated periodically in formal continuing education were less motivated to attend SOCE PCE courses.

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