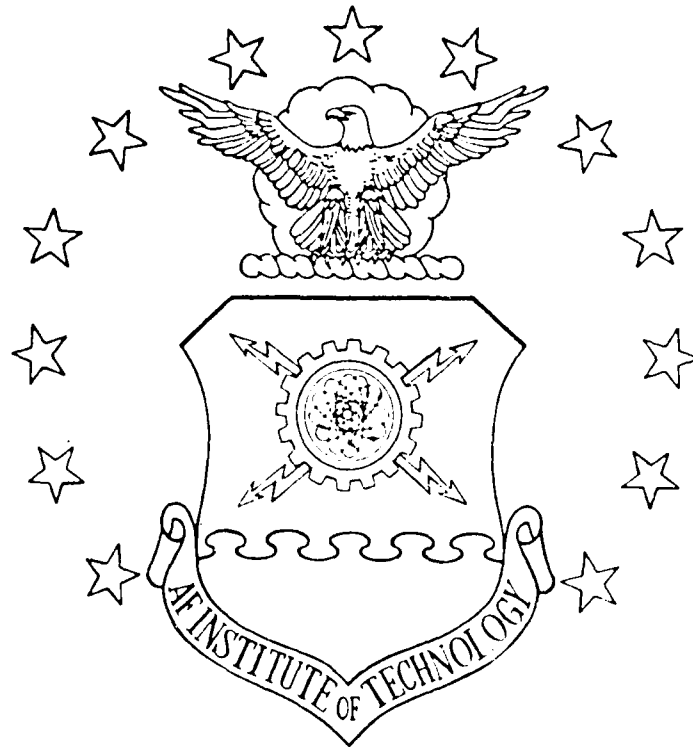


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AN INVESTIGATION OF EDUCATIONAL
 REQUIREMENTS IN FACILITIES ENGINEERING
 THESIS

DAVID M. KREAG
 Captain, USAF

AFIT/CDM/CDM/87-11

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AN INVESTIGATION OF EDUCATIONAL
REQUIREMENTS IN FACILITIES ENGINEERING

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

David M. Kreag, B.S.

Captain, USAF

September 1987

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David M. Kreaq

Table of Contents

	Page
Preface	ii
List of Tables	v
Abstract	vi
I. Introduction	1
Background	1
Specific Problem	3
Definition of Terms	3
Research Questions	4
Scope	5
II. Literature Review	6
Introduction	6
Background	6
Educational Programs	7
Program Assessment	7
Comparison of Subject Matter	8
Summary	11
III. Methodology	12
Introduction	12
Interviews	12
Academic Subject Generation	13
Survey	13
Survey Development	13
Population and Sample	16
Data Collection Plan	18
Research Question #1	18
Research Question #2	19
Research Question #3	19
Research Question #4	19
Analyses	21
IV. Results	22
Introduction	22
Demographic Results	22
Research Question #1	28
Research Question #2	28
Research Question #3	31
Research Question #4	33

	Page
V. Discussion and Conclusions	35
Introduction	35
Demographics	35
GEM Program	36
Previous Survey Results	36
Improvement to Program	36
Existing GEM Subjects	39
Potential GEM Inclusions	39
Summary	40
Appendix A: Information Request Letter	42
Appendix B: Organizations Contacted	43
Appendix C: Survey Package for Civilian Sample	44
Appendix D: Survey Package for Military Sample	56
Appendix E: AFIT Data Collection Form	68
Appendix F: GEM Course Titles	70
Appendix G: Responses to the Three Questions (By Military Rating)	71
Appendix H: Importance and Need Ratings of Academic Subjects (By Military Rating)	73
Appendix I: T-test	75
Appendix J: Programs and Data	77
Bibliography	99
Vita	101

List of Tables

Table	Page
I. Facility Management Programs	8
II. Required & Elective Courses	9
III. Academic Subjects	14
IV. Responses by Position	23
V. Responses by Rank	24
VI. Responses by Type of Company	24
VII. Responses by Experience	25
VIII. Responses by Education	26
IX. Responses by Civilian Undergraduate Education .	27
X. Responses by Budget	27
XI. Responses to the Three Questions by Category .	29
XII. Importance & Need Ratings of Academic Subjects (By Military Rating)	30
XIII. Need & Importance by Category	31
XIV. Academic Subjects Rated Significantly Higher by Civilians	33
XV. Academic Subjects Rated Important by Either Military or Civilian Respondents . .	37

Abstract

This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59%) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management,

budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN FACILITIES ENGINEERING

I. Introduction

This research will examine the perceptions of need and importance of academic subjects by both civilian and military facility managers. By comparing civilian facility managers' perceptions to the military's views, an insight may be gained for improvement in the facilities engineering program. The following sections discuss the background, specific problem, definition of terms, research questions, and scope of this research.

Background

The civil engineering officer is the Air Force's facility manager. Private sector facility managers do much the same thing for a company as civil engineering officers do for the Air Force. Both Air Force and private sector facility managers are responsible for maintenance of commercial and industrial type facilities, although the types of facilities may differ between the Air Force and the private sector due to location and mission.

The mission of the Air Force Civil Engineer is to "support . . . the Air Force mission and its people . . . [through the] operation, maintenance, and improvement of Air Force real and installed properties" (4:9). The civil

engineer manages the maintenance and repair of all base facilities and real property installed equipment, as well as the design and construction of new facilities.

A look at the mission of civilian facility managers reveals that indeed there are similarities. Examples of typical mission statements from three different private sector firms are as follow:

1) At Digital Equipment Corporation, the

plant engineer's major functions include maintenance of facilities and equipment, construction, and space planning. (8:28)

2) The Nissan motor plant near Smyrna, Tennessee, has its plant engineering department organized under three responsibility areas:

Plant energy systems, which includes plant utilities and plant systems

Central services, which includes maintenance planning and control, central maintenance, and environmental engineering

Engineering design and construction, which includes facilities engineering and construction projects. (20:58)

3) Plant Engineer Glen E. Flook, head of Frito-Lay's Casa Grande, Arizona, Engineering and Technical Services group said:

We operate the plant waste water treatment system, boilers, utilities, and fire protection systems; provide technical support; and keep all the maintenance records. (15:49)

All of the above private sector facility management job descriptions are similar in scope to what the civil engineering officer does on an Air Force base. Only three mission statements were listed to compare with the military mission statement; however, similar mission statements from private sector facility managers can be found in various periodicals on facility management.

Specific Problem

Since the private sector and the Air Force have similar mission statements covering facility management, they should rely on a common body of knowledge which might improve the Air Force's education program on facility management. Specifically, this research will focus on the academic subjects that private sector facility managers and civil engineering officers consider important for facility management. Individual educational programs will not be looked at. However, a compiled list of subject areas considered beneficial to the Air Force's educational program on facility management will be included.

Definition of Terms

1. Facility Manager--a person responsible for the management of the maintenance, repair, design, development, and construction of facilities and utility systems.

2. Plant Engineer--a person working in the private sector with the title of plant engineer conducting facility management type work.

3. Civil Engineering Officer--an Air Force officer with an Air Force Speciality Code of 55XX. Activities include "design and project preparation, drafting, surveying, planning, feasibility studies, construction surveillance, maintenance and repair, utilities operation, facility energy management, environmental control, land management, real estate and real property accounting, work measurement and analysis, and related installation support services" (5:A15-5).

4. GEM Program (Graduate Engineering Management)--the curriculum required to achieve a Master of Science degree in Engineering Management at the Air Force Institute of Technology (AFIT).

5. AIPE Foundation (American Institute of Plant Engineers)--the education and research arm of the American Institute of Plant Engineers.

Research Questions

1. What are some of the academic subjects in which facility managers have been educated?

2. Do facility managers perceive a need for these academic subjects?

3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers?

4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects?

Scope

The scope of this study follows these guidelines:

1) Academic subjects rather than the method of education will be focused upon. Academic subjects will include the knowledge, subjects, and abilities that facility managers see a need for in their jobs. The 59 academic subjects used are not an exhaustive list of all possible academic subjects that facility managers perceive as important.

2) A mailed survey was used, which limited the depth of knowledge gained from the study, and which also had a greater chance of misinterpretation than a personal or telephone interview.

3) The populations were limited to recipients of AIPE Facilities Management, Operations & Engineering magazine and past Air Force GEM students who graduated within the last five years. Samples from these populations were used to answer the research questions.

Ultimately, a list of subject areas considered important in the private sector was compiled so a comparison could be made with the Air Force's GEM program.

II. Literature Review

Introduction

This chapter will first give a general assessment of current education and training opportunities throughout all industries. Next, the Air Force's educational opportunities for civil engineering officers will be reviewed. Then a comparison will be made between the GEM, average American, average foreign, and International Facility Management Association (IFMA) curricula. Finally, a summary will explain how all of this information relates to the research.

Background

It is a costly venture to educate personnel. Generally, companies pay at least 70 percent of the educational expenses for courses that an employee voluntarily attends (10:36). Eighty-one percent of the respondents of Training magazine's 1986 Industry Report indicated that organizations sponsor education and training of personnel in hopes that they will lead to better job performance. Management subjects, technical subjects, supervisory subjects, communication subjects, and new methods or procedural courses were the top five subject areas taught throughout all the industries surveyed in the report (12:57).

Educational Programs

Air Force educational opportunities for facility managers include civilian institution graduate programs and a resident graduate degree program. The civilian institution graduate programs consist of engineering management and specific engineering areas such as architectural, civil, electrical, industrial, and mechanical (3:290). The resident graduate degree program for Air Force civil engineering officers is the GEM program at AFIT, which helps prepare the civil engineering officer for mid-level management positions in maintenance and repair of base facilities. Approximately 20-25 Air Force Officers per year attend the GEM program. This represents less than 2 percent of the lieutenants, captains, and junior majors in the civil engineering career field (19). Besides the GEM program, a range of professional civil engineering short courses is offered through the School of Civil Engineering and Services.

The GEM program at AFIT is not the only graduate level engineering management program. As of October 1984, 66 master of science level engineering management programs were offered at various colleges and universities in the United States (17:A-4).

Program Assessment. AFIT conducts two surveys annually to assess course effectiveness. One survey is the School of Systems & Logistics Annual Evaluation Report and the other

is the Graduate Post Course Survey. Fiscal year 1985 GEM students were surveyed upon course completion and asked which subjects they felt were important. The five subjects found to be the least important were operations research, statistical concepts, scientific research, accounting concepts, and evaluating distribution systems (1:69-70).

Comparison of Subject Matter. A comparison between the GEM, IFMA, and the average American and foreign engineering management curricula was made based on a 1984 paper on facility management disciplines presented at the International Congress on Technology and Technology Exchange. The average American and foreign engineering management curricula were divided into six categories (quantitative, qualitative, financial, project, engineering, and functional) as shown at Table I.

TABLE I

FACILITY MANAGEMENT PROGRAMS

<u>Category</u>	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Quantitative	30%	28%	17%	16%
Qualitative	19%	17%	29%	16%
Financial	15%	19%	12%	5%
Project	9%	5%	3%	14%
Engineering	4%	1%	0%	0%
Functional	23%	30%	39%	21%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program shows 16 percent quantitative, 16 percent qualitative, 5 percent financial, 14 percent project, no engineering, and 21 percent functional.

Functional courses are those that pertain to the day-to-day operations of the job and do not fall within the other categories. The GEM program has a large project percentage because of the requirement for a thesis (14 percent). It also shows less emphasis in the financial percentage (5 percent) compared to the other programs. All three programs list the quantitative and functional areas with the highest percentages, which seems to support the idea that these two categories are the most important.

The percentages of required and elective courses of the curricula were also compared, as shown at Table II.

TABLE II
REQUIRED & ELECTIVE COURSES

	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Required	55%	82%	80%	82%
Electives	45%	18%	20%	18%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program follows an 80 percent required 20 percent elective course program, like the foreign program. (See Appendix F.) The average American program offers a lower percentage of required courses (55 percent) and a higher percentage of electives (45 percent). This could be the result of the specific area coverage in the foreign and GEM courses. The GEM course is specifically designed for a civil engineering officer or civilian counterpart operating in the Air Force environment. The average engineering

management course in American programs probably offers more electives than the other programs due to more of a broad coverage that allows individuals to specialize in the areas that they are interested in rather than having to complete a required set of courses.

Facility management can be divided into its component parts. "Research has shown that 80-95 percent of facilities managers perform common tasks" (14:A-III). These nine common tasks are as follow:

- 1) Real Estate Acquisition and/or Disposal
- 2) Annual Facility Planning
- 3) Facility Financial Forecasting and Budgeting
- 4) Long Range Facility Planning
- 5) Interior Space Planning, Work-Place Specifications,
Installation and Space Management
- 6) Architectural and Engineering Planning & Design
- 7) New Construction and/or Renovation Work
- 8) Maintenance and Operations Management of the
Physical Plant
- 9) Tele-communications, Integration, Security, and
General Administrative Services

(14:A-III)

Since these tasks are common to all facility managers, it would be expected that education in related subjects should be of major importance toward effective job performance.

Summary

Education is a costly endeavor, but is conducted for better job performance. The Air Force, like most employers, pays educational costs to better prepare its employees. The civil engineering officer has many paths of education. There are the civilian institution program, resident GEM program, and AFIT's short courses. The GEM program is specifically designed for the civil engineering officer operating in the Air Force environment. There are many engineering management courses offered, some structured similarly to the GEM program. A comparison of other engineering management programs with the GEM program was conducted to search for improvements that may be incorporated. Specifically, academic subjects included in these engineering management programs were identified, to be incorporated into the survey which is described in the next section.

III. Methodology

Introduction

This chapter describes the methodology used in the research. This research focuses on how private sector facility managers and civil engineering officers perceive various academic subjects in relation to their job performance. Ultimately, a list of academic subjects considered important by these groups will be compared.

Interviews

Mr. Tom Klug, the Marketing Manager for AIPE Facility Management, Operations & Engineering, sees the future trend on education of facility managers to be from general to more specific subjects (functional). According to Klug, employers have been burdened with educating new employees on specific job tasks. He predicts a shift to a more useful education with the merging of theory and reality in colleges and universities through the co-op programs. He also predicts that more qualitative management courses will be emphasized (16).

The Assistant GEM Program Manager compared the GEM program to a few other Engineering Management programs being taught at civilian institutions, and thought they were very similar. The only area where he saw a lack was in human behavior and people subjects (qualitative) (9).

Academic Subject Generation

Letters were sent to various people and organizations involved with facility managers and plant engineers in the private sector. A copy of the letter and a listing of the organizations that responded to the letter are included at Appendices A and B. From their correspondence and from the literature, a list of academic subjects was compiled, as shown at Table III on the following page.

Survey

The survey instrument was developed to collect data on what academic subjects were deemed important by facility managers. No existing data base was available for study. The survey method was chosen because it was the most economical method available for collecting the required data. Two separate surveys were conducted to gather information on the academic subjects which private sector facility managers and past AFIT Graduate Engineering Management students believe are important in their jobs. A random sampling method was used to obtain a representative sample of the private sector facility managers. A census of past GEM students (Air Force military members still in service who graduated within the last five years) was undertaken.

Survey Development. The development of the survey questions was based on previous work by Lyman W. Porter and Edward E. Lawler (18). Their methodology requires three

TABLE III

Academic Subjects

Quantitative

- | | |
|------------------------|-------------------------|
| 1) Linear Programming | 2) Network Modeling |
| 3) Simulation Modeling | 4) Decision Theory |
| 5) Forecasting | 6) Queuing Theory |
| 7) Inventory Planning | 8) Statistical Analysis |

Qualitative

- | | |
|------------------------|---------------------------|
| 9) General Management | 10) Organizational Theory |
| 11) Behavioral Science | 12) Strategic Planning |
| 13) Leadership | 14) Personnel Management |
| 15) Master Planning | |

Financial

- | | |
|---------------------------|--------------------------|
| 16) Managerial Accounting | 17) Cost Accounting |
| 18) Engineering Economy | 19) Financial Management |
| 20) Budget Preparation | 21) Building Programming |
| 22) Life Cycle Costing | |

Project

- | | |
|------------------------|--------------------|
| 23) Project Management | 24) Group Projects |
|------------------------|--------------------|

Engineering/Architecture

- | | |
|-----------------------------|------------------------------|
| 25) Civil Engineering | 26) Mechanical Engineering |
| 27) Electrical Engineering | 28) Industrial Engineering |
| 29) Architectural Design | 30) Interior Design |
| 31) Computer Systems Design | 32) Safety Engineering |
| 33) Value Engineering | 34) Energy Efficient Designs |

Functional

- | | |
|------------------------------|-----------------------------|
| 35) Computer Science | 36) Information Systems |
| 37) Computer Aided Design | 38) Computer Room Design |
| 39) Communication | 40) Public Speaking |
| 41) Technical Writing | 42) Business Law |
| 43) Marketing | 44) Quality Control |
| 45) R & D Management | 46) Innovation Techniques |
| 47) Entrepreneur | 48) Professional Ethics |
| 49) Labor Relations | 50) Collective Bargaining |
| 51) Public Policy | 52) Contract Policy |
| 53) Building Fire Protection | 54) Real Estate Acq & Disp |
| 55) Installation & Space Mgt | 56) Construction Management |
| 57) Maintenance Management | 58) Facility Operations |
| 59) Energy Management | |

(2:A1-25+, 3:181-182, 14:A-III)

questions per academic subject. The first two questions are used to assess need, while the third assesses importance.

The survey questionnaire consists of subject areas which were assessed based on need, or the amount of difference between how much there is now and how much there should be. In addition, the importance of the subject was also measured. For each area, three questions were asked:

- a) How much are you able to apply now?
- b) How much should be applicable to your position?
- c) How important is this to you?

Need is calculated by subtracting the score of how much there should be from how much there is now ($b - a$). A positive number indicates that a need is seen, while a negative number indicates that too much emphasis is placed on the subject; a zero indicates that there is a good balance in this area.

A 7-point Likert scale was used on each question, with a 1 as the minimum amount and a 7 as the maximum amount. The breakdown of the scale is as follows:

Minimum	Little	Less Than Average	Average	More Than Average	Great Deal	Maximum
1	2	3	4	5	6	7

A pretest was conducted in order to determine validity of the survey. Validity is the concept that the survey instrument is being interpreted by the respondents in the desired way and measures what is intended to be measured.

Eight AFIT faculty members from the School of Civil Engineering and Services responded to the questionnaire, examined it, and made comments for improvement. These people were selected due to their experience in civil engineering and with surveys. The "expert" review added to the credibility of the survey instrument to ask what was intended to be asked. Comments from the pretest were used to develop the final survey.

Population and Sample

The first population consists of the current recipients of the AIPE's periodical Facilities Management, Operations & Engineering. This group was chosen to represent the civilian facility managers due to their relative ease of inclusion. A larger group would have been desirable, but would have been too costly and time-consuming. The Business Publications Audit of Circulation, Inc., found that the number of recipients during the May/June issue was 8,173, 53.3 percent in manufacturing and 46.7 percent in non-manufacturing industries. Using this population, the sample size was determined from the following general formula:

$$n = \frac{N(z^2)(p(1-p))}{1(N-1)(d^2) + (z^2)(p(1-p))}$$

where n= sample size
N= population size
p= maximum sample size factor (.50)
d= desired tolerance (10%)
z= factor of assurance (1.282) for 90% confidence level.

(13:11-14)

The maximum sample size factor is determined to be 0.50 because the true proportion to be estimated is not known. "To get around this difficulty, we shall make use of the fact . . . that $p(1-p) = 1/4 - (p-1/2)^2$ and, hence, that the maximum value of $p(1-p)$ is $1/4$." (11:239) Hence, a conservative estimate of 0.50 is used when the true value of p is unknown.

The desired tolerance is determined prior to collection of data. The determination is based on how much error is acceptable. The error is the percentage of deviation either positive or negative from the actual population statistics. The factor of assurance is obtained by subtracting one minus (d) and looking in the normal distribution tables to get (z).

The sample size determined by the formula was 40.9. Two hundred surveys were sent to insure that the actual number returned would be 41 or greater. A 90 percent confidence level means that the statistics generated from the answers received are representative of the population, within a tolerance of plus or minus 10 percent (13:11).

The second population consisted of the military members still in service who graduated from the Air Force Institute of Technology GEM program within the last five years. Using this population of 115 military members, a census was conducted due to the small size of the population. Even though a census theoretically yields a 100 percent

confidence level, the previous general formula was used as a guide to determine adequacy of response to the census. Changing the population size to 115, a sample size of at least 31 would be enough for a 90 percent confidence level. This assumes that the 31 respondents are randomly selected, when in reality they are self-selected. Therefore, if 31 surveys are returned, at least a 90 percent confidence level would be achieved.

Data Collection Plan

The mailed survey packages consisted of a cover letter, 10-page survey, AFIT data collection form (AFIT Form 11 E, Jan 85), and a pre-addressed, postage-paid, return envelope (See Appendices C, D, and E). The military officers were given four weeks to respond, while the civilians had seven weeks to respond. The civilians were given longer to respond because of previous low responses to surveys.

The AFIT data collection forms were gathered up to 20 June 1987 including forms that contained incomplete data. Additional comments made by the respondents were collected and used in the analyses wherever feasible.

Research Question #1. What are some of the academic subjects in which facility managers have been educated? From the literature review, the average Engineering Management curriculum contains courses in six broad categories (quantitative, qualitative, financial, project, engineering, and functional). Subjects were then compiled

to be included in these six categories that were thought to be potentially important academic subjects of facility managers. With the assistance of the GEM Program Manager, 59 academic subjects were incorporated in the survey and were classified into the six broad categories mentioned above.

Research Question #2. Do facility managers perceive a need for these academic subjects? Means were calculated for each question (a, b, and c) and listed by academic subject and category. Then, need (b - a) was calculated for each academic subject and category.

Research Question #3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers? This research question was answered by rank ordering the academic subjects according to the importance of the two samples and comparing their results. The following rating scale was used in the interpretation of the importance:

Very Little Or None	Little	Below Average	Average	Important	Very Important
1+	2+	3+	4+	5+	6+

Research Question #4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects? This research question was answered by conducting a t-test and a rank order correlation on the importance of the military and civilian respondents.

The t-test was used to check for a significant difference between means. A two sample t-test with the more conservative separate variance estimate was used. A separate variance estimate means that both population variances are not considered to be equal, and are therefore estimated by their respective sample variances. If, however, they were considered to be equal, then a single pooled variance estimator would result from the two sample variances. The separate variance estimate is a more conservative approach because the assumption that the two population variances are equal was not made (6:288).

In order to conduct this type of a "test of means," one assumption is necessary. Both populations require normality. A P-value was used to check against the chosen 95 percent level of statistical significance. A P-value smaller than 0.05 would lead to the rejection of the null hypothesis that the two means are equal, where a P-value larger than 0.05 would lead to the acceptance that the two means are equal (6:247,292).

The rank order correlation was conducted to find if a linear relationship exists between the two sets of ranks generated from the military and civilian respondents on the importance of the 59 academic subjects. The correlation gives an overall measure of how similarly the civilian and military respondents rated the academic subjects. Values from a rank order correlation can range between +1 to -1.

"Positive values indicate that 'high ranks tend to be associated with high ranks'; negative values indicate that 'high ranks on one variable tend to be associated with low ranks on the other'" (7:341). A rank order correlation of one would imply a perfect linear relationship between sample ranks of all 59 academic subjects, while a rank order correlation of zero would imply no correlation.

Analyses

The statistical measures applied to the data were the means, standard deviations, and frequency histograms. Copies of the programs used to answer the research questions are listed in Appendix J. The programs consist of a program for the military respondents and the data, a program for the civilian respondents and the data, a t-test program, and a rank order correlation program. The rank order correlation program was written in SAS. All other programs were written in SPSSX.

IV. Results

Introduction

This chapter includes the description of the demographic characteristics of the respondents and an illustration of the results of the analysis on the survey data.

Demographic Results

Two populations were surveyed, with a total of 315 surveys. Two hundred surveys were sent to the recipients of AIPE Facilities Management, Operations & Engineering, and 115 surveys were sent to Air Force GEM students who graduated within the last five years. Of the 200 surveys sent to the randomly sampled civilian facility managers, 65 (32.5 percent) were returned by the cutoff date. Of the 115 surveys sent to the civil engineering officers, 67 (58.3 percent) were returned by a given cutoff date. The military officers were given four weeks to respond, while the civilians had seven weeks to respond. Sample sizes of at least 41 civilians and 31 military were required to achieve the desired 90 percent confidence level that the samples were true representations of the populations. Since 65 civilians and 67 military responded, at least a 90 percent confidence level was achieved.

Table IV shows that over half the respondents are in middle management positions; 52.2 percent are military and

58.5 percent are civilians. More of the military (16.4 percent) than of the civilian (13.8 percent) respondents were in upper management positions. More of the civilian (16.9 percent) than of the military (7.5 percent) respondents were in supervisory positions. Engineering positions were represented equally by the military (10.4 percent) and the civilian (9.2 percent) respondents. More military (13.4 percent) did not respond to this question than the civilian (1.5 percent) respondents. Some military respondents did not feel that they fit in any of the categories provided in the survey so they wrote the following positions on the survey form: Staff Officer, Military Construction Program Manager, Site Civil Engineer, Faculty Instructor, Air Staff Officer, and Instructor.

TABLE IV
RESPONSES BY POSITION

<u>Position</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
Upper Management	11	9	16.4	13.8
Middle Management	35	38	52.2	58.5
Supervisor	5	11	7.5	16.9
Engineer	7	6	10.4	9.2
Unspecified	9	1	13.4	1.5
TOTAL	67	65	100.0	100.0

Table V shows that the predominant rank of the military responding to the survey is captain (80.6 percent). Also, majors represented 16.4 percent of the respondents, and three percent of the respondents left this area blank. The

ranks indicate middle management positions, which correspond to the majority (52.2 percent) of the military claiming middle management positions from the previous table.

TABLE V
RESPONSES BY RANK

<u>Rank</u>	<u>Frequency</u>	<u>Percent</u>
Lt. Colonel	0	0.0
Major	11	16.4
Captain	54	80.6
Lieutenant	0	0.0
Unspecified	<u>2</u>	<u>3.0</u>
TOTAL	67	100.0

Table VI shows that the majority of the civilians responding are employed by a manufacturing industry (66.2 percent). The non-manufacturing industry is represented by 30.8 percent of the respondents; 3.1 percent of the respondents left this area blank.

TABLE VI
RESPONSES BY TYPE OF COMPANY

<u>Type Company</u>	<u>Frequency</u>	<u>Percent</u>
Manufacturing	43	66.2
Non-Manufacturing	20	30.8
Unspecified	<u>2</u>	<u>3.1</u>
TOTAL	65	100.0

Table VII shows the majority of the military respondents falling equally into the 0-6 year and the 7-10 year experience range (41.8 percent), while the civilians

are distributed throughout all categories with the highest frequency in the 7-10 year and 16-20 year experience range (18.5 percent). This indicates that the civilians have more experience than the military respondents.

TABLE VII
RESPONSES BY EXPERIENCE

<u>Experience</u>	<u>Frequency</u>		<u>Percent</u>		<u>Cum %</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
0- 6 Years	28	9	41.8	13.8	41.8	13.8
7-10 Years	28	12	41.8	18.5	83.6	32.3
11-15 Years	8	9	11.9	13.8	95.5	46.2
16-20 Years	1	12	1.5	18.5	97.0	64.7
21-25 Years	0	10	0	15.4	97.0	80.1
26-30 Years	0	6	0	9.2	97.0	89.3
Over 30	0	6	0	9.2	97.0	98.5
Unspecified	<u>2</u>	<u>1</u>	<u>3.0</u>	<u>1.5</u>	100.0	100.0
TOTAL	67	65	100.0	100.0		

Table VIII shows that the majority of the civilian respondents to the survey had a Bachelor's degree (53.8 percent) and about a third had less than a Bachelor's degree (32.3 percent). It is not surprising that all the military had a Master's degree, since they were past graduates of the GEM program.

TABLE VIII
RESPONSES BY EDUCATION

<u>Education</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
High School	0	7	0.0	10.8
Associate	0	14	0.0	21.5
Bachelor	0	35	0.0	53.8
Master	65	8	97.0	12.3
Doctorate	0	0	0.0	0.0
Unspecified	<u>2</u>	<u>1</u>	<u>3.0</u>	<u>1.5</u>
TOTAL	67	65	100.0	100.0

Table IX shows that most of the civilian respondents have undergraduate education in engineering (70.8 percent), rather than in management or other disciplines (12.4 percent). This confirms a recent study (A Profile of Plant Engineers & Facility Managers) published in 1987 by AIPE. Approximately 56 percent of the plant engineers possess a Bachelor's degree or greater, and of those who possess a Bachelor's degree, 70.5 percent have an engineering degree. This finding also supports the premise that private sector facility managers, who are responsible for the maintenance and repair of facilities, have backgrounds similar to the civil engineering officers. It was assumed that these private sector firms would draw upon personnel with a background similar to the civil engineering officer (Bachelor's degree in engineering), which is indeed the case shown here. Respondents (13.8 percent) who did not have an undergraduate education marked the not applicable response. Two respondents left this area blank.

TABLE IX

RESPONSES BY CIVILIAN UNDERGRADUATE EDUCATION

<u>Undergraduate Education</u>	<u>Frequency</u>	<u>Percent</u>
Engineering	46	70.8
Management	4	6.2
Other	4	6.2
Not Applicable	9	13.8
Unspecified	<u>2</u>	<u>3.1</u>
TOTAL	65	100.0

Table X shows that the majority of military and civilian responses are responsible for an annual operating budget of over \$1,000,000 (58.2 percent military, 60 percent civilian). The biggest disparity between the military and civilian samples is in the smallest budget range, from \$0-100,000. A quarter of the military sampled fell within this range, while only 6.2 percent for the civilians. A possible reason may be that base level jobs have responsibility over people instead of money.

TABLE X

RESPONSES BY BUDGET

<u>Budgets</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
\$ 0-100K	17	4	25.4	6.2
\$100-500K	3	10	4.5	15.4
\$500K-1M	4	9	6.0	13.8
Over \$1M	39	39	58.2	60.0
Unspecified	<u>4</u>	<u>3</u>	<u>6.0</u>	<u>4.6</u>
TOTAL	67	65	100.0	100.0

Research Question #1

The 59 academic subjects that facility managers may perceive as important are divided into six broad categories as shown previously at Table III.

Research Question #2

Appendix G lists the mean responses to the three questions of (a) how much is applicable now, (b) how much should be applicable, and (c) the importance of the associated academic subject, as rated by the civilian and military respondents. By quick observation, it looks as if the mean ratings are close between the military and civilian responses for each question. This observation was suspect in some instances. Comments on three surveys said that there was not much differentiation between questions (a), (b), and (c), so these respondents generalized all three questions into one rating. A further investigation of the needs brings out this similarity in how the respondents answered the questions. The needs, which are discussed later in this section, showed only slight increases (less than one) in most academic subjects. This indicates that there were similar ratings of the (a) and (b) questions.

Table XI shows a pattern between the means of (a), (b), and (c). In each category the mean increases from (a) to (c). This suggests that there is an overall need for more application of academic subjects within all categories. The highest mean ratings of (a), (b), and (c) were on project

and qualitative categories, whereas the quantitative category received the lowest mean rating across the board. Financial, engineer/architect, and functional categories received average mean ratings. This result was not totally expected: the interviews suggested that the functional and qualitative categories would be rated higher than the other categories. While the qualitative category was rated important, the functional category was rated at only average importance.

TABLE XI
RESPONSES TO THE THREE QUESTIONS BY CATEGORY

<u>Categories</u>	<u>(a)</u>		<u>(b)</u>		<u>(c)</u>	
	<u>How Much Do</u>		<u>How Much</u>		<u>Importance</u>	
	<u>You Apply</u>		<u>Should You</u>			
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
Quantitative	2.691	2.218	3.265	2.697	3.402	3.109
Qualitative	4.152	4.429	4.723	4.940	4.968	5.310
Financial	4.051	3.217	4.639	3.713	4.906	4.167
Project	4.585	4.560	5.177	4.776	5.362	5.091
Engineer/Arch	4.012	3.069	4.563	3.538	4.809	4.114
Functional	3.844	3.507	4.394	3.887	4.664	4.361

Table XII lists the needs for academic subjects which were rated important by the military respondents. See Appendix H for a complete listing of academic subjects. A positive need indicates there is not enough of the skill now being applied. The need is calculated by subtracting (b) from (a). When (b) is greater than (a), there is a positive need. All but one need was positive, meaning there are not enough of these academic subjects now being applied. The

needs are not very distinctive; all out three [energy management (2.345), information systems (1.086), and interior design (1.079)] are less than one.

The civilian respondents had one negative need (building fire protection) and three needs greater than one (mentioned previously). The military respondents did not have any negative needs or needs greater than one, showing a good balance between what academic subjects were applicable in their job and what should be applied. Of the academic skills which the military rated important, the highest needs are in information systems, management principles, organizational theory, and communication.

Table XII

IMPORTANCE & NEED RATINGS OF ACADEMIC SUBJECTS
(BY MILITARY RATING)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.53
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08

Table XIII lists civilian and military needs by categories. The needs were higher in the qualitative and

financial categories for both military and civilian respondents. Even though the needs were shown to be greatest in these categories, the importance differs a little by showing the greatest ratings in the project and qualitative categories. The biggest disparity between the needs of the civilian and military was on the project category (0.391). The civilian respondents saw more need in the project area than did the military respondents, maybe because more problems exist in this area for the civilians than the military. Even though the project category is not rated highly by the military respondents, it does not imply it is not an important area. Rather, it only implies that the current amount of application is commensurate with how much should be applied.

TABLE XIII

NEED & IMPORTANCE BY CATEGORY

<u>Categories</u>	<u>Need</u>		<u>Importance</u>	
	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>
Quantitative	.574	.410	3.402	3.109
Qualitative	.601	.529	4.968	5.310
Financial	.622	.526	4.906	4.167
Project	.585	.194	5.362	5.091
Engineer/Arch	.549	.480	4.809	4.114
Functional	.568	.398	4.664	4.361

Research Question #3

Table XII lists the academic subjects that the military rated important. A complete listing of all academic subjects and their ratings is at appendix H. The academic

subjects which are seen as very important (a mean of 6+) are professional ethics, public speaking, and leadership. There were ten academic subjects (17 percent) rated as important (a mean of 5+), 17 academic subjects (29 percent) rated as average importance (a mean of 4+), 23 academic subjects (41 percent) rated as below average importance (a mean of 3+), five academic subjects (seven percent) rated as little importance (a mean of 2+), and one academic subject (two percent) rated as very little or of no importance (a mean of 1+).

The most important single academic subject was professional ethics: it was rated the most important academic subject by both the military (6.33) and civilian (6.109) respondents. There was also a consensus on the three least important academic subjects. They were queuing theory (Mil 2.84, Civ 2.839), linear programming (Mil 2.14, Civ 2.345), and simulation modeling (Mil 1.65, Civ 1.925). This result was reconfirmed by the AFIT GEM survey assessment. In it, operations research, statistical concepts, scientific research, and accounting concepts were rated low. Operations research includes queuing theory and linear programming, which were rated of little importance. However, statistical analysis was rated as important and cost accounting was rated of average importance; these results were not expected. The civilian respondents ranked more academic subjects between the important (36 percent)

and average (34 percent) range, while the military respondents ranked more academic subjects between the average (29 percent) and below average (41 percent) range.

Research Question #4

Appendix I lists the T-values and P-values from the t-test analyses which were used to check for differences in the importance means of academic subjects between the two samples.

The civilian respondents rated 20 academic subjects (34 percent) significantly higher than did the military; as shown in Table XIV.

TABLE XIV

ACADEMIC SUBJECTS RATED SIGNIFICANTLY HIGHER BY CIVILIANS

Energy Management	Safety Engineering
Mechanical Engineering	Installation and Space Management
Energy Efficient Designs	Building Fire Protection
Value Engineering	Electrical Engineering
Facility Operations	Maintenance Management
Inventory Planning	Managerial Accounting
Cost Accounting	Industrial Engineering
Budget Preparation	Contract Policy
Engineering Economy	Forecasting
Computer Room Design	Construction Management

Therefore, these academic subjects are considered more important to the civilian respondents than to the military respondents.

The military respondents rated four academic subjects (seven percent) significantly higher than did the civilians. These were information systems, leadership, public speaking,

and civil engineering. A reason information systems may be of more concern to the military is because of the work Information Management System (WIMS) initiative. WIMS minicomputer systems are being installed at Air Force Civil Engineering Squadrons throughout the world. Leadership is so ingrained with being a military officer and officership, it is of little wonder that this academic subject is rated higher by the military than by their civilian counterparts. Also, in the military there are more opportunities to speak publicly than there may be in the civilian environment. Finally, a reason civil engineering may be rated higher by the military than the civilian is the military title of civil engineering officer.

There were 35 academic subjects (59 percent) without a significant difference in means between the military and civilian respondents. This indicated that the civilian and military respondents rated these academic subjects of approximately equal importance.

A rank order correlation was used as an overall assessment of how closely the military and civilian respondents ranked the academic subjects. A correlation of 0.72 was obtained, which showed that there was a high correlation between how the military and civilian respondents ranked academic subjects by importance.

V. Discussion and Conclusions

Introduction

The purpose of this research was to investigate educational requirements of both military and civilian facility managers. The compiled list of academic subjects considered important by facility managers may help guide the GEM program to better fit the demand of facility managers. This chapter summarizes the results and makes recommendations based on the findings of this research.

Demographics

Two populations were surveyed, civilians represented by recipients of the AIPE Facilities Management, Operations & Engineering magazine, and military officers, represented by past Air Force GEM students who graduated within the last five years. There were 67 officers and 65 civilians who responded to the survey. A census was conducted on the military, while a random sampling plan was applied to the civilian population. The civilian sample achieved the desired 90 percent confidence level, meaning that the sample statistics were representative of the original population.

Some of the demographics included the fact that over half of the respondents indicated that they had a background in engineering, were in the middle management position, and were responsible for budgets exceeding \$1,000,000. The predominant rank of the military responding to the survey

was captain. The majority of the civilians responding are employed by a manufacturing industry. The civilian respondents have more years of experience than do the military respondents, but have less formal education.

GEM Program

The present GEM program is 15 months in duration. Five quarters of classes and a short term are taught during that time. Appendix F lists the course titles taught and the credits associated with the class.

Previous Survey Results. Fiscal year 1985 GEM students rated operations research along with a couple of other quantitative courses low. The results of this survey reinforce the fiscal year 1985 GEM student rating by identifying two components of operations research as considered not very important to facility management (queuing theory and linear programming).

Improvement to Program. This survey lists some possible inclusions into the GEM program which may improve the overall program. Professional ethics was seen by both samples to be the most important academic subject in the survey. Also, 25 other academic subjects were rated important by the civilian or military respondents, and may have a potential for inclusion into existing GEM courses. Table XV lists the ratings and difference in means of the 26 academic subjects mentioned.

TABLE XV

ACADEMIC SUBJECTS RATED IMPORTANT
BY EITHER MILITARY OR CIVILIAN RESPONDENTS

<u>Academic Subjects</u>	<u>Rating</u>	
	<u>Civ</u>	<u>Mil</u>
Professional Ethics	6+	6+
*Facility Operations	6+	4+
*Leadership	5+	6+
*Construction Management	5+	5+
Management Principles	5+	5+
Technical Writing	5+	5+
Communication	5+	5+
Statistical Analysis	5+	5+
Strategic Planning	5+	5+
*Public Speaking	5+	5+
*Maintenance Management	5+	4+
*Contract Policy	5+	4+
*Bldg Fire Protection	5+	4+
Life Cycle Costing	5+	4+
*Budget Preparation	5+	4+
Building Programming	5+	4+
Organizational Theory	4+	5+
Behavioral Science	4+	5+
*Civil Engineering	4+	5+
*Information Systems	4+	5+
*Energy Management	5+	3+
*Mechanical Engineering	5+	3+
*Safety Engineering	5+	3+
*Energy Efficient Design	5+	3+
*Install & Space Mgt	5+	3+
*Electrical Engineering	5+	3+
*Value Engineering	5+	3+

* Academic subjects that were rated significantly different, as obtained from t-test results.

Very Little Or None	Little	Below Average	Average	Important	Very Important
1+	2+	3+	4+	5+	6+

Only one academic subject was rated very important by the military and civilian respondents (professional ethics). Eight academic subjects were rated important by the military and civilian respondents (construction management, management principles, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking). The military rated leadership and public speaking significantly higher than did the civilian respondents. The civilian respondents rated facility operations higher than did the military respondents. Six academic subjects were rated important by the civilian respondents and rated average importance by the military (maintenance management, contract policy, building fire protection, life cycle costing, budget preparation, and building programming). Of the six academic subjects, two had no significant difference between means (building programming and life cycle costing). The rest (maintenance management, contract policy, building fire protection, and budget preparation) had a significant difference between the means, with the civilian respondents rating these academic subjects higher than did the military respondents. Four academic subjects were rated important by the military respondents and average importance by the civilian respondents (organizational theory, behavioral science, civil engineering, and information systems). Of these four academic subjects, two (organizational theory and behavioral

science) had no significant differences between the means of the military and civilian respondents. The other two (civil engineering and information systems) were rated higher by the military respondents than the civilian respondents. Seven academic subjects were rated important by the civilian respondents and rated below average in importance by the military respondents (energy management, mechanical engineering, safety engineering, energy efficient design, installation and space management, electrical engineering, and value engineering). All seven academic subjects were rated significantly higher by the civilian respondents than the military respondents.

Existing GEM Subjects. The academic subjects rated important by either the military or civilian respondents which the GEM program includes are:

Life Cycle Costing	Organizational Theory
Leadership	Management Principles
Contract Policy	Information Systems
Technical Writing	Energy Management
Communication	Strategic Planning
Statistical Analysis	Installation & Space Mgt
Public Speaking	Energy Efficient Designs

Potential GEM Inclusions. The academic subjects which are not included in the GEM program, but were rated important by either the civilian or military respondents:

Professional Ethics	Facility Operations
Construction Management	Building Fire Protection
Maintenance Management	Building Programming
Budget Preparation	Safety Engineering
Civil Engineering	Value Engineering
Mechanical Engineering	Electrical Engineering

Inclusion of these academic subjects may be achieved by allowing more electives into the GEM course.

Summary

In summary, a list of academic subjects was analyzed as to their importance in facilities management. The academic subjects were rated by military and private sector civilian facility managers. Ratings were given as to (a) how much is applicable now, (b) how much should be applicable, and (c) the importance. The need was determined by subtracting a from b ($b - a$). Differences in rating between the two populations were determined by t-tests and a rank order correlation.

The overall objective was to methodically and logically report and analyze academic subjects that may improve the GEM program. Professional ethics was seen by both populations to merit the most importance. Some of the popularity of this academic subject may stem from the recent publicity of Lt. Col. North and the Contra Arms Sales. Realizing the compressed 15-month scheduling of classes of the GEM program, it would be almost impossible to add courses into the already jammed course load. However, a shift of emphasis on some of the most important academic subjects included in Table XV may improve the scope of study.

Further research into this area is required. Only 59 academic subjects were addressed; many more may be of

potential interest. Also, only past GEM graduates were surveyed; more information may be gathered from civil engineering officers at base level. An area that was not addressed was how other government agencies educate their facility managers. It would have been interesting to include other services such as the Army and Navy engineers or facility engineers in charge of cities, colleges, or hospitals to see what their responses would have been.

Appendix A: Information Request Letter

20 January 1987

Gentlemen:

I am Captain David M. Kreag, an Air Force Institute of Technology student in Engineering Management at Wright Patterson AFB, Ohio. I am doing a thesis on how the private sector educates their facility managers (i.e., someone who is involved in overseeing the maintenance, repair, design, development, and construction of facilities) in comparison to how the Air Force conducts its program. The goal of my thesis is to improve the content of the Graduate Engineering Management program. What I want to focus on is subject matter: knowledge, subjects, and abilities that the facility engineer needs to do his/her job. I am also interested in certification qualifications or courses being taught either through colleges, universities, or by seminar. You can help me by providing a personal and/or a company list of subjects, course descriptions deemed important for facility managers, or anything else you think might be helpful. If you have any suggestions on publications to look at or people to contact to gain knowledge in this area, please let me know. I will appreciate any cooperation or suggestions you can give.

If you have anything you would like to share, please send it to the following address:

David M. Kreag
2361 Duncan Drive, Apt. #6
Fairborn, Ohio 45324

My phone number is (513) 429-4583; however with classes the best time to reach me is after 4 p.m. Thank you for your time.

Sincerely,

David M. Kreag

Appendix B: Organizations Contacted

Engineering Professional Development
University of Wisconsin
Madison, Wisconsin

TRW Operations & Support Group
Redondo Beach, California

California Polytechnic State University
San Luis Obispo, California

The Association of
Physical Plant Administrators of
Universities and Colleges
Alexandria, Virginia

XIT Grounding Systems
Torrance, California

Facilities Engineering
US Army Engineer School
Fort Belvoir, Virginia

American Society for Engineering Management
Lowell, Massachusetts

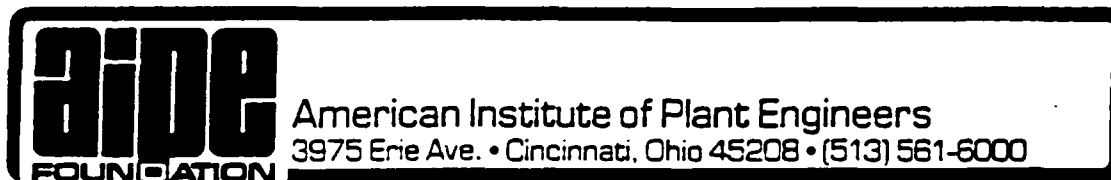
National Society of Professional Engineers
Alexandria, Virginia

University of Missouri
Department of Engineering Management
Rolla, Missouri

Bell Communications Research
Lisle, Illinois

American Institute of Plant Engineers
Cincinnati, Ohio

Appendix C: Survey Package for Civilian Sample



27 April 1987

You have been selected at random to participate in a study on educational requirements for facility and plant engineers. It will take about 20-30 minutes of your time. Response is voluntary and private, but we would greatly appreciate your input.

The hypothesis is that there is a common core of educational skills that facility and plant engineers see as important. The American Institute of Plant Engineers in conjunction with the Air Force Institute of Technology is conducting this research to influence college programs to better fit the needs of industry.

Your response will be held in strict confidentiality. The questionnaire has an identification number for mailing purposes only. Your name will not be put on your questionnaire.

In order to help shape the education of future facility and plant engineers, it is important that each questionnaire be completed and returned by May 31, 1987. Thank you for your assistance.

Sincerely,

A handwritten signature in cursive script that reads "Tom Klug".

Tom Klug
Director of Association Development

Education and Research Arm of the American Institute of Plant Engineers

SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum) 1 2 3 4 5 6 7 (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 5. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

QUANTITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?
- 002) How much should be applicable to your position?
- 003) How important is this to you?

Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))

- 004) How much are you able to apply now?
- 005) How much should be applicable to your position?
- 006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queuing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

- 025) How much are you able to apply now?
- 026) How much should be applicable to your position?
- 027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

- 028) How much are you able to apply now?
- 029) How much should be applicable to your position?
- 030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

- 031) How much are you able to apply now?
- 032) How much should be applicable to your position?
- 033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

- 034) How much are you able to apply now?
- 035) How much should be applicable to your position?
- 036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

- 037) How much are you able to apply now?
- 038) How much should be applicable to your position?
- 039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

- 040) How much are you able to apply now?
- 041) How much should be applicable to your position?
- 042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
- 044) How much should be applicable to your position?
- 045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
- 047) How much should be applicable to your position?
- 048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
- 050) How much should be applicable to your position?
- 051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
- 053) How much should be applicable to your position?
- 054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
- 056) How much should be applicable to your position?
- 057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
- 059) How much should be applicable to your position?
- 060) How important is this to you?

Building Programming (Including Building Planning Process, Site Evaluation, Total Space Requirements, and Total Building Energy & Control Systems)

- 061) How much are you able to apply now?
- 062) How much should be applicable to your position?
- 063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability & Maintainability, Cost Estimating Techniques, and Procurement)

- 064) How much are you able to apply now?
- 065) How much should be applicable to your position?
- 066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies for On-Time Project Completion, Developing Contingency Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
 - 068) How much should be applicable to your position?
 - 069) How important is this to you?
- Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
- 071) How much should be applicable to your position?
- 072) How important is this to you?

ENGINEERING/ARCHITECTURE (minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
- 074) How much should be applicable to your position?
- 075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
- 077) How much should be applicable to your position?
- 078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
- 080) How much should be applicable to your position?
- 081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL (minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
- 104) How much should be applicable to your position?
- 105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
- 107) How much should be applicable to your position?
- 108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
- 110) How much should be applicable to your position?
- 111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
- 113) How much should be applicable to your position?
- 114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
- 116) How much should be applicable to your position?
- 117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
- 119) How much should be applicable to your position?
- 120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
- 122) How much should be applicable to your position?
- 123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?

Labor Relations (Such as Landmark Judicial Decisions,
Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and
Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the
General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract
Discrepancies; Specification Writing; and Responsibilities
of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention,
Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal
Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and
Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is _____.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other _____ (Please specify.)

179. The company I work for does _____.

- 1) Manufacturing
- 2) Non-Manufacturing

180. My years of experience in facility maintenance and plant engineering is _____.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is

- 1) High School Diploma or Equivalent
- 2) Associate's Degree
- 3) Bachelor's Degree
- 4) Master's Degree
- 5) Doctorate

182. My undergraduate education is in _____.

- 1) Engineering/Technology
- 2) Management
- 3) Other _____ (Please specify.)
- 4) Not Applicable (No Bachelor's Degree)

183. The annual operating budget for which I am responsible is \$ _____.

- 1) \$ 0 - 100,000
- 2) \$ 100,001 - 500,000
- 3) \$ 500,001 - 1,000,000
- 4) \$ 1,000,001 - 5,000,000
- 5) \$ 5,000,001 - 10,000,000
- 6) \$ 10,000,001 - 15,000,000
- 7) \$ over 15,000,000

Appendix D: Survey Package for Military Sample

LS (Capt Kreag, AUTOVON 785-5435)

Educational Need Assessment Survey Package

1. Please take the time to complete the attached questionnaire and return it to us in the enclosed envelope by 15 June 1987.
2. The survey measures your perceptions and attitudes toward academic subjects that contribute to your job. The data we gather will become part of the Air Force Institute of Technology research project and may influence the courses taught in the Graduate Engineering Management program. Your individual responses will be combined with others and will not be attributed to you personally.
3. Your participation is completely voluntary, but we would certainly appreciate your help. For further information, contact Maj. Hal Rumsey at AUTOVON 785-5023.

HAL A. RUMSEY, Maj, USAF
GEM Program Director

2 Atch
1. Questionnaire
2. Return Envelope

SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum) 1 2 3 4 5 6 7 (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 6. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

QUANTITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?
- 002) How much should be applicable to your position?
- 003) How important is this to you?

Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))

- 004) How much are you able to apply now?
- 005) How much should be applicable to your position?
- 006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queuing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

- 025) How much are you able to apply now?
- 026) How much should be applicable to your position?
- 027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

- 028) How much are you able to apply now?
- 029) How much should be applicable to your position?
- 030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

- 031) How much are you able to apply now?
- 032) How much should be applicable to your position?
- 033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

- 034) How much are you able to apply now?
- 035) How much should be applicable to your position?
- 036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

- 037) How much are you able to apply now?
- 038) How much should be applicable to your position?
- 039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

- 040) How much are you able to apply now?
- 041) How much should be applicable to your position?
- 042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
- 044) How much should be applicable to your position?
- 045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
- 047) How much should be applicable to your position?
- 048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
- 050) How much should be applicable to your position?
- 051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
- 053) How much should be applicable to your position?
- 054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
- 056) How much should be applicable to your position?
- 057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
- 059) How much should be applicable to your position?
- 060) How important is this to you?

Building Programming (Including Building Planning Process, Site Evaluation, Total Space Requirements, and Total Building Energy & Control Systems)

- 061) How much are you able to apply now?
- 062) How much should be applicable to your position?
- 063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability & Maintainability, Cost Estimating Techniques, and Procurement)

- 064) How much are you able to apply now?
- 065) How much should be applicable to your position?
- 066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies for On-Time Project Completion, Developing Contingency Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
- 068) How much should be applicable to your position?
- 069) How important is this to you?

Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
- 071) How much should be applicable to your position?
- 072) How important is this to you?

ENGINEERING/ARCHITECTURE (minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
- 074) How much should be applicable to your position?
- 075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
- 077) How much should be applicable to your position?
- 078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
- 080) How much should be applicable to your position?
- 081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL (minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
- 104) How much should be applicable to your position?
- 105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
- 107) How much should be applicable to your position?
- 108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
- 110) How much should be applicable to your position?
- 111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
- 113) How much should be applicable to your position?
- 114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
- 116) How much should be applicable to your position?
- 117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
- 119) How much should be applicable to your position?
- 120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
- 122) How much should be applicable to your position?
- 123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?

Labor Relations (Such as Landmark Judicial Decisions,
Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and
Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the
General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract
Discrepancies; Specification Writing; and Responsibilities
of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention,
Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal
Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and
Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is _____.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other _____ (Please specify.)

179. My rank is _____.

- 1) Lieutenant
- 2) Captain
- 3) Major
- 4) Lt Colonel

180. My years of experience in civil engineering is _____.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is _____.

- 1) Bachelor's Degree
- 2) Master's Degree
- 3) Doctorate

182. The annual operating budget for which I am responsible is \$ _____.

- 1) \$ 0 - 1,000
- 2) \$ 1,001 - 10,000
- 3) \$ 10,001 - 100,000
- 4) \$ 100,001 - 500,000
- 5) \$ 500,001 - 1,000,000
- 6) \$ over 1,000,000

Appendix E (Continued)

101	1234567	130	1234567	159	1234567	188	1234567
102	1234567	131	1234567	160	1234567	189	1234567
103	1234567	132	1234567	161	1234567	190	1234567
104	1234567	133	1234567	162	1234567	191	1234567
105	1234567	134	1234567	163	1234567	192	1234567
106	1234567	135	1234567	164	1234567	193	1234567
107	1234567	136	1234567	165	1234567	194	1234567
108	1234567	137	1234567	166	1234567	195	1234567
109	1234567	138	1234567	167	1234567	196	1234567
110	1234567	139	1234567	168	1234567	197	1234567
111	1234567	140	1234567	169	1234567	198	1234567
112	1234567	141	1234567	170	1234567	199	1234567
113	1234567	142	1234567	171	1234567	200	1234567
114	1234567	143	1234567	172	1234567		
115	1234567	144	1234567	173	1234567		
116	1234567	145	1234567	174	1234567		
117	1234567	146	1234567	175	1234567		
118	1234567	147	1234567	176	1234567		
119	1234567	148	1234567	177	1234567		
120	1234567	149	1234567	178	1234567		
121	1234567	150	1234567	179	1234567		
122	1234567	151	1234567	180	1234567		
123	1234567	152	1234567	181	1234567		
124	1234567	153	1234567	182	1234567		
125	1234567	154	1234567	183	1234567		
126	1234567	155	1234567	184	1234567		
127	1234567	156	1234567	185	1234567		
128	1234567	157	1234567	186	1234567		
129	1234567	158	1234567	187	1234567		

Appendix F: GEM Course Titles

<u>GEM Course Titles</u>	<u>Credit Hours</u>
Elements of Financial and Managerial Accounting	2*
Introduction to AFIT Computer Systems	2*
Math Review for Engineers	2*
Research Orientation	0
Managerial Statistics	3
Theory and Practice of Professional Communication	3
Computer Programming	3
Organization and Management	3
Executive Engineering Management Symposia	0
Environmental & Energy Issues	4
Research Methods	2
Organizational Behavior	3
Managerial Statistics II	3
Independent Study	1
Executive Engineering Management Symposia	0
Engineering Management Information	3
Introduction. to Management Science	4
Elective	3
Independent Study	2
Executive Engineering Management Symposia	0
Contracting for Engineers	3
Engineering Management Techniques	4
Federal Financial Management	3
Elective	3
Independent Study	1
Executive Engineering Management Symposia	0
Independent Study	2
Seminar in Engineering Management	3
Elective	3
Executive Engineering Management Symposia	1
Independent Study	<u>6</u>
TOTAL CREDIT HOURS	72
Undergraduate Credit Hours	<u>-6</u>
Graduate Credit Hours	66

* Indicates Undergraduate Credit

Appendix G: Responses to the Three Questions
(By Military Rating)

<u>Academic Subject</u>	<u>How Much Do You Apply</u>		<u>How Much Should You</u>		<u>Importance</u>	
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
Professional Ethics	5.36	5.74	5.80	5.92	6.11	6.33
Public Speaking	4.38	5.41	5.03	5.85	5.27	6.18
Leadership	4.57	5.40	5.09	5.73	5.40	6.13
Management Prin	4.72	4.91	5.26	5.66	5.48	5.96
Technical Writing	4.79	5.58	5.39	5.79	5.72	5.86
Personnel Mgt	4.92	4.72	5.36	5.20	5.83	5.86
Communication	4.65	4.91	5.22	5.59	5.49	5.67
Construction Mgt	5.08	4.14	5.48	4.46	5.98	5.45
Behavioral Sci	4.31	4.44	4.64	4.95	4.95	5.30
Project Mgt	4.94	4.81	5.57	4.94	5.84	5.28
Organizational Beh	4.02	4.33	4.79	4.85	4.81	5.23
Civil Engrg	3.38	3.98	3.78	4.25	4.06	5.22
Information Sys	3.32	3.97	4.02	4.80	4.25	5.08
Contract Policy	4.89	4.03	5.52	4.46	5.77	4.98
Group Projects	4.17	4.42	4.75	4.70	4.84	4.96
Master Planning	4.02	4.03	4.66	4.73	4.81	4.95
Building Pgm	4.57	3.83	5.23	4.38	5.45	4.90
Facility Oper	5.22	3.71	5.81	4.02	6.05	4.83
Budget Prep	5.00	3.73	5.39	4.40	5.58	4.81
Maintenance Mgt	5.08	3.31	5.69	3.74	5.95	4.70
Innovation Tech	3.51	3.96	4.23	4.41	4.44	4.54
Life Cycle Cost	3.86	3.25	4.77	3.91	5.03	4.51
Computer Systems	2.81	3.39	3.89	4.15	4.16	4.49
Interior Design	3.93	3.11	4.44	3.74	4.67	4.41
Building Fire Prot	5.02	3.36	5.39	3.91	5.66	4.31
Arch Designs	3.68	3.09	3.90	3.59	4.00	4.30
Laoor Relations	3.22	3.11	3.67	3.55	4.20	4.27
Computer Science	2.73	3.45	3.60	3.89	3.86	4.20
Decision Theory	3.32	3.40	4.03	4.09	4.05	4.14
Engineering Econ	4.19	3.03	4.65	3.32	4.92	4.09
Managerial Acct	3.97	3.09	4.64	3.71	4.89	3.95
Energy Mgt	4.77	2.95	5.46	3.33	5.75	3.94
Mechanical Engrg	4.95	2.81	5.43	3.33	5.54	3.93
Energy Eff Designs	4.40	2.87	4.95	3.27	5.35	3.92
Collective Barg	3.44	2.61	4.09	3.00	4.57	3.90
Electrical Engrg	4.41	2.67	5.00	3.32	5.20	3.88
Value Engrg	4.44	3.00	4.83	3.46	5.16	3.83
Safety Engrg	4.63	3.10	5.20	3.63	5.52	3.81
Public Policy	2.51	2.91	3.02	3.24	3.40	3.76
Quality Control	3.71	2.79	4.16	3.15	4.31	3.70
Installation &	4.19	2.70	5.03	3.05	5.28	3.66
Business Law	3.12	2.85	3.48	3.28	3.66	3.65
Financial Mgt	3.34	2.94	3.60	3.21	4.00	3.63

Appendix G (Continued)

<u>Academic Subject</u>	<u>How Much Do You Apply</u>		<u>How Much Should You</u>		<u>Importance</u>	
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
CAD / CAM	2.67	2.07	3.78	2.81	3.83	3.62
Strategic Plan	2.67	2.98	3.27	3.36	3.40	3.62
Network Modeling	3.07	2.70	3.77	3.31	3.63	3.57
Cost Accounting	3.74	2.85	4.29	3.28	4.46	3.50
Computer Room Des	3.29	2.52	4.09	3.00	4.23	3.45
R & D Management	2.83	2.64	3.32	2.88	3.43	3.44
Marketing	2.69	2.69	2.98	2.97	3.11	3.39
Industrial Engrg	3.54	2.41	4.08	2.84	4.21	3.35
Statistical Anal	2.64	2.38	2.74	2.75	2.90	3.23
Forecasting	3.18	2.32	3.71	2.90	3.88	3.08
Real Estate Acq	2.76	2.18	2.71	2.61	3.11	2.97
Entrepreneurship	2.40	2.44	2.56	2.52	2.93	2.88
Inventory Plan	3.27	2.05	3.95	2.15	4.02	2.86
Queuing Theory	2.53	2.10	2.70	2.51	2.84	2.84
Linear Program	1.90	1.71	2.68	2.26	2.35	2.14
Simulation Modeling	1.48	1.15	1.94	1.46	1.93	1.65

Appendix H: Importance & Need Ratings of Academic Subjects
(By Military Rating)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.53
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08
Contract Policy	4.98	5.77	0.43	0.38
Group Projects	4.96	4.84	0.26	0.40
Master Planning	4.95	4.81	0.68	0.69
Building Programming	4.90	5.45	0.55	0.65
Facility Operations	4.83	6.05	0.30	0.69
Budget Preparation	4.81	5.58	0.67	0.37
Maintenance Management	4.70	5.95	0.39	0.60
Innovation Techniques	4.54	4.44	0.47	0.17
Life Cycle Costing	4.51	5.03	0.63	0.86
Computer Systems Design	4.49	4.16	0.85	0.56
Interior Design	4.41	4.67	0.63	1.08
Building Fire Protection	4.31	5.66	0.51	-0.02
Architectural Design	4.30	4.00	0.50	0.49
Labor Relations	4.27	4.20	0.48	0.69
Computer Science	4.20	3.86	0.44	0.68
Decision Theory	4.14	4.05	0.69	0.71
Engineering Economics	4.09	4.92	0.30	0.45
Managerial Accounting	3.95	4.89	0.62	0.67
Energy Management	3.94	5.75	0.38	2.35
Mechanical Engineering	3.93	5.54	0.52	0.59
Energy Efficient Designs	3.92	5.35	0.41	0.87
Collective Bargaining	3.90	4.57	0.39	0.45
Electrical Engineering	3.88	5.20	0.65	0.54
Value Engineering	3.83	5.16	0.47	0.55
Safety Engineering	3.81	5.52	0.53	0.40
Public Policy	3.76	3.40	0.33	0.63
Quality Control	3.70	4.31	0.36	0.44
Installation & Space Mgt	3.66	5.28	0.35	0.40

Appendix H (Continued)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Business Law	3.65	3.66	0.43	0.31
Financial Management	3.63	4.00	0.27	0.25
CAD / CAM	3.62	3.83	0.74	0.80
Strategic Planning	3.62	3.40	0.37	0.63
Network Modeling	3.57	3.63	0.60	0.80
Cost Accounting	3.50	4.46	0.43	0.56
Computer Room Design	3.45	4.23	0.48	0.57
R & D Management	3.44	3.43	0.24	0.72
Marketing	3.39	3.11	0.25	0.40
Industrial Engineering	3.35	4.21	0.43	0.22
Statistical Analysis	3.23	2.90	0.42	0.14
Forecasting	3.08	3.88	0.59	0.53
Real Estate Acq & Disp	2.97	3.11	0.43	0.84
Entrepreneur	2.88	2.93	0.05	0.46
Inventory Planning	2.86	4.02	0.10	0.73
Queuing Theory	2.84	2.84	0.41	0.20
Linear Programming	2.14	2.35	0.55	0.80
Simulation Modeling	1.65	1.93	0.30	0.48

Appendix I: T-test

<u>Subject</u>	<u>T</u> <u>Value</u>	<u>P</u> <u>Value</u>
Queuing Theory	-0.01	0.995
R & D Management	-0.02	0.983
Business Law	0.03	0.975
Entrepreneurship	0.12	0.903
Personnel Management	-0.15	0.881
Network Modeling	0.18	0.860
Labor Relations	-0.19	0.851
Decision Theory	-0.28	0.783
Innovation Technique	-0.34	0.733
Group Projects	-0.35	0.728
Real Estate Acquisition & Disp	0.42	0.672
Master Planning	-0.47	0.639
Technical Writing	-0.49	0.625
Communication	-0.58	0.566
CAD / CAM	0.58	0.565
Strategic Planning	-0.59	0.556
Linear Programming	0.77	0.442
Marketing	-0.78	0.435
Interior Design	0.79	0.432
Computer Systems Design	-0.88	0.373
Architectural Design	-0.93	0.352
Computer Science	-0.94	0.347
Statistical Analysis	-0.97	0.335
Professional Ethics	-1.02	0.308
Public Policy	-1.06	0.293
Financial Management	1.13	0.260
Behavioral Science	-1.15	0.251
Simulation Modeling	1.21	0.231
Organizational Theory	-1.34	0.182
Life Cycle Costing	1.75	0.082
Quality Control	1.81	0.073
Building Programming	1.82	0.071
Collective Bargaining	1.82	0.071
Management Principles	-1.94	0.055
Project Management	1.95	0.053
Construction Management	2.08	0.040
Computer Room Design	2.17	0.032
Forecasting	2.22	0.028
Engineering Economy	2.49	0.014
Budget Preparation	2.66	0.009
Contract Policy	2.66	0.009
Industrial Engineering	2.70	0.008
Information Systems	-2.69	0.008
Leadership	-2.73	0.007
Cost Accounting	2.95	0.004

Appendix I (Continued)

<u>Subject</u>	<u>T</u> <u>Value</u>	<u>p</u> <u>Value</u>
Inventory Planning	3.24	0.002
Managerial Accounting	3.09	0.002
Public Speaking	-3.54	0.001
Energy Management	6.04	0.000
Safety Engineering	5.52	0.000
Mechanical Engineering	5.30	0.000
Installation & Space Mgt	5.23	0.000
Energy Efficient Designs	4.71	0.000
Building Fire Protection	4.62	0.000
Value Engineering	4.44	0.000
Electrical Engineering	4.38	0.000
Facility Operations	4.22	0.000
Maintenance Management	4.15	0.000
Civil Engineering	-3.92	0.000

Appendix J: Programs and Data

SPSSX Program for Military Data

```
TITLE          THESIS RESEARCH
FILE HANDLE    THESIS / NAME = 'mil.dat'
DATA LIST      FILE = THESIS FIXED RECORDS = 3 /
               SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
               X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
               X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
               X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
               X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
               X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
               X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
               X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
               X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
               X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
               X101,X102,X103,X104,X105,X106,X107,X108,
               X109,X110,X111,X112,X113,X114,X115,X116,
               X117,X118,X119,X120,X121,X122,X123,X124,
               X125,X126,X127,X128,X129,X130,X131,X132,
               X133,X134,X135,X136,X137,X138,X139,X140,
               X141,X142,X143,X144,X145,X146,X147,X148,
               X149,X150,X151,X152,X153,X154,X155,X156,
               X157,X158,X159,X160,X161,X162,X163,X164,
               X165,X166,X167,X168,X169,X170,X171,X172,
               X173,X174,X175,X176,X177,X178,X179,X180,
               X181,X182
               (F8.0,52F1.0 / 60F1.0 / 60F1.0 / 10F1.0)

SET           BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X182 (9)

VALUE LABELS  X178 1 'UPPER MANAGEMENT'
               2 'MIDDLE MANAGEMENT'
               3 'FIRST LEVEL MANAGER'
               4 'ENGINEER' 5 'OTHER' /
X179 1 'LIEUTENANT' 2 'CAPTAIN'
               3 'MAJOR' 4 'LT COLONEL' /
X180 1 '0-6 YEARS' 2 '7-10 YEARS'
               3 '11-15 YEARS'
               4 '16-20 YEARS' 5 '21-25 YEARS'
               6 '26-30 YEARS' 7 'OVER 30 YEARS' /
X181 1 'BACHELOR' 2 'MASTER'
               3 'DOCTORATE' /
X182 1 '$0-1K' 2 '$1K-10K' 3 '$10K-100K'
               4 '$100K-500K' 5 '$500K-1M' 6 '$OVER $1M'

COMPUTE      NEED1 = X2 - X1
COMPUTE      NEED2 = X5 - X4
COMPUTE      NEED3 = X8 - X7
```

COMPUTE	NEED4 = x11 - x10
COMPUTE	NEED5 = x14 - x13
COMPUTE	NEED6 = x17 - x16
COMPUTE	NEED7 = x20 - x19
COMPUTE	NEED8 = x23 - x22
COMPUTE	NEED9 = x26 - x25
COMPUTE	NEED10 = x29 - x28
COMPUTE	NEED11 = x32 - x31
COMPUTE	NEED12 = x35 - x34
COMPUTE	NEED13 = x38 - x37
COMPUTE	NEED14 = x41 - x40
COMPUTE	NEED15 = x44 - x43
COMPUTE	NEED16 = x47 - x46
COMPUTE	NEED17 = x50 - x49
COMPUTE	NEED18 = x53 - x52
COMPUTE	NEED19 = x56 - x55
COMPUTE	NEED20 = x59 - x58
COMPUTE	NEED21 = x62 - x61
COMPUTE	NEED22 = x65 - x64
COMPUTE	NEED23 = x68 - x67
COMPUTE	NEED24 = x71 - x70
COMPUTE	NEED25 = x74 - x73
COMPUTE	NEED26 = x77 - x76
COMPUTE	NEED27 = x80 - x79
COMPUTE	NEED28 = x83 - x82
COMPUTE	NEED29 = x86 - x85
COMPUTE	NEED30 = x89 - x88
COMPUTE	NEED31 = x92 - x91
COMPUTE	NEED32 = x95 - x94
COMPUTE	NEED33 = x98 - x97
COMPUTE	NEED34 = x101 - x100
COMPUTE	NEED35 = x104 - x103
COMPUTE	NEED36 = x107 - x106
COMPUTE	NEED37 = x110 - x109
COMPUTE	NEED38 = x113 - x112
COMPUTE	NEED39 = x116 - x115
COMPUTE	NEED40 = x119 - x118
COMPUTE	NEED41 = x122 - x121
COMPUTE	NEED42 = x125 - x124
COMPUTE	NEED43 = x128 - x127
COMPUTE	NEED44 = x131 - x130
COMPUTE	NEED45 = x134 - x133
COMPUTE	NEED46 = x137 - x136
COMPUTE	NEED47 = x140 - x139
COMPUTE	NEED48 = x143 - x142
COMPUTE	NEED49 = x146 - x145
COMPUTE	NEED50 = x149 - x148
COMPUTE	NEED51 = x152 - x151
COMPUTE	NEED52 = x155 - x154
COMPUTE	NEED53 = x158 - x157
COMPUTE	NEED54 = x161 - x160
COMPUTE	NEED55 = x164 - x163

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COMPUTE      NEED56 = X167 - X166
COMPUTE      NEED57 = X170 - X169
COMPUTE      NEED58 = X173 - X172
COMPUTE      NEED59 = X176 - X175

COMPUTE      AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE      AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE      AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE      APROJ = MEAN (X67,X70)
COMPUTE      AE1 = MEAN (X73,X76,X79,X82,X85)
COMPUTE      AE2 = MEAN (X88,X91,X94,X97,X100)
COMPUTE      AENGR = MEAN (AE1,AE2)
COMPUTE      AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE      AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE      AF3 = MEAN (X145,X152,X154,X157,X160)
COMPUTE      AF4 = MEAN (X166,X169,X172,X175)
COMPUTE      AF5 = MEAN (X118,X121,X124,X127,X130)
COMPUTE      AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)

COMPUTE      SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE      SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE      SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE      SPROJ = MEAN (X68,X71)
COMPUTE      SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE      SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE      SENGR = MEAN (SE1,SE2)
COMPUTE      SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE      SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE      SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE      SF4 = MEAN (X125,X146,X149,X170,X173)
COMPUTE      SF5 = MEAN (X119,X122,X143,X167,X176)
COMPUTE      SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)

COMPUTE      IQJAN = MEAN (X3,X6,X12,X15,X18,X21,X24)
COMPUTE      IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE      IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE      IPROJ = MEAN (X69,X72)
COMPUTE      IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE      IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE      IENGR = MEAN (IE1,IE2)
COMPUTE      IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE      IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE      IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE      IF4 = MEAN (X123,X126,X147,X150,X174)
COMPUTE      IF5 = MEAN (X120,X144,X168,X171,X177)
COMPUTE      IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)

COMPUTE      NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE      NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE      NFIN = MEAN (NEED16 TO NEED22)
COMPUTE      NPROJ = MEAN (NEED23,NEED24)
COMPUTE      NENGR = MEAN (NEED25 TO NEED34)

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COMPUTE          NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES     VARIABLES = X178 (1,5) X179 (1,4) X180 (1,7)
                X181 (1,3) X182 (1,6) /
                STATISTICS = DEFAULT

FREQUENCIES     VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12 X15
                X18 X24 X27 X30 X33 X36 X39 X42 X45 X48 X51
                X54 X57 X60 X63 X66 X69 X71 X73 X75 X78 X81
                X84 X87 X90 X93 X96 X99 X102 X105 X108 X111
                X114 X117 X120 X123 X126 X129 X132 X135 X138
                X141 X144 X147 X150 X153 X156 X159 X162 X165
                X168 X171 X174 X177 AQUAN AQUAL AFIN APROJ
                AENGR AFUN SQUAN SQUAL SFIN SPROJ SENGR SFUN
                IQUAN IQUAL IFIN IPROJ IENGR IFUN NQUAN
                NQUAL NFIN NPROJ NENGR NFUN /
                FORMAT = ONEPAGE /
                STATISTICS = RANGE MEAN MEDIAN STDEV
                VARIANCE /

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Military Data

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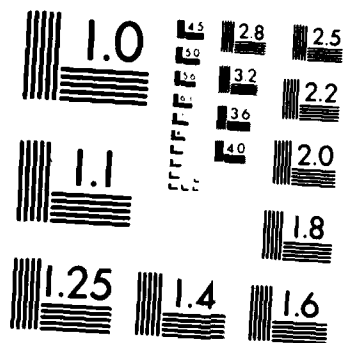
AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN
FACILITIES ENGINEERING(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. D H KREAG
SEP 87 AFIT/GEN/LSN/875-14 F/G 5/6

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UNCLASSIFIED

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

SPSSX Program for Civilian Data

TITLE THESIS RESEARCH
FILE HANDLE THESIS / NAME = 'civ.dat'
DATA LIST FILE = THESIS FIXED RECORDS = 3 /
 SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
 X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
 X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
 X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
 X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
 X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
 X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
 X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
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 X181,X182,X183
 (F8.0,52F1.0 / 60F1.0 / 60F1.0 / 11F1.0)

SET BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X183 (9)

VALUE LABELS X178 1 'UPPER MANAGEMENT'
 2 'MIDDLE MANAGEMENT'
 3 'FIRST LEVEL MANAGER'
 4 'ENGINEER' 5 'OTHER' /
 X179 1 'MANUFACTURING'
 2 'NONMANUFACTURING' /
 X180 1 '0-6 YEARS' 2 '7-10 YEARS'
 3 '11-15 YEARS' 4 '16-20 YEARS'
 5 '21-25 YEARS' 6 '26-30 YEARS'
 7 'OVER 30 YEARS' /
 X181 1 'HIGH SCHOOL' 2 'ASSOCIATE'
 3 'BACHELOR' 4 'MASTER' 5 'DOCTORATE' /
 X182 1 'ENGINEERING' 2 'MANAGEMENT'
 3 'OTHER' /
 X183 1 '\$0-100K' 2 '\$100K-500K' 3 '\$500K-1M'
 4 '\$1M-5M' 5 '\$5M-10M' 6 '\$10M-15M'
 7 '\$OVER \$15M'

COMPUTE NEED1 = X2 - X1
COMPUTE NEED2 = X5 - X4
COMPUTE NEED3 = X8 - X7

COMPUTE	NEED4 = X11 - X10
COMPUTE	NEED5 = X14 - X13
COMPUTE	NEED6 = X17 - X16
COMPUTE	NEED7 = X20 - X19
COMPUTE	NEED8 = X23 - X22
COMPUTE	NEED9 = X26 - X25
COMPUTE	NEED10 = X29 - X28
COMPUTE	NEED11 = X32 - X31
COMPUTE	NEED12 = X35 - X34
COMPUTE	NEED13 = X38 - X37
COMPUTE	NEED14 = X41 - X40
COMPUTE	NEED15 = X44 - X43
COMPUTE	NEED16 = X47 - X46
COMPUTE	NEED17 = X50 - X49
COMPUTE	NEED18 = X53 - X52
COMPUTE	NEED19 = X56 - X55
COMPUTE	NEED20 = X59 - X58
COMPUTE	NEED21 = X62 - X61
COMPUTE	NEED22 = X65 - X64
COMPUTE	NEED23 = X68 - X67
COMPUTE	NEED24 = X71 - X70
COMPUTE	NEED25 = X74 - X73
COMPUTE	NEED26 = X77 - X76
COMPUTE	NEED27 = X80 - X79
COMPUTE	NEED28 = X83 - X82
COMPUTE	NEED29 = X86 - X85
COMPUTE	NEED30 = X89 - X88
COMPUTE	NEED31 = X92 - X91
COMPUTE	NEED32 = X95 - X94
COMPUTE	NEED33 = X98 - X97
COMPUTE	NEED34 = X101 - X100
COMPUTE	NEED35 = X104 - X103
COMPUTE	NEED36 = X107 - X106
COMPUTE	NEED37 = X110 - X109
COMPUTE	NEED38 = X113 - X112
COMPUTE	NEED39 = X116 - X115
COMPUTE	NEED40 = X119 - X118
COMPUTE	NEED41 = X122 - X121
COMPUTE	NEED42 = X125 - X124
COMPUTE	NEED43 = X128 - X127
COMPUTE	NEED44 = X131 - X130
COMPUTE	NEED45 = X134 - X133
COMPUTE	NEED46 = X137 - X136
COMPUTE	NEED47 = X140 - X139
COMPUTE	NEED48 = X143 - X142
COMPUTE	NEED49 = X146 - X145
COMPUTE	NEED50 = X149 - X148
COMPUTE	NEED51 = X152 - X151
COMPUTE	NEED52 = X155 - X154
COMPUTE	NEED53 = X158 - X157
COMPUTE	NEED54 = X161 - X160
COMPUTE	NEED55 = X164 - X163

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COMPUTE      NEED56 = X167 - X166
COMPUTE      NEED57 = X170 - X169
COMPUTE      NEED58 = X173 - X172
COMPUTE      NEED59 = X176 - X175

COMPUTE      AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE      AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE      AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE      APROJ = MEAN (X67,X70)
COMPUTE      AE1 = MEAN (X73,X76,X79,X82,X85)
COMPUTE      AE2 = MEAN (X88,X91,X97,X100)
COMPUTE      AENGR = MEAN (AE1,AE2)
COMPUTE      AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE      AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE      AF3 = MEAN (X152,X154,X157,X160,X163)
COMPUTE      AF4 = MEAN (X121,X124,X145,X148,X172)
COMPUTE      AF5 = MEAN (X118,X142,X166,X169,X175)
COMPUTE      AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)

COMPUTE      SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE      SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE      SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE      SPROJ = MEAN (X68,X71)
COMPUTE      SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE      SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE      SENGR = MEAN (SE1,SE2)
COMPUTE      SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE      SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE      SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE      SF4 = MEAN (X119,X125,X149,X173,X176)
COMPUTE      SF5 = MEAN (X122,X143,X146,X167,X170)
COMPUTE      SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)

COMPUTE      IQUAN = MEAN (X3,X6,X12,X15,X18,X21,X24)
COMPUTE      IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE      IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE      IPROJ = MEAN (X69,X72)
COMPUTE      IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE      IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE      IENGR = MEAN (IE1,IE2)
COMPUTE      IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE      IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE      IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE      IF4 = MEAN (X120,X126,X150,X174,X177)
COMPUTE      IF5 = MEAN (X123,X144,X147,X168,X171)
COMPUTE      IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)

COMPUTE      NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE      NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE      NFIN = MEAN (NEED16 TO NEED22)
COMPUTE      NPROJ = MEAN (NEED23,NEED24)
COMPUTE      NENGR = MEAN (NEED25 TO NEED34)

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COMPUTE          NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES     VARIABLES = X178 (1,5) X179 (1,2) X180 (1,7)
                X181 (1,5) X182 (1,4) X183 (1,7) /
                STATISTICS = DEFAULT

FREQUENCIES     VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12
                X15 X18 X24 X27 X30 X33 X36 X39 X42 X45
                X48 X51 X54 X57 X60 X63 X66 X69 X71 X73
                X75 X78 X81 X84 X87 X90 X93 X96 X99 X102
                X105 X108 X111 X114 X117 X120 X123 X126
                X129 X132 X135 X138 X141 X144 X147 X150
                X153 X156 X159 X162 X165 X168 X171 X174
                X177 AQUAN AQUAL AFIN APROJ AENGR AFUN
                SQUAN SQUAL SFIN SPROJ SENGR SFUN IQUAN
                IQUAL IFIN IPROJ IENGR IFUN NQUAN NQUAL
                NFIN NPROJ NENGR NFUN /
                FORMAT = ONEPAGE /
                STATISTICS = RANGE MEAN MEDIAN STDEV
                VARIANCE /

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Civilian Data

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52256174576 32 34453 41332 32777256677 4 7777771116667777777
77666414311

SPSSX Program for T-Test

TITLE THESIS RESEARCH
FILE HANDLE THESIS / NAME = 'sur.dat'
DATA LIST FILE = THESIS FIXED RECORDS = 3 /
SURVEYNO, X1, X2, X3, X4, X5, X6, X7, X8, X9, X10,
X11, X12, X13, X14, X15, X16, X17, X18, X19, X20,
X21, X22, X23, X24, X25, X26, X27, X28, X29, X30,
X31, X32, X33, X34, X35, X36, X37, X38, X39, X40,
X41, X42, X43, X44, X45, X46, X47, X48, X49, X50,
X51, X52, X53, X54, X55, X56, X57, X58, X59, X60,
X61, X62, X63, X64, X65, X66, X67, X68, X69, X70,
X71, X72, X73, X74, X75, X76, X77, X78, X79, X80,
X81, X82, X83, X84, X85, X86, X87, X88, X89, X90,
X91, X92, X93, X94, X95, X96, X97, X98, X99, X100,
X101, X102, X103, X104, X105, X106, X107, X108,
X109, X110, X111, X112, X113, X114, X115, X116,
X117, X118, X119, X120, X121, X122, X123, X124,
X125, X126, X127, X128, X129, X130, X131, X132,
X133, X134, X135, X136, X137, X138, X139, X140,
X141, X142, X143, X144, X145, X146, X147, X148,
X149, X150, X151, X152, X153, X154, X155, X156,
X157, X158, X159, X160, X161, X162, X163, X164,
X165, X166, X167, X168, X169, X170, X171, X172,
X173, X174, X175, X176, X177, GROUP
(F8.0, 72F1.0 / 80F1.0 / 26F1.0)

SET BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X177 (9)

T-TEST GROUPS = grp (1,2) / VARIABLES = X3
T-TEST GROUPS = grp (1,2) / VARIABLES = X6
T-TEST GROUPS = grp (1,2) / VARIABLES = X9
T-TEST GROUPS = grp (1,2) / VARIABLES = X12
T-TEST GROUPS = grp (1,2) / VARIABLES = X15
T-TEST GROUPS = grp (1,2) / VARIABLES = X18
T-TEST GROUPS = grp (1,2) / VARIABLES = X21
T-TEST GROUPS = grp (1,2) / VARIABLES = X24
T-TEST GROUPS = grp (1,2) / VARIABLES = X27
T-TEST GROUPS = grp (1,2) / VARIABLES = X30
T-TEST GROUPS = grp (1,2) / VARIABLES = X33
T-TEST GROUPS = grp (1,2) / VARIABLES = X36
T-TEST GROUPS = grp (1,2) / VARIABLES = X39
T-TEST GROUPS = grp (1,2) / VARIABLES = X42
T-TEST GROUPS = grp (1,2) / VARIABLES = X45
T-TEST GROUPS = grp (1,2) / VARIABLES = X48
T-TEST GROUPS = grp (1,2) / VARIABLES = X51
T-TEST GROUPS = grp (1,2) / VARIABLES = X54
T-TEST GROUPS = grp (1,2) / VARIABLES = X57
T-TEST GROUPS = grp (1,2) / VARIABLES = X60
T-TEST GROUPS = grp (1,2) / VARIABLES = X63
T-TEST GROUPS = grp (1,2) / VARIABLES = X66

T-TEST	GROUPS = grp (1,2) / VARIABLES = X69
T-TEST	GROUPS = grp (1,2) / VARIABLES = X72
T-TEST	GROUPS = grp (1,2) / VARIABLES = X75
T-TEST	GROUPS = grp (1,2) / VARIABLES = X78
T-TEST	GROUPS = grp (1,2) / VARIABLES = X81
T-TEST	GROUPS = grp (1,2) / VARIABLES = X84
T-TEST	GROUPS = grp (1,2) / VARIABLES = X87
T-TEST	GROUPS = grp (1,2) / VARIABLES = X90
T-TEST	GROUPS = grp (1,2) / VARIABLES = X93
T-TEST	GROUPS = grp (1,2) / VARIABLES = X96
T-TEST	GROUPS = grp (1,2) / VARIABLES = X99
T-TEST	GROUPS = grp (1,2) / VARIABLES = X102
T-TEST	GROUPS = grp (1,2) / VARIABLES = X105
T-TEST	GROUPS = grp (1,2) / VARIABLES = X108
T-TEST	GROUPS = grp (1,2) / VARIABLES = X111
T-TEST	GROUPS = grp (1,2) / VARIABLES = X114
T-TEST	GROUPS = grp (1,2) / VARIABLES = X117
T-TEST	GROUPS = grp (1,2) / VARIABLES = X120
T-TEST	GROUPS = grp (1,2) / VARIABLES = X123
T-TEST	GROUPS = grp (1,2) / VARIABLES = X126
T-TEST	GROUPS = grp (1,2) / VARIABLES = X129
T-TEST	GROUPS = grp (1,2) / VARIABLES = X132
T-TEST	GROUPS = grp (1,2) / VARIABLES = X135
T-TEST	GROUPS = grp (1,2) / VARIABLES = X138
T-TEST	GROUPS = grp (1,2) / VARIABLES = X141
T-TEST	GROUPS = grp (1,2) / VARIABLES = X144
T-TEST	GROUPS = grp (1,2) / VARIABLES = X147
T-TEST	GROUPS = grp (1,2) / VARIABLES = X150
T-TEST	GROUPS = grp (1,2) / VARIABLES = X153
T-TEST	GROUPS = grp (1,2) / VARIABLES = X156
T-TEST	GROUPS = grp (1,2) / VARIABLES = X159
T-TEST	GROUPS = grp (1,2) / VARIABLES = X162
T-TEST	GROUPS = grp (1,2) / VARIABLES = X165
T-TEST	GROUPS = grp (1,2) / VARIABLES = X168
T-TEST	GROUPS = grp (1,2) / VARIABLES = X171
T-TEST	GROUPS = grp (1,2) / VARIABLES = X174
T-TEST	GROUPS = grp (1,2) / VARIABLES = X177

SAS Rank Order Correlation

```
options linesize=78;
data ranks;
input milrank civrank @@;
cards;
  1  1  2 20  3 17  4 15  5  9  6  6  7 14  8  3  9 24
10  5 11 28 12 40 13 35 14  7 15 27 16 16 17  2 18 11
19  4 20 29 21 33 22 23 23 39 24 30 25 10 26 43 27 38
28 45 29 41 30 25 31 52 32 26 33  8 34 12 35 18 36 31
37 21 38 22 29 13 40 51 41 34 42 19 43 47 44 42 45 46
46 50 47 48 48 32 49 36 50 49 51 54 52 37 53 56 54 44
55 53 56 55 57 57 58 58 59 59
;
proc cancorr data = ranks all;
var milrank; with civrank;
title 'educational skills ranked by importance';
title2 'military & civilian rank order correlation';
proc print;
```

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VITA

Captain David M. Kreag was born on 14 June 1959 in Peru, Indiana. He graduated from high school there in 1977, and attended Purdue University, from which he received a Bachelor of Science Degree in Industrial Engineering in December 1981. After graduation, Captain Kreag was commissioned in the United States Air Force through the Officer Training School at Medina Annex, Lackland AFB, Texas, on 26 August 1982. His initial assignment was to K. I. Sawyer AFB, Michigan, where he worked as Chief of Industrial Engineering, 410th Civil Engineering Squadron. In August 1984, he was assigned to the 6112th Civil Engineering Squadron at Misawa Air Base, Japan, which was changed to the 432nd Civil Engineering Squadron shortly thereafter. He was again assigned as Chief of Industrial Engineering in charge of implementing a prototype Work Information Management System minicomputer until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1986. Captain Kreag's next assignment will be at Wurtsmith AFB, Michigan.

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This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59 percent) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management, budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and Value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

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