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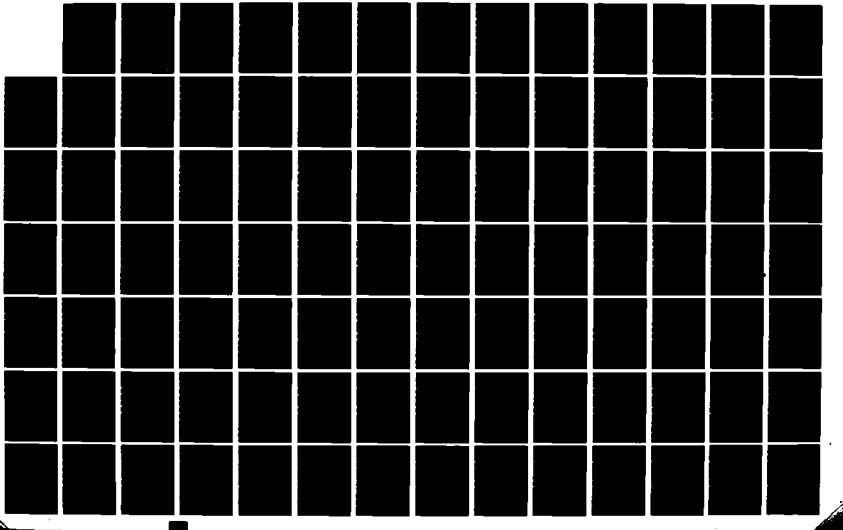

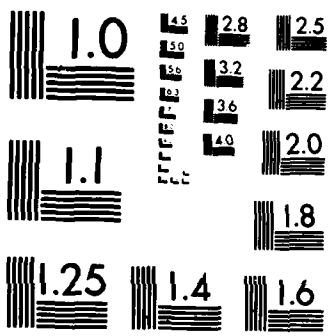

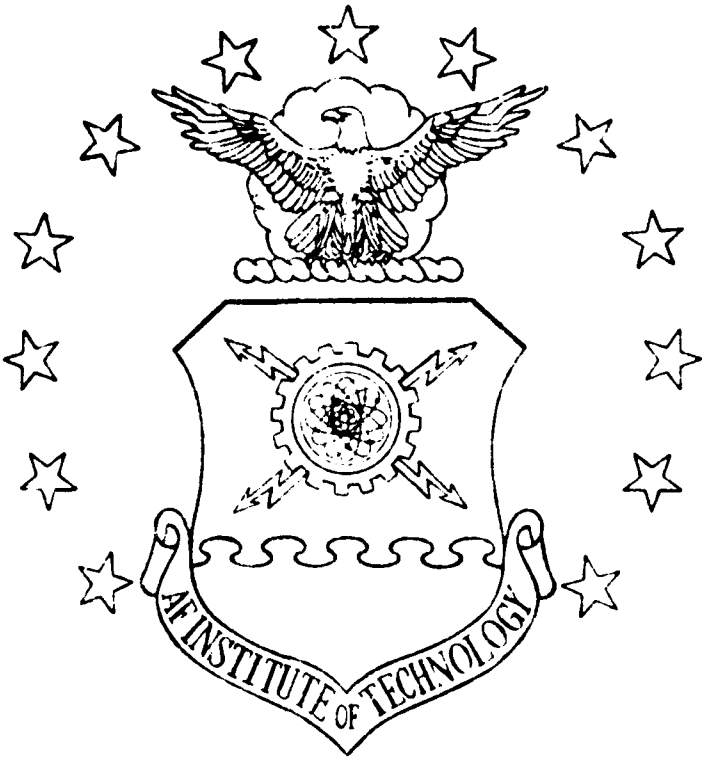

AN ANALYSIS OF THE PERCEIVED USEFULNESS OF AFIT'S GRADUATE ENGINEERING MANAGEMENT PROGRAM

William R. Halsey, Captain, USAF
Jeffrey G. Hooper, Captain, USAF

LSSR 26-83

DEPARTMENT OF THE AIR FORCE
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AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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The purpose of this thesis was to determine the perceived usefulness of the Graduate Engineering Management (GEM) program of the Air Force Institute of Technology (AFIT) in preparing civil engineering officers for positions in engineering management. The main research objective consisted of determining which subject areas are most useful to the graduates. The secondary objective was to determine the impact of the AFIT education on the graduates' career objectives. A questionnaire was developed and mailed to active duty Air Force officers who had graduated from the Facilities Management program or from the GEM program. A similar survey was sent with the graduate survey to the graduates' supervisors. Analysis of the responses to the surveys showed that the graduates and their supervisors perceive that most courses in the current GEM program are useful and that the graduates perceive that the AFIT education has had a favorable impact on their careers. It was concluded that the GEM program curriculum is appropriate and that the program is meeting the needs of its graduates. Recommendations included emphasizing communication, leadership, and supervision in the program curriculum and conducting similar research at least every four years.

LSSR 26-83

AN ANALYSIS OF THE PERCEIVED USEFULNESS OF AFIT'S GRADUATE ENGINEERING MANAGEMENT PROGRAM

A 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 Requirement for the

Degree of Master of Science in Engineering Management

By

William R. Halsey
Captain, USAF

Jeffrey G. Hooper
Captain, USAF

September 1983

This thesis, written by

Captain William R. Halsey

and

Captain Jeffrey G. Hooper

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN ENGINEERING MANAGEMENT

DATE: 28 September 1983

Alan E. M. Tucker

ALAN E. M. TUCKER, MAJOR
COMMITTEE CHAIRMAN

Charles R. Fenno

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READER

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CHAPTER 1

OVERVIEW

Chapter 1 presents an overview of the thesis. Background and justification for the study open the chapter, followed by the problem statement and the objectives of the research. The specific questions to be answered by the research are then enumerated. The scope and limitations of the research round out the overview.

Background

One important element in a strong national defense is well-trained personnel. For many military officers, being well trained means receiving appropriate graduate level education. The graduate programs offered by the Air Force Institute of Technology (AFIT) fulfill that role. For most Air Force civil engineering officers, the Master of Science in Engineering Management is the appropriate form of education for positions that require a graduate degree (20:26).

An engineer is a person who applies "scientific principles to practical ends [such] as the design, construction, and operation of efficient and economical structures, equipment, and systems" (21:433). The engineer also directs and controls the people, equipment, and other resources necessary to accomplish specific objectives. To direct and control these resources effectively, the professional engineer needs management skills.

In 1969, more than eighty percent of engineers surveyed by the Engineering Manpower Commission indicated that they "were regularly assigned to managerial duties" (33:275). Furthermore, according to the data of the Engineering Joint Council, "two-thirds of all engineers are likely to spend the last two-thirds of their careers as managers" (2:349).

Even though engineers spend much of their time performing managerial duties, most engineering curricula have not included subjects in management (2:349). Recognizing this deficiency, a number of universities have begun to offer engineering management programs at both the graduate and undergraduate level (33:275-276). In 1979, at least 70 colleges and universities were offering graduate programs in engineering management (17:350), and by June 1982 this figure had reached 100 (16:5).

Graduate programs in engineering management are designed for students who have technical undergraduate education. Engineering management programs provide students with the necessary background to handle the management aspects of the engineering profession (17:352; 33:275). The curricula of these programs vary, but usually include courses in operations research, management theory, and engineering economy. The other courses offered depend on the orientation of the program. Quantitative programs emphasize decision theory, statistics, and planning methodologies, while qualitative programs emphasize organizational theory and human behavior (17:350-351).

To provide suitable masters level management education for Air Force civil engineers, the Graduate Facilities Management (GFM) program

was developed by the AFIT School of Systems and Logistics in January 1973. The GFM program was 12 months in length and operated through June 1980. In June 1980, the program was extended to 15 months and renamed Graduate Engineering Management (GEM). The additional three months were added to allow students adequate time to complete course work and produce a quality thesis (19). By September 1982, one hundred fifty students had been awarded a Master of Science degree from the Facilities Management program and forty-nine students had earned the Master of Science degree from the Engineering Management program at AFIT.

Justification

The basic purpose of the GEM program is to prepare civil engineering officers to become effective engineering managers. As with any educational institution, AFIT must obtain feedback from the field so that the courses taught can be kept relevant to current needs. This study was undertaken to obtain such feedback.

Additionally, the current GEM program manager requested information concerning broader perspectives. He wanted to know if the graduates felt their AFIT education had affected their assignment selection and promotional potential. He also wanted to know the graduates' overall perception of the program. This information can be useful when attracting qualified applicants, as well as for program refinement.

Problem Statement

How useful is the GEM program in preparing civil engineering officers to become effective engineering managers? AFIT's GEM program consists of management, quantitative and qualitative courses, and a thesis. To meet its basic purpose in a dynamic environment, the program itself must be dynamic. The emphasis in a particular course might change, or courses may be deleted or added to meet particular educational needs. The problem then, involves determining the GEM program's ability to meet the needs of the ultimate user--officers in the civil engineering career field.

Research Objectives

The GEM program graduates and their supervisors are most qualified to evaluate the program's usefulness. Therefore, the objective of this thesis was to determine the perceived usefulness* of the AFIT GEM program in preparing civil engineering officers for engineering manager positions. The perceived usefulness was based on the subjective judgement of the graduate and the graduate's supervisor.

The primary research objective was to determine which subject areas are most useful to the graduates. The secondary objective was to

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*For this thesis, usefulness is defined as--
1. the degree to which particular courses help the graduates perform their current job, and
2. the degree to which the AFIT education is helping the graduate realize career goals.

determine the impact of the AFIT education on the graduates' career objectives.

Research Questions

In support of the research objectives, the following research questions were developed. The first three questions support the primary research objective--

1. Based on the perceptions of the graduates and their supervisors, knowledge in which subject areas (available in the GEM curriculum) is most helpful to the graduates on the job? This is a three part question--which subject areas do the graduates feel are most helpful, which subject areas do the supervisors feel would be most helpful, and which subject areas overall do the graduates and their supervisors feel are most helpful.

2. Based on the perceptions of the graduates and their supervisors, how should the GEM program curriculum be modified to meet current needs? In particular, what subject areas should be added to or deleted from the curriculum?

3. Based on the perceptions of the graduates, how suitable was AFIT's coverage of the subject areas contained in the curriculum? The purpose of this question was to determine if the emphases in the courses met the graduates' needs.

The secondary research objective was to determine the impact of the AFIT education on the graduates' career objectives. The following questions support this objective--

4. To what extent do the graduates feel that their AFIT education has influenced their assignment selection?

5. How do the graduates perceive that their AFIT education has affected their promotion potential?

6. To what extent do the graduates feel that the program has helped them become better engineering managers? The purpose of this question was to develop an overall perception of how well the program is meeting its basic purpose.

Scope and Limitations

As outlined in previous sections, this study relates directly to the basic purpose of the GEM program--to prepare civil engineering officers to become effective engineering managers. Primary interest lies in GEM and GFM graduates on active duty in the U.S. Air Force. Graduates who had separated from the Air Force and non-Air Force alumni were excluded from the study. The results of this study may be used by the GEM program manager to assess the need for change to the GEM curriculum.

There are many ways to assess the usefulness of an academic program. This research was limited to the perceptions of the direct users of the GEM program: the graduates and their supervisors.

CHAPTER 2

LITERATURE REVIEW

This chapter expands upon some of the background material presented in Chapter 1 and consists of three sections. The first section presents a history of engineering management education and a description of typical graduate programs in engineering management. The second section provides a history of AFIT's Graduate Engineering Management (GEM) program. The final section summarizes a review of research related to this thesis.

Engineering Management Education

As pointed out in Chapter 1, most engineers assume some type of management responsibility during their careers. According to a 1973 report by the Engineering Manpower Commission, as many as 82 percent of all engineers in the United States are involved in management (16:2). The type of management performed by these engineers is technical, for the most part. The term engineering management is commonly used to describe this type of management activity. Engineering management has been formally defined as "the art and science of planning, organizing, allocating resources, [and] directing and controlling activities which have a technological component" (33:275).

While engineers are often involved in managerial functions, they are usually not properly prepared by their formal engineering education for the intricacies of management decisions (16:2). Engineers

have also found that the rewards in industry are usually more favorable for those in managerial positions than in technical positions (17:350; 3:38). Thus, some engineers not specifically assigned to management positions have sought to enter management. For these reasons, numerous engineers are reeducating themselves through various business and management programs (17:350; 32:310). Some engineers have entered programs leading to the Master of Business Administration (MBA) degree, while others have pursued graduate degrees in engineering management (32:310).

Engineering management (EM) programs are generally distinguished from MBA programs in several ways. First, EM programs are usually designed for individuals with technical backgrounds, normally in engineering, while MBA programs accept persons with technical or nontechnical backgrounds. MBA programs normally are two years long and emphasize business topics. Graduate EM programs are one to 1.5 years long, and engineering students graduate "as engineers better able to perform their engineering functions" (24:811).

MBA programs have long been well established in academic communities, while EM programs have been developed more recently. As the emphasis on technology in the world economy has increased, resulting in an increased demand for engineering management programs, more and more educational institutions have begun to offer such programs, both undergraduate and graduate (33:275-276). Most of these programs have been at the graduate level (16:5; 33:276). In 1970, there were only 16 graduate level EM programs available. By 1979, 70 colleges and universities were offering graduate engineering management programs (Figure 1).

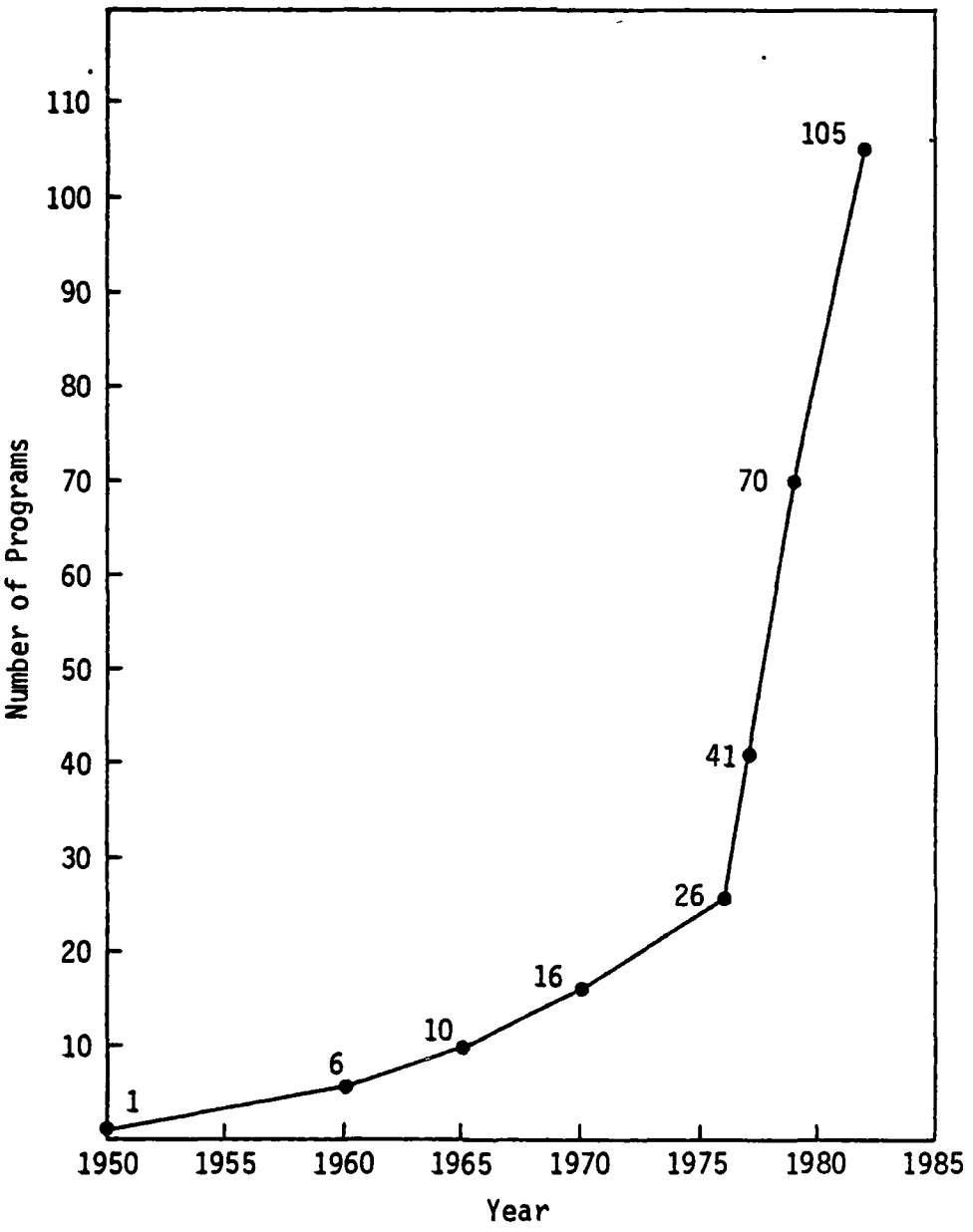


Figure 1. Growth of Graduate Level Engineering Management Programs (Adapted from 15:Fig. 1)

As of June 1982, 100 educational institutions--86 in the U.S. and 14 in foreign countries--had been identified as offering programs in engineering management. Twenty-eight bachelor, 87 master, and 18 doctoral degree programs in engineering management were available at these 100 institutions. (16:5)

In June 1982, Kocaoglu presented a paper (16) to the American Society for Engineering Education (ASEE) National Conference summarizing the results of a study of graduate engineering management programs. In this study, Kocaoglu surveyed 423 educational institutions worldwide. AFIT was one of these institutions. Of the 329 institutions that responded, 74 offering graduate level EM programs returned completed questionnaires regarding their programs. The results reported in the paper were based on these 74 surveys.

According to the 74 responses, various titles are used for the many engineering management-type programs presently available. "Engineering Management" is the most common title used, followed closely by "Management Option in Industrial Engineering" and "Engineering Administration." Most programs are administered by Schools of Engineering, but some are managed jointly by schools of Management and Engineering. (16:5)

Most of the EM programs include both part-time and full-time students. The average length of the full-time programs is 16 to 17 months. Part-time programs in the U.S. average 37 months and in foreign countries are about 31 months long. (16:5)

> The courses offered in Engineering Management Programs cover a wide area from mathematical modeling to organizational and behavioral concepts to economic decisions to advanced topics in engineering. [A] Masters degree in the USA typically requires 30-36 semester credits. About 60 percent of it is taken in core courses,

40 percent as electives. A Masters thesis is required in 28 percent of the programs, not required in 32 percent, and is optional in 40 percent. If a thesis is written, it is usually given 6 semester credits [16:15].

Most foreign programs require a thesis. The credit given for the thesis effort is about equivalent to that given in U.S. programs. (16:15)

Six major subject areas are usually covered in the core courses of the EM programs in the United States. These areas are quantitative, qualitative, functional, financial/economic, engineering, and projects (16:16). The aggregate percentage of core courses within each of the six subject areas is shown in Table 1.

The specific courses included in the various graduate engineering management programs depend on the particular emphasis given. More quantitative programs stress courses such as statistics, decision theory, and planning methodologies, while more qualitative programs stress courses in organizational theory and human behavior (17:351).

History of AFIT GEM Program

The Air Service Engineering School was established in 1919 at McCook Field, Dayton, Ohio, to provide special education in military aviation. This school was the forerunner of the Air Force Institute of Technology, which has operated (under various names) continuously since 1919, except for four years during World War II. The Institute received its present name in 1947 when the Air Force became a separate service. (1:2)

TABLE 1

Core Courses in EM Programs in the U.S.

Study Areas	Aggregate Percentage
1. Quantitative/Methodological Courses	
Operations Research:	14
Statistics:	11
Decision Theory:	5
Planning Methodology:	3
	33
2. Qualitative/Conceptual Courses	
Management Theory:	7
Behavioral Science/Personnel Mgt:	4
Organization Theory:	3
Strategic Planning Concepts:	1
Systems Theory/Policy Making:	1
	16
3. Financial Courses	
Finance/Engineering Economy:	11
Accounting:	2
	13
4. Project Courses	
Independent/Group Projects:	6
Project Management:	5
	11
5. Engineering Courses	11
6. Functional Courses	
Computers & Information Systems:	5
Marketing:	3
Productivity:	2
Engineering Law:	2
Communications:	1
Others: Case Studies, Manufacturing, Innovation, R&D Management, Ethics:	3
	16

(Adapted from 16:Table 6)

AFIT was authorized by the 83rd Congress in 1954 to confer degrees through its Resident College, which was later divided into three schools: Engineering, Logistics, and Business. In 1963, the School of Logistics was renamed the School of Systems and Logistics (1:2-3). That same year, the Systems and Logistics school began offering graduate degree programs (1:169).

Even though AFIT resident programs in management at the graduate level were then available, none were specifically designed for Air Force civil engineers. Thus, civil engineering officers were enrolled by the AFIT civilian institutions program in MBA or engineering administration programs at civilian graduate schools. These programs were designed to prepare students for management positions in a civilian business or industrial environment. Thus, the civilian programs were not considered totally suitable for the Air Force student, who would return to the Air Force work environment. (27:11)

In 1967, the AFIT Academic Director, H. W. Barlow, submitted a proposal for a master's degree program for civil engineering officers to Colonel Robert H. Armstrong, Director, Civil Engineering Center (4). The proposed program was similar to EM programs described in the previous section and was to be called either "Engineering Construction Management" or "Civil Engineering Management." The proposed curriculum was to include such courses as Survey of Economic Principles, Accounting, Federal Government Financial Management, Statistics, Operations Research, Computer Programming, Contract Law, Engineering Management, Behavioral Sciences in Management, Labor Relations, and Engineering Economy. The proposed program was to contain 48 hours: 33 credit-hours of required,

or core, courses and 12 credit-hours of elective courses with no thesis requirement. (4:Atch.1)

Additional correspondence and meetings concerning the establishment of a master's degree program for Air Force civil engineers eventually lead to the identification in 1971 of this requirement through the Air Force Education Requirements Board (23). The School of Systems and Logistics subsequently developed the M.S. program entitled "Facilities Management." Final approval for the program, often referred to as "Graduate Facilities Management," was given in Fall 1972 with an initial quota of 20 students annually (10 semiannually). The first group of seven students, Class 74A, enrolled in January 1973 (19:p.3-1). The initial GFM program included 57 quarter hours of credit and a thesis. The curriculum for Class 74A is shown in Table 2.

The GFM program was 12 months long and was conducted from 1973 to 1980. During this period, 150 students completed the program, graduating with an M.S. degree in Facilities Management. Between 1973 and 1980, the curriculum underwent a number of changes to improve the academic quality and relevance of the program. The curriculum for the 1980 class is also shown in Table 2. This curriculum consisted of 59 credit hours--53 graduate and 6 undergraduate (30:2).

As a result of program reviews conducted in 1978 and 1979, two problems in the Facilities Management program were identified (19:p.3-3). First, 12 months were insufficient time to produce a quality thesis in addition to the course work required in the GFM program. Second, the name "Facilities Management" neither correctly described the nature of the program nor was well regarded by the students.

TABLE 2

GFM Curricula

Class 74A	Class 80
Review Term	**Review Term**
English Review	Introduction to Computers
Quantitative Preparation	Introduction to Research
Introduction to Computer Programming	Quantitative Methods
Accounting	Accounting
First Term	**First Term**
Concepts in Management	Statistics I
Financial Mgt in Federal Government	Financial Mgt in Federal Government
Procurement & Acquisition Mgt	Operations Research I
Statistics I	Economic Analysis
	Contracting for Civil Engineers
Second Term	**Second Term**
Cost & Economic Analysis	Statistics II
Inventory Control & Management	Operations Research II
Statistics II	*Concepts & Techniques in Research*
Research Principles & Techniques	Organization & Mgt Theory
Third Term	**Third Term**
Seminar in Material Control & Transportation	Maintenance & Production Mgt
Maintenance Management	Analysis of Energy Issues
Systems Analysis	Analysis of Environmental Issues
Economic Analysis for CEs	Elective
Fourth Term	**Fourth Term**
Human Resource Mgt & Labor Relations	Organizational Behavior
Problems in Environmental Protection	Engineering Mgt Information Systems
Selective	CE Applications
Thesis	Thesis

(Adapted from 30:Fig.1)

At the April 1980 meeting of the Civil Engineering Program Review Committee, several changes to the GFM program were proposed. The proposed changes included strengthening the program's technical content, lengthening the program to 15 months, allowing for individually written theses (as opposed to team theses), and renaming the program as "Engineering Management" (26:7). The Program Review Committee endorsed the proposed program length and name changes (26:7), which were approved by Headquarters Air Force in May 1980 (19:p.3-5). These changes became effective in June 1980 with the enrollment of Class 81S. The 81S curriculum, which included 65 graduate and four undergraduate hours (for a total of 69 hours), is shown in Table 3.

In 1982, the Accreditation Board for Engineering and Technology (ABET) accredited AFIT's Graduate Engineering Management (GEM) program. The GEM program is the first graduate level engineering management program to receive the distinction of accreditation through ABET. (29:28) Also, the American Society for Engineering Education gave recognition to the GEM program by listing it, for the first time, in the March 1983 issue of their journal, Engineering Education. (18:435)

In July 1982, the Executive Engineering Management Symposia series was initiated with a speech by Major General Clifton D. Wright, Director of Civil Engineering. The series includes 10 to 12 presentations by top managers in Air Force Engineering and Services during the 15-month program. This part of the GEM program was instituted to provide students with "an understanding of executive-level management styles, programs, problems and decision-making processes" (29:28) to

TABLE 3

GEM Curricula

Class 81S	Class 84S
Review Term	**Review Term**
Introduction to Computers	Elements of Financial & Managerial Accounting
Algebra/Calculus Review	Introduction to AFIT Computer Systems
	Math Review for Engineering Managers
	Research Orientation
First Term	**First Term**
Managerial Statistics I	Managerial Statistics
Organization & Management	Computer Programming for Managers
Financial Mgt in Federal Government	Theory & Practice of Professional Communication
Communication for Managers & Analysts	Organization & Management Theory
Contracting for Civil Engineers	
Second Term	**Second Term**
Managerial Statistics II	Federal Financial Management
Operations Research I	Research Methods
Research Methods	Organizational Behavior
Computer Programming for Managers	Applied Data Analysis for Managers
Elective	Independent Study (Thesis)

TABLE 3 (Continued)

Class 81S	Class 84S
Third Term	**Third Term**
Economic Analysis and Public Policy	Engineering Mgt Information Systems
Organizational Behavior	Quantitative Decision Making
Operations Research II	Independent Study (Thesis)
Analysis of Energy Issues	Elective
Analysis of Environmental Issues	
Fourth Term	**Fourth Term**
Engineering Mgt Information Systems	Production Management
Production Management	Contracting for Engineers
Independent Study (Thesis)	Independent Study (Thesis)
Elective	Elective
	Elective
Fifth Term	**Fifth Term**
Civil Engineering Applications	Engineering Mgt Applications
Independent Study (Thesis)	Independent Study (Thesis)
Elective	Elective

(Adapted from 19:Fig.3; 30:Fig.1)

further prepare GEM students for the Air Force civil engineering roles they will assume.

The GEM program, just as the GFM program before it, has undergone several curriculum changes to assure continued academic quality and relevance. The curriculum for Class 84S, which enrolled in June 1983, is shown in Table 3. The total work load for the 84S program is 69 credit hours (63 graduate, six undergraduate), including a thesis.

Study of Tables 1, 2, and 3 shows that both the GFM and GEM curricula are comparable to the typical master's level engineering management program. However, the AFIT engineering management-type programs, past as well as present, emphasize research and written communication more than many other EM programs. In comparing the GEM and GFM programs, it is clear that more flexibility has been built into the GEM program, which includes four elective, or selective, courses versus one in the GFM program.

The quota for GEM students is presently 25 per year, as compared with 20 per year under the former GFM program. Also, there is only one class per year now. As of September 1982, 49 students had graduated from AFIT's Engineering Management program.

Review of Related Research

A number of studies have examined the appropriateness and/or usefulness of engineering education. Some of these studies are closely related to the purpose of this thesis--determining the perceived usefulness of the GEM program--while others are only remotely related. Also, several AFIT theses have investigated the usefulness of management

programs or curricula. The first part of this section reviews five studies dealing with engineering education; the second portion reviews six AFIT theses dealing with the usefulness of various programs or curricula.

Engineering Education Studies

The five studies reviewed here are difficult to categorize because each study had a different purpose. They will be reviewed in increasing order of relevance to this report.

In 1978, Schiff conducted a study (25:180) which identified several items related to communication skills of graduates of bachelor's programs in engineering. Schiff surveyed 905 Michigan Technological University engineering alumni, Classes of 1973 and 1976. Forty-one percent (367) of the alumni returned completed questionnaires. These graduates were from the engineering fields of chemical, civil, electrical, geological, mechanical, metallurgical, and mining. The respondents rated the importance of 30 specific communication tasks in accomplishing their jobs. The graduates also indicated how often they performed certain communication tasks.

Schiff used a 7-point Likert scale to rank the respondents' perceptions of the importance of the 30 communications skills to performance of their jobs. The ten highest ranked communication skills for job importance, based on their means, are shown in Table 4.

TABLE 4

Rank Order of Job Importance Responses
(Scale: 1 = least important, 7 = most important)

Rank	Communication Skill	Mean	Std. Dev.
1	One-to-one talks with technically sophisticated personnel	5.939	1.311
2	Writing using graphs, charts, and/or other illustrated aids	5.396	1.714
3	Project proposals (written)	5.332	1.817
4	Participation in a small group or committee made up of only technically sophisticated members	5.269	1.773
5	Instructions for completing a technical process (written)	5.244	1.832
6	One-to-one talks with non-technical personnel	5.072	1.907
7	Project progress reports (written)	5.061	1.630
8	Project proposal presentations (oral)	5.059	1.979
9	Writing to communicate technical information to non-technical audiences	4.916	1.940
10	Oral presentations using graphs, charts, and/or other aids	4.914	1.962

(Adapted from 25:Table 1)

Evidently, the respondents considered oral communication skills as important as written communication skills. Also, the respondents indicated that they had to display their speaking skills frequently (25:180). Schiff concluded that "developing the skills necessary for concise, personable, and convincing oral communication will require more attention from engineering colleges during the 1980s" (25:181).

In another study (14:210), Kimel and Monsees, of the University of Missouri-Columbia (UMC) College of Engineering, sent a survey to national employers of civil, electrical, and mechanical engineering graduates of UMC. The survey was also sent to the faculty of UMC's

Engineering College and to Kansas City members of the American Society of Civil Engineers, the Institute of Electrical and Electronic Engineers, and the American Society of Mechanical Engineers. The purpose of the study was to determine how qualified recent engineering graduates were to assume their engineering responsibilities and fulfill the needs of their employment.

About 2000 questionnaires were mailed to the companies and individuals described above. Four hundred-sixty responses to the survey were obtained. The respondents were asked to rate the importance of various attributes, or areas of competence, specifically related to each engineering field. The respondents also rated the capabilities of recent graduates (having one to five years' experience) with respect to the attributes listed. Though most of the attributes were different for each engineering practice area, some attributes overlapped. (14:211)

Respondents for all three engineering fields rated writing and speaking as one of the most important of 13 attributes--first in importance for civil and electrical engineers and second for mechanical engineers. However, the capability of recent engineering graduates in the area of written and oral communication was rated as less than adequate. Thus, Kimel and Monsees concluded that engineering educators, as well as administrators of junior and senior high schools, should place more emphasis on improving communication skills through required courses in both speaking and writing. (14:210,212)

The primary purpose of the third study in this review was to determine why engineering graduates and practicing engineers pursued the MBA (32:310,312). This study, conducted by Washbush in 1975, when

there were 26 or fewer engineering management-type programs, consisted of a survey of engineering graduates who were students in the Marquette University MBA program and supervisors of practicing engineers in the Milwaukee area. Washbush sent the survey to 57 students and 52 supervisors; 37 students and 38 supervisors returned completed questionnaires.

The open-ended survey included questions concerning deficiencies in the respondents' undergraduate programs and specific business-related course areas they felt engineering undergraduates should study, as well as questions regarding reasons for seeking the MBA. Deficiencies listed by most students and supervisors included practical applications and business/economics courses. Other deficiencies cited by students include engineering/computer courses, communication skills, social science/humanities, and human relations. Other deficiencies cited by supervisors included engineering courses, communication skills, and originality (32:311). The business-related study areas recommended for engineering majors are shown in Table 5.

The results of Washbush's study showed that students and supervisors generally agreed that engineers should study business at the undergraduate level. Washbush noted that this outcome was probably biased since the respondents worked for business organizations. However, he pointed out that "no engineer practicing his trade can be free from factors of cost, finance, marketing, and organizational relationships" (32:312-313). He further recommended that engineering programs should be planned to provide undergraduate engineers with the opportunity to

study business/economics course areas as part of their degree work if they desire such study (32:313).

TABLE 5

Business-Related Study Areas Recommended for Engineering Majors

Subject	Students (%)	Supervisors (%)
Accounting	21.8	25.8
Finance	19.1	12.4
Economics	17.3	15.7
Marketing	16.4	14.6
Organization & Behavior	11.8	15.7
Operations (Production)	10.9	5.6
Business Law	2.7	5.6
Other, including Data Processing, Labor Relations	0	4.5

(Adapted from 32:311)

The thrust of another study done in 1978 by Williamson and Pearce (34:353) of Vanderbilt University, was to determine how recruiting methods for engineering management could be improved. Their study is pertinent to this thesis in that the surveys sent out requested information concerning program deficiencies and the most valuable subjects in graduate level engineering management programs. The survey was sent to 211 people who were students in engineering management programs or alumni of such programs at nine American universities. Williamson and Pearce sent surveys to all of Vanderbilt's EM alumni and students, which represented 46 percent of the entire sample. Eighty-eight usable questionnaires, 44 of which were from Vanderbilt students and alumni, were returned.

The subjects listed as most valuable by the respondents included behavioral sciences, personnel management, psychology, and human relations. However, Williamson and Pearce pointed out that the emphasis of the Vanderbilt program is on the human side of management, so the results may have been biased. The next most valuable subject area mentioned was management theory, practice, and principles. Mathematical subjects were considered almost as important as the management courses. The specific subjects mentioned were operations research, probability and statistics, and quantitative methods and analysis. (34:355)

In the Vanderbilt study, the respondents were also asked if they felt that the time, effort, and expense they had invested in going through their respective EM programs had been worthwhile. Every respondent answered affirmatively. (34:355)

The fifth study (15:2) dealing with engineering education was concerned with the impact of the University of Pittsburgh's engineering management program (master's level) on the careers of the graduates. The thrust of this study, conducted by Kocaoglu, was on the overall benefits of Pittsburgh's EM program rather than on which courses are needed by engineers. Kocaoglu surveyed the 50 graduates who had completed Pittsburgh's master's degree program in EM by April 1979. Twenty-three graduates returned completed surveys.

The respondents were asked what jobs they had before and after entering the engineering management program. Also, they were asked if the EM program had had an impact on their careers in six categories, what their objectives had been for enrolling in the program, and the extent to which their objectives had been fulfilled. (15:6-9,14)

The majority of the respondents had engineering jobs before entering the engineering management program, as well as after. The jobs held by the respondents were categorized as engineer, senior engineer, engineering supervisor, and "other." Within each job category except "other," at least half of the graduates had moved up one level or more since completing the program. Six of the 23 respondents had moved up one level, and seven had moved up two levels. (15:7)

For the career areas impacted by the EM program, the respondents indicated which areas they felt their EM education had affected. The answers to this question are shown in Table 6.

TABLE 6

Career Areas Impacted by the University of Pittsburgh EM Program

Impact Category	% of Respondents Who Felt EM Program Had an Impact
1. Improved ability to handle technical management tasks	91
2. Increased decision-making capabilities in engineering and management	86
3. Increased visibility within the organization	82
4. Increased responsibilities	77
5. Promotion within company	55
6. Move to a better position in another company	45

(Adapted from 15:Table 7)

Kocaoglu stated that the objectives for enrolling in the EM program listed by the graduates were categorized as follows (15:14):

1. "Move from engineering/science specialty to technical management."

2. "Gain knowledge in engineering management techniques and state-of-the-art."

3. "Develop broad decision making capabilities within a technical organization."

4. "Career advancement within current company."

5. "Marketability."

6. "Management education other than MBA."

The respondents, overall, felt the program had fulfilled their objectives. The levels of fulfillment and the percentage of graduates choosing that level were "very high," four percent; "high," 70 percent; "uncertain," 22 percent; "low," zero percent; and "very low," four percent. (15:14)

The first three studies reviewed in this section identified deficiencies in undergraduate engineering programs. Because the emphasis in baccalaureate programs in engineering will undoubtedly continue to be technical in nature and because most of these programs are only four years long, some deficiencies, particularly in management and business-related areas, will probably continue to exist. In any case, the results of these three studies underscore the need for the curricula offered in most engineering management programs--specifically the courses in communication skills, both oral and written, and in management of resources, including personnel, materials, and funds. The fourth study's results indicate that the curricula of EM programs at a number of universities are of value to graduates on the job.

The results of Kocaoglu's study indicated that the University of Pittsburgh's engineering management program had had a positive influence on the careers of the program graduates. Also, the program

was meeting the objectives of most of the students. These results may or may not be indicative of engineering management programs in general.

AFIT Research

Of the six AFIT studies reviewed, four considered programs of the School of Systems and Logistics similar to the GEM program, and the other two dealt exclusively with the needs of Air Force civil engineers. The four "non-civil engineering" theses are reviewed first.

Crowder and Davidson carried out a study in 1978 (7) to determine how much graduates of management programs of the School of Systems and Logistics use their education. Those surveyed included graduates of the Logistics Management and Facilities Management programs, class years 1971 through 1975, and their supervisors. Their study analyzed survey responses from 217 graduates and 185 supervisors of graduates without any matching of responses from graduates with those from supervisors. The questionnaires sent to the graduates and their supervisors were almost identical, a fact which made comparison of the results quite easy.

Crowder and Davidson drew a number of conclusions from their analysis of the data. First of all, both graduates and supervisors felt that the Logistics Management program was useful. In addition, supervisors felt the program was more useful than the graduates thought their supervisors would. Finally, according to Crowder and Davidson, the graduates, as a group, felt they could better use their education in other assignments than in their present ones. (7:50,56-58)

In 1979, Brown and Hollingsworth conducted a study (5) similar to the one completed by Crowder and Davidson. Brown and Hollingsworth

surveyed 1963-78 alumni of the School of Systems and Logistics graduate management programs, including Facilities Management, but not their supervisors. The two researchers mailed 1045 questionnaires; 845 of these were returned and analyzed. The conclusions Brown and Hollingsworth reached, based on the data collected, include the following (5:57):

1. Graduates felt that attending AFIT had increased their promotion potential.

2. Graduates felt that the Graduate Logistics Management Program was useful to the Air Force as well as to themselves.

3. Graduates viewed their supervisors' opinions towards the AFIT program as being favorable.

4. Finally, graduates believed that the courses offered by the Logistics School were useful on the job, but that their assignments were inappropriate for the education they had received.

Brown and Hollingsworth also analyzed the graduates' perceptions of the usefulness of various courses available in the Logistics School at the time of the study. They found that Speech, Writing, Organizational Behavior, Analytical Techniques, Organization and Management, and Financial Management were considered by graduates to be the most useful (in order) of the 26 subject areas about which they were asked (5:34).

In a 1979 study of the perceived usefulness of the Systems Management Program (28), graduates of the 1969 through 1978 classes of the Graduate Systems Management program were surveyed. The purpose of this research, conducted by Speck, was to determine if the AFIT Graduate Systems Management (GSM) program was fulfilling Air Force

needs according to the perceptions of GSM graduates. Speck concluded, based on the 148 responses to his questionnaire, that "the GSM program as a whole seems to be meeting the needs of the program graduates" (28:59-60). He also determined that graduates felt more emphasis should be placed on practical applications and less on theory. The most needed courses, according to GSM graduates, were Oral Communication, Organizational Behavior, Technical Writing, Federal Financial Management, and Organizational Management. (28:52,56-57)

The remaining non-civil engineering study, completed in 1982 by Gillette and Wayne (11), involved measuring the usefulness of the Contracting and Acquisition Management (CAM) program through a survey of CAM graduates (classes of 1974B through 1981) and their supervisors. The researchers sent the survey to 105 active duty Air Force military and civilian AFIT CAM graduates and 78 of their supervisors. Seventy-seven graduates and 41 supervisors returned usable responses.

According to Gillette and Wayne, the respondents, both graduates and their supervisors, perceived that the CAM program was useful to the graduates in their postgraduate assignments. Also, graduate respondents' perceptions of the usefulness of the CAM program had not changed over time. Regarding the CAM curriculum, the graduate and supervisor respondents ranked the contracting specific courses as among the most useful to the graduates in their jobs. Based on the responses, Gillette and Wayne concluded that the AFIT CAM program had maintained topic currency and met the needs of the Air Force contracting/manufacturing community. (11:107-108,110)

The next two studies reviewed dealt exclusively with the needs of Air Force civil engineering.

A 1977 study (10), conducted by Gauntt and Stann, was concerned with the type of degrees (and level) required by base level civil engineering managerial staff and the most appropriate subject areas for improved capabilities of these personnel. To determine these needs, Gauntt and Stann analyzed 552 completed questionnaires, returned by the Base Civil Engineer, the Chief of the Programs Branch, the Chief of the Engineering and Construction Branch, and the Chief of the Operations and Maintenance Branch of 89 Air Force base civil engineering squadrons in the U.S. The major conclusions of the study, as stated by Gauntt and Stann, were as follows (10:40,42):

1. "Most, but not all, individuals entering Air Force Civil Engineering should have at least a bachelor's degree in an engineering discipline."

2. "The base level management positions needing master's level education need as many nontechnical as technical degrees."

3. "For those surveyed, there were more military managers with master's than military jobs needing master's degrees."

Gauntt and Stann also found that five of the ten courses which the respondents rated as most needed by base level civil engineering managers had been taken by less than 50 percent of the respondents. These five courses were Energy Conservation, Contracting for Civil Engineers, Environmental Resources Management, Financial Management, and Economic Analysis for Civil Engineers. (10:42,64)

In 1980, Johns and Ray completed a study (13) comparing the usefulness of the AFIT Graduate Facilities Management (GFM) program with similar programs offered at civilian institutions. They surveyed

graduates of both the AFIT GFM program (1972-79) and similar civilian university programs (1970-79). Their overall conclusion was that both AFIT GFM resident programs and similar civilian school programs are current and relevant, but that the AFIT program was more useful because of its Air Force orientation. The five courses determined to be most useful according to Johns' and Ray's analysis were Writing, Speech, Organizational Behavior, Organizational Management, and Leadership Theory.

It is evident from the studies reviewed that the graduate programs offered by AFIT's School of Systems and Logistics are perceived as useful by the graduates and their supervisors. Also, these studies demonstrate that surveying the graduates of both the GFM and the GEM programs and their supervisors is a very effective way to assess the perceived usefulness of the current GEM program.

Chapter Summary

The first section of this chapter included a brief history of engineering management education and a description of a "typical" master's degree program in engineering management. The history and development of the AFIT GEM program was presented to show that the program's growth and content parallel that of EM programs in general. Some of the research findings presented point out deficiencies in engineering education at the bachelor's level. Educational institutions have developed master's level programs in engineering management to alleviate many of these deficiencies. Other studies included in this review show that these engineering management programs are fulfilling

the needs of engineers, particularly in regard to their managerial duties. The AFIT theses provide current feedback on the perceived usefulness of management programs offered by the AFIT School of Systems and Logistics. Finally, all the studies reviewed in this chapter indicate that the use of surveys is an effective means for obtaining various kinds of information on educational programs--both engineering and management.

CHAPTER 3

METHODOLOGY

Chapter Introduction

A methodology is a system of methods used to conduct a scientific inquiry (31:841). This chapter outlines the methods used to answer the research questions developed in Chapter 1.

Emory (9:65-66) proposes a four level hierarchy of questions to guide a research project. The first level is the management problem or question which indicates the need for information and initiates the research process. The second level consists of questions relating to the objectives of the research effort. The third level is the specific questions the researcher must answer to satisfy the research objectives. The final level in Emory's hierarchy is the measurement level. At this level the researcher must develop the measurement questions used to gather information. Emory points out that research "questions are more typical in applied and descriptive studies; hypotheses are more common in causal and pure research" (9:66).

In this study the manager is the GEM program manager. His task is managing a program whose purpose is to educate civil engineering officers to become effective engineering managers. A natural management question is how useful is the current program to the ultimate users in the field. The objectives of this research project, comparable to Emory's second level, are to determine which subject areas are most

useful as perceived by the graduates and their supervisors, and to determine the impact of the AFIT education on the graduates' career objectives. The third level in the hierarchy is the questions outlined in Chapter 1 as the research questions. The final level is the measurement level, which involves decisions as to what information can be collected, how the information can be classified and described, and what type of analyses are appropriate to the information collected. Classification and analysis of the information gained through the measurement questions should provide the answers to the research questions, satisfy the research objectives, and ultimately provide the information necessary for the program manager to answer the management question.

This chapter describes the methods used in level four--the measurement level. The population of interest sets the initial bound on the collection of information and is described first, along with the method of sampling. The methods used to collect the information are then detailed, followed by a description of the measurement questions used. The methods used to describe and analyze the information conclude the chapter.

The Population and the Sample

The population of interest was GFM and GEM graduates on active duty in the U.S. Air Force. Often it is not practical or even possible to collect information from every source in a research population. So it is with this study. Although information was sought from every active duty Air Force GFM and GEM graduate and every graduate's

supervisor, it would have been unrealistic to expect that information could be obtained from each and every one. The subset of the population from which information was obtained was a sample of the population. From a sample, certain inferences can be made about characteristics of the population.

To properly draw inferences from a sample, the sample should be representative of the population. One commonly used method to obtain representative samples is randomization. Another method is sampling a large proportion of the population. In any event, the goal is to obtain a sample that is representative of the population.

The sample obtained in this study may not be random. Information was sought from every element of the population as in a census. One hundred fifty-four graduates and 154 supervisors were polled. Those who responded make up the sample. Sixty-four percent of the graduates and 47 percent of the supervisors provided the requested information. It is assumed that this sample is representative of the population and is equivalent to a random sample.

Data Collection

Research information can be gathered either by observation or interrogation (9:213). Interrogation was the method used in this study. As Emory suggests, "we can learn little about what a person knows or believes except by asking" (9:213). The information needed was the perceptions of graduates and their supervisors.

Due to the geographic dispersion of the population, the use of personal interviews to gather information was deemed impractical.

Telephone interviews were ruled out because of the volume of information requested. Mailed questionnaires were the most practical means to collect the information, so printed questionnaires were developed for information gathering. The package sent to each graduate included a graduate survey, a supervisor survey, and postage paid return envelopes. The graduates were asked to give the supervisor's survey and a return envelope to their immediate supervisor. The graduate and supervisor could then independently complete and mail the questionnaires. The questionnaires are described in the following section.

Besides being practical, mailed questionnaires have other advantages. The printed surveys allowed the respondents ample time to read the questions and supply the requested information. Since each graduate received the same package, personal interviewer bias was not a factor. The printed surveys also allowed the respondents a degree of anonymity. Additionally, by including the supervisor's survey in the package to the graduate, it was not necessary to determine the name and address of each supervisor.

Mailed questionnaires have disadvantages as well. The anonymity afforded by mailing can make nonresponse more appealing than with an interview. Anonymity and the impersonal nature of a mailed questionnaire may make it easier for the respondent to knowingly give untrue or misleading answers than with a personal interviewer (9:214). It is assumed that the respondents provided truthful answers and, as stated in the previous section, the sample obtained is representative of the population.

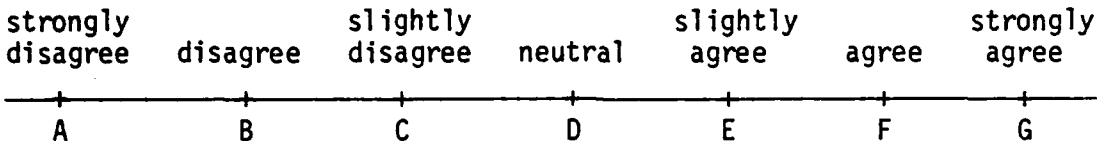
The Survey Instruments

Two surveys were developed, one for the graduates and one for their supervisors. The format of both surveys was patterned after one done by Crowder and Davidson in a similar study for the Graduate Logistics Management program (7:62-87). The graduates' and supervisors' surveys are shown in Appendix A. The graduate survey consisted of four parts. Part I requested demographic information, such as years of job experience and job organizational level. Part II was the longest section in the survey. The graduates were asked to evaluate the importance of each course or subject area in the GEM curriculum and to evaluate the suitability of AFIT's coverage of each subject area. Part III requested general information about the GEM curriculum and asked specific questions concerning the graduates' assignment selection and promotional potential. Part IV of the graduate survey asked open-ended questions, such as which subject areas should be added to or deleted from the curriculum.

The supervisors' survey was shorter. Part I requested demographic information and Part II asked the supervisors to evaluate the importance of the subject areas in the GEM curriculum. Part III of the supervisors' survey asked the supervisors the same open-ended questions that were asked of the graduates.

Nearly all the survey questions were multiple choice. The respondents could circle the appropriate answer directly on the survey. No computer scan answer sheet was required. A familiar seven point Likert scale was used in Part II for the questions about individual courses and in Part III of the graduate survey concerning general

questions. The scale is shown below.



Part II was the longest section in each survey. Both the graduates and the supervisors were asked to evaluate the importance of each course or subject area in the GEM curriculum. In addition, the graduates were asked to evaluate the suitability of AFIT's coverage of each subject area.

Prior to mailing, the graduate survey was pre-tested. Twenty-five AFIT GEM students were asked to complete the survey and comment on its format and content. Nineteen surveys were returned and the comments were generally favorable. Two students expressed dissatisfaction with the two-part question format in Part II. The format was not changed because separating the evaluations into two sections would have made the survey too long.

The 154 survey packages were mailed on April 20 and 22, 1983. July 11, 1983, was established as the final return date so that data analysis could begin.

Data Analysis

A first step in analyzing a set of information is to determine the nature of the data. Data are commonly classified according to the scale of measurement used--nominal, ordinal, interval, or ratio. Most of the survey questions used a Likert scale for responses. This type

of data is at least ordinal since the responses can be ordered or ranked from "strongly disagree" to "strongly agree."

For data to be considered interval scale, "the size of the interval between measurements, that is, the size of the difference (in a subtraction sense) between two measurements" (6:65) must be known. This requires the establishment of a zero point of reference and the assignment of numbers to the responses that accurately reflect the differences in responses. The fact that the survey responses were based on the perceptions of the respondents, suggests that any assignment of numbers to properly reflect the differences between the Likert scale responses would be arbitrary at best. As a result, the measurement level was considered ordinal. "The Likert scale is ordinal only . . . . We can report respondents are more or less favorable to a topic, but we cannot tell how much more or less favorable they are" (9:274).

Because the level of measurement had been determined to be ordinal, nonparametric statistical methods were used to analyze the data. "Most nonparametric methods assume the nominal or ordinal scale to be appropriate" (6:66). Nonparametric tests "are the only technically correct tests to use with ordinal data." (9:413)

To manipulate the data, the response "strongly disagree" was assigned the rank 1, "disagree" the rank 2, and so forth, with "strongly agree" being assigned rank 7.

Descriptive Statistics

Descriptive statistics are some of the simplest methods to analyze data. Frequency counts, the actual number of times each

response was selected for a question, are perhaps the simplest. Frequency counts give an overall picture of the pattern of responses. A measure of central tendency appropriate for ordinal data is the median. If the ranks of all the responses to a particular question are ordered from smallest to largest, the middle number is the median. If there is an even number of responses, the two middle ranks are averaged for the median. The response selected most often is the mode.

When reporting descriptive statistics, the authors included the mean and variance. Although these measures are applicable only for interval or ratio data, they do provide additional information. For these measures to be interpreted, it must be assumed that the difference in perception between each response is the same--one unit. That is, the difference between "neutral" and "slightly agree" is the same as the difference between "slightly agree" and "agree," and so forth. Again, the statistical tests applied in this thesis do not require this assumption of equal difference between responses because the tests were based only on the rank or relative order of the responses. The mean and variance are shown only to provide additional information, such as how the ties were broken when two subject areas had the same median.

Statistical Tests

Statistical tests are based on hypothesized characteristics of a population or populations. The hypothesis being tested is called the null hypothesis. Usually an alternative hypothesis is stated so that if the null hypothesis is rejected, the alternative hypothesis will be accepted. For example, the null hypothesis that a population median is

greater than four might be tested, with the alternative hypothesis being the population median is less than or equal to four.

To test the null hypothesis, a sample is collected from the population.

> The [null] hypothesis is tested on the basis of the evidence contained in the sample. The hypothesis is either rejected, meaning the evidence from the sample casts enough doubt on the hypothesis for us to say with some degree of confidence that the hypothesis is false, or accepted, meaning that it is not rejected [6:75].

The evidence contained in the sample is usually computed in the form of a test statistic. The test statistic is "used to determine how close a specific sample result falls to one of the hypotheses being tested" (12:352). An extreme value of the test statistic means that the evidence contained in the sample suggests the null hypothesis is false. A probability value (p-value), or the observed level of significance, expresses the probability of obtaining a test statistic as extreme as the one observed, when the null hypothesis is true.

To arrive at a decision to accept or reject the null hypothesis, a critical value is selected. If the decision maker is willing to accept a five percent chance of rejecting the null hypothesis when it is in fact true (Type I error), the critical level is set at 0.05. If the reported p-value is less than or equal to the critical level, the null hypothesis is rejected. In this case, the alternative hypothesis is accepted. If the reported p-value is greater than the critical level, there is insufficient evidence in the sample to reject the null hypothesis.

A critical level of 0.05 was selected for statistical decision making. However, the probability value will be reported for each

statistical test presented so readers may make their own statistical decision and interpretation, a procedure suggested by Harnett (12:351). The following paragraphs describe the statistical tests used and present brief examples of their application. The complete description of how the research questions were analyzed appears in the next section.

The Mann-Whitney Test

The Mann-Whitney test is used when there are samples from two populations. The test is used to determine if there is a difference in the population medians. The parametric counterpart for this test is the two sample t-test (6:215). While the t-test requires the assumption that both populations are normally distributed and have equal variances, the Mann-Whitney test requires only that the populations have similarly shaped distributions. The Mann-Whitney test then detects differences in the population medians. For example, Part II of both surveys asked respondents to evaluate the importance of subject areas. The two populations are the graduates and the supervisors. The null hypothesis that the graduates' and supervisors' perceptions are the same concerning the importance of the subject area can be tested. If the null hypothesis is rejected, it is concluded that the population medians are different. A comparison of the medians will show which population considers the subject area more important on the job.

The Kruskal-Wallis Test

The Kruskal-Wallis test is an extension of the Mann-Whitney test. The Kruskal-Wallis test, however, can examine the differences in several populations simultaneously. The equivalent parametric procedure is

called a one-way analysis of variance (6:237).

The graduates were asked if they felt their AFIT education enhanced their promotion potential. The populations considered are the different pay grades (2Lt, 1Lt, Capt, etc.). The null hypothesis that graduates of different pay grades have similar perceptions concerning promotion potential can be tested. If the null hypothesis is rejected, multiple comparisons are made to determine which populations have different perceptions.

Kendall's Tau

Kendall's coefficient of correlation is an appropriate measure of association for ordinal data. This measure was chosen over Spearman's coefficient because "Kendall coefficients are somewhat more meaningful when the data contain a large number of tied ranks" (22:289) as do data in this study. Kendall coefficients vary from -1 to +1.

Correlation coefficients measure association. Part II of the graduate survey asked for two evaluations about each subject area--importance to job and suitability of AFIT's coverage. If high ratings of importance are associated with high ratings of coverage and low ratings of importance are associated with low ratings of coverage, the correlation is positive and the coefficient will be near +1. If high ratings of importance are associated with low ratings of coverage, or vice versa, the correlation is negative and the coefficient will be near -1. A correlation near zero indicates little or no association.

One final note concerning statistical tests needs to be made before the particular applications used in this thesis are discussed. If a large number of statistical tests are performed, there is a chance

that some of the tests will incorrectly reject the null hypothesis. For example, if 100 statistical tests are made with a critical level of 0.05, the investigator might expect that five of the 100 tests will incorrectly suggest rejection of a true null hypothesis due to chance or random error. Such is the nature of statistical testing. This is another reason why the probability value has been reported in this study for each statistical test presented. "Statistical data are always more valuable to the user when their scope and limitations are known and taken into account" (8:82).

Applied Analysis

This section describes how the research questions were answered. Each research question is stated, followed by the methods used and the analysis performed to answer that question.

> 1. Based on the perceptions of the graduates and their supervisors, knowledge in which subject areas (available in the GEM curriculum) is most helpful to the graduates on the job?

Part II of both surveys was designed to obtain the information necessary to answer this question. Each subject area in the curriculum was listed, followed by several phrases that described the general content of each subject area. Of the two evaluations asked about each subject area on the graduate survey, the evaluation dealing with the importance of the subject on the job was applicable to this research question.

The respondents were asked to read the description of each subject area and then circle the Likert scale response corresponding to their answer. The specific statement to be used by the graduates in the

evaluation was, "A person doing my current job should be knowledgeable in this subject area." The supervisors considered the statement, "A person in this position should be knowledgeable in this subject area," to make their evaluation.

Initially, a direct statement such as "Knowledge in this subject area is helpful to me on the job," was contemplated for the graduates' evaluation. However, a statement such as this was judged too personal and capable of arousing emotions that could bias the responses. For example, if knowledge in a certain subject area was important on the job, and the graduate did not feel very knowledgeable in that area, the response might be biased. In addition, care was also needed to avoid giving the impression that the graduate's responses would be used to make a personal evaluation of the respondents, even though names were not requested on the survey. The statements in the preceding paragraph were used to avoid these pitfalls.

Descriptive statistics were used to answer this research question. The median response was computed for each subject area. A list of the subject areas was made, ranking the areas from highest median to lowest. When subject areas had the same median, the mean was used to break ties. The subject areas ranked at the top of the list were considered most useful and the subject areas near the bottom of the list the least useful.

Initially, two lists ranking the courses were made--one based on the perceptions of the graduates and one based on the perceptions of the supervisors. Comparing the two lists provided an indication of where the perceptions of the graduates and supervisors differed. The

Mann-Whitney test was used, as described earlier, to determine where the actual differences were. Finally, the responses of the graduates and the supervisors were combined and the courses again ranked. This final ranking was used to answer the research question. The Statistical Package for the Social Sciences (SPSS version 8.0) was used as an aid in the analysis. The computer programs used with this package and the data files are shown in Appendix E.

The evaluations of importance made by the graduates and supervisors in Part II of their surveys were for the courses currently offered in the GEM curriculum. To provide the program manager an additional range of perceptions, open-ended questions were used. The graduates were asked to list five subject areas in which competency is most important on the job. The supervisors were asked to list the five subject areas in which competency is most important to the people they supervise. Both groups were asked to list the subject areas in order of importance. The subject areas, of course, were not limited to those offered in the curriculum.

To analyze these responses, a simple method of scoring was used. The subject area at the top of a respondent's list was assigned a score of "5", the second in the list a score of "4", and so forth. If more than five subject areas were listed, the additional areas were assigned a score of "1". The scores were totaled for each subject area, and the subject areas ranked from the highest score to the lowest. The subject areas ranked at the top of the list were considered to be most important, as perceived by the graduates and their supervisors. Again, the results

of this analysis were shown to provide the program manager additional information on which to base his decisions.

2. Based on the perceptions of the graduates and their supervisors, how should the GEM program be modified to meet current needs?

The approach taken to answer the first research question might suggest the degree of emphasis to be placed on the individual subject areas. This same approach was taken to determine the graduates' perceptions of the emphasis given to written research reports, computer applications, and the degree of theory versus practicality of the courses offered in the curriculum. However, open-ended questions were used to directly answer the research question.

Two statements were used to evaluate the graduates' perceptions of written research reports. The 7-point Likert scale was used for the responses. The first statement asked the graduates if the written papers required in the courses enhanced their knowledge of course material or related subject areas. The second statement asked if the graduates would have preferred to take more management and technical courses in lieu of completing a thesis. The median response was computed for each statement and the extent to which the graduates agreed or disagreed with the statements provided an indication of how they felt about the emphasis on written research reports.

To determine the graduates' perceptions of the emphasis on computer applications, they were asked to evaluate the statement, "My job requires the use of a computer." To analyze the graduates' perceptions of the amount of theory and practical applications in the content of the courses, two parallel statements were used. All three

of these statements used the 7-point Likert scale for responses. The median response was computed for each statement. The extent to which the graduates agreed or disagreed with these statements provided an indication of how they felt about the emphasis on computer applications, and the balance between theory and practical applications in the courses.

To completely answer the research question, open-ended questions were necessary. Part III of the supervisors' survey and Part IV of the graduate survey asked the respondents to list the subject areas they recommended adding to or deleting from the GEM curriculum. Those recommendations were summarized and tabulated to answer the research question.

In June 1980 the GFM program was extended to 15 months and renamed the GEM program. To investigate the effect of this change, the graduates were asked to evaluate the length and workload of their program. The Mann-Whitney test was used to determine if the graduates of the two programs felt differently about the length of the program and the program workload. For example, the graduates of the GFM program might perceive the length of their program as a little short while GEM graduates might perceive the length of the program to be about right. The two populations were graduates of the GFM and GEM programs. SPSS was used as an aid in this analysis.

3. Based on the perceptions of the graduates, how suitable was AFIT's coverage of the subject areas contained in the curriculum?

The second evaluation in Part II of the graduates' survey was devised to obtain the information necessary to answer this research

question. Rather than potentially bias responses by providing a list of factors to consider, the evaluation was left open ended. The statement that prompted the evaluation for each subject was, "AFIT's coverage of this subject area was suitable." Using their own job experiences, the graduates could consider the factors they deemed appropriate to make the evaluation.

A secondary method to provide supplementary information to answer this research question was a check for correlation. Kendall's coefficient of correlation was computed for each subject area to check for association between the perceptions of importance and the perceptions of coverage. Negative correlation indicated that the subject areas considered important were not covered suitably while the subject areas not considered important were covered well. Positive correlation indicated that the subject areas considered important were covered suitably and the subject areas not considered important were not covered suitably. This measure provided additional, limited information to answer the research question.

4. To what extent do the graduates feel their AFIT education has influenced their assignment selection?

Two questions in Part III of the graduate survey were included to provide the necessary information to answer this question. The first question asked whether the graduates perceived their AFIT education had had an influence on their first assignment following graduation. Graduates are usually assigned to a base that has a job opening for a position requiring an advanced academic degree code appropriate to the graduate's speciality. The second question asked if the graduates

perceived their AFIT education had an influence on their later, follow-on, assignments. The 7-point Likert scale was used for the responses.

The median response was calculated for each question. A median response less than 3.5 was interpreted to mean the graduates felt their education was not considered in their assignment selection. A median response between 3.5 and 4.5 was interpreted as no significant impact, between 4.5 and 5.5 as a slight impact, between 5.5 and 6.5 as a definite impact, and above 6.5 as a strong impact on their assignment selection.

5. How do the graduates perceive that their AFIT education has affected their promotion potential?

Part III of the graduate survey asked the graduates to evaluate the following statement: "My AFIT education has enhanced my promotion potential." The same Likert scale was used for the responses. The median response was computed. A median response less than 3.5 was interpreted as meaning the graduates perceived their AFIT education has not enhanced their promotion potential. A median response between 3.5 and 4.5 was interpreted as no appreciable effect, between 4.5 and 5.5 as a slightly positive effect, between 5.5 and 6.5 as a definite positive effect, and above 6.5 as a strong positive effect on their promotion potential.

6. To what extent do the graduates feel that the program has helped them become better engineering managers?

Two evaluations were sought in the graduate survey to determine how much of their AFIT education the graduates used on the job. The first statement was an evaluation of how much of their AFIT education they used on their first assignment following graduation. The second

statement was a similar evaluation about later, follow-on assignments. The median response on the 7-point Likert scale was computed for each statement. The extent to which the graduates agreed or disagreed with these statements provided an indication of how much of their AFIT education the graduates felt they used on the job.

To directly answer the research question, the graduates were asked to evaluate the following statement: "My AFIT education has prepared me to become an effective engineering manager." The median response was computed from the sample. The Likert response corresponding to the median was used to determine the extent the graduates felt the program has helped them. A median response less than 3.5 was interpreted as meaning the graduates felt the program had not helped them become better engineering managers. A median response between 3.5 and 4.5 was interpreted as no appreciable help, between 4.5 and 5.5 as slight help, between 5.5 and 6.5 as definite help, and above 6.5 as strong help.

One other evaluation was used to determine the graduates' overall perception of the program. The graduates evaluated this statement: "I would recommend the GEM (formerly GFM) program to other civil engineering officers." The extent to which the graduates agreed with this statement was used as an indication of how useful they perceived the program to be.

The final open-ended question in each survey provided a forum for the respondents to comment on the GEM program. Those comments are summarized in Appendix C.

CHAPTER 4

ANALYSIS AND RESULTS

This chapter is made up of two sections. The first section outlines the demographic information that describes the sample. The second section presents the results of the analyses described in the previous chapter.

Demographic Information

The purpose of this section is to describe the demographic characteristics of the respondents. The information is provided in table form and serves as a background for the analysis that follows.

The Graduates

Rank. Table 7 shows both the absolute numbers and relative percentage of the ranks of the graduates when they responded to the survey.

TABLE 7

Ranks of the Graduate Respondents

Rank	N	%
2Lt	3	3.0
1Lt	8	8.2
Capt	49	50.0
Maj	27	27.6
Lt Col	9	9.2
Col	1	1.0
No Response	1	1.0

Job Experience and Service Time. Table 8 shows the number of years of experience the graduates had in their current job and their total years of service in DOD organizations.

TABLE 8

Graduates' Job Experience and Service Time

Years	Job Experience N	Job Experience %	Service Time N	Service Time %
1 or less	20	20.4	1	1.0
between 1 and 3	19	19.4	2	2.0
between 3 and 5	14	14.3	13	13.3
between 5 and 7	15	15.3	9	9.2
between 7 and 9	11	11.2	6	6.1
9 or more	19	19.4	67	68.4

Job Categories and Organizational Level. Table 9 summarizes the job categories held by the graduate respondents. Table 10 shows the organizational level at which they work.

TABLE 9

Graduates' Job Categories

Job Category	N	%
Programming/Planning	16	16.3
Design & Engineering Mgt	11	11.2
Construction/Project Mgt	11	11.2
Fire Protection	4	4.1
Operations (Chiefs)	7	7.1
Resources & Requirements	6	6.1
Readiness	4	4.1
Inspection	5	5.1
Systems/Information Mgt	4	4.1
Command (Commanders)	3	3.1
C.E. Staff Officers	5	5.1
Non-Civil Engineering	19	19.4
No Response	3	3.1

TABLE 10

Graduates' Job Organizational Level

Organizational Level	N	%
Squadron	39	39.8
Group	3	3.1
Wing	3	3.1
Air Division	2	2.0
Majcom	22	22.4
HQ USAF	13	13.3
Other	16	16.3

Class Representation. In the last nine years, there have been fifteen graduating classes from AFIT GFM and GEM programs. The last two classes were from the GEM program. Table 11 shows the number of graduates polled and the number of respondents for each year. The final column represents the yearly percentage of all graduates who responded. The earlier classes graduated twice a year, were smaller, and had fewer graduates still on active duty.

TABLE 11

Class Representation

Graduating Class	No. Polled	Number of Respondents	% of Graduate Respondents
74A,B	4	0	0
75A,B	17	12	12.3
76A,B	12	9	9.1
77A,B	24	17	17.4
78A,B	17	7	7.1
79A,B	13	10	10.2
80J	27	10	10.2
81S	17	14	14.3
82S	23	19	19.4

Education Information. Table 12 shows the graduate responses to the question, "My current job requires an advanced academic degree code."

TABLE 12

Degree Code Information

Response	N	%
Yes	25	25.5
No	60	61.2
Don't Know	12	12.3
No response	1	1.0

Table 13 shows the formal education activity completed by the graduates since graduation from AFIT.

TABLE 13

Further Formal Education

	N	%
No formal education activity	75	76.5
Additional B.S.	1	1.0
Some additional graduate work	8	8.2
Additional M.S.	2	2.1
Ph.D.	0	
Other	11	11.2
No response	1	1.0

Those graduates that clarified their "other" response listed Professional Military Education (PME).

The Supervisors

Managerial Experience and DOD Service. Table 14 summarizes the years of managerial experience and Department of Defense (DOD) service of the supervisors who responded to the survey.

TABLE 14

Supervisors' Managerial Experience and Years of Service in DOD

Years	Managerial Experience N	Managerial Experience %	DOD Service N	DOD Service %
1 or less	3	4.2	0	0
between 1 and 3	13	18.1	1	1.4
between 3 and 5	8	11.1	1	1.4
between 5 and 7	5	6.9	1	1.4
between 7 and 9	5	6.9	2	2.8
9 or more	38	52.8	67	93.0

Job Organizational Level. Table 15 shows the organizational levels where the supervisors work.

TABLE 15

Supervisors' Job Organizational Level

Organizational Level	N	%
Squadron	27	37.5
Group	6	8.3
Wing	5	6.9
Air Division	4	5.6
Majcom	18	25.0
HQ USAF	9	12.5
Other	3	4.2

Job Categories. Table 16 shows the job categories of the supervisors.

TABLE 16

Supervisors' Job Categories

Job Category	N	%
Programming/Planning	3	4.2
Design & Engineering Mgt	12	16.7
Construction/Project Mgt	2	2.8
Fire Protection	1	1.4
Operations (Chiefs)	8	11.1
Resources & Requirements	2	2.8
Readiness	3	4.2
Inspection	4	5.5
Systems/Information Mgt	3	4.2
Command (Commanders)	13	18.0
Directorate/Division (Chiefs)	5	6.9
Housing & Services	2	2.8
Non-Civil Engineering	13	18.0
No Response	1	1.4

Analyses Results

This section presents the results of the analyses described in Chapter 3. The tables presented in this section are abbreviated for ease in reading. Complete tables are provided in Appendix B.

Usefulness of Subject Areas

Both the graduates and the supervisors were asked to evaluate the usefulness of the subject areas offered in the GEM curriculum. Those subject areas with a median response of 6.0 or higher are shown in Table 17. A median of 6.0 or 7.0 reflects that the respondents agree or strongly agree that the subject area is useful.

TABLE 17

The Most Useful Subject Areas as Perceived by Graduates and Supervisors

Rank	Graduates	Supervisors
1	Communication	Communication
2	Organizational Behavior	Organizational Behavior
3	Organization and Management	Organization and Management
4	Contracting for Engineers	Contemporary Leadership
5	Mgt Information Systems	Supervision Seminar
6	Contemporary Leadership	Engineering Mgt Applications
7	Engineering Mgt Applications	Mgt Information Systems
8	Supervision Seminar	Contracting for Engineers
9	Construction Cost Estimating	Federal Financial Management
10	-	Environmental Issues
11	-	Construction Cost Estimating
12	-	Contingency Engineering
13	-	Energy Issues
14	-	Computer Programming
15	-	Production Mgt

Only one subject area, microeconomics, had a median response less than 4.0 or "neutral" for either the graduates or the supervisors. The median response of the graduates was 3.0 for this subject area, indicating that the graduates slightly disagreed with the statement, "A person doing my current job should be knowledgeable in this subject area." A complete list of the ranking of all 27 subject areas by the respective groups appears in Appendix B. Also shown in Appendix B are

tables of descriptive statistics for each subject area evaluated by the two groups.

The Mann-Whitney test was used to investigate differences between the graduates and supervisors in their perceptions of the usefulness of the subject areas. During the encoding of survey responses, the authors noted that the evaluations, or relative rank of importance of each subject area, of the supervisors tended to be higher than those for the graduates. This observation was substantiated during the statistical analysis. The mean of the ranks of importance for the supervisors was higher than the corresponding evaluation by the graduates for every subject area. This diminished the usefulness of this statistical tool to determine which subject areas the graduates and supervisors disagreed on regarding importance. At the established critical level (0.05), 17 of the 27 subject areas were perceived to be more important by the supervisors than by the graduates. The pattern of responses, however, suggests that the supervisors generally tended to rate all subject areas higher in importance than did the graduates. Table 29 in Appendix B lists all the subject areas. The table ranks the subject areas from the greatest to the least difference in perceptions. The observed critical level of the statistical test is shown for each subject area.

To determine the overall usefulness of each subject area as perceived by both the graduates and the supervisors, the evaluations of both groups were combined. Table 18 shows the most useful subject areas, according to the perceptions of the graduates and their supervisors. These subject areas had a median response of 6.0 or higher, which means

the respondents agreed or strongly agreed that the subject area was useful. A complete ranking of all 27 subject areas is provided in Appendix B.

TABLE 18

The Most Useful Subject Areas: Joint Evaluation by Graduates and Supervisors

Rank	Subject Area
1	Communication
2	Organizational Behavior
3	Organization and Management
4	Contemporary Leadership
5	Supervision Seminar
6	Contracting for Engineers
7	Engineering Management Applications
8	Management Information Systems
9	Federal Financial Management
10	Construction Cost Estimating
11	Computer Programming
12	Contingency Engineering

To provide the program manager with additional information for decision making, the respondents were asked an open-ended question: the graduates and supervisors were asked to list five subject areas they felt were most important on the job. The responses to this open-ended question were not limited to subject areas offered in the GEM

curriculum. Their responses were tabulated and scored as discussed in the previous chapter. The most useful subject areas as determined by this open-ended evaluation are shown in Table 19. All of the subject areas included in this table had a score of 35 or higher.

TABLE 19

The Most Useful Subject Areas as Determined by Open-ended Evaluation

Rank	Subject Area
1	Communication
2	Organization and Management
3	Contracting for Engineers
4	Organizational Behavior
5	Contemporary Leadership
6	Engineering Management Applications
7	Federal Financial Management
8	Supervision Seminar
9	Technical Expertise
10	Management Information Systems
11	Quantitative Decision Making
12	Construction Cost Estimating
13	Computer Programming
14	Contingency Engineering

A comparison of Tables 18 and 19 shows reasonable agreement in the rankings of the most useful subject areas using the two methods

previously discussed. All twelve of the most useful subject areas listed in Table 18 are also included in Table 19. The overall agreement between the two methods of ranking the usefulness of the subject areas provides strong support for the validity of the surveys.

Technical expertise is evidently regarded as important on the job by a number of graduates and their supervisors. However, Air Force civil engineering officers develop technical expertise through their undergraduate engineering education, experience on the job, and short course work at the AFIT Civil Engineering School. Technical competence can be developed to only a limited extent in the GEM program, as its purpose is to develop managerial competence in engineering officers.

The high ranking of Quantitative Decision Making compared with the ranking of 22 based on median response (Appendix B) may be due to the authors' subjective categorization of the subject areas listed by the respondents. Subject areas such as "decision-making ability" and "problem-solving ability" were classified as Quantitative Decision Making. The respondents may have been thinking, as for technical expertise, of abilities developed through experience, or of other subject areas. Engineering Management Applications, Organization and Management, and Production Management include some of the same topics as Quantitative Decision Making.

Suggested Program Modifications

Multiple choice questions using the 7-point Likert scale were used to determine the graduate's perceptions of the emphasis given to written research reports, computer applications, and the degree of theory

versus practical nature of the courses offered in the GEM curriculum. The graduates agreed (median response 6.0) that written papers for courses enhanced their knowledge of course material or related subject areas. They also slightly agreed (median response 5.0) with the statement, "I would have preferred to take more management and technical courses instead of completing a thesis." The graduates perceived communication to be the most useful subject area. Perhaps they prefer to gain the writing skills of this subject area in course papers rather than the thesis.

The graduates disagreed (median response 2.0) with the statement, "I feel that the content of the courses was too practical in nature." The graduates felt neutral (median response 4.0) about the statement, "I feel the courses dealt too much with theory." This suggests that, while the amount of theory presented in the courses is about right, more emphasis could be placed on practical applications. Also, in response to the final open-ended question, seven of the graduate and supervisor respondents suggested that more emphasis should be given to practical applications in the GEM program.

The graduates slightly agreed (median response 5.0) to the statement, "My job requires the use of a computer." Out of the 27 subject areas, the graduates ranked computer programming as the twelfth most important. This suggests that orientation to and use of the computer are useful in the GEM curriculum. In the final open-ended question, two respondents indicated that computer applications and programming should be emphasized. Two others stated that the coverage

was inappropriate and one felt that inclusion of this subject area was questionable.

In June 1980, the GFM program was expanded to 15 months and renamed the GEM program. The Mann-Whitney test was used to determine if the graduates of the two programs felt differently about the length of the program and the program workload. The median response for the GFM graduates (4.0) indicates that they felt the workload was a little heavy, and the median response for the GEM graduates (3.0) indicates that they felt the workload to be about right. The observed significance level of the Mann-Whitney test (0.296), however, suggests that this difference is not significant. Concerning the program length, the median for GFM graduates (4.0) indicates that they felt the length to be a little short, while the median for the GEM graduates (3.0) indicates they felt the length of the program to be about right. The significance level of the Mann-Whitney test (0.007) indicates that this difference in perception is significant. So while the graduates of both programs feel about the same concerning the program workload, the perceptions differ significantly about the program length, with the GFM graduates feeling that the length was a little too short.

Seventy-six percent of the graduate respondents provided various recommendations for modifying the GEM curriculum in the open-ended questions. However, only 42 percent of the supervisors provided specific suggestions for modifying the curriculum. The specific subject areas recommended for addition to the GEM program cover a wide range of topics related to civil engineering. In general, these subject areas can be categorized into broader study areas. The categories of courses most

frequently cited (by four or more respondents) as needing increased emphasis in the GEM program are shown in Table 20. A more detailed listing of the suggested additions/modifications is provided in Appendix D.

TABLE 20

Subject Areas Recommended by Four or More Respondents for Increased Emphasis in GEM Program

Subject Area	N
Technical Electives	10
Contracting	9
Computer Programming/Applications	8
Communication	7
Engineering Economy	6
Federal Financial Management	4
Comprehensive Planning	4
Personnel Management	4
Project Management	4

Specific technical electives listed by the graduates, in addition to those presently available, include airport planning and design, mechanical systems (heating, ventilating, and air conditioning), electrical courses, structural steel, structural engineering, and maintenance engineering.

Subject areas recommended for deletion from the GEM curriculum by four or more respondents are shown in Table 21. A minor difficulty was encountered when summing the number of respondents who recommended

deleting microeconomics or macroeconomics. Eight of the respondents listed economics as a course which should be deleted, 12 listed microeconomics, and five listed macroeconomics. It was impossible to tell if the respondents who listed economics were referring to microeconomics, macroeconomics, or both. For that reason, all references to economics were combined and placed in the economics subject area shown in Table 21. Engineering Economy, however, is not included in this classification since it is strictly an applications course, not an "economics" course. The complete table of recommended deletions is shown in Appendix B.

TABLE 21

Courses Recommended for Deletion from GEM Program by Four or More Respondents

Subject Area	N
Economics	25
Statistics II	14
Production/Manufacturing	9
Thesis	8
Statistics I	8
Quantitative Decision Making/ Operations Research	6
Research Methods	5
Transportation/Delivery	4
Federal Financial Management	4

Evidently, Statistics II and Economics were considered two of the least useful courses by the graduate and supervisor respondents. This result corresponds well with the ranking of the subject areas based on median responses. Statistics II ranked 24, Macroeconomics ranked 25, and Microeconomics ranked 27.

Apparently some graduate respondents were uncertain whether the transportation and manufacturing courses they had taken are still required. A number of the respondents recommended deletion of these two courses from the GEM program. In fact, the transportation and manufacturing courses had already been deleted.

Three of the eight respondents listed above recommended making the thesis optional. Other respondents made suggestions regarding the thesis in response to the final open-ended question. Two recommended making it optional, one recommended deleting the requirement, and two suggested that it should be more practically-oriented.

Coverage of Subject Areas

Part II of the graduates' survey asked for two evaluations about each subject area in the curriculum. The graduates evaluated the importance of each subject on the job and the suitability of AFIT's coverage of each subject. To check for association between the perceptions of importance and perceptions of coverage, Kendall's coefficient of correlation was computed for each subject area. Only two subject areas, foundations engineering and construction cost estimating, had negative correlation. There were few responses for coverage in these two courses, eight and 14 respectively, and the correlation was not significant. The remaining 25 subject areas were positively correlated. In

all, 20 of the 27 subject areas showed significant positive correlation between the graduates' perceptions of importance and their perceptions of coverage. This means that the graduates felt that the most useful subject areas were covered well and the least important subject areas were not covered well. Appendix B contains a table of the subject areas with the computed correlation coefficients and the observed significance levels.

To determine which subject areas were covered most adequately, the median response was computed for each subject. Twenty of the 27 subject areas had a median of 6.0 or higher, which indicates the graduates agreed or strongly agreed that AFIT's coverage was suitable. Table 22 shows the 10 subject areas that the graduates felt were covered best.

TABLE 22

The 10 Most Adequately Covered Subject Areas

Rank	Subject Area
1	Timber Design
2	Organization and Management
3	Organizational Behavior
4	Statistics I
5	Communication
6	Engineering Economy
7	Quantitative Decision Making
8	Statistics II
9	Labor Relations
10	Thesis

A complete list of all 27 subject areas, from best covered to least covered, is shown in Appendix B.

Influence on Assignments

Upon graduation, AFIT alumni are usually assigned to a base that has a job opening for a position requiring an academic degree code appropriate to the graduate's specialty. The graduates were asked if they felt their AFIT education was considered by the Air Force Manpower and Personnel Center in determining their initial assignment. The median response to this question, 6.0 on a seven point scale, indicated that the graduates felt that their AFIT education had a definite impact on their initial assignment after graduation.

A similar question was asked to determine their perceptions about later, follow-on assignments. The median response to this question, 4.0, indicated that the graduates felt that their AFIT education had no significant impact on follow-on assignments.

Four of the graduates, in their responses to the final open-ended question, stated that they had not used their AFIT education because of inappropriate assignments.

Effect on Promotion

In a direct question, the graduates were asked if they felt their AFIT education had enhanced their promotion potential. The median response, 6.0, indicated that the graduates felt that their AFIT education definitely had a positive impact on their promotion potential.

The Kruskal-Wallis test was used to determine if there were differences in the perceptions of the different military ranks, or pay

grades concerning the effect of this AFIT education. The observed significance level of this test was 0.301, which indicates that there is no significant difference in the perceptions of impact on promotion potential among the different ranks.

Overall Usefulness

The graduates were asked if they were able to use a significant portion of their AFIT education on their first assignment following graduation and on later assignments. The 7-point Likert scale was used for the responses. The median response concerning their first assignment was 5.0 (slightly agree), which indicates that they used a good portion of their education on their first assignment. The median response about later, follow-on assignments was 5.5. This indicates that the graduates felt they use more of their AFIT education in later assignments, when they assume middle and upper level management positions.

As another indication of how the graduates perceived the program overall, the graduates were asked if they would recommend the GEM program to other civil engineering officers. The median response to this question, 6.0, indicates that the graduates would recommend the program to others.

The primary question used to evaluate the graduates' overall perception of the program was, "My AFIT education has prepared me to become an effective engineering manager." The median response to the question, 6.0, indicates that the graduates felt that the program definitely provided help toward becoming an effective engineering manager.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter provides a brief summary of the study, presents the conclusions based on the results obtained, and outlines recommendations to the program manager and recommendations for future research.

Project Overview

This study was undertaken to provide the GEM program manager current information on which to base his decisions regarding curriculum development. The primary objective of the research was to determine which subject areas in the GEM curriculum are most useful to the graduates of the program. The secondary objective was to determine the impact of the AFIT education on the graduates' career objectives.

Surveys were developed to gather the perceptions of GFM and GEM graduates and their supervisors. The surveys that were completed and returned were analyzed and the results were presented in Chapter 4. The following section presents the conclusions based on those results.

Conclusions

The conclusions stated below are presented in relation to the research questions that guided the study.

1. Based on the perceptions of the graduates and their supervisors, knowledge in which subject areas (available in the GEM curriculum) is most helpful to the graduates on the job?

The subject areas were ranked by the median response. The subjects found most useful are repeated in Table 23 below.

TABLE 23

The Most Useful Subject Areas: Joint Evaluation by Graduates and Supervisors

Rank	Subject Area
1	Communication
2	Organizational Behavior
3	Organization and Management
4	Contemporary Leadership
5	Supervision Seminar
6	Contracting for Engineers
7	Engineering Management Applications
8	Management Information Systems
9	Federal Financial Management
10	Construction Cost Estimating
11	Computer Programming
12	Contingency Engineering

It is notable that eight of the top 12 subject areas found to be most useful to the graduates of the GFM program by Johns and Ray (13:43) in 1980 are included in Table 23. Writing and Speech were found most useful to the GFM graduates in 1980. Communicative skills were again found most useful for both GFM and GEM graduates in this study. Similar conclusions about communications skills were drawn in two other studies reviewed in Chapter 2. In their 1979 study of the qualifications of

recent engineering graduates, Kimel and Monsees (14:212) found that writing and speaking were rated as the most important "attribute," or area of competence, for civil engineers. Brown and Hollingsworth (5:34), in their 1979 study of the usefulness of the AFIT School of Systems and Logistics graduate management programs, found that the graduates considered Speech and Writing to be the most useful courses of the 26 about which they were asked.

Of the 12 most useful subject areas as determined by Johns and Ray, four do not appear in Table 23 and are shown below:

Economics for Engineers
Counseling
Energy
Environmental Analysis

Evidently, the emphasis has shifted to the following areas:

Supervision
Engineering Management Applications
Construction Cost Estimating
Computer Programming
Contingency Engineering

It is also worth noting that the respondents in this study considered 22 of the 27 courses which they rated to be useful to GFM and GEM graduates (median responses were 5.0 or higher). In addition, the 12 most useful subject areas (median responses of 6.0 or higher) shown in Table 23 were among the 14 most useful subject areas as determined by scoring the open-ended responses. These two results indicate that the content of the GEM program curriculum is appropriate to the needs of the graduates.

2. Based on the perceptions of the graduates and their supervisors, how should the GEM curriculum be modified to meet current needs?

Seven of the top nine subject areas recommended for increased emphasis are offered in the current curriculum, which suggests the program is evolving to meet the graduates' needs. The two areas not presently covered as courses are comprehensive planning and project management. Increased emphasis in these areas might help the graduates on the job.

Three of the 12 subject areas considered the most useful by the respondents are presently electives rather than required courses. The three courses are Contemporary Leadership, Supervision Seminar, and Contingency Engineering. Increased emphasis in these subject areas might be useful to the graduates in their assignments.

On the other hand, two subject areas or courses traditionally included in the GEM core curriculum, Statistics II and Microeconomics, were ranked as 24th and 27th in importance by the graduates and their supervisors. Also, Economics and Statistics II were recommended by 10 or more respondents for deletion. The two subject areas might better serve the graduates as electives than as required courses. During the 84S curriculum development process, microeconomics was deleted from the core curriculum and is available to GEM students as an elective. This curriculum change was further supported by the results of this research.

3. Based on the perceptions of the graduates, how suitable was AFIT's coverage of the subject areas contained in the curriculum?

According to the graduates, Timber Design was covered the best. The least suitably covered subject area was Foundations Engineering. The graduates felt neutral about the coverage of this subject. It should be noted, however, that the number of respondents who had taken

these two courses was small. Only 17 of the graduates had taken Timber Design, and only eight had taken Foundations Engineering.

Based on median responses, the graduates agreed that 20 of the 27 subject areas were covered suitably. This high percentage suggests that, overall, the emphasis within the courses is meeting the graduates' needs.

4. To what extent do the graduates feel that their AFIT education has influenced their assignment selection?

Although the graduates felt their education had a definite impact on their initial assignments after graduation, later assignments were not perceived to be influenced by their education. These findings agree with those found in the 1980 study of GFM graduates conducted by Johns and Ray (13:46-47). As discussed in Chapter 4, the graduates felt they had used their AFIT education more in later assignments than in their initial assignments. So even though their education was not a factor in the determination of their follow-on assignments, it proved to be more useful in these later jobs.

5. How do the graduates perceive that their education has affected their promotion potential?

The graduates felt their education had enhanced their promotion potential. This finding agrees with that of the 1979 study of Logistics Management program graduates (5:57), which included GFM graduates, and the 1980 study of GFM graduates (13:78).

6. To what extent do the graduates feel that the program has helped them become better engineering managers?

The graduates felt the program definitely provided help toward becoming an effective engineering manager and would recommend the GEM program to other engineering officers.

Based on the overall results of this study, the following conclusion was reached: The GEM program, overall, is meeting the needs of its direct users, the graduates and their supervisors.

Recommendations

The following sections outline recommendations for the GEM program manager and recommendations for further research.

Program Recommendations

Recommendation 1. Communicative skills should continue to be emphasized in the GEM curriculum. The expansion of the Communications for Managers course in the 84S curriculum from two to three credit-hours and the inclusion of briefings in this course are steps in the right direction. Both the graduates and supervisors perceived this subject area to be the most important.

Recommendation 2. The results of this study support the GEM program manager's decision to remove Microeconomics from the core curriculum. If Statistics II is not required because of ABET criteria or the objectives of the School of Systems and Logistics, curriculum developers should consider removing the course from the required curriculum and offering it as an elective. Out of the 27 courses offered, Microeconomics was ranked 27th in importance and Statistics II was 24th. These two areas were also the ones most often recommended for deletion from the curriculum. Curriculum developers should consider replacing Microeconomics and Statistics II with Contemporary Leadership and Supervision Seminar. The latter two subjects were ranked fourth and fifth in importance as perceived by the graduates and their supervisors.

Contemporary Leadership and Supervision Seminar might serve the graduates better as required courses than as electives.

Recommendation 3. Curriculum developers should consider increasing emphasis in, or developing elective courses to cover, comprehensive planning and project management. These areas were recommended by the graduates and supervisors for increased emphasis.

Recommendations for Further Research

The results and conclusions presented in this study are based on the current perceptions of the graduates and their supervisors. As pointed out in Chapter 1, to educate engineering officers to become effective engineering managers the GEM program must be dynamic. It must evolve to meet the needs of officers in the civil engineering career field.

The primary research objective was to determine which subject areas are most useful to the GEM program graduates. The conclusions section above highlighted differences in the perceived importance of courses in a 1980 study (13) with the results of this study. These differences underscore the need for periodic research of this nature. Current feedback is necessary to keep the GEM program in tune with the changing needs in the field. Thus, research similar to this study should be accomplished, as a minimum, every four years.

The following paragraphs summarize specific recommendations for a future study. The recommendations are based on the authors' experience in conducting this study, and if a future study uses a similar methodology these recommendations should be useful.

The graduate survey was rather long. As a result, the return rate may have been reduced. The length of Part II could be reduced by removing the questions on coverage. Graduate perceptions concerning coverage could be obtained by including another open-ended question which asks the respondents to list the courses they felt had not been adequately or suitably covered. Additional information could be obtained by asking the graduates to explain what they would recommend to improve the coverage.

The second open-ended question concerning course deletions should be restructured. The required courses and electives should be listed and the respondents asked to line through the courses they recommend for deletion. This would make it easier for the respondents to answer the question and at the same time present the entire curriculum for inspection and evaluation.

APPENDIX A

THE SURVEY INSTRUMENTS

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

10 APR 1983

REPLY TO ATTN OF LS (Capt Halsey/Capt Hooper, AV 785-4437)

SUBJECT AFIT Graduate Engineering Management Program Survey (AUSCN 83-19)

TO AFIT GEM/GFM Alumnus

1. The AFIT Graduate Engineering Management (GEM) program has been in existence since 1980 when the School of Systems and Logistics lengthened the Graduate Facilities Management (GFM) program to 15 months and changed its name. The GEM program, along with all other AFIT programs, needs to be reviewed periodically to insure its continued relevance. The attached graduate survey was prepared to help meet that need.

2. Also enclosed is a supervisor survey which should be given to your immediate supervisor for his or her completion. The data we gather from these two surveys will be used to analyze the need for changes to the AFIT GEM program. The perceptions of both graduates and supervisors regarding the usefulness of the AFIT GEM program are needed for this thesis effort. You need not place your name on the questionnaire. Individual responses will be treated as confidential.

3. Your participation in this survey is strictly voluntary, but please bear in mind that without your reply the success of this project may be hampered. If you would like a copy of the final report, send us your name and address by separate correspondence or on the questionnaire.

4. Please return the completed survey in the enclosed envelope within 10 working days. Thank you for your help.

William R. Halsey

WILLIAM R. HALSEY, Capt, USAF
GEM Student, 83S

Jeffrey G. Hooper

JEFFREY G. HOOPER, Capt, USAF
GEM Student, 83S

1 Atch
Survey Packet

10 APR 1983

1st Ind (AFIT/LS)

TO: AFIT GEM/GFM Alumnus

1. I hope you will take the time to complete the attached questionnaire and return it in the preaddressed envelope. Your inputs to this research effort will be invaluable in helping to insure that future GEM students continue to receive a relevant education.

2. As stated above, participation is completely voluntary, but would be much appreciated.

Larry L. Smith

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

1 Atch
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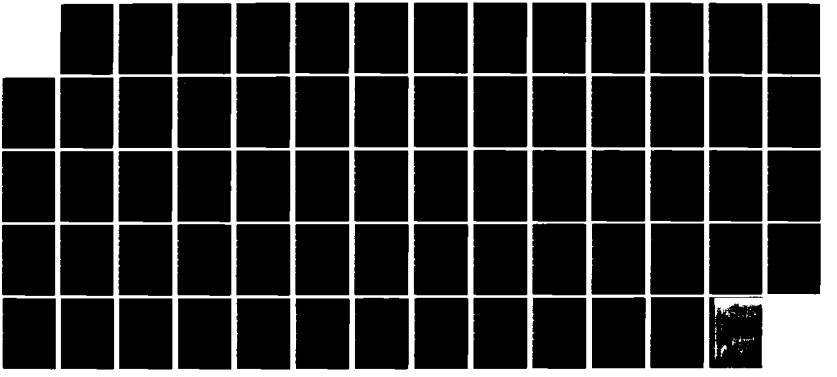
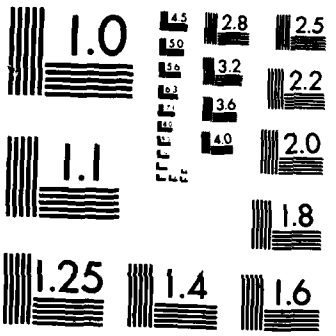
AD-A134 339 AN ANALYSIS OF THE PERCEIVED USEFULNESS OF AFIT'S (AIR 2/2
FORCE INSTITUTE OF..(U) AIR FORCE INST OF TECH
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST..
UNCLASSIFIED W R HALSEY ET AL. SEP 83 AFIT-LSSR-26-83 F/G 5/9 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

PRIVACY STATEMENT

In accordance with paragraph 8, AFR 12-35, the following information is provided as required by the Privacy Act of 1974:

a. Authority:

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

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

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

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

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

c. Routine Uses. The survey data will be converted to information for use in research of management related problems. Results of the research, based on the data provided, will be included in written master's theses and may also be included in published articles, reports, or texts. Distribution of the results of the research, based on the survey data, whether in written form or presented orally, will be unlimited.

d. Participation in this survey is entirely voluntary.

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

GENERAL INSTRUCTIONS

This packet contains two surveys. Please give the supervisor's survey to your immediate supervisor.

It is not necessary to put your name on the survey. Each survey will become part of a data base to analyze the need for change to the graduate engineering management program. No attempt will be made to attribute responses to individuals.

Read each question carefully. On multiple choice questions, circle the letter corresponding to your answer. There is no machine scoreable answer sheet to complete.

Some multiple choice questions use a scale of responses. This scale will appear at the top of each page for easy reference.

After completing the questionnaire, enclose it in the envelope provided and return via official mail.

Return within ten working days.

AUSCN 83-19

1983 GRADUATE SURVEY

AFIT GRADUATE FACILITIES MANAGEMENT AND
ENGINEERING MANAGEMENT DEGREES

PART I--BACKGROUND INFORMATION

For multiple-choice questions, circle the appropriate response.

1. My current grade is _____.

   a. O-1
   b. O-2
   c. O-3
   d. O-4
   e. O-5
   f. O-6
   g. Other (please specify)

2. My job title is _____.

3. I work at the _____ organizational level.

   a. Squadron
   b. Group
   c. Wing
   d. Air Division
   e. Major Command
   f. HQ Air Force
   g. Not applicable
   h. Other (please specify)

4. I have _____ years experience in my current job field.

   a. 1 or less
   b. Between 1 and 3
   c. Between 3 and 5
   d. Between 5 and 7
   e. Between 7 and 9
   f. 9 or more

5. I have ____ years service in DOD organizations.

   a. 1 or less
   b. Between 1 and 3
   c. Between 3 and 5
   d. Between 5 and 7
   e. Between 7 and 9
   f. 9 or more

6. My current job requires an advanced academic degree code.

   a. Yes
   b. No
   c. Don't know

7. I graduated from AFIT School of Systems and Logistics Class _____.

74A	75A	76A	77A	78A	79A	80J	81S
74B	75B	76B	77B	78B	79B		82S

8. I have completed the following formal education activity since graduation from AFIT:

   a. No formal educational activity
   b. Additional B.S.
   c. Some additional graduate work
   d. Additional M.S.
   e. Ph.D.
   f. Other (please specify)

PART II--EDUCATION USEFULNESS/JOB REQUIREMENTS INFORMATION

This part contains a list of subjects in the AFIT School of Systems and Logistics curriculum. We ask you to give us two evaluations about each subject. The first evaluation deals with the importance of the subject on the job. The second evaluation concerns AFIT's coverage of the subject.

Use the following scale to select your responses--

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

The specific statements to keep in mind for each subject are--

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

After reading the list of topics included in each subject area, circle the letter corresponding to your response. If you did not take an AFIT course on the subject, circle "NA" for AFIT's coverage.

---REQUIRED COURSES---

9. ORGANIZATION AND MANAGEMENT (includes: Management Theory; Organizational Structure and Effectiveness; Goal Setting; Organization Change and Development; Managerial Planning, Control, and Decision Making)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

10. ORGANIZATIONAL BEHAVIOR (includes: Motivation and Performance, Job Design, Group Behavior, Leadership, Performance Evaluation and Rewards)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

---

11. COMMUNICATION (includes: Technical Writing, Style and Tone, Expression and Mechanics, Patterns for Organization, Citation and Bibliography, Elements of Proposal and Thesis, Briefing Techniques)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

12. MICROECONOMICS (includes: Supply, Demand, and Market Price, Consumer Choice, Principles of Production, Market Structure Analysis, Resource Pricing, Employment and Allocation, Distribution, Equilibrium, and Welfare)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

13. STATISTICS I (includes: Descriptive Statistics, Probability Theory, Probability Distributions, Sampling and Sampling Distributions)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

14. STATISTICS II (includes: Estimation and Confidence Intervals, Hypothesis Testing, Regression, Correlation, Analysis of Variance, Nonparametric Statistics)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

15. QUANTITATIVE DECISION MAKING/OPERATIONS RESEARCH (includes: Inventory Theory, Decision Theory, Queuing Theory, Linear Programming)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

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16. RESEARCH METHODS (includes: Scientific Thinking, Research Design, Experimental Design, Measurement, Nature of Sampling, Survey Instrument Design, Reporting Statistics, Elements of Proposal and Thesis)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

17. PRODUCTION MANAGEMENT (includes: Output Selection, Facility Location, System Design, Quality Control, Job Scheduling, Preventative Maintenance, Inventory Systems, Startup Considerations)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

18. COMPUTER PROGRAMMING (includes: Computer Language, Flow Charts, Looping, Arrays, Modeling, Structured Programming)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

19. CONTRACTING FOR ENGINEERS (includes: Procurement, Types of Contracts, The Law and Courts, Remedies, Specifications, Inspection, Quality Assurance and Evaluation)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

20. MANAGEMENT INFORMATION SYSTEMS (includes: The Decision Making Process, Information Needs and Purposes, Organizational Response to Complexity, Design of MIS Processes, MIS Concepts)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

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21. ENGINEERING MANAGEMENT APPLICATIONS (includes: Engineering Management Process and Problem-Solving; Project Management Techniques such as Project Planning, Cost Estimating, Project Network Analysis, and Cost/Schedule Variance Analysis; Evaluation of Alternatives and Feasibility Considerations)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

22. FEDERAL FINANCIAL MANAGEMENT (includes: Federal Budgeting Concepts, Practices, and Processes; Defense vs. Non-Defense Spending; DOD Resource Management Systems; Five-Year Defense Program; Fund Control and Performance Measurement; Planning, Programming, and Budgeting System)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

23. THESIS (for a management problem of interest to the Department of Defense, an extensive and independent research investigation resulting in a published thesis report)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

---ELECTIVES---

Graduates had the opportunity to take, at most, three electives. As before, if you didn't take the course at AFIT, circle the "NA" response for AFIT coverage. Even if you circle "NA" for AFIT's coverage, still indicate the importance of each subject area on the job.

24. ENGINEERING ECONOMY (includes: Equivalence, Interest, Annual Costs, Present Worth, Benefit-Cost Ratio, Incremental Analysis, Depreciation, Effects of Inflation)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

25. ENERGY ISSUES (includes: Trends in the Availability, Production, Distribution, and Consumption of Energy Resources; Relationships Between Energy and Economic, Ecological, Political, Social, and Technological Factors; Energy-Related Problems Associated with Various Defense Activities)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

26. ENVIRONMENTAL ISSUES (includes: Air, Water, Noise, and Thermal Pollution; Solid and Toxic Wastes; Land Use Planning; Environmental Planning and Control; Environmental Impact of Defense Activities)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

---

27. LABOR RELATIONS (includes: Collective Bargaining Process, Labor Union Contracts, Executive Orders and Federal Legislation Relevant to Personnel Management, Dispute Settlement Procedures, and Labor Relations Movement)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

28. FOUNDATIONS ENGINEERING (includes: Design of Foundations Including Stresses in Soil, Soil Shear Strength, Consolidation Theory, Bearing Capacity of Shallow and Deep Foundations, Settlement, Lateral Soil Pressures on Earth Retaining Structures)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

29. TIMBER DESIGN (includes: Structural Properties of Wood, Beam Design, Glue-Laminated Timber, Connections, Truss Design, Column Design, Maintenance and Rehabilitation of Timber Structures, Horizontal Load Resistance, Economical Considerations)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

30. PAVEMENT DESIGN (includes: Materials Composition and Depths in Streets, Highways, and Runways, Construction Techniques, Materials Specification and Testing, Soil Stabilization, Drainage of Pavements)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

31. CONSTRUCTION COST ESTIMATING (includes: Preliminary Design Estimates, Comprehensive Project Cost Estimates, Replacement Cost Estimates, and Cost Estimates for Modification of Existing Facilities)

Importance to Job	A	B	C	D	E	F	G	
AFIT's Coverage	A	B	C	D	E	F	G	NA

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

NA = Not Applicable

Importance to Job - A person doing my current job should be knowledgeable in this subject area.

AFIT's Coverage - AFIT's coverage of this subject was suitable.

---

32. CONTINGENCY ENGINEERING (includes: Troop and Aircraft Beddown; Expedient Airfield Pavement Expansion and Maintenance; Damage Assessment; Chemical Defense; Water, Waste, Fuel, and Electrical Systems)

Importance to Job	A	B	C	D	E	F	G
AFIT's Coverage	A	B	C	D	E	F	G	NA

33. MACROECONOMICS (includes: Profit Maximization, Return on Investment, Demand Estimation, Empirical Cost Estimation, Capital Budgeting, Risk Analysis, and Government Influence on the Price Mechanism)

Importance to Job	A	B	C	D	E	F	G
AFIT's Coverage	A	B	C	D	E	F	G	NA

34. CONTEMPORARY LEADERSHIP (includes: Contemporary Leadership Theories, Effect of Leadership Style on Organizational Effectiveness, and the Situational Approach to Leadership)

Importance to Job	A	B	C	D	E	F	G
AFIT's Coverage	A	B	C	D	E	F	G	NA

35. SUPERVISION SEMINAR (includes: Supervisory Skills, the Role and Function of the Modern Supervisor, Contemporary Issues, and Discussion of Case Histories)

Importance to Job	A	B	C	D	E	F	G
AFIT's Coverage	A	B	C	D	E	F	G	NA

PART III--GENERAL QUESTIONS

This section contains general questions pertaining to your AFIT education.

Use the following scale to select your responses--

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

UKN = Unknown

---

36. I was/am able to use a significant portion of my AFIT education on my first assignment following graduation.

A B C D E F G UKN

37. I was/am able to use a significant portion of my AFIT education in later assignments.
(Circle "NA" if still on initial assignment)

A B C D E F G UKN NA

38. I feel that the courses dealt too much with theory.

A B C D E F G UKN

39. I feel that the content of the courses was too practical in nature.

A B C D E F G UKN

40. My AFIT education has enhanced my promotion potential.

A B C D E F G UKN

41. Writing papers for courses enhanced my knowledge of course material or related subject areas.

A B C D E F G UKN

42. My job requires the use of a computer.

A B C D E F G UKN

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

UKN = Unknown

---

43. My AFIT education was considered by MPC in determining my initial assignment following graduation.

A B C D E F G UKN

44. My AFIT education was considered by MPC in determining my later assignments.
(Circle "NA" if still on initial assignment)

A B C D E F G UKN NA.

45. I would have preferred to take more management and technical courses instead of completing a thesis.

A B C D E F G UKN

46. My AFIT education has prepared me to become an effective engineering manager.

A B C D E F G UKN

47. I would recommend the GEM (formerly GFM) program to other civil engineering officers.

A B C D E F G UKN

48. The workload for the AFIT program I completed was

a. Much too light
b. A little light
c. About right
d. A little heavy
e. Much too heavy

49. The length of the AFIT program I completed, for the amount of work required, was

a. Much too long
b. A little long
c. About right
d. A little short
e. Much too short

PART IV--OPEN-ENDED QUESTIONS

In this section, please write your responses in the space below each question.

50. What courses or subject areas would you recommend adding to the Graduate Engineering Management (GEM) curriculum?
(Please include a brief description of the content of each recommended course.)

51. What courses which you were required to study at AFIT would you recommend deleting from the GEM program?
(Again, please include a brief description of the content of each recommended course.)

52. In your opinion, competency in what five subject areas are the most important on the job? (List in order of importance.)

As you know, the basic purpose of the GEM program is to prepare civil engineering officers to become effective engineering managers. Please include any comments you might have regarding areas for improvement in the AFIT Graduate Engineering Management program (to help meet its basic purpose better) in the space below.

Thank you for completing this questionnaire. Please enclose the questionnaire in the envelope provided and return via official mail.

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

10 APR 1983

REPLY TO ATTN OF LS (Capt Halsey/Capt Hooper, AV 785-4437)

SUBJECT AFIT Graduate Engineering Management Program Survey (AUSCN 83-20)

TO Supervisor of an AFIT GEM/GFM Alumnus

1. The AFIT Graduate Engineering Management (GEM) program has been in existence since 1980 when the School of Systems and Logistics lengthened the Graduate Facilities Management (GFM) program to 15 months and changed its name. The GEM program, along with all other AFIT programs, needs to be reviewed periodically to insure its continued relevance. The attached survey was prepared to help meet that need. An AFIT graduate you supervise has also received a similar questionnaire.

2. The data we gather from these two surveys will be used to analyze the need for changes to the AFIT GEM program. The perceptions of both graduates and supervisors regarding the usefulness of the AFIT GEM program are needed for this study. You need not place your name on the questionnaire. Individual responses will be treated as confidential.

3. Your participation in this survey is strictly voluntary, but please bear in mind that without your reply the success of this project may be hampered. If you would like a copy of the final report, send us your name and address by separate correspondence or with the questionnaire.

4. Please return the completed survey in the enclosed envelope within 10 working days. Thank you for your help.

William R. Halsey

WILLIAM R. HALSEY, Capt, USAF
GEM Student, 83S

Jeffrey G. Hooper

JEFFREY G. HOOPER, Capt, USAF
GEM Student, 83S

1 Atch
Survey Packet

10 APR 1983

1st Ind (AFIT/LS)

TO: AFIT GEM/GFM Alumnus Supervisor

1. I hope you will take the time to complete the attached questionnaire and return it in the preaddressed envelope. Your inputs to this research effort will be invaluable in helping to insure that future GEM students continue to receive a relevant education.

2. As stated above, participation is completely voluntary, but would be much appreciated.

Larry L. Smith

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

1 Atch
nc

PRIVACY STATEMENT

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a. Authority:

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

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

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

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

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

c. Routine Uses. The survey data will be converted to information for use in research of management related problems. Results of the research, based on the data provided, will be included in written master's theses and may also be included in published articles, reports, or texts. Distribution of the results of the research, based on the survey data, whether in written form or presented orally, will be unlimited.

d. Participation in this survey is entirely voluntary.

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

GENERAL INSTRUCTIONS

The basic purpose of AFIT's Graduate Engineering Management program is to educate engineering officers to become effective engineering managers. As with any institutional education, it is imperative to obtain feedback from the field so that the courses taught are relevant to current needs. This survey was developed to obtain your opinion as to what subject areas you feel are most important to a person in the position of the AFIT graduate you supervise.

It is not necessary to put your name on the survey. Each survey will become part of a data base to analyze the need for change to the Graduate Engineering Management program. No attempt will be made to attribute responses to individuals.

Read each question carefully. On multiple choice questions, circle the letter corresponding to your answer. There is no machine scoreable answer sheet to complete.

Some multiple choice questions use a scale of responses. This scale will appear at the top of each page for easy reference.

After completing the questionnaire, enclose it in the envelope provided and return via official mail.

Return within ten working days.

AUSCN 83-20

1983 SUPERVISOR SURVEY

PART I--BACKGROUND INFORMATION

For multiple-choice questions, circle the appropriate response.

1. My job title is _____.

2. I work at the _____ organizational level.

   a. Squadron
   b. Group
   c. Wing
   d. Air Division
   e. Major Command
   f. HQ Air Force
   g. Not Applicable
   h. Other (please specify)

3. I have _____ years of managerial experience in my current job field.

   a. 1 or less
   b. Between 1 and 3
   c. Between 3 and 5
   d. Between 5 and 7
   e. Between 7 and 9
   f. 9 or more

4. I have _____ years service in DOD organizations.

   a. 1 or less
   b. Between 1 and 3
   c. Between 3 and 5
   d. Between 5 and 7
   e. Between 7 and 9
   f. 9 or more

PART II--EDUCATION USEFULNESS/JOB REQUIREMENTS INFORMATION

This part contains a list of subjects in the AFIT School of Systems and Logistics curriculum. We ask you to evaluate the importance of each subject area to a person holding the job of the AFIT graduate you supervise. Specifically:

Importance to Job - A person in this position should be knowledgeable in this subject area.

Use the follcwing scale to select your responses--

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

Courses required by the AFIT Graduate Engineering Management program are listed first, followed by typical electives. AFIT students have the opportunity to take three electives.

After reading the list of topics included in each subject area, circle the letter corresponding to your response.

---REQUIRED COURSES---

5. ORGANIZATION AND MANAGEMENT (includes: Management Theory; Organizational Structure and Effectiveness; Goal Setting; Organization Change and Development; Managerial Planning, Control, and Decision Making)

   Importance to Job A B C D E F G

6. ORGANIZATIONAL BEHAVIOR (includes: Motivation and Performance, Job Design, Group Behavior, Leadership, Performance Evaluation and Rewards)

   Importance to Job A B C D E F G

7. COMMUNICATION (includes: Technical Writing, Style and Tone, Expression and Mechanics, Patterns for Organization, Citation and Bibliography, Elements of Proposal and Thesis, Briefing Techniques)

   Importance to Job A B C D E F G

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

Importance to Job - A person in this position should be knowledgeable in this subject area.

---

8. MICROECONOMICS (includes: Supply, Demand, and Market Price, Consumer Choice, Principles of Production, Market Structure Analysis, Resource Pricing, Employment and Allocation, Distribution, Equilibrium, and Welfare)

   Importance to Job A B C D E F G

9. STATISTICS I (includes: Descriptive Statistics, Probability Theory, Probability Distributions, Sampling and Sampling Distributions)

   Importance to Job A B C D E F G

10. STATISTICS II (includes: Estimation and Confidence Intervals, Hypothesis Testing, Regression, Correlation, Analysis of Variance, Nonparametric Statistics)

    Importance to Job A B C D E F G

11. QUANTITATIVE DECISION MAKING/OPERATIONS RESEARCH (includes: Inventory Theory, Decision Theory, Queuing Theory, Linear Programming)

    Importance to Job A B C D E F G

12. RESEARCH METHODS (includes: Scientific Thinking, Research Design, Experimental Design, Measurement, Nature of Sampling, Survey Instrument Design, Reporting Statistics, Elements of Proposal and Thesis)

    Importance to Job A B C D E F G

13. PRODUCTION MANAGEMENT (includes: Output Selection, Facility Location, System Design, Quality Control, Job Scheduling, Preventative Maintenance, Inventory Systems, Startup Considerations)

    Importance to Job A B C D E F G

14. COMPUTER PROGRAMMING (includes: Computer Language, Flow Charts, Looping, Arrays, Modeling, Structured Programming)

    Importance to Job A B C D E F G

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

Importance to Job - A person in this position should be knowledgeable in this subject area.

---

15. CONTRACTING FOR ENGINEERS (includes: Procurement, Types of Contracts, The Law and Courts, Remedies, Specifications, Inspection, Quality Assurance and Evaluation)

    Importance to Job A B C D E F G

16. MANAGEMENT INFORMATION SYSTEMS (includes: The Decision Making Process, Information Needs and Purposes, Organizational Response to Complexity, Design of MIS Processes, MIS Concepts)

    Importance to Job A B C D E F G

17. ENGINEERING MANAGEMENT APPLICATIONS (includes: Engineering Management Process and Problem-Solving; Project Management Techniques such as Project Planning, Cost Estimating, Project Network Analysis, and Cost/Schedule Variance Analysis; Evaluation of Alternatives and Feasibility Considerations)

    Importance to Job A B C D E F G

18. FEDERAL FINANCIAL MANAGEMENT (includes: Federal Budgeting Concepts, Practices, and Processes; Defense vs. Non-Defense Spending; DOD Resource Management Systems; Five-Year Defense Program; Fund Control and Performance Measurement; Planning, Programming, and Budgeting System)

    Importance to Job A B C D E F G

19. THESIS (for a management problem of interest to the Department of Defense, an extensive and independent research investigation resulting in a published thesis report)

    Importance to Job A B C D E F G

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

Importance to Job - A person in this position should be knowledgeable in this subject area.

---ELECTIVES---

20. ENGINEERING ECONOMY (includes: Equivalence, Interest, Annual Costs, Present Worth, Benefit-Cost Ratio, Incremental Analysis, Depreciation, Effects of Inflation)

Importance to Job A B C D E F G

21. ENERGY ISSUES (includes: Trends in the Availability, Production, Distribution, and Consumption of Energy Resources; Relationships Between Energy and Economic, Ecological, Political, Social, and Technological Factors; Energy-Related Problems Associated with Various Defense Activities)

Importance to Job A B C D E F G

22. ENVIRONMENTAL ISSUES (includes: Air, Water, Noise, and Thermal Pollution; Solid and Toxic Wastes; Land Use Planning; Environmental Planning and Control; Environmental Impact of Defense Activities)

Importance to Job A B C D E F G

23. LABOR RELATIONS (includes: Collective Bargaining Process, Labor Union Contracts, Executive Orders and Federal Legislation Relevant to Personnel Management, Dispute Settlement Procedures, and Labor Relations Movement)

Importance to Job A B C D E F G

24. FOUNDATIONS ENGINEERING (includes: Design of Foundations Including Stresses in Soil, Soil Shear Strength, Consolidation Theory, Bearing Capacity of Shallow and Deep Foundations, Settlement, Lateral Soil Pressures on Earth Retaining Structures)

Importance to Job A B C D E F G

Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
A	B	C	D	E	F	G

Importance to Job - A person in this position should be knowledgeable in this subject area.

---

25. TIMBER DESIGN (includes: Structural Properties of Wood, Beam Design, Glue-Laminated Timber, Connections, Truss Design, Column Design, Maintenance and Rehabilitation of Timber Structures, Horizontal Load Resistance, Economical Considerations)

    Importance to Job A B C D E F G

26. PAVEMENT DESIGN (includes: Materials Composition and Depths in Streets, Highways, and Runways, Construction Techniques, Materials Specification and Testing, Soil Stabilization, Drainage of Pavements)

    Importance to Job A B C D E F G

27. CONSTRUCTION COST ESTIMATING (includes: Preliminary Design Estimates, Comprehensive Project Cost Estimates, Replacement Cost Estimates, and Cost Estimates for Modification of Existing Facilities)

    Importance to Job A B C D E F G

28. CONTINGENCY ENGINEERING (includes: Troop and Aircraft Beddown; Expedient Airfield Pavement Expansion and Maintenance; Damage Assessment; Chemical Defense; Water, Waste, Fuel, and Electrical Systems)

    Importance to Job A B C D E F G

29. MACROECONOMICS (includes: Profit Maximization, Return on Investment, Demand Estimation, Empirical Cost Estimation, Capital Budgeting, Risk Analysis, and Government Influence on the Price Mechanism)

    Importance to Job A B C D E F G

30. CONTEMPORARY LEADERSHIP (includes: Contemporary Leadership Theories, Effect of Leadership Style on Organizational Effectiveness, and the Situational Approach to Leadership)

    Importance to Job A B C D E F G

31. SUPERVISION SEMINAR (includes: Supervisory Skills, the Role and Function of the Modern Supervisor, Contemporary Issues, and Discussion of Case Histories)

    Importance to Job A B C D E F G

PART III--OPEN-ENDED QUESTIONS

In this section, please write your responses in the space below each question.

32. What courses or subject areas would you recommend adding to the Graduate Engineering Management (GEM) curriculum? (Please include a brief description of the content of each recommended course.)

33. What courses would you recommend deleting from the GEM program? (Again, please include a brief description of the content of each recommended course.)

34. In your opinion, competency in what five subject areas are the most important to the people you supervise? (List in order of importance.)

As you know, the basic purpose of the GEM program is to prepare civil engineering officers to become effective engineering managers. Please include any comments you might have regarding areas for improvement in the AFIT Graduate Engineering Management program (to help meet its basic purpose better) in the space below.

Thank you for completing this questionnaire. Please enclose the questionnaire in the envelope provided and return via official mail.

APPENDIX B

STATISTICS AND TABLES

TABLE 24

Descriptive Statistics--Importance of Courses
The Graduates' Responses

Subject Area	Median	Mode	Range	N	Mean	Variance
Organization and Management	6	6	6	97	5.773	1.656
Organizational Behavior	6	7	5	98	5.776	1.619
Communication	7	7	6	98	6.122	1.655
Microeconomics	3	2	6	98	3.347	2.724
Statistics I	4	5	6	98	4.061	2.986
Statistics II	4	5	6	98	3.806	3.251
Quantitative Decision Making	5	5	6	98	4.214	2.830
Research Methods	5	5	6	98	4.480	2.994
Production Mgt	5	5	6	96	4.510	3.242
Computer Programming	5	6	6	97	4.845	3.174
Contracting for Engineers	6	7	6	97	5.515	3.398
Mgt Information Systems	6	5	6	96	5.438	1.933
Engineering Mgt Applications	6	6	6	92	5.283	2.447
Federal Financial Management	5.5	5	6	98	5.327	2.573
Thesis	4	4	6	97	4.309	3.049
Engineering Economy	5	5	6	96	5.115	2.650
Energy Issues	5	5	6	90	4.522	2.904
Environmental Issues	5	6	6	93	4.763	2.835
Labor Relations	5	5	6	83	4.470	3.911
Foundations Engineering	4	1	6	75	3.640	4.125
Timber Design	4	1	6	79	3.392	4.216
Pavement Design	5	5	6	84	4.119	4.323
Construction Cost Estimating	6	7	6	77	4.935	4.509
Contingency Engineering	5	6	6	75	4.427	5.140
Macroeconomics	4	4	6	79	3.810	2.592
Contemporary Leadership	6	6	6	79	5.291	2.850
Supervision Seminar	6	6	6	80	5.262	2.905

TABLE 25

Descriptive Statistics--Importance of Courses
The Supervisors' Responses

Subject Area	Median	Mode	Range	N	Mean	Variance
Organization and Management	7	7	6	72	6.458	0.815
Organizational Behavior	7	7	2	72	6.514	0.338
Communication	7	7	3	72	6.611	0.438
Microeconomics	4	5	5	72	3.847	2.413
Statistics I	5	5	6	71	4.634	2.378
Statistics II	5	5	6	71	4.268	2.599
Quantitative Decision Making	5	5	6	72	4.306	2.722
Research Methods	5	6	6	72	4.903	2.230
Production Mgt	6	6	6	72	5.250	2.472
Computer Programming	6	6	6	72	5.389	2.185
Contracting for Engineers	6	7	6	72	5.903	1.610
Mgt Information Systems	6	6	5	72	5.903	0.990
Engineering Mgt Applications	7	7	5	72	6.139	1.614
Federal Financial Management	6	7	5	72	5.847	1.371
Thesis	5	5	5	72	4.694	1.962
Engineering Economy	5.5	6	5	72	5.319	1.629
Energy Issues	6	6	5	72	5.403	1.709
Environmental Issues	6	6	4	72	5.667	1.127
Labor Relations	5	5	6	72	5.042	2.576
Foundations Engineering	5	5	6	72	4.458	2.843
Timber Design	4	4	6	72	4.056	3.011
Pavement Design	5	4	6	71	4.789	2.712
Construction Cost Estimating	6	7	6	72	5.611	2.156
Contingency Engineering	6	7	6	72	5.514	2.591
Macroeconomics	4	4	6	72	4.167	2.620
Contemporary Leadership	7	7	3	72	6.333	0.817
Supervision Seminar	7	7	3	72	6.264	0.817

TABLE 26

Descriptive Statistics--Importance of Courses
Graduates and Supervisors

Subject Area	Median	Mode	Range	N	Mean	Variance
Organization and Management	6	7	6	169	6.065	1.406
Organizational Behavior	6	7	5	170	6.088	1.205
Communication	7	7	6	170	6.329	1.193
Microeconomics	4	2	6	170	3.559	2.639
Statistics I	5	5	6	169	4.302	2.795
Statistics II	4	5	6	169	4.000	3.012
Quantitative Decision Making	5	5	6	170	4.253	2.770
Research Methods	5	5	6	170	4.659	2.699
Production Mgt	5	6	6	168	4.827	3.030
Computer Programming	6	6	6	169	5.077	2.810
Contracting for Engineers	6	7	6	169	5.680	2.659
Mgt Information Systems	6	6	6	168	5.637	1.574
Engineering Mgt Applications	6	7	6	164	5.659	2.251
Federal Financial Management	6	7	6	170	5.547	2.119
Thesis	5	4	6	169	4.473	2.608
Engineering Economy	5	6	6	168	5.202	2.210
Energy Issues	5	6	6	162	4.914	2.551
Environmental Issues	5	6	6	165	5.158	2.280
Labor Relations	5	5	6	155	4.735	3.352
Foundations Engineering	4	5	6	147	4.041	3.642
Timber Design	4	4	6	151	3.709	3.728
Pavement Design	5	5	6	155	4.426	3.675
Construction Cost Estimating	6	7	6	149	5.262	3.465
Contingency Engineering	6	7	6	147	4.959	4.163
Macroeconomics	4	4	6	151	3.980	2.620
Contemporary Leadership	6	7	6	151	5.788	2.141
Supervision Seminar	6	7	6	152	5.737	2.155

TABLE 27

Descriptive Statistics--Coverage of Courses
The Graduates' Responses

Subject Area	Median	Mode	Range	N	Mean	Variance
Organization and Management	6	6	5	97	5.918	0.701
Organizational Behavior	6	6	5	98	5.908	0.991
Communication	6	6	6	97	5.856	1.812
Microeconomics	5	6	6	92	5.033	2.054
Statistics I	6	6	5	98	5.888	1.297
Statistics II	6	6	5	98	5.765	1.522
Quantitative Decision Making	6	6	5	98	5.827	1.114
Research Methods	6	6	6	97	5.309	1.987
Production Management	6	6	5	91	5.484	1.519
Computer Programming	6	6	5	94	5.436	1.388
Contracting for Engineers	6	6	6	93	5.333	2.703
Mgt Information Systems	5	6	5	90	5.067	2.063
Engineering Mgt Applications	5	5	5	86	5.209	1.673
Federal Financial Management	6	6	6	98	5.388	2.034
Thesis	6	7	6	98	5.643	2.108
Engineering Economy	6	6	5	89	5.831	1.255
Energy Issues	6	6	6	71	5.268	2.142
Environmental Issues	6	6	6	80	5.287	2.106
Labor Relations	6	6	6	46	5.739	1.486
Foundations Engineering	4	4	6	8	3.625	4.839
Timber Design	7	7	6	17	5.294	5.471
Pavement Design	6	7	6	30	5.500	3.293
Construction Cost Estimating	4.5	7	6	14	4.500	5.038
Contingency Engineering	5	7	6	14	4.786	4.027
Macroeconomics	5	6	6	39	5.154	2.081
Contemporary Leadership	6	6	6	40	5.425	2.097
Supervision Seminar	6	6	6	24	5.375	2.766

TABLE 28

Ranking of Courses by Importance
Graduates versus Supervisors

Rank	Graduates	Supervisors
1	Communication	Communication
2	Organizational Behavior	Organizational Behavior
3	Organization and Management	Organization and Management
4	Contracting for Engineers	Contemporary Leadership
5	Management Information Systems	Supervision Seminar
6	Contemporary Leadership	Engineering Mgt Applications
7	Engineering Mgt Applications	Management Information Systems
8	Supervision Seminar	Contracting for Engineers
9	Construction Cost Estimating	Federal Financial Management
10	Federal Financial Management	Environmental Issues
11	Engineering Economy	Construction Cost Estimating
12	Computer Programming	Contingency Engineering
13	Environmental Issues	Energy Issues
14	Energy Issues	Computer Programming
15	Production Management	Production Management
16	Research Methods	Engineering Economy
17	Labor Relations	Labor Relations
18	Contingency Engineering	Research Methods
19	Quantitative Decision Making	Pavement Design
20	Pavement Design	Thesis
21	Thesis	Statistics I
22	Statistics I	Foundations Engineering
23	Macroeconomics	Quantitative Decision Making
24	Statistics II	Statistics II
25	Foundations Engineering	Macroeconomics
26	Timber Design	Timber Design
27	Microeconomics	Microeconomics

TABLE 29

Differences in Perceptions of Importance
Graduates and Supervisors

Subject Area	Mann-Whitney Test Statistic	Z	Observed Significance Level
Contemporary Leadership	1721.0	- 4.3932	0.0000
Organization and Management	2246.0	- 4.2550	0.0000
Engineering Mgt Applications	2103.0	- 4.1719	0.0000
Supervision Seminar	1847.5	- 3.9894	0.0001
Organizational Behavior	2353.5	- 3.9721	0.0001
Environmental Issues	2357.5	- 3.3504	0.0008
Energy Issues	2274.0	- 3.3306	0.0009
Production Management	2597.0	- 2.8074	0.0050
Contingency Engineering	2006.5	- 2.7502	0.0060
Communication	2798.5	- 2.6181	0.0088
Foundations Engineering	2121.0	- 2.2827	0.0224
Statistics I	2798.0	- 2.2207	0.0264
Mgt Information Systems	2811.0	- 2.1443	0.0320
Federal Financial Management	2902.5	- 2.0407	0.0413
Microeconomics	2902.5	- 2.0057	0.0449
Timber Design	2324.0	- 1.9723	0.0486
Computer Programming	2890.5	- 1.9677	0.0491
Pavement Design	2530.0	- 1.6493	0.0991
Research Methods	3024.5	- 1.6239	0.1044
Statistics II	2991.5	- 1.5817	0.1137
Labor Relations	2575.0	- 1.5082	0.1315
Macroeconomics	2448.5	- 1.5030	0.1328
Construction Cost Estimating	2395.5	- 1.4718	0.1411
Thesis	3080.5	- 1.3327	0.1826
Contracting for Engineers	3292.5	- 0.6649	0.5061
Quantitative Decision Making	3385.0	- 0.4594	0.6460
Engineering Economy	3350.5	- 0.3482	0.7277

TABLE 30

Ranking of Courses by Importance
Joint Evaluation by Graduates and Supervisors

Rank	Subject Area	Median
1	Communication	7
2	Organizational Behavior	6
3	Organization and Management	6
4	Contemporary Leadership	6
5	Supervision Seminar	6
6	Contracting for Engineers	6
7	Engineering Management Applications	6
8	Management Information Systems	6
9	Federal Financial Management	6
10	Construction Cost Estimating	6
11	Computer Programming	6
12	Contingency Engineering	6
13	Engineering Economy	5
14	Environmental Issues	5
15	Energy Issues	5
16	Production Management	5
17	Labor Relations	5
18	Research Methods	5
19	Thesis	5
20	Pavement Design	5
21	Statistics I	5
22	Quantitative Decision Making	5
23	Foundations Engineering	4
24	Statistics II	4
25	Macroeconomics	4
26	Timber Design	4
27	Microeconomics	4

TABLE 31

Ranking of Subject Areas Listed in Open-ended Section (All Respondents)

Rank	Subject Area	Score	Frequency
1	Communication	370	103
2	Organization and Management	241	64
3	Contracting for Engineers	145	52
4	Organizational Behavior	140	50
5	Contemporary Leadership	138	36
6	Engineering Mgt Applications	118	38
7	Federal Financial Mgt	94	35
8	Supervision Seminar	88	30
9	Technical Expertise	77	29
10	Mgt Information Systems	77	28
11	Quantitative Decision Making	66	26
12	Construction Cost Estimating	56	22
13	Computer Programming	39	21
14	Contingency Engineering	37	15
15	Engineering Economy	31	15
16	Statistics I	30	15
17	Production Management	26	10
18	Time Management	24	7
19	Labor Relations	21	11
20	Logical/Creative Thinking	18	4
21	Personnel Management	17	6
22	Environmental Issues	16	8
23	Research Methods	16	7
24	CE Regulations/Mission	16	5
25	Project Management	13	5
26	Energy Issues	12	6
27	CE Programming	12	3
28	CE Design & Construction Mgt	12	3
29	Systems Management	10	3
30	Knowing One's Job	10	2
31	Thesis	8	3
32	Economics	8	3
33	Statistics II	7	5
34	Facility Maintenance Mgt	6	2
35	Scheduling Work	6	2
36	Comprehensive Planning	5	1
37	Analytical Evaluation of Complex Issues	4	1
38	Understanding the System	3	3
39	Social Science	3	2
40	Intergovernmental Coordination	2	1
41	Material Management	1	1

TABLE 32

Courses Recommended for Deletion

Subject Area	N
Economics	25
Statistics II	14
Production/Manufacturing	9
Thesis	8
Statistics I	8
Quantitative Decision Making/Operations Research	6
Research Methods	5
Transportation/Delivery	4
Federal Financial Management	4
Organizational Behavior	3
Accounting	2
Energy Issues	2
Technical (Engineering) Electives	2
Labor Relations	2
Procurement & Acquisition Mgt	2
Logistics-type courses	1
Human Factors in AF Work Environments	1
Contracting for Engineers	1
Finance & Systems Command Acquisition Mgt System	1
Computer	1
Systems Management	1
Environmental Issues	1
Engineering Economy	1
Supervision Seminar	1

Also, one respondent recommended less management theory; another recommended deemphasizing engineering electives; and another recommended downplaying marketplace management principles.

TABLE 33

Ranking of Courses by Coverage
The Graduate Perceptions

Rank	Subject Area	Median
1	Timber Design	7
2	Organization and Management	6
3	Organizational Behavior	6
4	Statistics I	6
5	Communication	6
6	Engineering Economy	6
7	Quantitative Decision Making	6
8	Statistics II	6
9	Labor Relations	6
10	Thesis	6
11	Pavement Design	6
12	Production Management	6
13	Computer Programming	6
14	Leadership Seminar	6
15	Federal Financial Management	6
16	Supervision Seminar	6
17	Contracting for Engineers	6
18	Research Methods	6
19	Environmental Issues	6
20	Energy Issues	6
21	Engineering Management Applications	5
22	Macroeconomics	5
23	Management Information Systems	5
24	Microeconomics	5
25	Contingency Engineering	5
26	Construction Cost Estimating	4.5
27	Foundations Engineering	4

TABLE 34

Correlation Between Importance and Coverage
Based on Graduates' Responses

Rank	Subject Area	Kendall's Tau	N	Observed Significance Level
1	Production Management	0.3802	91	0.001
2	Organizational Behavior	0.3249	98	0.001
3	Organization and Management	0.3096	97	0.001
4	Federal Financial Management	0.2921	98	0.001
5	Thesis	0.2184	97	0.001
6	Energy Issues	0.2479	71	0.002
7	Engineering Economy	0.2192	89	0.002
8	Communication	0.2118	97	0.002
9	Microeconomics	0.2090	92	0.002
10	Quantitative Decision Making	0.2048	98	0.002
11	Research Methods	0.2031	97	0.002
12	Labor Relations	0.2880	46	0.003
13	Contemporary Leadership	0.3008	40	0.004
14	Supervision Seminar	0.3524	24	0.008
15	Engineering Mgt Applications	0.1732	86	0.010
16	Statistics I	0.1605	98	0.010
17	Pavement Design	0.2895	30	0.013
18	Mgt Information Systems	0.1518	90	0.018
19	Contracting for Engineers	0.1290	93	0.034
20	Statistics II	0.1138	98	0.049
21	Macroeconomics	0.1717	39	0.062
22	Computer Programming	0.1026	94	0.072
23	Environmental Issues	0.1079	80	0.079
24	Foundations Engineering	- 0.2449	8	0.199
25	Construction Cost Estimating	- 0.0854	14	0.336
26	Contingency Engineering	0.0760	14	0.353
27	Timber Design	0.0601	17	0.369

APPENDIX C

RESPONDENT COMMENTS

Graduates' Comments

Keep the pace "hot". . . at AFIT I learned to work a long day at a fast steady pace. That, plus the writing (mainly the thesis), has been invaluable . . . . I may not be able to outsmart everyone--but I can sure outwork a lot of them.

Looks like the electives in design are a step in the right direction.

Delete the GEM program from AFIT and send students to reputable civilian institutions . . . civilian institutions would provide more variety and quality of resources available for student use. Degrees would be more recognized or just as recognized as AFIT degrees.

I think the program is right on track.

I have used my degree since graduation . . . it has paid handsome dividends.

The estimating and war fighting courses should help prepare an individual for engineering as well as combat engineering duties.

Publicize the program better to increase retention of needed engineers.

Consider using this degree to convert 9-15 year officers with science, math, or appropriate degrees to 55XX officers to help fill current shortages. Appropriate engineering electives can give them the engineering they need.

Teach us how to use the computer that is available to us for specialized studies and general management.

The coverage of statistics was poor . . . if it had been better, I may be able to see a connection between statistics and my job.

The computer knowledge I got at AFIT and on my job I have learned on my own . . . this point must be changed.

More real life situational applications would enhance the theoretical information taught in most courses, otherwise a very good program.

I would not put "practical" courses in the curriculum . . . technology changes and standard practices change as better methods evolve. The purpose of a master's program is to develop mental and personal abilities and expose individuals to as broad a program as possible, not to make it a vocational/technical training school.

I think the lack of a course in ethics/business morality is a serious deficiency.

The effectiveness of many managers can be hindered by not having developed their professional engineering skills. Students should be encouraged to obtain a graduate degree while simultaneously developing professional engineering and professional engineering management skills.

Students should be given a choice of electives to choose from . . . either any three electives or a series of electives to enhance those students wanting more technical expertise . . . a student should be able to develop a general engineering management background with one area of technical expertise.

We need more general engineering topics--understanding of which is required to maintain our old facilities . . . we need more facility engineering/maintenance to supplement the management.

Add an athletic program. AFIT should build the mind and body. Let's get back to the basics of being soldiers.

The management related courses are the ones that have helped me the most . . . a B.S. in engineering provides the necessary problem solving skills for most situations . . . the name of the game is leadership and management . . . increase the number of management related courses to teach engineers how to be leaders and managers.

The program was taught at a level consistent with an academic master's program. I was glad to see the addition of the engineering concept courses.

Entering the 55XX at a mid-management position, I was at a definite competitive disadvantage to those who "grew up" in the career field. The AFIT GEM program is not the forum to close this gap. AFIT short courses, like the one for BCEs, should be expanded to give the mid-career "newcomer" a better basis for doing his job.

As one of the few lieutenants to enter the program upon receiving my undergraduate degree, I realize my situation is rare. The Air Force has wasted the funds spent on me for the type of work I've been doing the last three years. I have made my desires for a management position known, yet have not received one. MPC should insure all officers will be filling a job requiring the degree. The GEM program was very good but I have not used it at all in my work environment.

Delete the requirement for a thesis. It takes too much time away from course work for its completion--without any application to the job.

The thesis requirement should be used to work "real" CE problems. If the students research non-CE areas, the development of their engineering management skills are not improved . . . a choice should be offered to the students based on whether a thesis is capable of being done in a CE area of interest or not. If not, then additional courses related to CE should be taken.

The addition of several engineering courses to the curriculum satisfied my main suggestion for improvement.

As an engineer with a management master's degree, I found myself very competitive in the program management career field . . . the GEM program should not be limited to civil engineers but should be offered to all USAF engineers . . . it is an excellent method to prepare the USAF engineer for the management role he will eventually fill.

The biggest complaint I had was course length--that has been corrected. I understand there are more elective blocks as well.

Require work programs where the student actually solves a problem at some base, MAJCOM, etc.

I recommend changing from theoretical research type thesis to a practical type thesis. My research topic could have aided the Air Force more had it been more practically oriented.

The elective in international logistics was a real horizon broadener. I feel it would benefit any engineer.

Spend more time talking about how to solve base level problems.

More emphasis is needed on practical applications of supervision, leadership, and communication . . . some technical courses should be required electives as the entire program lacks the hard core courses needed to really call it an engineering management degree.

Management and supervision were the primary skills utilized in my 4 years in CE. Quantitative courses, statistics, etc., were not utilized at all (less than 5%).

Experienced officers have a definite advantage over new 2Lt's introduced into the program. This should be taken into account as the individual courses are taught and when counseling and guiding students toward meaningful thesis accomplishment.

It was an outstanding program and I could not have picked a better one.

The utility of learning how to program a computer is questionable. An inordinate amount of time was spent developing and debugging computer programs. The principles are essential but often the capabilities exist in another organization and the availability of a computer to run individually developed programs is doubtful.

The program was one of the most challenging and rewarding in my life . . . the experience has broadened my horizon by giving me self-confidence, understanding, and useful decision making skills . . . out of the service, I used my AFIT skills daily and achieved some very surprising results in the engineering community . . . I'm back in flying now--when I again leave, I'll be secure in the knowledge that the Air Force has prepared me very well to do engineering work . . . I have not used my AFIT training in the Air Force . . . it's been a waste of time and effort on the Air Force's part to educate me this way and not use the results.

Add more practicality to the courses--relate the subject matter more to civil engineering . . . add more writing and speaking assignments.

No more than four classes should be assigned per quarter. This will keep the workload reasonable.

I have found practical uses for every subject area at one time or another, especially contingency engineering . . . this area has received too little emphasis in the past. Contingency engineering should be a required course.

Gear up for state of the art engineering management. Include use of computers and computer graphics in project preparation.

I'd like to see close interaction between AFMPC and the GEM program in job placement. If the AF feels the GEM degree is so vital, MPC should insure that we can use what we learn immediately in the field. Don't assign grads into design jobs as I and several classmates were.

Concentrate on the management. That's the aspect of the job that is often forgotten unless the manager is given an opportunity, such as AFIT or PME in residence, to sit back and evaluate his own techniques--and compare them with others.

The only thing I would change is the timing. I was one of the first 2Lts to go through your program. I now know what I should have spent more time on . . . I now have 6 years experience and realize each base is different with different problems. Most of the problems come from HQ. They are the ones who need your program the most.

My only real complaint is that I was assigned to the squadron level following graduation and for almost a year find myself doing the exact same job in the squadron as I had prior to going to AFIT. I find it ridiculous that my choice of bases after completing AFIT is limited to those with a "validated" degree requirement in this situation.

Possibly it's time to consider "refresher" or follow-on courses to augment/supplement what we were exposed to 7-8 years ago.

Since we are preparing civil engineering officers to become effective managers, suggest you consider preparations for effective leadership as well.

I feel that more class work as an option to a thesis would be better in preparing officers/graduates for their AF jobs.

Supervisors' Comments

Deemphasize engineering electives; concentrate on management applications as they relate to the electives.

The practical application of management theory to technical disciplines is essential . . . use case studies of base civil engineer problems--real not imaginary.

Delete the thesis in lieu of "research design" to prove the student can set up the thesis--writing skills are proven throughout the program. A well researched case study will do more for the student than a thesis will do for the Air Force.

Have the students become familiar with architect-engineer contracting procedures.

All AFIT GEMs have been outstanding managers . . . whatever you're doing to them--keep it up.

Our CE officers are a small group that work in CE and systems management fields . . . I would hesitate to recommend changes because the students assigned to other organizations might need the courses offered.

Add a review course for the EIT and PE that consists of many problems. Studying and taking the EIT/PE while at AFIT is a perfect time.

Computer aided engineering management is becoming increasingly important . . . our applications and use of computer software is limited, it appears, because our engineers are not adequately trained to develop sophisticated applications or define sophisticated requirements.

Prepare the younger students for the sustained heavy workloads they will encounter . . . stress the importance of their role as an officer . . . a graduate degree will help you do a better job as an engineer and manager, but it won't necessarily make you a better professional officer . . . the environment of your graduate program can be enhanced by interjecting the need for professional officership throughout your curriculum.

The graduate I supervise is an excellent staff officer, pilot, eloquent airspace spokesman and innovative thinker . . . part of his present excellence can be attributed to that course of study . . . keep up the good work.

Spend some time on information such as effective ways of writing OERs and APRs and how to use management skills at the different jobs at base level . . . give a two week course similar to the BCE course for those new to the CE field or have them work with engineers at WPAFB before they start classes.

The graduate I supervise does not work in CE but based on his overall managerial knowledge and expertise, I think AFIT is on the right track with its management, communication, and problem solving courses.

Concentrate on the design and construction arena . . . need further theoretical study in operations and maintenance . . . include reliability data on RPIE, preventative maintenance and workforce scheduling.

I think the program is doing a good job.

Teach more communicative skills.

The curriculum is exactly what the Air Force needs . . . the graduate I supervise has one of the most demanding CE jobs and has performed well . . . keep up the good work.

Excellent course.

The difficulty in making the transition from practicing engineer to manager is working with people as opposed to things, making others do/want to do the work for you as opposed to doing it yourself, and accepting the fact that the results of the team effort will probably not be the "perfect" solution . . . the challenge is to lead and motivate several heterogeneous groups and build synergism . . . for each group of individuals there are different motivational factors and different personnel rules.

I'm very impressed with the technical competence and managerial ability of the graduate I supervise. He is the best civil engineering field grade officer I have observed. I'm sure your program is partly responsible.

The "engineer" I am presently supervising is filling a flying squadron director of operations position and does not get to display what he learned at AFIT on a routine basis. His leadership and management are superb but reflect other experiences.

Graduates' Suggestions

Computer programming/applications (7)*

More technical electives (5)

Strengthen engineering economy (5)

Comprehensive planning (4)

Expand technical writing and speech (4)

Contingency engineering (3)

Leadership course (3)

Meaningful course in statistics (in place of existing course) (3)

Construction cost estimating (3)

Make project management mandatory, rather than elective (3)

Additional "contract administration" course (3)

Concepts of power distribution systems and mechanical systems (2)

Strengthen quantitative decision making/problem solving course (2)

DOD/Air Force civilian personnel system (2)

Computer programming (2)

Word processing (as elective) (2)

C.E. regulations and roles (2)

Supervisory skills (2)

Heating & air conditioning and electrical (2)

Content of contingency course--include force development, manpower requirements, TPFDL, AFRES (mandays, etc.), UNITREP

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*The number in parentheses is for the number of respondents who made this, or a very similar, suggestion. If no number is shown, only one person made the suggestion.

Political considerations relevant to U.S. engineering overseas

Expand PPBS (Federal Financial Management) to include base level budgeting

Airport planning and design

Architectural programming

Strengthen environmental analysis

Electives in management and behavioral theory

Ethics/business morality

Military engineering laws/rules

Air Command and Staff Seminar Program

Make engineering economy mandatory rather than elective

Logistics management

Basic statistics

Basic Operations Research

Basic contracting course

In Federal Financial Management, stress relationship of MCP to POM

More on management of people

Time management

Additional management courses

Split communication course into two--one for those doing theses involving questionnaires and one for those not using questionnaires

Maintenance engineering

Reimbursements and cost account code--CEMAS

Change theoretical research type thesis to practical type

Introduction to International Logistics

Timber design course related to renovation

Make macroeconomics mandatory

Federal Financial Management (respondent understood that it had been deleted)

Energy issues

Construction Manager course (as elective)

More research theory and applications

More accounting--capitalization of real property

More statistics

A/E package development

Design manhour scheduling

Address personnel management more

Supervisors' Suggestions

Three supervisors who responded to this question suggested more emphasis in the communications area. One suggested that a course in oral communication be added to the GEM curriculum. The other two supervisors recommended the inclusion of "more speaking and writing." The other suggestions listed below were made only once.

Seminar in the public policy issues--case studies in contemporary policy issues

Seminar in intergovernmental coordination--federal, state, and local government interaction

Seminar in public administration

Architect-engineer contracting

Civilian personnel system

Review course for EIT and PE

Construction law

Worldwide Military Command & Control System (WWMCCS)/Joint Operation Planning System (JOPS)

More financial management or finance courses

Elective with emphasis on management of a small business

Case study course that reviews business cases in the "outside world" (outside DOD)

Practical applications/techniques of trade crafts

Airspace management

Construction specification writing

Computer programming and operation

Course giving overview of approvals for the different construction programs

Elective on Corps of Engineers & U.S. Navy construction management, change order processing, and case histories on Armed Services Board of Contract Appeals

Readiness initiatives

Protective coating design

Mechanical & electrical engineering courses for mechanical & electrical supervision

Control Program

```
PRINT BACK      CONTROL
RUN NAME        GEM STUDY
VARIABLE LIST   D1,D2,Q1 TO Q76
INPUT MEDIUM    CARD
N OF CASES      UNKNOWN
INPUT FORMAT    FIXED(F1.0,F3.0,1X,8F1.0,1X,38F1.0,1X,
                24F1.0,1X,14F1.0)
MISSING VALUES Q1 TO Q8 (0)/
MISSING VALUES Q9 TO Q76 (0,8,9)/
VAR LABELS      D1,SAMPLE NUMBER/D2,CASE NUMBER/
                Q1,GRADE/Q2,JOBLEVEL/
                Q3,EXPER/Q4,SERVICE/Q5,DEGCODE/Q6,CLASS/Q7,CLASS/Q8,EDUCATION/
                Q9,ORGMGT1/Q10,ORGMGT2/Q11,ORGBEH1/Q12,ORGBEH2/Q13,COMM1/
                Q14,COMM2/
                Q15,MICROECON1/Q16,MICROECON2/Q17,STATI1/Q18,STATI2/Q19,STATII1/
                Q20,STATII2/Q21,QDM1/Q22,QDM2/Q23,RESEARCH1/Q24,RESEARCH2/
                Q25,PDTMGT1/Q26,PDTMGT2/Q27,COMPSCI1/Q28,COMPSCI2/Q29,CONTRACT1/
                Q30,CONTRACT2/Q31,MIS1/Q32,MIS2/Q33,ENGMGT1/Q34,ENGMGT2/
                Q35,FEDFINMGT1/Q36,FEDFINMGT2/Q37,THESIS1/Q38,THESIS2/
                Q39,ENGECON1/Q40,ENGECON2/Q41,ENERGY1/Q42,ENERGY2/Q43,ENVIRON1/
                Q44,ENVIRON2/Q45,LABREL1/Q46,LABREL2/Q47,FOUNDENG1/Q48,FOUNDENG2/
                Q49,TIMBER1/Q50,TIMBER2/Q51,PVMT1/Q52,PVMT2/Q53,CONCOST1/
                Q54,CONCOST2/Q55,CONTCCY1/Q56,CONTCCY2/Q57,MACROECON1/
                Q58,MACROECON2/Q59,LDSHP1/Q60,LDSHP2/Q61,SUPVSR1/Q62,SUPVSR2/
                Q63,USEFIRST/Q64,USELATER/Q65,THEORY/Q66,PCTAL/Q67,PROMO/
                Q68,PAPERS/Q69,COMPTR/Q70,AST1/Q71,AST2/Q72,CVST/
                Q73,ENGMGR/Q74,RECOMD/Q75,WKLD/Q76,LGNTH/
VALUE LABELS    D1 (1)GRADUATES (2)SUPERVISORS/
                Q1 (1)2LT (2)1LT (3)CAPT (4)MAJ (5)LTCOL (6)COL (7)OTHER/
                Q2 (1)SQUADRON (2)GROUP (3)WING (4)AIR DIVISION
                   (5)MAJCOM (6)HQAF (7)NA (8)OTHER/
                Q3,Q4 (1)1 OR LESS (2)1 TO 3 (3)3 TO 5 (4)5 TO 7 (5)7 TO 9 (6)9 OR MORE/
                Q5 (1)YES (2)NO (3)DON'T KNOW/
                Q6 (1)74A (2)75A (3)76A (4)77A (5)78A (6)79A (7)80J (8)81S/
                Q7 (1)74B (2)75B (3)76B (4)77B (5)78B (6)79B (7)MISCODE (8)82S/
                Q8 (1)NONE (2)+BS (3)+COURSES (4)+MS (5)PHD (6)OTHER/
                Q9 TO Q74 (1)STRONGLY DISAGREE (2)DISAGREE (3)SLIGHTLY DISAGREE
                (4)NEUTRAL (5)SLIGHTLY AGREE (6)AGREE (7)STRONGLY AGREE
                (8)NA (9)UKN/
                Q75 (1)TOO LIGHT (2)LITTLE LIGHT (3)ABOUT RIGHT
                (4)LITTLE HEAVY (5)MUCH TOO HEAVY/
                Q76 (1)TOO LONG (2)LITTLE LONG (3)ABOUT RIGHT
                (4)LITTLE SHORT (5)TOO SHORT
```

```
COMPUTE         RQ6 = Q6
COMPUTE         RQ7 = Q7*10
COMPUTE         ALLCLASS = RQ6 + RQ7
IF              (ALLCLASS NE 8 AND NE 80)MAJOR = 1
IF              (ALLCLASS EQ 8 OR  EQ 80)MAJOR = 2
IF              (ALLCLASS NE 8 AND NE 80)GFMCLASS = ALLCLASS
IF              (ALLCLASS EQ 8 OR  EQ 80)GFMCLASS = 100
IF              (ALLCLASS EQ 8 OR  EQ 80)GEMCLASS = ALLCLASS
IF              (ALLCLASS NE 8 AND NE 80)GEMCLASS = 100
ASSIGN MISSING GFMCLASS,GEMCLASS (100)
VAR LABELS      ALLCLASS, ALL CLASSES/MAJOR, CLASS MAJOR/
                GFMCLASS, GFM CLASSES ONLY/GEMCLASS, GEM CLASSES ONLY/
VALUE LABELS    ALLCLASS,GFMCLASS,GEMCLASS (1)74A (2)75A (3)76A (4)77A
                (5)78A (6)79A (7)80J (8)81S
                (10)74B (20)75B (30)76B (40)77B (50)78B (60)79B
                (70)MISCODE (80)82S/
                MAJOR (1)GFM GRADS (2)GEM GRADS
```

Procedures

```
LIST CASES      CASES=10/VARIABLES=Q6,Q7,RQ6,RQ7,MAJOR,GEMCLASS,GFMCLASS,ALLCLASS
TASK NAME       FREQUENCIES - GRAD SURVEY
FREQUENCIES     GENERAL=Q1 TO Q76,MAJOR,GEMCLASS,GFMCLASS,ALLCLASS
OPTIONS         6,8,9
STATISTICS      ALL
READ INPUT DATA
FINISH


TASK NAME       FREQUENCIES - SUPERVISOR SURVEY
FREQUENCIES     GENERAL=Q2,Q3,Q4,Q9,Q11,Q13,Q15,Q17,Q19,Q21,Q23,Q25,Q27,Q29,
                 Q31,Q33,Q35,Q37,Q39,Q41,Q43,Q45,Q47,Q49,Q51,Q53,Q55,Q57,Q59,Q61
OPTIONS         6,8,9
STATISTICS      ALL
READ INPUT DATA
FINISH


TASK NAME       WORKLOAD, LENGTH, THESIS, COMPUTER BY MAJOR (M-W)
NPAR TESTS      M-W=Q75,Q76,Q72,Q69 BY MAJOR (1,2)
STATISTICS      1
READ INPUT DATA
FINISH


TASK NAME       IMPORTANCE OF CORE COURSES - GRAD VS SUPER (M-W)
 NPAR TESTS      M-W=Q9,Q11,Q13,Q15,Q17,Q19,Q21,Q23,Q25,Q27,Q29,
                Q31,Q33,Q35,Q37 BY D1 (1,2)
STATISTICS      1
READ INPUT DATA
FINISH


TASK NAME       IMPORTANCE OF ELECTIVES - GRADS VS SUPER (M-W)
 NPAR TESTS      M-W=Q39,Q41,Q43,Q45,Q47,Q49,Q51,Q53,Q55,Q57,Q59,
                Q61 BY D1 (1,2)
STATISTICS      1
READ INPUT DATA
FINISH


TASK NAME       PROMO, AST1,AST2 BY GRADE (K-W)
NPAR TESTS      K-W=Q67,Q70,Q71 BY Q1 (1,7)
STATISTICS      1
READ INPUT DATA
FINISH
```

```
*RECODE        Q9 TO Q38 (1=1)(2=2)(3=3)(4=4)(5=5)(6=6)(7=7)(ELSE=0)
 MISSING VALUES Q9 TO Q38 (0)
TASK NAME      SPEARMAN'S CORRELATION - CORE COURSES
  NONPAR CORR    Q9,Q10/Q11,Q12/Q13,Q14/Q15,Q16/Q17,Q18/
                 Q19,Q20/Q21,Q22/Q23,Q24/Q25,Q26/Q27,Q28/Q29,Q30/Q31,Q32/
                 Q33,Q34/Q35,Q36/Q37,Q38
READ INPUT DATA
FINISH


  *RECODE        Q39 TO Q62 (1=1)(2=2)(3=3)(4=4)(5=5)(6=6)(7=7)(ELSE=0)
MISSING VALUES Q39 TO Q62 (0)
TASK NAME      SPEARMAN'S CORRELATION - ELECTIVES
NONPAR CORR    Q39,Q40/Q41,Q42/Q43,Q44/Q45,Q46/Q47,Q48/
               Q49,Q50/Q51,Q52/Q53,Q54/Q55,Q56/Q57,Q58/Q59,Q60/Q61,Q62
READ INPUT DATA
FINISH


TASK NAME      KENDALL'S CORRELATION - CORE COURSES
NONPAR CORR    Q9,Q10/Q11,Q12/Q13,Q14/Q15,Q16/Q17,Q18/
               Q19,Q20/Q21,Q22/Q23,Q24/Q25,Q26/Q27,Q28/Q29,Q30/Q31,Q32/
               Q33,Q34/Q35,Q36/Q37,Q38
OPTIONS        5
READ INPUT DATA
FINISH


TASK NAME      KENDALL'S CORRELATION - ELECTIVES
NONPAR CORR    Q39,Q40/Q41,Q42/Q43,Q44/Q45,Q46/Q47,Q48/
               Q49,Q50/Q51,Q52/Q53,Q54/Q55,Q56/Q57,Q58/Q59,Q60/Q61,Q62
OPTIONS        5
READ INPUT DATA
FINISH

TASK NAME      FREQUENCIES - ALL RESPONDENTS (IMPORTANCE)
FREQUENCIES    GENERAL=Q9,Q11,Q13,Q15,Q17,Q19,
               Q21,Q23,Q25,Q27,Q29,Q31,Q33,Q35,Q37,
               Q39,Q41,Q43,Q45,Q47,Q49,Q51,Q53,Q55,Q57,Q59,Q61
OPTIONS        6
STATISTICS     ALL
READ INPUT DATA
FINISH
..
```

Graduate Data

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1002	55660021	555576666767676754666354005677	66686654585858578545858 56536647956654
1003	41662201	666656325655555555657755665645	66686655585868686868385855 34436656965633
1004	33462041	767665265654556555571644561666	26262656181818181818157666 76225652267634
1005	36562701	766665555777766776656456445544 4	78655458585858585556565558 35446656656644
1006	21232061	565666582626264626467644682546	66365628282828768466828 26226622246644
1007	38162001	666672664444555566666662626611	66446648484844684844666 6	24442119272155
1008	35333001	776676526666766356666666667377	00565600004757000055000	78116666846733
1009	11362401	666666164614472766665200351777	777768585848686000000000	16131611715733
1010	48462051	656677634455542424535464545335	544363000000000000000008	45226523265333
1011	48162201	777776587757677756565856587777	56585766181858578677768	77117771117755
1012	41663501	777777476757777777777677767777	677777777878787878677777	77217747767755
1013	36361601	777777575757677757677777777777	770867770000000000000008	76117777117751
1014	35142001	655536141212342658755375645545	564115281818151818386868	56219479896733
1015	38261703	666666482626362648467656685645	545655685848486856486868	38225527875745
1016	41562031	667666454667565646357745774546	560000670000000000000708	56537657927743
1017	35441001	767677335555537525208755355635 6	676600770000857000000000	48637757877733
1018	38551706	576677182626475657263757466707	463557381818584828162838	58246629845644
1019	38561501	664673261616261612267372727717	262667181818587818181848	77617117777733
1020	46661401	666677565656565656467575656666	566666565858585848366666	66316666626633
1021	31462001	666665245643563366566665433646	564525485858564865286868	68326606826733
1022	48661001	664677255645556666457767345546	565656000006660000000008	45544629925252
1023	21132001	666666535757455455657654555566	454400550066660066000008	38539625866733
1024	21132003	777752214747773177445243525542	684040000817170070000008	61517522777733
1025	41162203	756666555666665500466868666655	666866666068686868686868	54626611166633
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1027	41261706	777777676767576777677777777767	676777000000000008577777	68227757817734
1028	36363701	666677255717356558566163567156	625541681818186858386868	58419557875644
1029	46262043	777777465757376747461700086717	000866151818181818187868	65226737915933
1030	48162701	767676242525257624735355546422	131472281818181818587878	45622672275644
1031	36252004	777776171717571777757177771717	171717171717171717177777	68627779816755
1032	37262601	666675565656562256222323232322	565656282828282828285648	48336322877555
1033	35252501	767677147676767700667576005777	660044000000000000440000	66516646926655
1034	54463401	665644466646575565567554767466	677565685858587863505468	55626657564534
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1036	21332001	454267114444454555666762535365	441852286847767158115141	48716540000000
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Supervisor Data

2001	556	7	7	7	5	6	5	5	6	4	5	6	6	7	6	5	6	7	7	6	4	4	4	5	6	5	7	7
2002	236	7	7	6	4	5	5	5	4	6	6	6	5	5	7	4	6	7	5	4	5	4	6	6	4	4	7	6
2003	256	7	7	7	2	5	4	2	7	6	6	5	6	4	5	3	6	6	4	2	4	1	1	1	6	4	5	7
2004	566	6	6	7	2	2	2	2	2	2	6	6	4	6	6	4	2	2	5	2	4	5	5	6	4	2	6	6
2005	166	6	6	7	6	6	6	6	6	6	6	5	6	6	6	3	4	4	4	5	3	3	4	5	5	5	6	7
2006	366	7	7	7	4	5	5	5	6	6	7	6	7	7	7	6	5	7	7	6	5	5	6	5	7	3	6	7
2007	166	7	7	7	2	6	2	3	2	4	7	7	5	7	7	5	7	5	5	6	4	2	5	7	7	5	7	7
2008	856	7	7	6	2	2	2	3	4	6	4	5	6	7	6	6	4	6	5	4	6	4	4	5	5	1	1	5	4
2009	514	6	7	7	5	4	4	4	4	4	3	7	5	7	7	7	6	5	4	6	4	4	4	5	5	6	4	6	5
2010	166	7	7	7	5	5	5	5	3	6	4	7	7	7	7	4	5	6	6	7	4	4	4	5	6	4	7	7
2011	666	7	6	7	3	2	2	2	5	2	6	7	7	7	7	5	7	7	7	5	7	7	7	7	2	7	7	7
2012	466	6	7	6	3	4	5	4	5	5	6	7	7	7	6	4	4	3	5	5	5	2	5	6	2	3	6	7
2013	546	6	7	7	5	6	8	5	5	7	6	7	7	7	7	6	5	6	6	5	6	6	6	7	5	5	7	6
2014	516	6	7	7	1	5	5	4	6	2	2	5	6	4	5	7	4	4	4	5	1	1	4	4	4	4	6	6
2015	166	7	7	7	1	2	2	2	2	7	6	7	7	7	5	4	5	5	7	7	5	3	5	5	6	1	7	7
2016	666	6	7	7	4	5	3	4	5	6	5	6	6	5	7	4	5	5	5	7	3	3	3	5	7	6	7	7
2017	626	6	6	7	4	5	5	6	6	5	4	5	6	6	6	5	5	5	5	6	6	6	6	6	6	6	6	6
2018	326	6	6	7	1	1	1	1	6	5	2	5	7	6	5	2	4	4	4	4	1	1	1	1	1	1	6	6
2019	566	6	6	5	2	3	2	2	3	5	5	6	6	7	7	6	5	6	6	4	6	5	7	7	6	6	7	7
2020	146	7	7	7	2	2	2	2	4	4	2	2	2	2	2	2	2	4	4	4	2	2	4	2	4	2	7	7
2021	426	7	7	7	4	6	6	5	6	5	6	5	5	6	7	7	5	6	5	6	5	4	4	4	4	4	7	6
2022	136	7	7	6	6	5	5	6	5	5	4	5	6	6	5	5	6	6	6	7	4	4	4	5	5	4	7	7
2023	666	7	7	7	5	4	4	5	7	4	7	7	7	7	7	4	6	3	3	4	3	4	4	7	6	4	7	7
2024	626	7	7	7	4	4	4	6	5	7	7	6	7	7	7	3	4	4	4	4	4	2	2	6	6	3	7	7
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2029	116	6	7	7	2	2	4	5	3	6	6	7	5	6	7	4	3	6	6	5	5	5	5	5	6	2	7	7
2030	566	7	5	7	4	7	7	7	7	4	7	6	5	4	4	7	4	4	5	3	7	7	7	7	7	5	7	4
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2032	166	7	7	6	5	5	5	6	5	7	6	5	7	7	6	6	5	7	7	6	5	5	5	6	7	6	7	7
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2034	166	6	6	7	6	6	6	6	6	6	6	7	6	7	7	6	6	7	7	6	7	7	7	7	7	6	7	6
2035	566	7	7	6	4	6	3	6	4	4	6	4	7	7	4	5	4	3	5	6	2	3	3	4	6	4	7	7
2036	366	6	6	6	2	5	4	3	5	4	5	3	6	5	4	4	3	3	4	5	2	2	2	4	4	5	7	7
2037	126	7	6	7	5	5	6	5	5	7	5	6	5	7	6	5	7	6	7	7	5	5	5	7	7	5	6	6
2038	336	6	5	6	3	4	2	2	4	3	2	5	5	3	5	5	4	6	6	6	4	5	5	6	5	2	4	5
2039	536	5	6	6	4	6	5	4	6	5	6	4	5	6	5	4	5	4	4	5	4	4	4	4	4	5	5	5
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2041	822	7	7	7	6	6	6	6	6	6	6	7	7	6	6	5	6	6	6	7	6	6	6	6	7	6	7	7
2042	666	7	7	7	2	6	6	4	3	7	7	7	7	7	5	2	7	5	6	7	4	4	4	6	6	6	7	7
2043	626	6	6	7	4	4	4	4	5	5	5	4	5	5	7	5	4	5	6	5	4	3	4	4	6	5	7	7
2044	166	7	6	7	6	7	7	6	6	7	6	6	6	6	5	6	5	6	7	5	5	5	6	6	7	5	7	6
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2058	136	7 7 7 5 5 4 6 5 6 6 5 6 5 5 4	5 5 5 5 4 4 4 5 5 4 6 6
2059	836	7 7 7 3 5 5 3 2 4 7 6 6 7 6 5	4 5 5 4 3 2 3 6 4 4 7 7
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2061	366	6 6 5 5 6 5 6 6 6 7 6 7 6 5 6	6 7 7 6 4 4 4 5 7 4 6 6
2062	566	6 6 7 5 2 2 2 2 2 5 6 4 5 3 3	5 5 6 4 5 5 5 5 6 4 5 5
2063	226	7 6 7 6 6 6 7 7 7 6 7 6 7 5 7	6 4 6 4 7 4 7 7 4 4 4 6
2064	166	7 7 7 6 5 5 6 6 7 7 7 7 7 7 7	7 7 7 7 7 7 7 7 7 6 7 7
2065	156	6 6 6 6 5 5 5 6 6 5 6 6 6 6 5	6 5 5 5 5 5 5 5 7 4 6 6
2066	166	6 6 6 4 5 4 5 4 6 6 7 6 7 7 5	5 6 5 7 6 5 7 7 6 4 7 5
2067	146	7 7 7 1 1 1 1 4 6 6 6 4 6 3 5	4 2 4 1 5 4 6 6 7 1 7 5
2068	166	7 7 7 5 5 4 6 7 7 6 7 6 7 6 4	7 7 7 7 6 5 7 7 7 5 7 7
2069	126	5 6 5 2 5 3 4 6 3 5 1 5 2 5 6	2 5 6 5 1 1 1 5 6 1 7 7
2070	166	7 7 7 5 6 6 6 7 7 5 7 5 7 6 6	6 6 6 6 7 7 7 7 7 5 6 7
2071	166	7 7 7 2 4 2 1 6 6 6 7 5 7 7 2	7 7 7 1 5 3 6 6 7 6 7 7
2072	246	7 7 7 6 5 5 6 6 7 7 7 6 7 7 5	6 7 6 5 7 4 6 7 7 6 7 7

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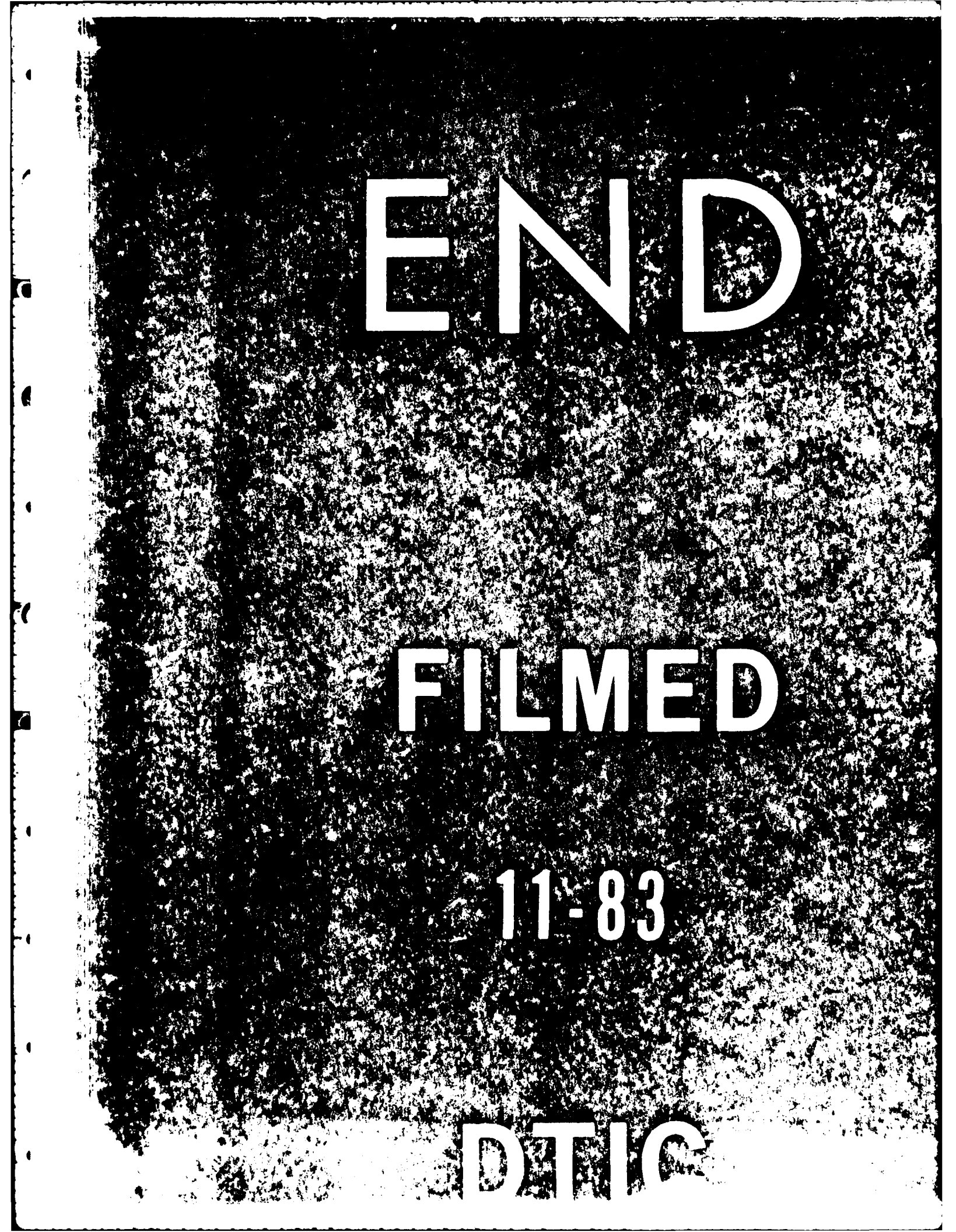
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