

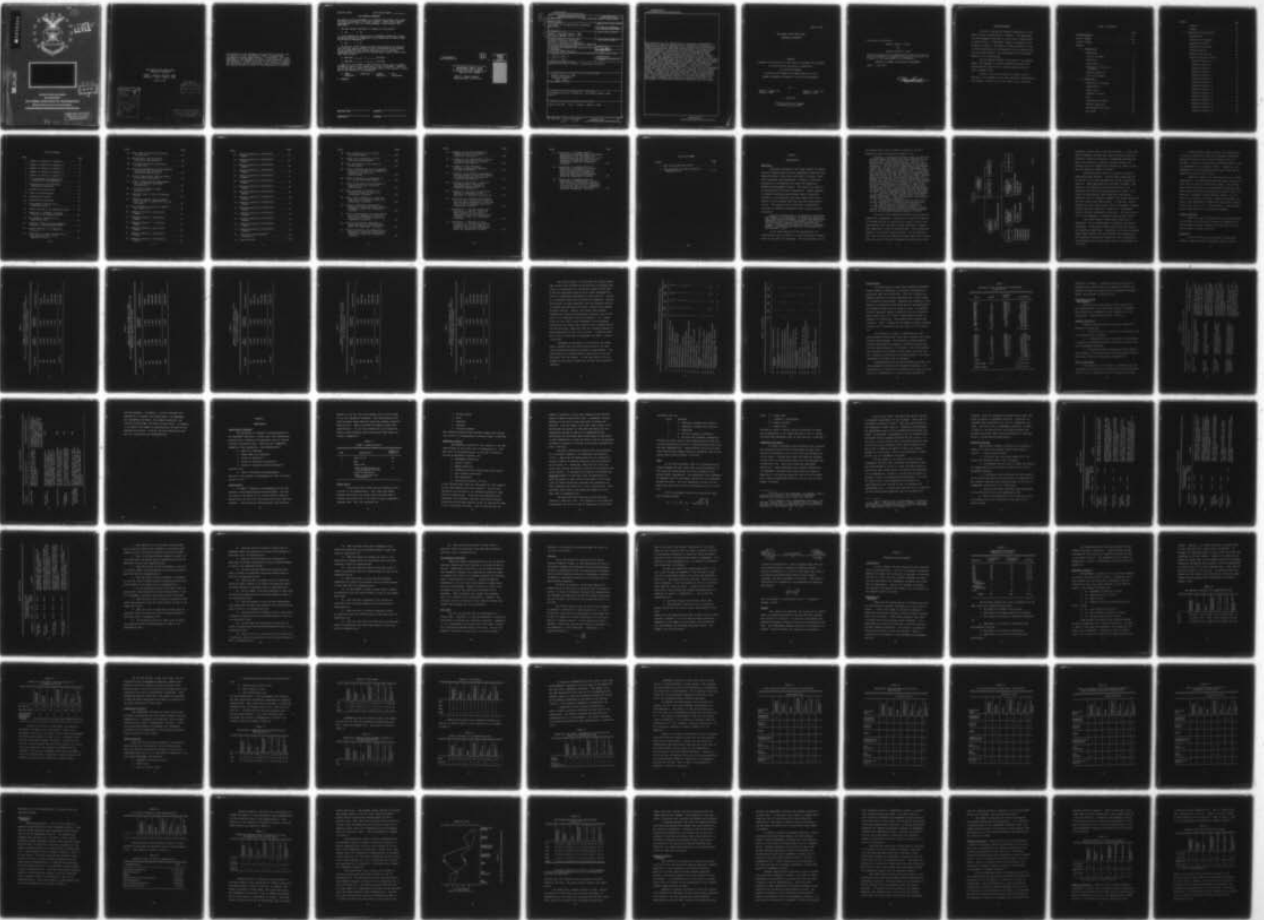
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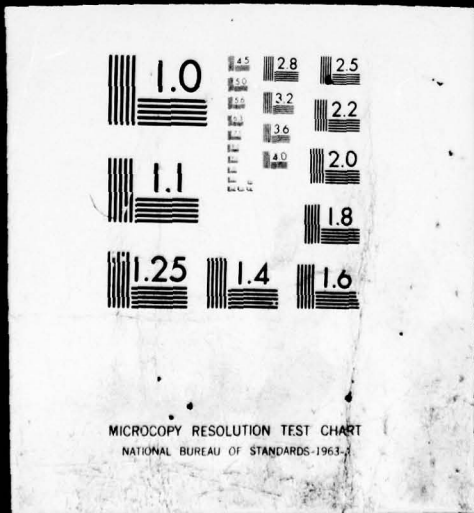
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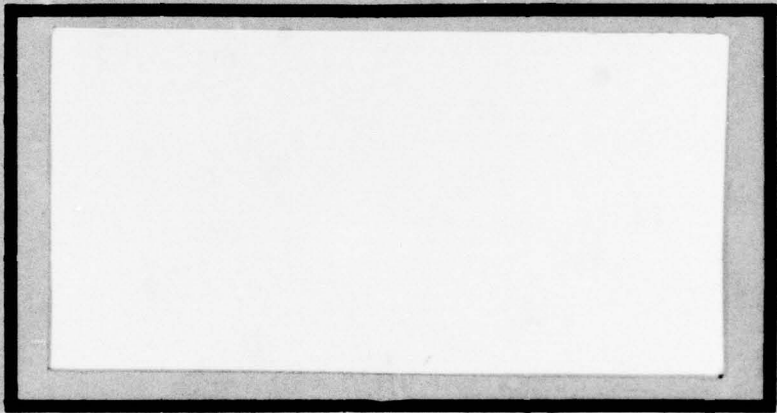


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THE VALUE OF THE BASE LEVEL  
INDUSTRIAL ENGINEER

Buddy C. Caples, Captain, USAF  
Anthony J. Kwan, Captain, USAF

LSSR 12-79A

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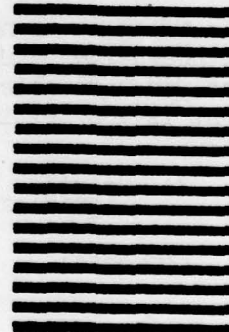


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The objectives of this thesis were to calculate the perceived benefit/cost index of each base level Industrial Engineering (IE) responsibility and to determine the variables that significantly affect the perceived value and effectiveness of each base level IE responsibility. The majority of the thesis was developed around a questionnaire entitled Industrial Engineering Cost Effectiveness. The questionnaire was mailed to all Air Force bases having an industrial engineering branch of three or more personnel. The population surveyed included officers and civilians holding the following positions at each base: Base Civil Engineer, Deputy Base Civil Engineer, Chief of Industrial Engineering, Chief of Engineering and Environmental Planning, Chief of Operations and Chief of Resources and Requirements. The results of the survey indicate that the perceptions of the value and effectiveness, importance and benefit/cost index are different for each responsibility. Variables that influence the perceived value and effectiveness of base level IE were identified. Some of the changes that would enhance the perceived value of each IE responsibility are: giving IE personnel training in writing techniques, oral techniques, feedback and quantitative analysis; allowing IE to participate in establishing goals and objectives for its branch.

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INDUSTRIAL ENGINEER

A Thesis

Presented to the Faculty of the School of Systems and Logistics  
of the Air Force Institute of Technology

Air Training Command

In Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Facilities Management

By

Buddy C. Caples, MA  
Captain, USAF

Anthony J. Kwan, BS  
Captain, USAF

June 1979

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This thesis, written by

Captain Buddy C. Caples

and

Captain Anthony J. Kwan

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 FACILITIES MANAGEMENT

DATE: 3 June 1979

  
COMMITTEE CHAIRMAN

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## Chapter 1

### INTRODUCTION

#### Background

Industrial Engineering (IE) today extends far beyond the work simplification and work measurement techniques that Frederick Taylor (1856—1915) and Frank B. Gilbreth (1856—1925) introduced and popularized. Currently, Industrial Engineering is synonymous with terms like Operations Research and Management Science. This means that today IE is concerned with the whole organization. Recent advances in computer technology have allowed today's Industrial Engineer to use statistical and other quantitative techniques to solve problems that span the whole organization (14:19). The scope of IE is reflected in the American Institute of Industrial Engineers (AIIE) current practice definition:

Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of men, materials and equipment. It draws upon specialized knowledge and skill in the mathematical, physical and social sciences, together with the principles and methods of engineering analysis and design, to specify, predict, and evaluate the results to be obtained from such systems [1:116].

In Air Force base level Civil Engineering (CE) organizations, the IE branch is a staff organization responsible to the Base Civil Engineer. The IE's position in the

CE Organizational Chart is shown in Figure 1; the IE's responsibilities as specified in AFR 85-1 are:

Industrial engineering provides consulting services directed toward increasing work force productivity and improving base level CE resource use. Services IE provides can include special studies, analysis, application of IE techniques and development of innovative procedures. The IE's [BIE's] [Base Industrial Engineer] clients are the BCE and all levels of management and labor. The IE [BIE] is a "problem solver." The responsibility for problem identification, prioritizing studies, conducting the study, and follow-on implementation should be shared with the IE's [BIE's] clients. Subject areas for studies can include bench stock, BCE taxi system, IWP, hospital and housing reimbursements, supply expenditures and discipline, service calls, and vehicles. In solving problems, it is necessary for IEs [BIEs] to work with similar analysis functions in supply, procurement, transportation, and accounting and finance. The IE [BIE] is also a facilitator who removes barriers to communication and coordination impacting the proper operation of our management system. The IE [BIE] also:

- (1) Analyzes, and advises the BCE and key members of the staff on work done, problem areas, and recommended improvement. Topics for analyses may be generated by the IE [BIE] or the staff.

- (2) Advises BCE management staff on the quality control evaluation of in-service and self-help work.

- (3) Directs the cost accounting function to include cost collection, analysis and reporting.

- (4) Directs the real property function to assure control of real property facilities including management of the building custodian program [4:18-19].

The role of the Industrial Engineer in many private industries is expanding. Realization of the IE's potential to increase profits, by analyzing an industry using a systems approach, has lead many private industries to devote more resources to their IE organizations. One illustrative example is the United California Bank. In this organization, the IE branch has undergone several structural changes. This bank has 191 offices throughout California and is the

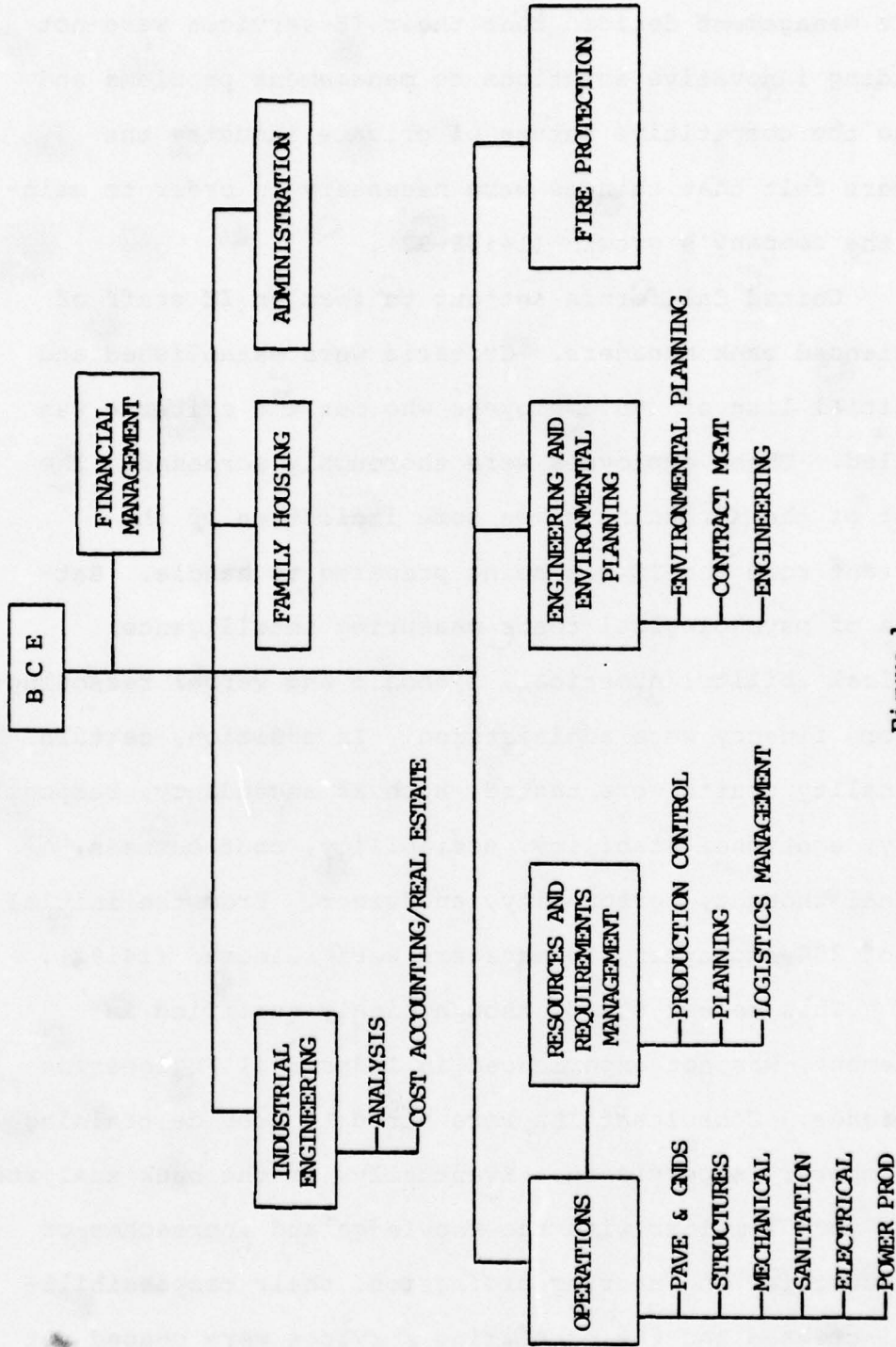


Figure 1

The CE Organizational Chart

[4:34]

fourteenth largest bank in the United States. In 1956, the bank's management decided that their IE services were not providing innovative solutions to management problems and due to the competitive nature of private industry the managers felt that changes were necessary in order to maintain the company's growth (14:88-92).

United California set out to form an IE staff of experienced bank managers. Criteria were established and an initial list of 200 employees who met the criteria was compiled. These employees were thoroughly screened. The extent of the screening gives some indication of the important role the IE was being prepared to handle. Batteries of psychological tests measuring intelligence; numerical ability; numerical, symbolic and verbal reasoning; and word fluency were administered. In addition, certain personality traits were tested, such as ascendancy, responsibility, emotional stability, sociability, cautiousness, original thought, personality, and vigor. From the initial list of 200 employees, 10 managers were selected (14:92).

This select staff, though highly qualified in management, was not experienced in Industrial Engineering techniques. Consultant IEs were hired to provide training and temporary supervision. Eventually, as the bank analysts became more familiar with the knowledge and approaches of the industrial engineering profession, their responsibilities increased and the consulting services were phased out (14:92-93).

United California Bank has been very pleased with the results obtained by these elite Industrial Engineers. Because the bank provides uniform services at all its branches, a solution to one branch's problems generally can be implemented at all branches (14:98). Summing up, top management at United California Bank states "today the IE program is a way of life [14:89]."

Productive change is an integral part of any viable organization. An organization must continually evaluate its goals and its ability to achieve its goals. Only through honest self evaluation can an organization recognize areas where resources are being wasted and not used to their full potential. Although, within America's society, the Air Force is not faced with "direct" competitive pressure, all areas of the Department of Defense are continually asked to do more with less (3:1-3). The necessity to use resources wisely leads directly to our problem statement.

#### Problem Statement

There is a need to determine the cost effectiveness of each base level Industrial Engineering responsibility and to determine those variables that influence the cost effectiveness of these activities.

#### Motivation

In 1977, two Air Force Institute of Technology students, Captain Farineau and Captain Tucker, wrote a

thesis entitled "The Role of Industrial Engineering Within Base Civil Engineering." This thesis provided the motivation for our investigation.

Using a questionnaire, this thesis team took a census of all major<sup>1</sup> Air Force Civil Engineering (CE) Squadron Commanders and Branch Chiefs in order to determine the role of the Industrial Engineer. Some of their conclusions were:

- 1) Industrial engineering capability is needed within the Base Civil Engineering organizations.
- 2) The IE staff should be built around a nucleus of degreed IE personnel.
- 3) Quality control-type activities should be eliminated from the IE function.
- 4) The IE staff should concentrate its activities on solving management problems.
- 5) The Base Civil Engineer and the various branch chiefs should be provided training in how to use the IE effectively.
- 6) The Chief of IE should be a qualified IE who has at least two years of BCE experience.
- 7) The IE branch should not be encumbered with an overload of additional duties.
- 8) An Industrial Engineering team capability should be established above the base level to study and resolve common Base Civil Engineering management problems [6:143-145].

Upon reviewing their thesis, we find that the views of the Chiefs of Operations, Chiefs of Engineering and Design, and the Chiefs of Programs are not consistent with those of the BCE and BIE concerning the perceived utility of

---

<sup>1</sup>There are 126 Air Force bases worldwide which have an Industrial Engineering (IE) Branch. However, twelve bases have an IE Branch of 3 or less. These small bases were eliminated and 114 bases were surveyed (6:30).

the IE function. Five typical questions that summarize this inconsistency which is present in all the survey questions are summarized in Tables 1 through 5. Basically, the responses demonstrate that the operational branch chiefs are undecided as to the usefulness and effectiveness of the IE branch and its solutions to management problems. On the other hand, the BCE and the BIE seem to agree that the BIE and his solutions are useful and effective, and that the squadron would be worse off if the IE branch was dissolved (6:27-98).

One plausible explanation for this inconsistency is that both the BCE and the BIE have a vested interest in stating that Industrial Engineering is useful and effective. The BIEs are aware that their jobs are at stake, should they state that they are not effective and perform a relatively useless service. While the BCEs are also aware of this situation, there is always a tendency for the head of an organization to protect the integrity of that organization (12:87). Although base Industrial Engineers may not be performing up to their potential, and this is merely a hypothesis, it would be a rare occasion that the BIEs contributed nothing to the civil engineering organization. Therefore, many BCEs would see the loss of IE as a direct loss to their local CE organization and not as a possible increase in the overall Air Force efficiency.

Table 1  
 Summary of Results to Question 1 (5:98)  
 (The IE can be relied upon to provide objective and effective  
 solutions to management problems?)

Treatment	Mean Response	Standard Deviation	Interpretation
DE	3.8830	0.8781	Agree
DEE	2.7660	1.2820	Undecided
DEI	4.0719	1.0686	Agree
DEM	3.1087	1.3350	Undecided
DEP	3.0978	1.1100	Undecided
Overall	3.3902	1.2068	Undecided

Table 2

Summary of Results to Question 2 (5:85)  
 (The IE recommendations are given serious consideration and  
 implemented a majority of the time?)

Treatment	Mean Response	Standard Deviation	Interpretation
DE	4.0851	0.7282	Agree
DEE	2.9681	1.1864	Undecided
DEI	3.2396	1.2957	Undecided
DEM	3.3804	0.9816	Undecided
DEP	3.2717	1.0598	Undecided
Total	3.3889	1.1290	Undecided

Table 3

Summary of Results to Question 3 (5:96)  
 (The IE is responsive to the problem  
 solving needs of management?)

Treatment	Mean Response	Standard Deviation	Interpretation
DE	4.0000	0.8920	Agree
DEE	2.9149	1.2151	Undecided
DEI	3.9072	1.0905	Agree
DEM	3.1957	1.1601	Undecided
DEP	3.1630	1.1220	Undecided
Overall	3.4414	1.1800	Undecided

Table 4

Summary of Results to Question 4 (5:95)  
 (IE studies play a significant role in improving  
 the CE organization?)

Treatment	Mean Response	Standard Deviation	Interpretation
DE	3.9362	1.0453	Agree
DEE	2.7553	1.2242	Undecided
DEI	3.5464	1.2418	Agree
DEM	3.1413	1.1914	Undecided
DEP	3.2500	1.0755	Undecided
Overall	3.3284	1.2208	Undecided

Table 5  
 Summary of Results to Question 5 (5:87)  
 (The Base CE organization would be adversely affected  
 if the IE Branch were dissolved?)

Treatment	Mean Response	Standard Deviation	Interpretation
DE	3.8191	1.0571	Agree
DEE	2.7128	1.3490	Undecided
DEI	3.4021	1.3743	Undecided
DEM	3.1957	1.2600	Undecided
DEP	3.1957	1.1696	Undecided
Total	3.2665	1.2940	Undecided

The single aspect of the Farineau and Tucker thesis that we felt most interesting and was also our primary motivation to investigate the cost effectiveness of base level IE was the open-ended question which asked respondents to list five noteworthy achievements of base level IE. A total of 31 different areas were indicated as noteworthy. Twenty-four percent of those responding gave the response "Quality IE Studies with Realistic Solutions," making this response the most frequent. However, the second most frequent response was "Nothing Noteworthy/Not Important" and 16 percent of all respondents gave this response. It is interesting to note that so many respondents would disregard instructions and answer this question with a response which was not solicited, especially when this response appears to show dissatisfaction with the IE branch. A complete breakdown of the 31 areas and the responses are shown in Table 6 (6:102-103).

Responses to questions of the Farineau and Tucker thesis indicate that the cost effectiveness of the base level Industrial Engineering program is questionable. This questionable cost effectiveness of base level IE was the motivation for this thesis. In the next section, we will attempt to justify the reasons why we feel this research is important.

Table 6

IE's Noteworthy Achievements as Perceived by the Respondents [6:102-103]

	DE	DEE	DEI	DEM	DEP
1. Quality IE Studies with Realistic Solutions	22	14	23	19	18
2. IE Analysis Capability/Accomplishments	9	3	4	10	4
3. Management Consultant Capability	6	3	7	7	9
4. QC/Activity Evaluation Type Work	8	3	2	7	4
5. MBO Monitor/Motivator	5	5	3	3	5
6. BEAMS/BLIS/Computer Expertise	7	1	9	6	17
7. Manpower Expertise/Accomplishments	6	6	6	5	2
8. Customer Relations Program Monitor/Motivator	2	2	-	-	1
9. Outstanding IG/CESMET Ratings	1	-	5	-	-
10. Implementing Squadron Safety Program	1	-	-	-	-
11. RECON Monitor/Motivator	1	-	1	-	-
12. Development of Visible Mgt Information System	1	-	1	-	-
13. Excellent Work on Additional Duties	1	-	-	-	-
14. COCESS Implementation Assistance	1	-	-	-	-
15. "Nothing Noteworthy/Not Important"	2	32	3	14	11
16. Establishing a BCE Customer Service Center	-	-	1	-	-
17. Improved Rapport with Other Branches, Willingness to Help	-	2	11	3	2

Table 6 (Continued)

	DE	DEE	DEI	DEM	DEP
18. Development of an Automated DEE Design Schedule	-	4	1	-	-
19. Training Activity (Associated with new Procedures)	-	1	2	-	2
20. Implementing Word Processing Center	-	-	2	-	-
21. Implementation of Test Reorganization	-	-	1	-	-
22. Energy Conservation Program Accomplishments	-	2	-	2	-
23. Troubleshooting Problem Areas	-	1	-	1	-
24. Effective Writing & Speaking Ability	-	1	-	1	-
25. Thorough Knowledge of BCE Organization and Procedures	-	-	-	1	-
26. Development of AICUZ	-	-	-	1	-
27. Negative Achievement--"Black Hat Image"	-	-	-	2	-
28. Development of Squadron Operating Instruction	-	-	-	-	1
29. Upgrade of "Unsatisfactory" IE Staff to "Satisfactory"	-	-	2	-	-
30. Administrative Assistance	-	1	-	-	-
31. Monitor MRC Meetings & Weekly Stand-Up Briefings	-	1	-	-	-

### Justification

An investigation of base level Industrial Engineering was needed to determine if resources allocated to IE were being used cost effectively. AFR 178-1 requires an economic analysis of on-going programs when a major change to a program is anticipated. Therefore the analysis in this thesis is a preliminary step which must be performed before any changes to base level IE should be made. But perhaps the most important reason to determine the cost effectiveness of base level IE is that a large amount of money is invested in IE salaries. This money should be spent productively. Table 7 summarizes the number of people assigned to base level IE worldwide and the value of their salaries (9).

Our analysis in Chapter 3 determined the cost effectiveness of base level IE and the variables that affect the cost effectiveness. This analysis provides managers evidence that shows how changes in different factors vary the cost effectiveness of an IE branch. With this information, managers will be able to make better decisions that will increase the efficiency and effectiveness of the money allocated to the base level IE resource.

Studying base level IE has provided new insight into the problems of the base level Industrial Engineer. Our conclusions as to what are the problems facing the base level IE and our recommendations to solve these problems are

Table 7

Worldwide Costs of Industrial Engineering  
Salaries (9)

Rank	Number	Monthly Salary	Cost/Month
LTCOL	1	2640.8	2,640.8
MAJ	5	2250.8	11,254
CAP	35	1970.8	68,978
1LT	18	1525.8	27,464.4
2LT	24	1072.8	25,747.2
CMS	4	1748.0	6,992
SMS	14	1563.0	21,882
MSG	81	1301	105,381
TSG	108	1187	128,196
SSG	160	1034	165,440
E-4	138	871	120,198
ALC	44	773	34,012
AMN	18	707	12,726
A/B	9	659	5,931
<b>TOTAL</b>	<b>659</b>		<b>\$ 736,842.4</b>
GS-13	1	2669	2,669
GS-12	23	2244.75	51,629.25
GS-11	51	1872.75	95,510.25
GS-10	18	1704.3	30,677.99
GS-9	107	1747.9	165,627
GS-8	48	1401.1	67,256
GS-7	67	1265.3	84,777.3
GS-6	18	1138.5	20,493
GS-5	79	1021.4	80,691.9
GS-4	94	913	85,822
GS-3	43	813.4	34,976.9
GS-2	3	721.4	2,164.3
GS-1	1	638	638
<b>TOTAL</b>	<b>553</b>		<b>\$ 722,933.0</b>
<b>GRAND TOTAL</b>	<b>1212</b>		<b>\$ 1,459,775.4</b>
<b>YEARLY TOTAL</b>			<b>\$17,517,304.8</b>

presented in Chapter 4. There are always better ways of accomplishing a service and it is hoped the insights our research provides will help key Civil Engineering managers resolve the problems of base level IE.

#### Definition of Terms and Concepts

So that most of the ambiguity that stems from a poor understanding of the terms and concepts discussed in this thesis are eliminated, we have compiled a list of definitions. These definitions are in Table 8.

#### Research Objectives

There are three objectives that this research is designed to accomplish:

1. To collect data to calculate the operating costs of each base level IE branch.
2. To determine how well each base level IE branch is meeting its responsibilities as outlined in AFR 85-1 and the IE Management Brochure.
3. To determine those variables that most significantly affect the perceived value and effectiveness of each base level Industrial Engineering responsibility.

#### Plan of the Report

The remainder of this thesis is concerned with the procedures that were used to investigate the cost effectiveness of each IE responsibility and interpreting the data

Table 8

Concepts and Definitions (6:31-34)

Concept	Descriptive Definition	Operational Definition
Base Civil Engineer	A person who fills the Base Civil Engineering (BCE) position at an Air Force Base (AFB).	A respondent who in a questionnaire survey is currently assigned as a Base Civil Engineer at one of the 99 AFBs identified in the population.
Deputy Base Civil Engineer	A person who fills the Deputy Base Civil Engineering position at an AFB.	A respondent who in a questionnaire survey is currently assigned as a Deputy Base Civil Engineer at one of the 99 AFBs identified in the population.
Chief of Industrial Engineering	A person who fills the Chief of Industrial Engineering (BIE) position within the BCE organization at an AFB.	A respondent who in a questionnaire survey is currently assigned as a Chief of an Industrial Engineering Branch at one of the 99 AFBs identified in the population.
Chief of Engineering and Environmental Planning	A person who fills the Chief of Engineering and Environmental Planning position within the BCE organization at an AFB.	A respondent who in a questionnaire survey is currently assigned as a Chief of an Engineering and Environmental Planning Branch at one of the 99 AFBs identified in the population.

Table 8 (continued)

Concept	Descriptive Definition	Operational Definition
Chief of Operations	A person who fills the Chief of Operations position within the BCE organization at an AFB.	A respondent who in a questionnaire survey is currently assigned as a Chief of an Operations Branch at one of the 99 AFBs identified in the population.
Chief of Resources and Requirements	A person who fills the Chief of Resources and Requirements position within the BCE organization at an AFB.	A respondent who in a questionnaire survey is currently assigned as a Chief of a Resources and Requirements position at one of the 99 AFBs identified in the population.
Education	The education level attained by individuals.	The highest education level of a respondent in a questionnaire survey.
Experience	The total amount of job experience attained by individuals.	The highest education level of experience in time at base level of a respondent in a questionnaire survey.
Strongly Disagree	Refers to an opinion of a respondent indicating the least favorable degree of response to a particular survey question.	The value of 1 associated to a response on a questionnaire survey indicating the least favorable degree of response. In the analysis, a value greater than 0 but less than

Table 8 (continued)

Concept	Descriptive Definition	Operational Definition
Disagree	Refers to an opinion of a respondent indicating the second least favorable degree of response to a particular survey question.	<p>1.5 indicates the strongly disagree position.</p> <p>The value of 2 associated to a response on a questionnaire survey indicating the second least favorable degree of response. In the analysis, a value of 1.5 or greater but less than 2.5 indicates the disagree position.</p>
Undecided	Refers to an opinion of a respondent indicating no degree of favorableness or unfavorableness to a particular survey question.	<p>The value of 3 associated to a response on a questionnaire survey indicating no degree of favorableness or unfavorableness. In the analysis, a value of 2.5 or greater but less than 3.5 indicates an undecided position.</p>
Agree	Refers to an opinion of a respondent indicating the second most favorable degree of response to a particular survey question.	<p>The value of 4 associated to a response on a questionnaire survey indicating the second most favorable degree of response. In the analysis, a value of 3.5 or greater but less than 4.5 indicates the agree position.</p>

Table 8 (continued)

Concept	Descriptive Definition	Operational Definition
Strongly Agree	Refers to an opinion of a respondent indicating the most favorable degree of response to a particular survey question.	The value of 5 associated to a response on a questionnaire survey indicating the most favorable degree of response. In the analysis, a value of 4.5 or greater indicates the strongly agree position.
Base Civil Engineering	The base level organization whose primary mission is to acquire, control, maintain and operate real property facilities and provide related management engineering and other support work and services.	N/A
Quality Control	The BCE section which is responsible for the quality, efficiency, and adequacy of civil engineering work.	N/A
Management Consultant	The role of the Industrial Engineer as an internal management consultant to assist all levels of BCE management.	N/A
Key Civil Engineering Management Personnel	The six identified Base Civil Engineering persons identified to be surveyed--BCE, Chief of IE, Chief of Operations, Chief of E&EP and Chief of Resources and Requirements and Deputy BCE.	N/A

that we gathered. In Chapter 2, we have discussed the population of interest, our questionnaire, the dependent and independent variables, the research questions, the analysis we performed, and other related topics. In Chapter 3, we present the number of questionnaires returned and the analysis of the data. Finally, the last chapter will present our conclusions and recommendations.

## Chapter 2

### METHODOLOGY

#### Population of Interest

The population of interest is the perceptions of key management personnel, in base level Civil Engineering organizations, concerning the perceived value of various IE branch responsibilities. There are six independent elements of this population. The perceptions of:

1. Base Civil Engineer;
2. Deputy Base Civil Engineer;
3. Chiefs of Operations;
4. Chiefs of Industrial Engineering;
5. Chiefs of Engineering and Environmental

Planning; and

6. Chief of Resources and Requirements.

Typically, each manager is represented at every CE organization (4:1-22).

#### Questionnaire

In order to determine the perceptions of the key managers, three questionnaires were developed. One form was given to the Chiefs of IE, another form to BCEs and Deputy BCEs, and the third form was given to all other key managers. Three different questionnaires were developed

because it was felt that each manager did not have access to all the information required. Each questionnaire only asked managers those questions they most probably should be familiar with. Table 9 provides information about each questionnaire. All Air Force bases with an IE branch of three or more personnel were surveyed and these bases are listed in Appendix A.

Table 9  
Types of Questionnaires

Type	Respondents	Number of Questions
1	Chief of IE	81
2	BCE Deputy BCE	74
3	Chief of Engineering and Environmental Planning Chief of Operations Chief of Resources and Requirements	37

Likert Scale

A five point Likert scale was the response option for most of the questionnaire. This scale was chosen because historically the Likert scale has been used to evaluate perceptions and it provides an easily understood response mode. The five responses are:

1. Strongly Agree
2. Agree
3. Undecided
4. Disagree
5. Strongly Disagree

The response categories were assigned numbers one through five, with five corresponding to Strongly Agree (5:248-250).

#### Dependent Variable

The dependent variable for our research is the cost effectiveness of each base level IE responsibility. The base level IE responsibilities, as outlined in AFR 85-1 and the IE Management Brochure, are:

1. Management Consulting;
2. Quality Control;
3. BEAMS Consulting;
4. Communications and Coordination Facilitating;
5. Real Property Accounting;
6. Cost Accounting;
7. Training and Testing (10:1-22).

A cost effectiveness index was determined for each responsibility using benefit-cost ratio analysis. The cost was defined as the salaries of all personnel assigned to base level IE organizations. This cost was determined quite accurately from personnel computers files which maintain authorized and assigned manning levels, by rank and by base, of all IE branches worldwide. Thus, by multiplying the

number of personnel in each rank category by the average salary of people holding that rank, a reasonably accurate estimate of the cost of each base level IE branch was obtained. From our census of all base level chiefs of IE, we obtained the percent of time that each base level IE organization spends on each of its responsibilities. Multiplying the individual base's percentage of time spent in each responsibility times the base's cost for IE salaries provided an estimate of the cost of individual responsibilities (7:456-486).

The major problem with benefit-cost ratio analysis of a government program is in determining the benefits (7:471). Base level IE organizations are not required to maintain records of benefits resulting from the operation of the branch (8). Therefore, there does not exist any actual data stating the benefits portion of our benefit-cost ratio analysis. To overcome this problem, we obtained the perceived benefit of each base level IE responsibility. Each key manager in base level CE was asked if their base level IE branch effectively performs each responsibility. Their responses were noted on a 5 point Likert scale. This provided a mean score of the perceived benefits of each base level IE responsibility.

The mean score was evaluated by assigning each response a numerical value. The responses to the questions that measure the value of each IE responsibility and their

assigned value are:

Value	Response
5	a. Extremely valuable and effective
4	b. Moderately valuable and effective
3	c. Undecided
2	d. Not too valuable or effective
1	e. No value and extremely ineffective

Dividing the mean value of each responsibility by the cost of each responsibility gave us a modified benefit-cost ratio for each responsibility. These modified ratios are called cost effectiveness indexes which are frequently used in comparing public works projects (7:472-473).

### Bias

As the data indicates, there is a significant difference between the BCE, Deputy BCE, and BIE perception of the value and effectiveness of IE when compared to the branch chiefs' perceptions. We investigated this difference by computing the 95% confidence interval for the difference between two means. The null hypothesis was that the two means were equal and that their difference was zero (15:212-216).

The 95% confidence interval was calculated using the following formula:

$$(\mu_1 - \mu_2) = (\bar{x}_1 - x_2) \pm t_{.025} \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$$

where  $\bar{x}$  = sample mean  
t = students t distribution  
 $s^2$  = sample variance  
n = sample size.

Although our data is ordinal and the calculation of means can be questioned, it is common practice to use "t" values and means when performing such an item analysis (5:248-250).<sup>2</sup>

### Independent Variables

In order to determine those variables that influence the perceived value and cost effectiveness of base level industrial engineering, we initially used the Farineau and Tucker thesis. Farineau and Tucker had asked key managers in base level CE organizations what were the weaknesses and limitations of IE. There were twenty-one weaknesses identified.<sup>3</sup> These weaknesses were actually descriptions of independent variables that either could be viewed as enhancing or limiting the perceived value of the IE branch. Thus, these IE weaknesses became our initial list of independent variables.

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<sup>2</sup>For details of this procedure, see Edwards, Allen L., *Techniques of Attitude Scale Construction* (New York: Appleton-Century-Crofts, Inc., 1957), pp. 152-154.

<sup>3</sup>For a complete list of weaknesses/limitations, see Farineau, Captain Mark J., and Captain Alan E. M. Tuckers, "The Role of Industrial Engineering Within Base Level Civil Engineering" (AFIT Thesis, 1977), pp. 66.

Farineau and Tucker also asked the BCE and the BIE to recommend improvements to the IE branch. There were 35 improvement categories listed.<sup>4</sup> Many were very similar to the weaknesses of base level IE. Combining the weaknesses and improvement areas for IE as identified by Farineau and Tucker, we developed a comprehensive list of variables that influenced how key managers perceived the IE's value. At this point, certain factors were eliminated because we knew we could not gain information about them or because there was no way to measure the degree to which the variable existed at a given base. Thus, we had developed a comprehensive list of independent variables.

The next phase in our search to identify those independent variables that influenced the perceived value and effectiveness of IE was to review validated questionnaires that were concerned with evaluating the performance of an organization. Primarily, we used the University of Michigan, Survey of Organizations questionnaire (15:1-158). We tried to see if the researchers at Michigan had asked questions that related to the IE's weakness and improvement areas. We found that they had, but, in addition, we also noticed other questions that the University of

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<sup>4</sup>For a complete list of improvements, see Farineau, Captain Mark J., and Captain Alan E. M. Tucker, "The Role of Industrial Engineering Within Base Level Civil Engineering" (AFIT Thesis, 1977), pp. 104-106.

Michigan, Survey of Organizations questionnaire asked that might influence our dependent variables. Therefore, we included these variables in our list of independent variables. Our final list of independent variables, as shown in Table 10, was derived from two primary sources--the Farineau and Tucker thesis and the University of Michigan, Survey of Organizations questionnaire.

### Research Questions

The following research questions were selected to enable us to attain the research objectives listed in Chapter 1. These objectives were:

1. To collect data that would enable us to calculate the operating costs of each IE branch.
2. To determine how well each IE branch was meeting its responsibilities as outlined in AFR 85-1 and the IE Management Brochure.
3. To determine those variables that most significantly affect the perceived value of each IE responsibility. The research questions were primarily based on our list of independent variables and are listed below:
  1. What are the direct personnel costs associated with providing each of the IE responsibilities?
  2. What is the perceived value of each base level IE responsibility that is provided to the BCE and his branch chiefs?

Table 10

Independent Variables

Variables	Related Questions From the Questionnaires			Concept
	BCE's	BIE's	Branch Chiefs	
Ability to use IE resource	10-13		10-13	Each respondent was asked to evaluate how well he knew how to use each IE service.
Confidence in IE branch	14,15		14,15	Respondents were asked if they felt confident to implement IE solutions and if the IE solutions influenced the respondent's management of his organization.
Conflicting roles in IE	8,9	8,9	8,9	Any inconsistency between the IE's Management Consulting role and his Quality Control role was investigated.
IE branch consulting area		10-12		The location and the privacy of the IE branch as well as the IE's access to computer terminals was investigated.
IE personnel experience	19-24	13-18		Respondents were asked to evaluate the experience level of IE personnel with regard to each IE responsibility except the training and testing responsibility.

Table 10 (continued)

Variables	Related Questions From the Questionnaire		Branch Chiefs	Concept
	BCE's	BIE's		
IE personnel manning	66-73	71-78		Respondents were asked to evaluate the over- all manning level as well as the manning level of each IE responsibility.
IE personnel training	25-32	19-26		Respondents were asked to evaluate the IE branch personnel's level of training in each IE responsibility area and respondents were asked if the IE branch needed more people with IE degrees.
IE use of quantita- tive tech- nique	39-41	39-41		The IE branch's use of flow process charts, PERT, CPM and other quantitative techniques was investigated.
Rules and regulations	42-44	42-44		The influence of squadron, base and Air Force regulations on base level IE was investigated.
Other branch support	45,46	18		The respondents were asked if the branch chiefs support the IE's efforts to increase productivity.

Table 10 (continued)

Variables	Related Questions From the Questionnaire		Concept
	BCE's	BIE's Branch Chiefs	
Number of vehicles assigned	79		The IE was asked to indicate the number of vehicles assigned to the IE branch.
BCE communi- cation	30-32		The respondents were asked if the BCE's instructions were clear and understandable; also, respondents were asked if the BCE was easy to talk to and if the BCE let the IE branch know his perception of their quality of work.
IE's feed- back to clients	36-38	33-35 16,17	The respondents were asked if the IE branch provided good oral and written feedback.
Goals and objectives of IE branch	16-18	36-38	The respondents were asked if IE branch was involved in establishing goals and objectives, if goals were clearly stated and if goals could be measured.
IE's job motivation	45-47	47-49	The respondents were asked if IE personnel were satisfied with their jobs, if they had a feeling of accomplishment and if the IE branch was under-utilized.

Table 10 (continued)

Variables	Related Questions From the Questionnaire		Concept
	BCE's	BIE's	
BIE Management style		50-52	The IE was asked which management style he used: authoritarian, democratic or laissez-faire.
Recognition of IE branch	51-53	53-55	The respondents were asked if the BCE and the branch chiefs attempted to gain recognition for the IE branch when it performed well.
Work climate in IE branch	33-35	27-29	Respondents were asked if the IE personnel work together as team, if they help each other and if they get along well together.
BCE's deligation of responsibility	63-65	68-70	Respondents were asked if the BCEs allow employees to make decisions on their own with out checking with the BCE, and if the BCE expects an outstanding performance from the IE branch.
Women in the IE branch		80	The IE was asked to indicate the number of women assigned to his branch.

Table 10 (continued)

Variables	Related Questions From the Questionnaire		Branch Chiefs	Concept
	BCE's	BIE's		
BCE management style	48-50	56-58	34-36	Respondents were asked to evaluate the BCE management style (authoritarian, democratic and Laissez-Faire).
BCE's job competence	60-62	65-67	28-30	Respondents were asked if BCE possessed the technical qualifications to do his job, if he was an effective organizer and if he was trained in human relations.
Oral ability of IE branch	54-56	59-61	22-24	Respondents were asked to evaluate the IE branches' oral communications with regards to how dynamic, accurate and effective the communication is.
Writing ability of IE branch	57-59	62-64	25-27	Respondents were asked to evaluate IE written reports for clarity, conciseness, accuracy and completeness.

3. What percent of its available time does base level IE devote directly and indirectly to providing each responsibility to the BCE and each of his branch chiefs?

4. What is the relationship between the amount of time dedicated to providing each IE responsibility and the perceived value of each responsibility?

5. Does the ability of key CE managers to use the IE resource affect the perceived value and effectiveness of each base level IE responsibility?

6. Does the level of key CE managers' confidence in the base level IE branch affect the perceived value and effectiveness of each base level IE responsibility?

7. Do the conflicting roles of the base level IE branch affect the perceived value and effectiveness of the IE's management consulting and quality control services?

8. Does the base level IE branch's consulting area affect the perceived value and effectiveness of each of its responsibilities?

9. Does the level of experience of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility?

10. Do the manning levels of base level IE affect the perceived value and effectiveness of each of its responsibilities?

11. Does the level of training of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility?

12. Does the use of quantitative techniques by base level IE affect the perceived value and effectiveness of each of its responsibilities?

13. Do the rules and regulations governing base level IE affect the perceived value and effectiveness of each of its responsibilities?

14. Does the level of support given to base level IE by the other branches in CE affect the perceived value and effectiveness of each base level IE responsibility?

15. Do the number of vehicles assigned to base level IE affect the perceived value and effectiveness of each of its responsibilities?

16. Does the manner in which the BCE communicates with base level IE affect the perceived value and effectiveness of each of its responsibilities?

17. Does the amount of feedback given by base level IE affect the perceived value and effectiveness of each of its responsibilities?

18. Do the goals and objectives of base level IE affect the perceived value and effectiveness of each of its responsibilities?

19. Does the level of job motivation for base level IE personnel affect the perceived value and effectiveness of each IE responsibility?

20. Does the base level BIE's management style affect the perceived value and effectiveness of each base level IE responsibility?

21. Does the amount of recognition given to the base level IE branch affect the perceived value and effectiveness of each IE responsibility?

22. Does the working climate inside base level IE affect the perceived value and effectiveness of each of its responsibilities?

23 Does the manner in which the BCE delegates responsibility affect the perceived value and effectiveness of each base level IE responsibility?

24. Do the number of women in base level IE affect the perceived value and effectiveness of each of its responsibilities?

25. Does the BCE's management style affect the perceived value and effectiveness of each base level IE responsibility?

26. Does the level of BCE job competence affect the perceived value and effectiveness of each base level IE responsibility?

27. Does the oral ability of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility?

28. Does the writing ability of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility?

#### Environmental Variables

There are certain characteristics of the IE environment, that theoretically are variable, over which we have no control. Organization structure is one of these variables. Joan Woodward's research into organization structure seems to indicate that there is an optimum structure for different types of organizations (12:30-31). Perhaps Industrial Engineering in the Air Force could operate in modes other than as a staff agency. However, we have no control over the manner in which the regulations structure the CE squadrons. Other variables like climate and geography could also influence the IE organization. However, this influence also has no meaning in this research because the climate and geography are not controllable.

#### Data Level

The data we obtained from our questionnaire is ordinal data. Therefore, we have used Spearman's correlation coefficients to perform our correlation analysis. Spearman's ( $\rho$ ) is a nonparametric statistic that can be used to determine correlations between ordinal level data. Use of non-parametric statistics insures that, to the best degree

possible, our correlation analysis matches the level of our data (11:257-274).

### Analysis

Using the statistical package for the Social Sciences Computer Program, we have determined the level of correlation between the perceived value and effectiveness of each IE responsibility and the questionnaire responses which provide information about our independent variables. In addition, descriptive statistics are provided for all questionnaire responses.

To begin our analysis, we obtained descriptive statistics on the data that we received from the questionnaires. We used the Frequency Program which computed one-way frequency distributions and various summary statistics, such as the mean, the mode and the standard deviation (13:181-202).

The second statistic that we used for our analysis is Spearman's Coefficient of Rank Correlation ( $\rho$ ). This correlation coefficient is nonparametric, which means that it does not depend on a normal distribution or the metric quality of internal scales. It does require the use of rankings, rather than the absolute values of variables, in the computation of the coefficient. Spearman's  $\rho$  is formally defined as:

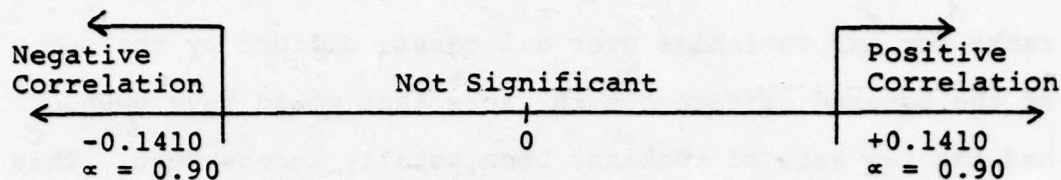
$$\rho = 1 - \frac{6\sum d_i^2}{N^3 - N}$$

That is the sum of the squared differences in the paired ranks for two variables over all cases, divided by the sum of the squared differences in ranks that would have been, had the two sets of rankings been totally independent. This quotient is then subtracted from 1 to produce the standardized coefficient (13:288-292).

We will now discuss the significance level ( $\alpha$ ) of the  $\rho_s$  that we used to determine if the variable in question has a significant impact on the value and effectiveness of IE. The question of how large the  $\alpha$  must be is not easily answered. It is not possible to set up a criterion which does not allow any error. Looking at the risk of being wrong, one realizes that certain considerations are necessary to assist in establishing  $\alpha$ . Two of the considerations are:

1. Any known results from similar tests; and
2. What possible losses may occur by accepting results which turn out to be in error (seriousness of the test).

There is no real panacea figure that is used, but most tests express a standard  $\alpha$  of .90 or more as being significant. Depending on the number of valid cases, the correlations will be different for the same significant level. For example, for 83 valid cases:



A positive correlation of .1410 or greater means that the two variables tend to increase or decrease together. A negative correlation of -0.1410 or less means that there is an inverse relationship which means as one variable increases, the other decreases (13:276-279). The level of significance for Spearman's  $\rho$  was determined by comparing the quantity

$$\rho \left( \frac{N - 2}{1 - \rho^2} \right)^{\frac{1}{2}}$$

with the student's t distribution with  $N - 2$  degrees of freedom (13:290).

### Summary

This chapter has described the population we investigated, the three questionnaires we used and how variables were selected for analysis. In addition, the chapter also presents the types of analysis that we have performed on the data. This Methodology chapter serves as an introduction to Chapter 3 where we present the results of our analysis.

## Chapter 3

### FINDINGS AND DATA ANALYSIS

#### Introduction

In this chapter, we have analyzed the data obtained from our questionnaires. First we will present information showing the number and the percent of responses we received. Then we will look at how the different managers evaluated the IE's performance and independent variables that affect the IE's performance. Next we will present our benefit cost analysis and conclude the chapter with a discussion of the research question findings.

#### Questionnaire Response

There were 594 surveys mailed to 99 bases which had at least three IE personnel assigned to the base level IE branch. A list of the bases is included in Appendix A. There were 488 surveys returned, giving an overall response rate of 82.15 percent. Among those returned, there were 15 surveys which were returned without responses. Four questionnaires could not be used due to the fact that they had been answered incorrectly. And finally, 18 questionnaires were returned too late for analysis. Table 11 illustrates the breakdown of the respondents by management position.

Table 11  
Questionnaires Returned  
(Response by Position)

Position	# of Surveys Mailed	# of Surveys Returned	% Returned
DE	99	74	74.75
DDE	99	71	71.72
DEI	99	83	83.84
DEE	99	73	73.74
DEM	99	71	71.72
DEMR	99	79	79.80
Returned Unanswered	--	15	---
Answered Incorrectly	--	4	---
Late	--	18	---
TOTALS	594	488	82.15

The following symbols were used to designate the key base level civil engineering positions:

1. DE refers to the Base Civil Engineer.
2. DDE refers to the Deputy Base Civil Engineer.
3. DEI refers to the Chief of Industrial Engineering.
4. DEE refers to the Chief of Engineering and Environmental Planning.
5. DEM refers to the Chief of Operations.
6. DEMR refers to the Chief of Resources and Requirements.

The questionnaire data was manipulated using the computer programs in Appendix E. These programs yielded the Spearman Correlations and Frequency data that we used in our thesis analysis. The Frequency data is located in Appendixes C, D and E. The Spearman Correlation data is in Appendix F.

#### Dependent Variables

The dependent variables are the individual responsibilities of the base level IE branch. Information on how each manager rated the individual responsibilities was obtained from the first seven questions of the questionnaires. The dependent variables are:

1. V1: Management Consulting's rating.
2. V2: Quality Control's rating.
3. V3: BEAM's rating.
4. V4: Communications and Coordination Facilitator's rating.
5. V5: Cost Accounting's rating.
6. V6: Real Property Accounting's rating.
7. V7: Training and Testing's rating.

Each manager's perceived value and effectiveness of each IE responsibility is listed in Table 12. The data in Table 12 was taken from Appendix C and represents the means of all respondents. Because our data is ordinal level, the calculation of means may be questioned by some

readers. However, it is common practice to compute means of data obtained with a Likert scale (5:248-250). An argument for computing means with our Likert scale data was presented in the last chapter. However, we would like to remind the reader that in this chapter much of the analysis, especially the benefit-cost analysis, involves manipulation of ordinal data as if it were interval data. This does not mean the analysis is of no value. It does mean that the reader must not focus on the calculation of any one number. Instead, he must examine the calculations to identify trends (5:250).

Table 12

Key Manager's Ratings of IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DE	*3.85	3.17	*4.00	3.40	*4.36	*4.44	2.81
DDE	*3.80	3.06	*4.31	3.24	*4.32	*4.47	2.96
DEI	*4.05	2.96	*4.68	*3.71	*4.64	*4.59	2.86

Table 12 (continued)

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DEE	2.57	2.26	3.28	2.64	*3.67	*3.76	2.46
DEM	3.00	2.70	*3.62	2.58	*3.97	*3.85	2.62
DEMR	3.17	2.53	*3.97	2.74	*3.81	*4.03	2.29

Each key manager's perception of the various IE responsibilities are presented in Table 12. Research question 2 asked what was the perceived value and effectiveness of each IE responsibility. This research question is answered by the data in Table 12. Note that in Table 12, only those intersections that contain an asterisk are above 3.50. These intersections represent the only responsibilities that are perceived to be at least "moderately valuable and effective."

Table 13 shows the mean responses of all questionnaire respondents. Only the responsibilities of BEAMS, Cost Accounting and Real Property fall above 3.50. This indicates that only these responsibilities are perceived to be at least "moderately valuable and effective."

Table 13

## Overall Ratings of IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Means	3.41	2.78	3.98	3.05	4.01	4.19	2.67

Table 14 is used to illustrate the bias perceptions of the BCE, Deputy BCE and BIE concerning each IE responsibility at the .95 level of significance. These perceptions are higher than the branch chiefs' perceptions of each IE responsibility. This means that there is only a 5 percent chance that the difference between the two groups' means are explained by chance. In addition, if one examines the branch chiefs' perceptions, only Real Property, Cost Accounting and BEAM are perceived to be at least moderately valuable; while the branch chiefs perceive Management Consulting and Communication and Coordination responsibilities to be of "undecided" value; and Quality Control and Training and Testing are perceived by the branch chief to be "not too valuable or effective."

Table 14

Comparison of Managers' Combined Ratings of  
IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DE, DDE, DEI	3.90	3.06	4.33	3.45	4.50	4.50	2.88
DEE, DEM, DEMR	2.91	2.48	3.62	2.65	3.82	3.88	2.46
95% Confidence Interval for Difference of Two Means	.99±.23	.59±.23	.71±.21	.80±.22	.68±.18	.62±.18	.42±.24

Looking at the data, we see there is a definite difference in almost all of the ratings. Some, like Management Consulting, are a full level of opinion different. The exact cause cannot be stated, but it is apparent that some bias does exist between the groups. Looking at the ratings, it would appear that the branch chiefs, as a group, view Cost Accounting, Real Property and BEAMS as being valuable. The value of Management Consulting and Communication and Coordination is undecided. Quality Control and Training and Testing are rated as not being valuable.

The DE, DDE and DEI, on the other hand, view the responsibilities of Management Consulting, BEAMS, Cost Accounting and Real Property as being valuable, while Quality Control, Training and Testing and Communication and Coordination are seen as questionable (undecided). When viewing the results of the data, the reader is encouraged to make the above comparisons for himself to determine if any other indications of bias exist.

#### Independent Variables

The independent variables are those factors that influence the perceived value and effectiveness of each IE responsibility. Frequency and Correlation data on these variables can be found in Appendixes C through F. Correlation analysis between the dependent and independent variables will be accomplished in the Research Questions Findings section of this chapter.

#### Ranking Analysis

Data for the last seven independent variables was obtained from the last question of each questionnaire. This last question required the managers to rank the IE responsibilities from 1—7 in the order of importance. The last seven independent variables are:

1. Management Consulting's rank.
2. BEAM's rank.
3. Quality Control's rank.

4. Communication and Coordination Facilitator's rank.

5. Testing and Training's rank.

6. Real Property's rank.

7. Cost Accounting's rank.

For the questionnaire, 1 was the highest rank; however, the data values were reversed to accommodate our computer manipulations. Thus, when viewing the data, it should be remembered that the highest rank is now 7 and the lowest rank is 1. The mean will be the only statistic used for the following analysis. All of the Frequency data for these variables can be found in Appendixes C, D and E. The analysis results are shown in Table 15.

Table 15

Key Managers' Rankings of IE Responsibilities  
(Mean Responses)

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DE	5.03	2.85	3.95	2.47	4.55	4.25	1.79
DDE	5.03	2.72	4.254	2.55	4.61	4.59	2.14
DEI	6.04	2.494	4.886	3.11	4.95	4.98	1.71

Table 15 (continued)

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DEE	4.09	2.66	4.47	3.19	4.94	5.143	2.99
DEM	5.09	3.696	5.33	2.71	4.52	3.80	2.86
DEMR	5.01	3.03	5.57	2.81	4.72	4.12	2.62

Remembering that the larger the mean, the higher the ranking, we then rank ordered the responsibilities with 7 being the highest rank. This result is shown in Table 16.

Table 16

Sequential Display of Key Managers' Ranking of IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DE	7	3	4	2	6	5	1
DDE	7	3	4	2	6	5	1

Table 16 (continued)

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DEI	7	2	4	3	5	6	1
DEE	4	1	5	3	6	7	2
DEM	6	3	7	1	5	4	2
DEMR	6	7	3	2	1	4	5

Combining the means of the different managers, we then get an overall mean for each responsibility, as shown in Table 17.

Table 17  
Overall Rankings of IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Mean	5.05	2.91	4.74	2.81	4.71	4.45	2.35
Ranking	7	3	6	2	5	4	1

It should be remembered that the rating of the first seven dependent variables is not the same as the ranking of the last seven independent variables. They appear to be the same because both deal with the IE's responsibilities. However, there is a distinct difference between the rating, of how effective something is perceived to be; and the ranking, of how important something is perceived to be.

A comparison of the ratings and rankings in Table 18 shows a definite difference between some of the perceptions. The ranking indicates how important the responsibility is to the managers. The rating indicates how valuable and effective each responsibility is perceived to be.

Table 18

Comparison of Overall Perceptions of the Rating and Rank of IE Responsibilities

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Rating (Value)	3.41	2.78	3.98	4.01	4.01	4.79	2.67
Ranking (Importance)	7	3	6	2	5	4	1

Management Consulting, which ranks high in importance, is rated undecided in effectiveness. Real Property and Cost Accounting, which are ranked medium in importance, are rated high in effectiveness. The IE appears to be doing a poor job on the important responsibilities and a good job on the responsibilities of medium importance.

To compare the relationships of the ratings and ranking, we will look at the Spearman Correlations ( $\rho$ 's) from Appendix F. Only those  $\rho$ 's that are significant at the .90 level will be presented and they are indicated with an \* . The reader is encouraged to view all the correlations in Appendix F. An \* alone will indicate a positive correlation; a -\* will indicate a negative correlation. All the correlation analysis is shown in Tables 70-75 in Appendix F.

Looking at the BCE's correlations of the IE responsibilities rating and ranking, we see that all the relationships are not significant. Singling out the ratings of Communication and Coordination Facilitating, we see that as its effectiveness (rating) goes up, the importance of Quality Control and Real Property decreases. Continuing on, we can see how changing the rating of one responsibility will significantly change the importance of the responsibilities for the BCE. Data on each of the managers is presented in Tables 19 through 24.

Table 19

BCE's Rank and Rating Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting	*						
Quality Control		*		- *	- *	- *	
BEAMS			*				
Communication Coordination				*	*		
Cost Accounting	- *						
Real Property	- *	- *		- *		*	
Training and Testing						- *	*

Table 20

Deputy BCE's Rank and Rating Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting	*	*	*	*			*
Quality Control					- *		
BEAMS			*				
Communication Coordination							
Cost Accounting	- *	- *	- *	- *			- *
Real Property		- *	- *		*		
Training and Testing							

Table 21

IE's Rank and Rating Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting	*			*		*	*
Quality Control	-*	*		-*	-*		-*
BEAMS		-*					
Communication Coordination		-*		*			
Cost Accounting							
Real Property							
Training and Testing	*	-*	*	*	*		

Table 22

Chief of Engineering and Environmental Planning's  
Rank and Rating Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting		*	*	*	*		
Quality Control	*	*					*
BEAMS			*	-*	-*	-*	
Communication Coordination	*			*		*	*
Cost Accounting			*		*		-*
Real Property	-*	*			-*		-*
Training and Testing							*

Table 23

Chief of Operations' Rank and Rating  
Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting	*					- *	
Quality Control		*					
BEAMS			*				
Communication Coordination							
Cost Accounting				- *			- *
Real Property				- *			*
Training and Testing							*

Table 24

Chief of Resources and Requirements' Rank and Rating Significant Correlations

Perceived Value							
Perceived Rate	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
Management Consulting					*		
Quality Control					- *	- *	
BEAMS	*		*		- *		- *
Communication Coordination			- *	*			
Cost Accounting							
Real Property			*			*	
Training and Testing							*

Because each manager group in all CE organizations has different perceptions about what is important (ranking), an overall relationship between rank and rating is of questionable value. The affect of giving additional emphasis to any IE responsibility in an effort to improve its perceived value must be tempered with knowledge of what each manager thinks is important. Our findings indicate significant correlations between certain independent variables and the ratings of the perceived value and effectiveness of each IE responsibility. The findings also show that there are significant correlations between the rating and the rank of each IE responsibility. Therefore, both the rank and the rating are influenced by the independent variables. Knowledge of the relationships between each of the independent variables and both the rating and rank becomes very valuable. For instance, if it is desired to increase the BCE's rating of management consulting the correlation analysis shows this can be done by decreasing the rank (importance) of Real Property and Cost Accounting. However, the reader is cautioned we have only considered the BCE perceptions and any decisions must take into account the perception of all managers. Therefore, each manager's correlation analysis table must be considered, and a decision reached, which in most cases will involve a compromise. In that, perhaps the BCE and Deputy BCE's

perception will be increased while all branch chief perceptions decrease.

#### Benefit-Cost Analysis

Research questions 1, 3 and 4 of our thesis are answered using benefit/cost data. Research question 1 asks what the direct personnel costs associated with providing each of the IE responsibilities are. The question was answered with the help of Mr. William L. Jarvis, Chief, Personnel Systems Management Section, AFIT Personnel Office. With his help, we were able to acquire information on the number of people working in IE and the rank or rating they hold. The information can be viewed in Chapter 1, Table 7, of this thesis. The total yearly direct personnel costs are \$17,517,304.8. To get the cost associated with providing each IE responsibility, we used the data obtained from each base level IE as to the percent of time he spent on each IE responsibility. This data also answers research question 3 which asks what percent of the IE's available time is devoted directly or indirectly to each of his responsibilities. The average amount of time spent by the IE on each responsibility is shown in Table 25.

Table 25

% of Time IE Spends on Each Responsibility

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
%	17	6	12	7	27	28	3

Multiplying the total personnel costs by the percentage of time gives the personnel costs of each responsibility. This analysis is shown in Table 26.

Table 26

Personnel Cost for Each IE Responsibility

Responsibility	Cost
Management Consulting	\$ 2,977,942
Quality Control	1,051,038
BEAMS	2,102,077
Communication and Coordination	1,226,211
Cost Accounting	4,729,672
Real Property Accounting	4,904,845
Training and Testing	525,519

Research question 4 asks what the relationship is between the amount of time dedicated to each responsibility and the perceived value of each responsibility. This question can be answered by referring to Tables 18 and 25. These results are combined in Table 27.

Table 27

Comparison Between Overall Perceptions of Each IE Responsibility and Time Spent

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
% Time	17	6	12	7	27	28	3
Overall Ratings	3.41	2.78	3.98	3.05	4.01	4.19	2.67
Overall Ranking	7	3	6	2	4	5	1

Reviewing Table 27 indicates that the amount of time being spent on each responsibility seems to agree with the effectiveness (rating) of the job. In general, the higher the percent of time spent, the higher the rating the responsibility received. When we compare the percentages to the ranking, a discrepancy is evident. The lower ranked jobs agree with the low percentages, but the higher

ranked jobs do not. The highest ranked jobs are not getting the largest amount of the IE's time, while the medium ranked jobs are getting the largest amount of the IE branch's time. Thus, while the IE may be doing a good job (rating) where he spends most of his time, he may not be spending enough time on the responsibilities the managers think are important (rank). This relationship is graphed in Figure 2.

The benefit/cost index for each IE responsibility was derived by taking the mean of the rating (benefit) of each IE responsibility (Table 15) and dividing it by the cost of the responsibility (Table 26). Recall that a mean greater than 3.50 indicates the responsibility is valuable; a mean less than 2.49 indicates a responsibility has little value; a mean between 3.5 and 2.49 indicates the value of the responsibility is undecided. The benefit/cost indexes are displayed in Table 28.

The benefit/cost index analysis was intended to indicate the perceived cost-effectiveness of each IE responsibility. The reader must realize that the benefit cost indexes displayed in Table 28 are an additional way to view the survey data. The ratios consider both the time and money spent on a responsibility as well as the perceived value and effectiveness of each responsibility. Because both time and perceived value are considered together, it is likely to expect that the results of the benefit/cost

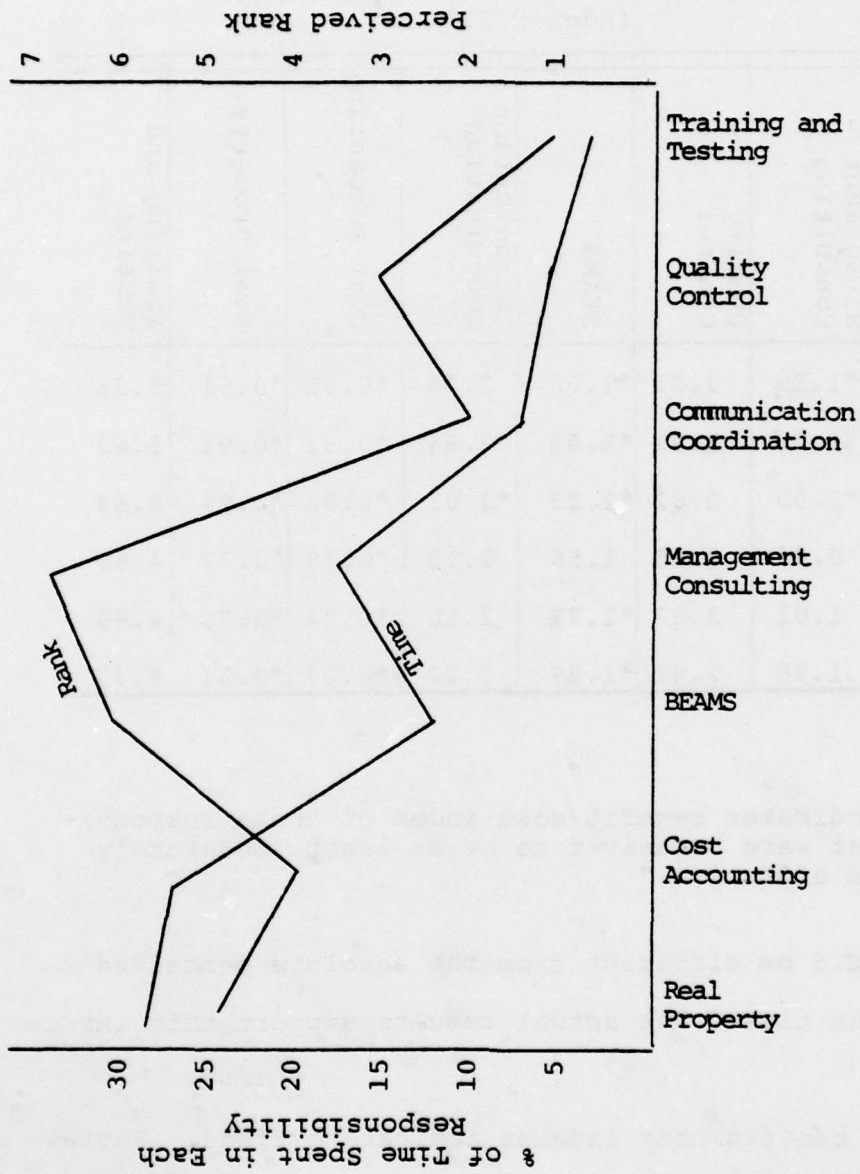


Figure 2  
The Time Spent and Rank of Each IE Responsibility

Table 28

The Perceptions of the IE's Benefit/Cost  
Index x 10<sup>6</sup>

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
DE	*1.29	3.02	*1.90	2.78	*0.92	*0.91	5.35
DDE	*1.28	2.91	*2.05	2.64	*0.91	*0.91	5.63
DEI	*1.50	2.82	*2.23	*3.03	*0.98	*0.94	5.63
DEE	0.86	2.15	1.56	2.15	*0.78	*0.77	4.68
DEM	1.01	2.57	*1.72	2.10	*0.84	*0.78	4.99
DEMR	1.06	2.41	*1.89	2.23	*0.80	*0.81	4.35

\* Indicates benefit/cost index of those responsibilities that were perceived to be at least "moderately valuable and effective."

analysis would be different from the absolute perceived values or the time. The actual results support this expectation.

The benefit/cost indexes indicate a trend. Reviewing Tables 25 and 28 shows that the less time spent on a responsibility, the higher the calculated benefit/cost index. Thus, Training and Testing has the highest benefit/cost

index, while Real Property and Cost Accounting have the lowest benefit/cost indexes. The complexity of our data begins to surface after examining the benefit/cost analysis.

It becomes apparent that there are responsibilities that have high benefit/cost indexes that are perceived to be relatively unimportant. Therefore, even though from a benefit/cost perspective it may appear wise to put some emphasis in Training and Testing, such a move would not be justified considering the absolute values of the rating and ranking of the Training and Testing responsibility. Therefore, the reader must consider all of the data before trying to reach any conclusions.

Research Question  
Findings

This section is concerned with reporting the findings for all but the first four research questions (research questions 1—4 were answered in the previous section). There is no single answer to these research questions; however, this section presents the varied opinions of each key manager. In interpreting any of the results, one must insure that he is aware of the value-system of the different managers whose opinions are used.

Appendix D contains six tables in which the correlations between each dependent variable and all other questions are displayed. One must realize that three different questionnaires were used and, therefore, the questions that

measure the independent variables are numbered differently on each table. At the end of each table is a legend which shows the level of significance for each correlation coefficient. The reader is urged to review the tables to see the exact correlation for any particular relationship of interest.

In order to answer the research questions, correlations were calculated which measure the relationships between certain independent variables and a key manager's opinion of the value and effectiveness of the IE responsibility. Research questions were written for each independent variable expressing a desire to determine the relationships between each independent variable and the perceived value and effectiveness of each of the IE's responsibilities. Because there are six key managers in CE, there are also six different perceptions of each independent and dependent variable.

Several questions were developed to obtain information about each independent variable. Then each of these questions was correlated to the perceived value and effectiveness of each IE responsibility. The first seven questions on each questionnaire provided the manager's perception of how valuable and cost-effective IE was. The remaining responses on each questionnaire provided the manager's perceptions about the independent variables. For each possible combination of dependent variable and question

with information about an independent variable, a correlation coefficient was calculated. This meant that for every possible independent and dependent variable relationship, there were at least three, and as many as twenty-four, correlation coefficients calculated. No single coefficient expresses the complete relationship between an independent variable and a dependent variable. Instead, the significance of the relationship is measured by the relative number of coefficients that were significant above the .90 level of significance.

The range of significant correlations was from zero to 95 percent of the total number calculated. Obviously, if no correlations were significant, there was a weak relationship between the independent variable and the perceived value of the IE's responsibilities. The higher the percentage of correlation coefficients that were significant above the .90 level, the stronger the relationship between the independent variable and the dependent variable.

The reader should realize that there does not exist an absolute one-to-one correspondence between dependent and independent variables. What does exist are relationships of varying strength that are affected by many intervening variables. To properly use the findings to the research questions, the reader must be aware of the very complex interactions and always temper any decision with knowledge

that the findings provide an indication of the relationship between the variables, not the complete picture.

The reader is encouraged to review the questionnaires before examining the correlations. It is difficult to quantify many of the independent variables; thus, the reader should be aware of the wording of each question that was asked, so as to get the best possible information from the correlation tables.

Research question 5. Does the ability of key CE managers to use the IE resource affect the perceived value of each base level IE responsibility? Based on questions 10—13 on every questionnaire (except the IE's), 20 different correlation coefficients were calculated for each IE responsibility. Not all correlations were significant at the .90 level. There is no single answer to this question, but the results in Table 29 seem to indicate a relationship, as stipulated in research question 5.

Only the responsibilities of Management Consulting and Communication and Coordination Facilitator had more than 51 percent of the calculated  $\rho$ 's above the .90 level of significance. This indicates that if the IE branch had limited time to devote to showing managers how to use all its services, the time should only be spent if one believes that the key managers perceived value and effectiveness of the Management Consulting or Communication and Coordination

services should be improved. Other services the IE provides seem to be more insensitive to the manager's ability to use the services. Increasing a key manager's ability to use the IE resource is positively correlated to a manager's perception of IE's value and effectiveness in providing Management Consulting and Communication and Coordination services.

Table 29

Research Question 5 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	15	5	9	13	6	4	8
Total $\rho$ 's Calculated	20	20	20	20	20	20	20

(All significant  $\rho$ 's were positive)

Research question 6. Does the level of key CE managers' confidence in the base level IE branch affect the perceived value and effectiveness of each base level IE responsibility? Based on questions 14 and 15 on all questionnaires (except the IE's), 10 different correlation coefficients were

calculated for each responsibility. Not all correlations were significant at .90 level. There is no single answer to this question, but the results in Table 30 seem to indicate a relationship as stipulated in research question 6.

Table 30  
Research Question 6 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	10	9	7	10	7	7	9
Total $\rho$ 's Calculated	10	10	10	10	10	10	10

(All  $\rho$ 's were positive)

BEAMS, Cost Accounting and Real Property appear to be services that are less sensitive to a manager's confidence in the IE branch. However, the perceived value and effectiveness of all IE services are highly correlated to the confidence key managers have in the IE branch. This indicates that if an organization does not demonstrate confidence in the IE branch, the branch's perceived value can be expected to be low.

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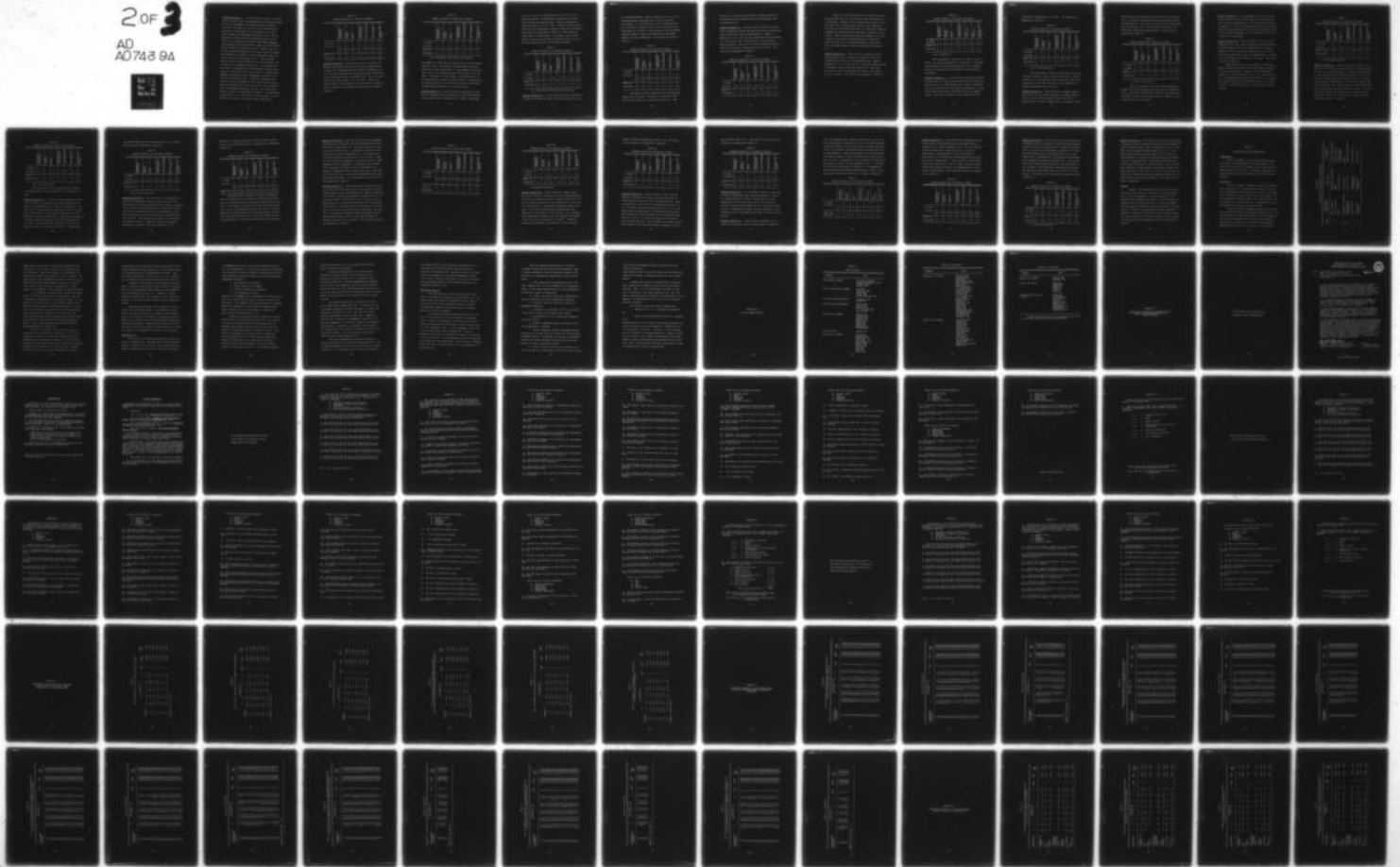
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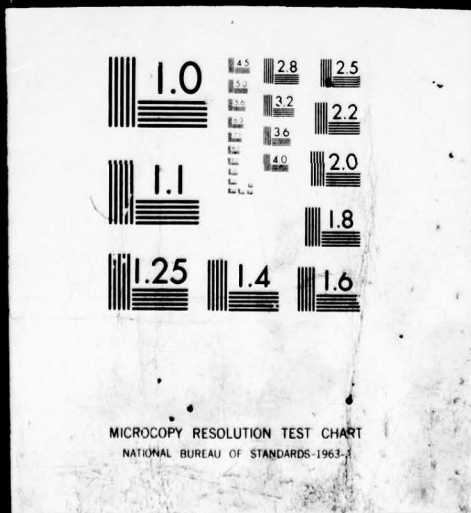
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Research question 7. Do the conflicting roles of the base level IE branch affect the perceived value and effectiveness of the IE's Management Consulting and Quality Control services? Two questions, 8 and 9 on all questionnaires, were used to investigate the inconsistency of the IE's Quality Control and Management Consulting roles. Twelve different correlations were calculated for each service. Eight of ten correlations showed a significant negative relationship between the perceived value of Quality Control and the perceived inconsistent roles. However, only two of the correlations showed a significant negative relationship between the perceived value of Management Consulting and the perceived inconsistent roles. This indicates Quality Control is more sensitive to the inconsistent role problem than is Management Consulting. Only the BCEs and the Chiefs of Engineering and Environmental Planning indicate, at a significant level, that there is a relationship between the perceived value of Management Consulting and the IE's inconsistent roles. Therefore, decreasing the perceived conflict between the IE's roles is more likely to improve the perceived value of the Quality Control service than the Management Consulting service. The correlation analysis results are summarized in Table 31. The percentage of significant  $\rho$ 's is less than 1/3 of the total  $\rho$ 's calculated which indicates a relatively weak relationship.

Table 31

Research Question 7 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
p's Above							
.90 Level: +	0	0	2	0	0	1	0
-	2	8	0	3	2	3	5
Total p's							
Calculated	12	12	12	12	12	12	12

Research question 8. Does the base level IE branch's consulting area affect the perceived value and effectiveness of each of its responsibilities? Based on questions 10 to 12 on the IE's questionnaire, three correlation coefficients were calculated for each IE responsibility. Not all correlations were significant at the .90 level. There is no single answer to this question, but the results in Table 32 seem to indicate a relationship as stipulated in research question 8.

Table 32

## Research Question 8 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	3	1	2	2	2	0	2
Total $\rho$ 's Calculated	3	3	3	3	3	3	3

(All significant correlations are positive)

The number of significant correlations for all the responsibilities varies. The extremes are Management Consulting, where all  $\rho$ 's were significant, to Real Property Accounting, where none of the correlations were significant at the .90 level. Therefore, one would expect the perceptions of an IE responsibility's value and effectiveness to increase more for those responsibilities with more positive correlations as improvements are made to the IE's work area.

Research question 9. Does the level of experience of base level IE personnel affect the perceived cost effectiveness of each base level IE responsibility? Based on questions

13 to 18 on the IE's questionnaire and 19 to 24 on the BCE questionnaire, 18 different correlations were calculated for each IE responsibility. Not all correlations were significant at the .90 level. However, those correlations that are significant, indicate a positive correlation. The results are summarized in Table 33. The relatively large number of significant  $\rho$ 's indicates a very strong positive correlation between the perceived value of the IE and the experience level of the people assigned.

Table 33  
Research Question 9 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	15	12	13	16	16	13	16
Total $\rho$ 's Calculated	18	18	18	18	18	18	18

(All significant correlations were positive)

Research question 10. Do the manning levels of base level IE affect the perceived value and effectiveness of each of

its responsibilities? Based on questions 66 to 73 on the BCE questionnaire and questions 71 to 78 on the IE's questionnaire, 24 correlations for each IE responsibility were calculated. Less than 1/4 of the correlations were significant at .90 level. Forty percent of the significant responses showed a negative correlation and 60 percent showed a positive correlation. The results are shown in Table 34.

Table 34  
Research Question 10 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level:							
+	2	1	1	3	4	5	5
-	4	0	5	0	0	4	1
Total $\rho$ 's Calculated	24	24	24	24	24	24	24

The results are not conclusive; any relationships appear to be very weak. Therefore, we cannot say that manning level affects the perceived value of IE. This

could be a very significant finding, indicating manning of IE branches could be reduced without any subsequent loss in perceived value.

Research question 11. Does the level of training of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility? Based on questions 19 to 26 from the IE's questionnaire and questions 25 to 32 from the BCE's questionnaire, 24 correlations were calculated. More than 3/4 of the correlations showed a positive correlation, significant above .90 level. The results are summarized in Table 35.

Table 35

Research Question 11 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	18	21	15	19	19	16	20
Total $\rho$ 's Calculated	24	24	24	24	24	24	24

There is a very strong positive correlation between the perceived value of the IE and the level of training of IE personnel. However, the one question that asked if more IE people with IE degrees were required, was answered by both the IEs and the BCEs such that the correlation analysis yielded very low positive and even some low negative correlations. This indicates that these two managers do not see a need to have more IE degreed personnel at base level which indicates that IE degreed personnel at base level could be reduced without affecting the perceived value of IE.

Research question 12. Does the use of quantitative techniques by base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on questions 39 to 41 on both the IE's and BCE's questionnaires, 9 correlation coefficients were calculated. More than 90 percent of the correlations were positive and significant at .90 level. The results are summarized in Table 36.

Table 36

## Research Question 12 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	9	9	7	9	9	6	9
Total $\rho$ 's Calculated	9	9	9	9	9	9	9

(All  $\rho$ 's positive)

The large number of positive  $\rho$ 's above .90 level shows a very strong relationship. Definitely, a very good way to improve the perceived perception of an IE branch would be to encourage the IE branch to use quantitative techniques.

Research question 13. Do the rules and regulations governing base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on questions 42 to 44 on both the IE's and BCE's questionnaire, 9 correlation coefficients were calculated for each IE responsibility. More than 80 percent of the coefficients were

positive and significant at .90 level. The results are summarized in Table 37.

Table 37

Research Question 13 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	8	8	7	8	6	6	9
Total $\rho$ 's Calculated	9	9	9	9	9	9	9

(All  $\rho$ 's were positive)

The large number of positive coefficients above the .90 level indicates a very positive relationship. Further examination of the questions asked showed base regulations, as perceived by the BCE, have very little correlation to the BCE's perceived value of the IE.

Research question 14. Does the level of support given to base level IE by the other branches in CE affect the perceived value and effectiveness of each base level IE responsibility? Based on question 18 on the branch chief's

questionnaire and questions 45 and 46 on the IE's questionnaire, 5 correlation coefficients were calculated for each IE responsibility. Less than 60 percent of the coefficients were significant at the .90 level and all but one of the significant coefficients were positive. The results are summarized in Table 38.

Table 38

Research Question 14 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	4	1	2	4	3	3*	2
Total $\rho$ 's Calculated	5	5	5	5	5	5	5

\* 1 negative correlation

Table 38 indicates a relatively weak relationship between the level of support given and the IE's perceived value. This would indicate that efforts to encourage other branches to support the IE branch will not improve the perceived value of the IE branch.

Research question 15. Do the number of vehicles assigned to base level IE affect the perceived value and effectiveness of each IE responsibility? The correlation analysis of question 79 on the IE's questionnaire shows that as more vehicles are assigned to the IE branch, the perceived value of the IE branch increases for all responsibilities at the .90 level of significance.

Research question 16. Does the manner in which the BCE communicates with base level IE affect the perceived value and effectiveness of each IE responsibility? Based on questions 30 to 32 on the IE's questionnaires, 3 coefficients were calculated for each IE responsibility. Fifteen of 21 coefficients were positive at .90 level. The results are shown in Table 39.

Table 39 indicates a strong positive correlation between the perceived value of IE and the BCE's communication with the IE branch. However, if one examines just question 32, "Is the BCE easy to talk to?", one finds only 2 of 7 correlations positive and significant at .90 level. This would indicate that the BCE does not have to be easy to talk to in order for the IE to be perceived as doing a good job.

Table 39

## Research Question 16 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	3	2	1	2	2	2	3
Total $\rho$ 's Calculated	3	3	3	3	3	3	3

(All  $\rho$ 's were positive)

Research question 17. Does the amount of feedback given by base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on questions 36 to 38 from the BCE's questionnaire, questions 33 to 35 from the IE's questionnaire, and questions 16 and 17 from the branch chief's questionnaire, 15 correlation coefficients were calculated. More than 90 percent of the coefficients were positive and significant at the .90 level. This indicates that feedback is very strongly correlated to the perceived value of IE. The results of the correlation analysis are shown in Table 40.

Table 40

## Research Question 17 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	15	13	15	15	14	12	15
Total $\rho$ 's Calculated	15	15	15	15	15	15	15

(All  $\rho$ 's were positive)

The importance of the IE providing good feedback is demonstrated by the large number of  $\rho$ 's above the .90 level.

Research question 18. Do the goals and objectives of base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on questions 36 to 38 from the IE's questionnaire and questions 16 to 18 from the BCE's questionnaire, 9 correlation coefficients were calculated for each IE responsibility. More than 80 percent of the coefficients were positive and significant above the .90 level. This indicates the perceived value of IE is highly correlated to the IE participation in establishing

and understanding the goals and objectives of his branch. The results are summarized in Table 41.

Table 41  
Research Question 18 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	9	8	8	9	7	3	9
Total $\rho$ 's Calculated	9	9	9	9	9	9	9

(All  $\rho$ 's were positive)

Research question 19. Does the level of job motivation for base level IE personnel affect the perceived value and effectiveness of each IE responsibility? Based on questions 45 to 47 from the BCE questionnaire, 9 correlation coefficients were calculated for each IE responsibility. More than 80 percent of the coefficients were significant above the .90 level. The questions that asked if the IE branch was underutilized got a number of significant negative correlations; however, these were expected *a priori*.

Therefore, it appears job motivation has positive correlation to the IE perceived values. The results are summarized in Table 42.

Table 42  
Research Question 19 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level: +	6	6	6	7	5	4	6
-	3	1	3	2	2	0	2
Total $\rho$ 's	9	9	9	9	9	9	9

The Deputy BCE's response to question 47 showed a positive correlation and the BCE and IE showed significant negative correlations when correlated to the perceived value of IE. This seems to indicate that the Deputy BCE believes that, as the IE organization is used less, the IE has more capacity to provide Communication and Coordination services while the BCE and IE feel that if the IE is underutilized, the Communication and Coordination service's value declines.

Research question 20. Does the base level BIE's management style affect the perceived value and effectiveness of each base level IE responsibility? Based on questions 50 to 52 on the IE's questionnaire, 3 correlation coefficients were calculated for each IE responsibility. Forty percent of the correlations were significant at the .90 level. Examination of the data in Appendix F also showed that the three management styles (democratic, authoritarian and laissez-faire) affected the perceived value in different ways. A democratic management style was more positively correlated with authoritarian and laissez-faire management styles were negatively correlated. The significant correlation results are summarized in Table 43.

Research question 21. Does the amount of recognition given to the base level IE branch affect the perceived value and effectiveness of each IE responsibility? Based on questions 51 to 53 on the BCE's questionnaires, questions 19 to 21 on the branch chief's questionnaires, and 53 to 55 on the IE questionnaire, 18 correlation coefficients were calculated. Fifty percent of the coefficients were positive and significant at .90 level and one significant coefficient was negative. The analysis indicates a weak relationship between the perceived value of the IE branch and the amount of recognition given to the IE branch. The correlation results are summarized in Table 44.

Table 43

Research Question 20 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above							
.90 Level: +	1	1	1	1	1	1	1
-	0	0	0	0	0	0	0
Total $\rho$ 's Calculated	3	3	3	3	3	3	3

Table 44

Research Question 21 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	13	8	10	13	6*	3	11
Total $\rho$ 's Calculated	18	18	18	18	18	18	18

\* 1 negative coefficient

Research question 22. Does the working climate inside base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on questions 33 to 35 on the BCE's questionnaire and questions 27 to 29 on the IE's questionnaire, 9 correlation coefficients were calculated. More than 80 percent of the coefficients were positive and significant at the .90 level. This indicates that the perceived value of the IE is directly correlated to how well the IE personnel work together. Therefore, improving the personnel relationships in the IE branch

should increase the perceived value of IE. The results of the analysis are summarized in Table 45.

Table 45  
Research Question 22 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	9	6	7	9	9	7	6
Total $\rho$ 's Calculated	9	9	9	9	9	9	9

Research question 23. Does the manner in which the BCE delegates responsibility affect the perceived value and effectiveness of each base level IE responsibility? Based on questions 68 to 70 on the IE's questionnaire and 63 to 65 on the BCE's questionnaire and question 31 to 33 on the branch chief's questionnaire, 18 correlation coefficients were calculated. Only 20 percent of the coefficients were significant and 1/6 of those were negative coefficients while 5/6 were positive. This includes a very weak relationship between the way the BCE delegates responsibility and

the perceived value of IE. The results of the correlation analysis are summarized in Table 46.

Table 46

Research Question 23 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level: +	6	2	3	1	3	5	2
-	1	0	1	0	0	0	2
Total $\rho$ 's							
Calculated	18	18	18	18	18	18	18

Research question 24. Do the number of women in base level IE affect the perceived value and effectiveness of each of its responsibilities? Based on question 80 of the IE questionnaire, which asked each IE how many women were assigned to their branch, there were no significant correlations. Indicating the number of women assigned to an IE branch has very little affect on how that IE branch is perceived.

Research question 25. Does the BCE's management style affect the perceived value and effectiveness of each base

level IE responsibility? Based on questions 56 to 58 on the IE's questionnaire, questions 48 to 50 on the BCE's questionnaire and questions 34 to 36 on the branch chief's questionnaire, 18 correlation coefficients were calculated for each IE responsibility. Weak relationships are indicated because less than 50 percent of the coefficients were significant at the .90 level. Investigation of the correlation coefficients did reveal a trend in the BCE management style. A thorough review of the correlations in Appendix F is recommended to best understand any suspected relationships. Table 47 summarizes the correlation analysis for research question 25.

Table 47  
Research Question 25 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level: +	5	1	2	4	2	1	2
-	3	1	1	2	1	2	2
Total $\rho$ 's Calculated	18	18	18	18	18	18	18

Research question 26. Does the BCE's job competence affect the perceived cost effectiveness of each base level IE responsibility? Based on questions 28 to 30 on the branch chief's questionnaire, questions 65 to 67 on the IE's questionnaire, and questions 60 to 62 on the BCE's questionnaire, 18 correlation coefficients were calculated for each IE responsibility. Only 25 percent of the coefficients were significant at the .90 level indicating a weak relationship between the BCE's job competence and the perceived IE performance. The correlation results are summarized in Table 48.

Table 48  
Research Question 26 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level:							
+	6	5	1	5	5	5	3
-	2	0	0	0	0	0	2
Total $\rho$ 's Calculated	18	18	18	18	18	18	18

Research question 27. Does the oral ability of base level IE personnel affect the perceived value and effectiveness of each base level IE responsibility? Based on questions 59 to 61 on the IE's questionnaire, questions 54 to 56 on the BCE's questionnaire, and questions 22 to 24 on the branch chief's questionnaire, 18 correlation coefficients were calculated for each IE responsibility. Over 90 percent of the coefficients were positive and significant at the .90 level. This indicates a strong positive correlation between the perceived value of IE and the IE's oral ability. The results of the correlation analysis is shown in Table 49.

Table 49  
Research Question 27 Correlation Summary

	Management Consulting	Quality Control	BEAMS	Communication Coordination	Cost Accounting	Real Property	Training and Testing
$\rho$ 's Above .90 Level	18	16	17	18	17	16*	18
Total $\rho$ 's Calculated	18	18	18	18	18	18	18

\* 1 negative correlation

Research question 28. Does the writing ability of base level IE personnel affect the perceived value and effectiveness of each IE responsibility? Based on questions 25 to 27 on the branch chief's questionnaires, questions 57 to 59 on the BCE's questionnaires and questions 62 to 64 on the IE's questionnaire, 18 correlation coefficients were calculated for each IE responsibility. More than 90 percent of the coefficients were positive and significant at the .90 level. This indicates a strong positive relationship between the perceived value of the IE and the IE's writing ability. All correlation coefficients for this research question and all other research questions discussed in this chapter can be found in Appendix F.

#### Summary

Chapter 3 has presented our findings and analysis. We began by describing our response rate for the questionnaire, then we discussed our frequency analysis of the dependent and independent variables. Next we examined how important each IE responsibility was to the key managers, and investigated the benefits and cost associated with base level IE. Finally, the findings of research questions 5 through 28, which were involved with the correlation analysis, were presented. In our last chapter, we will present the conclusions and recommendation that resulted from our research.

## Chapter 4

### CONCLUSIONS AND RECOMMENDATIONS

#### Introduction

The final chapter of this report presents conclusions about the study drawn by the investigators. The results of the study are assessed and the implications of these results are discussed. The chapter concludes with recommendations for both management action and follow-on research.

#### Conclusions

Table 50 presents a summary of some of the perceptions concerning IE. The benefit/cost indexes, the perceived importance, and the perceived value of IE all represent a different view of the data that was gathered. Any single measure has limited power, but, taken together, the three measures in Table 50 do give a comprehensive picture of the perceptions concerning base level IE.

Table 50 indicates Management Consulting was found to be ranked the highest in perceived importance of all the responsibilities (this would indicate it is considered the most important responsibility by most of the managers). When viewing the amount of time the IE branch spends on Management Consulting (17%), we see it is significantly

Table 50  
Comparison of Key Managers' Perceptions

Number	Value and Effectiveness	Importance	Benefit/Cost Index
1	Real Property	Management Consulting	Training and Testing
2	Cost Accounting	BEAMS	Quality Control
3	BEAMS	Cost Accounting	Communication Coordination
4	Management Consulting	Real Property	BEAMS
5	Communication Coordination	Quality Control	Management Consulting
6	Quality Control	Communication Coordination	Cost Accounting
7	Training and Testing	Training and Testing	Real Property

lower than the time spent on Accounting responsibilities (56 percent of IE's time is spent in Cost Accounting and Real Property). This would indicate that Management Consulting is no longer the primary job of the IE branch. The fourth place ranking Management Consulting received for its perceived value and effectiveness in Table 50 is probably due in part to the fact that it receives such a small amount of time compared to Real Property or Cost Accounting.

It is important to realize that during the reorganization, the role of the IE branch was expanded. The role of Industrial Engineering, as a management science, was not changed. These facts lead to some confusion about what is meant by the term Industrial Engineering Branch. An organization which spends 17 percent of its time doing Management Consulting and 56 percent of its time doing Cost Accounting and Real Property responsibilities might be more aptly named the "Accounting and Industrial Engineering Branch." Such a name change may clarify the Industrial Engineering Branch's current role.

One final conclusion involves the IE's role as a Communication and Coordination Facilitator. In our questionnaire, we failed to clarify which Communication and Coordination role we were interested in. The IE's role of communicating and coordinating his own solutions to squadron problems is one possible role. The IE's role to improve relations within the CE squadron by improving squadron

communication and coordination is another possible IE role. Perhaps respondents were confused as to which communication and coordination role our questionnaire referred. Such confusion could account for the IE's low (6 of 7) ranking for its Communication and Coordination Facilitating role.

Because of our failure to confirm which IE role we meant, we must conclude managers were confused by the questions in our questionnaire that referred to the Communication and Coordination role of IE. Therefore, we must caution the reader about this possible fault so that when the data is reviewed the most accurate picture possible is formed.

Many factors contribute to an organization's perceived value and effectiveness. The correlation coefficients give some information on a number of these factors. Much of the information is useful in recommending ways to improve the perceived value and effectiveness of base level Industrial Engineering. Resources can be used effectively by concentrating only on those variables that have a significant impact on the responsibility that is to be enhanced.

#### Recommendations

Reviewing our analysis and conclusions leads us to certain recommendations. Implementation of these recommendations, according to our analysis, should enhance the key manager's perceptions of base level Industrial Engineering.

If management's goal is to improve the perceived value of IE, the recommendations in this section should be considered. Our correlation analysis indicated a strong positive correlation between the perceived value of IE and the following independent variables:

1. Oral Ability of IE Branch
2. Writing Ability of IE Branch
3. IE Use of Qualitative Techniques
4. IE's Feedback to Clients

Therefore, we recommend that IE personnel be given training that will enhance their ability to perform in each of the above areas. For example, sending IE personnel to a speech course or an effective writing course can improve their oral or writing ability. Improvement in these skills should improve the perceptions of IE.

Certain actions within each CE squadron can enhance the perceived value and effectiveness of IE. Our correlation analysis indicates that if IE can improve how its personnel work together and how they get along with one another, the perceived value of IE should increase. Also, allowing IE personnel to be more active in forming the goals and objectives for its branch should enhance key managers' perceptions of IE. Providing IE with more vehicles is still another squadron action that should enhance the perceived value of IE. We recommend managers

take the above actions to try to improve the perceived value of Industrial Engineering.

The final recommendations that stem from the correlation analysis involve things the BCE can do to improve the perceived value of IE. According to the correlation analysis, if the BCE demonstrates confidence in his IE unit, the perceived value of IE should improve. Having the BCE give clear and understandable instructions to his IE branch and letting the branch know where it stands should also contribute to IE's perceived value and effectiveness.

Our analysis showed that 12 percent of the IE's time is spent doing BEAMS Consulting. To effectively use a management information system like BEAMS, a manager must understand the system (2:5-23). The fact that the IE branches are spending almost as much time in BEAMS Consulting (12%) as they are in Management Consulting (17%) indicates managers in CE are not as familiar with BEAMS as they should be. Therefore, we recommend key managers in CE be given additional training in BEAMS by the AFIT Civil Engineering School. This action should significantly reduce the IE's BEAMS Consulting role.

The final recommendations involve the Quality Control and Training and Testing IE responsibilities. Both of these responsibilities are perceived to have the lowest values of all IE responsibilities. Training and Testing

was perceived as the least important responsibility IE performed, while Quality Control was the fifth most important IE responsibility. Because of these low perceptions, we recommend that IE branches deemphasize these two IE roles. Reducing time spent in the above two areas will provide more time for the IE branch to perform its Management Consulting role.

#### Additional Research

Our investigation of base level Industrial Engineering increased our awareness of the problems in IE. We believe there are several IE problems that still remain unsolved and that further research should be performed. The additional research would provide facts to support solutions to these IE problems.

Our analysis showed the Management Consulting role of IE to be perceived as the most important IE responsibility. However, respondents did not feel that the base level IE branches were performing this function better than all other responsibilities. In fact, Management Consulting was the fourth lowest rated responsibility. This put Management Consulting in the middle with regard to perceived value of the service. Three responsibilities were perceived to be done better and three worse. We believe this indicates better ways must be found to deliver the IE Management Consulting service.

There are several possible ways of providing Management Consulting that should be investigated. Some of these alternatives involve structural changes to the existing Civil Engineering organizations and are listed below:

1. Move traditional IE responsibilities to the Major Command level, Air Force Regional Civil Engineering level, or give these responsibilities to the Engineering and Services Center at Tyndall AFB.

2. Create a new center whose sole responsibility was the traditional IE role of Management Consulting.

3. Create at the base level an IE center for Management Consulting.

4. Increase IE's traditional role by having both a base level IE center and a higher level center.

5. Contract-out for IE's traditional Management Consulting service.

6. Create a combined services IE center for the entire Department of Defense.

7. Create a separate Financial Management Branch at base level by combining the IE branch and the Financial Management Section. Traditional IE services of Management Consulting could be performed at base level by this new branch or by one of the above options.

8. Assign a small IE staff to each branch in CE to do the traditional Management Consulting work and create

a new Financial Management Branch as described in preceding alternative.

These changes involve significant shifting of personnel and should be thoroughly investigated before any one is implemented.

Another area worthy of investigation is requiring each organization to budget and pay for any IE services it requires. Thus, if an IE branch was to survive, it must sell its services to the other branches in CE. This has been an effective mode of operation at Eastman Kodak (14:117). However, its applicability to Air Force Civil Engineering should be verified.

The final two areas for further research are:

1. Changing the title of Industrial Engineering;
- and
2. Requiring more experienced officers be assigned to IE.

Changing the title of IE should be investigated because the name of a function is very influential in determining how it is perceived (12:125-175). Similarly, a new lieutenant may be as capable as an experienced major. However, he/she may not be able to sell his/her ideas because clients perceived a lack of understanding and experience with CE problems. Both of these options should be investigated as ideas for improving base level IE organizations.

APPENDIX A  
LIST OF BASES SURVEYED

Table 51

## Bases Surveyed

Command	Base
Air Defense Command	Air Force Academy Duluth International Apt. Peterson Field Tyndall AFB
Air Force Logistics Command	Hill AFB McClellan AFB Robins AFB Tinker AFB Wright-Patterson AFB
Air Force Security Service	Goodfellow AFB Misawa AB
Air Force Systems Command	Edwards AFB Eglin AFB* Kirtland AFB L. G. Hanscom AFB Patrick AFB
Air Training Command	Chanute AFB Columbus AFB Keesler AFB Laughlin AFB Lowry AFB Mather AFB Reese AFB Sheppard AFB Williams AFB
Air University	Maxwell AFB
Military Air Command	Altus AFB Andrews AFB* Charleston AFB Dover AFB Little Rock AFB McChord AFB McGuire AFB Norton AFB Pope AFB Scott AFB Travis AFB

Table 51 (continued)

Command	Base
Strategic Air Command	Anderson AFB
	Barksdale AFB
	Beale AFB*
	Blytheville AFB
	Davis Monthan AFB
	Dyess AFB
	Ellsworth AFB
	F. E. Warren AFB
	Fairchild AFB
	Grand Forks AFB
	Griffiss AFB
	Grissom AFB
	K. I. Sawyer AFB
	Loring AFB
	Malmstrom AFB
	March AFB
	McConnell AFB
	Minot AFB
	Offutt AFB
	Pease AFB
	Plattsburgh AFB
	Rickenbacher AFB
	Vandenberg AFB
	Whiteman AFB
	Wurtsmith AFB
Tactical Air Command	Bergstrom AFB
	Cannon AFB
	England AFB
	George AFB
	Howard AFB
	Holloman AFB
	Homestead AFB
	Langley AFB
	Luke AFB
	MacDill AFB
	Moody AFB
	Mt. Home AFB
	Myrtle Beach AFB
	Nellis AFB
	Seymour Johnson AFB
Shaw AFB	

Table 51 (continued)

Command	Base
Alaskan Air Command	Eielson AFB Elmendorf AFB
Pacific Air Force	Clark AB Hickam AFB Kadena AB Kunsan AB Osan AB Yokota AB
United States Air Force Europe	Aviano AB Bitberg AB Clicksands AB Hahn AB Ramstein AB Rhein Mein AB Sembach AB Spangdahlem AB Terrejon AB Zweibrucken AB

\*These bases have two civil engineering units, each unit received a separate questionnaire package.

APPENDIX B

THREE TYPES OF INDUSTRIAL ENGINEERING COST-  
EFFECTIVENESS QUESTIONNAIRES, AND  
COVER LETTERS



DEPARTMENT OF THE AIR FORCE  
OFFICE OF THE ASSISTANT SECRETARY FOR  
OPERATIONS AND SUPPORT

The following cover letters were  
attached to each questionnaire.

DEPARTMENT OF THE AIR FORCE  
AIR FORCE INSTITUTE OF TECHNOLOGY (ATIC)  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



REPLY TO  
ATTN OF:

LSGR (LSSR 12-79A)/Capt B. Caples/  
Capt A. Ewan/AUTOVON 785-6513

2 APR 1979

SUBJECT:

Industrial Engineering Cost-Effectiveness  
Questionnaire

TO:

1. The attached questionnaire was prepared by a research team at the Air Force Institute of Technology, Wright-Patterson AFB, Ohio. The purpose of the questionnaire is to acquire data concerning how you rate the value and effectiveness of the Industrial Engineering Branch in providing its services to the Civil Engineering Squadron and to determine the variables that influence your rating of the Industrial Engineering Branch.

2. You are requested to provide an answer or comment for each question. Headquarters USAF Survey Control Number 79-75 has been assigned to this questionnaire. Your participation in this research is voluntary.

3. This questionnaire or a similar form is being administered to all key managers in base level Civil Engineering Squadrons. The key managers include: Base Civil Engineer (BCE); Deputy BCE; the Chiefs of Operations, Industrial Engineering, Resources and Requirements, and Engineering and Environmental Planning.

4. Your responses to the questions will be held confidential. Please remove this cover sheet before returning the completed questionnaire. Your cooperation in providing this data will be appreciated and will be very beneficial in examining the environment in which the Industrial Engineering Branch works. Please return the completed questionnaire in the attached envelope within one week after receipt to your Squadron Administrative Officer/NCO. Any questions/comments you have may be directed to Capt Buddy Caples or Capt A. J. Kwan, AFIT/LSG, AUTOVON 785-6513. Your effort in supporting this research will be sincerely appreciated.

*Donald R. Edwards*

DONALD R. EDWARDS, Lt Col, USAF  
Associate Dean for Graduate Education  
School of Systems and Logistics

2 Atch

1. Questionnaire
2. Return Envelope

### INSTRUCTIONS

1. Most questions can be answered by filling in one of the answer spaces. If you do not find the exact answer that fits your case, use the one that is closest to it.
2. Please answer all questions in order.
3. Remember the value of the study depends upon your being straightforward in answering this questionnaire. You will not be identified with your answers.
4. The questionnaire is designed for automatic scanning of your responses. Questions are answered by marking the appropriate answer spaces on the answer sheet.
5. Please use a soft pencil (No. 2) and observe carefully these important requirements:
  - Make heavy black marks that fill the answer space.
  - Erase cleanly any answer you wish to change.
  - Where written answers are called for, stay within the area designated.
  - Make no stray markings of any kind.
6. Your responses will be confidential and will not be reviewed by anyone besides the researchers.

Now that you have completed the instructions, please turn the page and begin.

PRIVACY STATEMENT

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

a. Authority:

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

The following questionnaire was sent  
to the Base Civil Engineer and the  
Deputy Base Civil Engineer.

## SECTION I

The questions in this section are concerned with determining how you rate the value and effectiveness of the IE Branch in providing its services to you. Please use the following responses:

- a. Extremely valuable and effective
- b. Moderately valuable and effective
- c. Undecided
- d. Not too valuable or effective
- e. No value and extremely ineffective

1. How would you rate the value and effectiveness of the IE Branch in providing you with management consultant services and/or problem solving assistance?
2. How would you rate the value and effectiveness of the IE Branch in providing you with Quality Control services?
3. How would you rate the value and effectiveness of the IE Branch in providing you with BEAMS Consulting services?
4. How would you rate the value and effectiveness of the IE Branch as a Communication and Coordination Facilitator?
5. How would you rate the value and effectiveness of the IE Branch in providing you with Cost Accounting services?
6. How would you rate the value and effectiveness of the IE Branch in providing you Real Property Accounting services?
7. How would you rate the value and effectiveness of the IE Branch in providing you Testing and Training services?

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## SECTION II

The questions in the remainder of this questionnaire are concerned with determining factors which influenced how you rated the value and effectiveness of the IE Branch in providing its services to the CES. Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

8. I feel that IE's quality control role is inconsistent with the IE's role as a management consultant.

9. I do not believe the same IE personnel who perform Quality Control inspections should also perform management consulting duties.

10. I know how to use the management consulting service provided by the IE Branch.

11. I know how to use the Industrial Engineer's expertise with BEAMS to enhance the management of the CES.

12. I know how to use the Industrial Engineering Branch to facilitate communication and coordination.

13. I know how to use the Industrial Engineering Branch's Quality Control analysis.

14. I feel confident to implement solutions to problems generated by the IE Branch.

15. My confidence in the IE Branch's solutions to problems allows IE to influence the manner in which I manage the CES.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

16. The IE Branch is involved in establishing goals and objectives for the IE Branch.
17. The goals and objectives of the IE Branch are clearly stated and understood.
18. The goals and objectives of the IE Branch can be measured.
19. The people assigned to the IE Branch are experienced management consultants.
20. The people assigned to the IE Branch are experienced in the use of quantitative IE techniques.
21. The people assigned to the IE Branch are experienced and familiar with BEAMS.
22. The people assigned to the IE Branch are experienced and familiar with Quality Control.
23. The people assigned to the IE Branch are experienced and familiar with Real Property Accounting.
24. The people assigned to the IE Branch are experienced and familiar with Cost Accounting.
25. The people in base level IE are properly trained to be management consultants.
26. There should be more people with IE degrees assigned to IE Branches.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

27. The people in base level IE are properly trained to use BEAMS.

28. The people in base level IE are properly trained in Quality Control.

29. The people in base level IE are properly trained in facilitating communication and coordination within Civil Engineering.

30. The people in base level IE are properly trained in Cost Accounting.

31. The people in base level IE are properly trained in Real Property Accounting.

32. The people in base level IE are properly trained in Training and Testing.

33. Personnel in the IE Branch work together as a team.

34. Personnel in the IE Branch help each other in their jobs.

35. Personnel in the IE Branch get along well together.

36. The IE Branch provides its clients good oral feedback concerning progress being made with solutions to their problems.

37. The IE Branch provides its clients good written feedback concerning progress being made with solutions to their problems.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

38. The IE Branch provides the BCE with good feedback concerning progress being made with solutions to its customers' problems.

39. The IE Branch uses work simplification techniques like Flow Process Charts.

40. The IE Branch uses quantitative techniques to determine shop stock levels.

41. The IE Branch uses PERT or CPM to analyze problems in project management.

42. AFR 85-1, AFR 85-200 and other regulations provide helpful guidance to the IE Branch.

43. CE Squadron policies are easily understood and help guide the IE Branch.

44. Base regulations are easily understood and help guide the IE Branch.

45. The people in the IE Branch have a feeling of accomplishment.

46. The people in the IE Branch are satisfied with their jobs.

47. The IE Branch is underutilized.

48. I am an Authoritarian leader.

49. I am a Democratic leader.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

- 50. I am a Laissez-Faire (hands-off) leader.
- 51. Attempts are made to gain recognition for the IE Branch.
- 52. As the BCE, I reward the IE Branch when it performs well.
- 53. Other Branch Chiefs acknowledge a job well done by the IE Branch.
- 54. The oral communication of the IE Branch is dynamic.
- 55. The oral communication of the IE Branch is accurate.
- 56. The oral communication of the IE Branch is effective.
- 57. The written reports generated by the IE Branch are clear and concise.
- 58. The written reports generated by the IE Branch are accurate.
- 59. The written reports generated by the IE Branch are complete.
- 60. As the BCE, I am an effective organizer.
- 61. As the BCE, I possess the technical qualifications to do his job.
- 62. As the BCE, I am trained in human relations.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

63. As the BCE, I allow employees to make decisions on their jobs.

64. As the BCE, I like employees to make decisions without checking with me first.

65. As the BCE, I expect outstanding job performance from employees.

Please use the following responses:

- a. Greatly overmanned
- b. Overmanned
- c. About right
- d. Undermanned
- e. Greatly undermanned

66. The level of manpower of the IE Branch, as a whole, can be described as:

67. The manpower assigned to the IE Branch to accomplish Cost Accounting can be described as:

68. The manpower assigned to the IE Branch to accomplish Management Consulting can be described as:

69. The manpower assigned to the IE Branch to accomplish Real Property Accounting can be described as:

70. The manpower assigned to the IE Branch to accomplish Quality Control functions can be described as:

71. The manpower assigned to the IE Branch to provide BEAMS consulting can be described as:

Please use the following responses:

- a. Greatly overmanned
- b. Overmanned
- c. About right
- d. Undermanned
- e. Greatly undermanned

72. The manpower assigned to the IE Branch to facilitate Communication and Coordination can be described as:

73. The manpower assigned to the IE Branch to provide Testing and Training can be described as:

(TURN TO THE NEXT PAGE)

SECTION III

Please answer the following question on the questionnaire instead of the answer sheet.

74. Rank the following base level IE responsibilities, 1-7, in order of importance to you, with number 1 being most important.

- \_\_\_\_\_ a. Management Consulting
- \_\_\_\_\_ b. BEAMS
- \_\_\_\_\_ c. Quality Control
- \_\_\_\_\_ d. Communication and Coordination Facilitator
- \_\_\_\_\_ e. Training and Testing
- \_\_\_\_\_ f. Real Property Accounting
- \_\_\_\_\_ g. Cost Accounting

Please return the questionnaire and answer sheet to the Administrative NCO/Officer.

Your cooperation in completing this questionnaire is appreciated

The following questionnaire was sent  
to the Chief of Industrial Engineering.

## SECTION I

The questions in this section are concerned with determining how you rate the value and effectiveness of the IE Branch in providing its services to the CE Squadron. Please use the following responses:

- a. Extremely valuable and effective
- b. Moderately valuable and effective
- c. Undecided
- d. Not too valuable or effective
- e. No value and extremely ineffective

1. How would you rate the value and effectiveness of the IE Branch in providing the CES management consultant services and/or problem solving assistance?
2. How would you rate the value and effectiveness of the IE Branch in providing the CES Quality Control services?
3. How would you rate the value and effectiveness of the IE Branch in providing the CES BEAMS Consulting services?
4. How would you rate the value and effectiveness of the IE Branch as a Communication and Coordination Facilitator?
5. How would you rate the value and effectiveness of the IE Branch in providing the CES Cost Accounting services?
6. How would you rate the value and effectiveness of the IE Branch in providing the CES Real Property Accounting services?
7. How would you rate the value and effectiveness of the IE Branch in providing the CES Testing and Training services?

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## SECTION II

The questions in the remainder of this questionnaire are concerned with determining factors which influenced how you rated the value and effectiveness of the IE Branch in providing its services to the CES. Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

8. I feel the IE's quality control role is inconsistent with the IE's role as a management consultant.

9. I do not believe the same IE people who perform quality control inspections should also perform management consulting duties.

10. The Industrial Engineering Branch has a sufficiently private area where clients can discuss their management problems.

11. The Industrial Engineering Branch is conveniently located to its clients.

12. The IE Branch has adequate access to computer terminals.

13. The people assigned to your IE Branch are experienced management consultants.

14. The people assigned to your IE Branch are experienced in the use of quantitative IE techniques.

15. The people assigned to your IE Branch are experienced and familiar with BEAMS.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

16. The people assigned to your IE Branch are experienced and familiar with Quality Control.

17. The people assigned to your IE Branch are experienced and familiar with Real Property Accounting.

18. The people assigned to your IE Branch are experienced and familiar with Cost Accounting.

19. There should be more people with IE degrees assigned to IE Branches.

20. The people in base level IE are properly trained to be management consultants.

21. The people in base level IE are properly trained to use BEAMS.

22. The people in base level IE are properly trained in Quality Control procedures.

23. The people in base level IE are properly trained in facilitating communication and coordination within Civil Engineering.

24. The people in base level IE are properly trained in Cost Accounting.

25. The people in base level IE are properly trained in Real Property Accounting.

26. The people in base level IE are properly trained to perform training and testing.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

- 27. Personnel in the IE Branch work together as a team.
- 28. Personnel in the IE Branch help each other in their jobs.
- 29. Personnel in the IE Branch get along well together.
- 30. The BCE provides clear and understandable instructions to the IE Branch.
- 31. The BCE lets the IE Branch know where the IE Branch stands.
- 32. The BCE is easy to talk to.
- 33. The IE Branch provides its clients good oral feedback concerning progress being made with solutions to their problems.
- 34. The IE Branch provides its clients good written feedback concerning progress being made with solutions to their problems.
- 35. The IE Branch provides the BCE with good feedback concerning progress being made with solutions to its customers' problems.
- 36. The IE Branch is involved in establishing goals and objectives for the Branch.
- 37. The goals and objectives of the IE Branch are clearly stated and understood.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

38. The goals and objectives of the IE Branch can be measured.

39. Your IE Branch uses work simplification techniques like Flow Process Charts.

40. Your IE Branch uses quantitative techniques to determine shop stock levels.

41. Your IE Branch uses PERT or CPM to analyze problems in project management.

42. AFR 85-1, AFR 85-200 and other regulations provide helpful guidance to your IE Branch.

43. CE Squadron policies are easily understood and help guide the IE Branch.

44. Base regulations are easily understood and help guide the IE Branch.

45. The Operations Branch supports (i.e., encourages) IE's effort to increase productivity.

46. The Engineering and Environmental Branch supports (i.e., encourages) the IE's effort to increase productivity.

47. The people in the IE Branch have a feeling of accomplishment.

48. The people in the IE Branch are satisfied with their jobs.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

- 49. The IE Branch is underutilized.
- 50. I am an Authoritarian leader.
- 51. I am a Democratic leader.
- 52. I am a Laissez-Faire (hands-off) leader.
- 53. Attempts are made to gain recognition for the IE Branch when it performs well.
- 54. The BCE rewards the IE Branch when it performs well.
- 55. Other Branch Chiefs acknowledge a job well done by the IE Branch.
- 56. The BCE is an Authoritarian leader.
- 57. The BCE is a Democratic leader.
- 58. The BCE is a Laissez-Faire (hands-off) leader.
- 59. The oral communication of the IE Branch is dynamic.
- 60. The oral communication of the IE Branch is accurate.
- 61. The oral communication of the IE Branch is effective.
- 62. The written reports generated by the IE Branch are clear and concise.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

63. The written reports generated by the IE Branch are accurate.

64. The written reports generated by the IE Branch are complete.

65. The BCE is an effective organizer.

66. The BCE possesses the technical qualifications to do his job.

67. The BCE is trained in human relations.

68. The BCE allows employees to make decisions on their jobs.

69. The BCE likes employees to make decisions without checking with him first.

70. The BCE expects outstanding job performance from employees.

Please use the following responses:

- a. Greatly overmanned
- b. Overmanned
- c. About right
- d. Undermanned
- e. Greatly undermanned

71. The level of manpower of the IE Branch, as a whole, can be described as:

Please use the following responses:

- a. Greatly overmanned
- b. Overmanned
- c. About right
- d. Undermanned
- e. Greatly undermanned

72. The manpower assigned to the IE Branch to accomplish Cost Accounting activities can be described as:

73. The manpower assigned to the IE Branch to accomplish Management Consulting can be described as:

74. The manpower assigned to the IE Branch to accomplish Real Property Accounting can be described as:

75. The manpower assigned to the IE Branch to accomplish Quality Control functions can be described as:

76. The manpower assigned to the IE Branch to provide BEAMS Consulting can be described as:

77. The manpower assigned to the IE Branch to facilitate Communication and Coordination can be described as:

78. The manpower assigned to the IE Branch to provide Testing and Training can be described as:

Please use the following responses:

- a. None
- b. One
- c. Two
- d. Three
- e. Four or more

79. The IE Branch has how many vehicles permanently assigned for personnel use?

80. How many women, excluding secretaries, are assigned to your IE Branch?

SECTION III

Please answer the following questions on the questionnaire instead of the answer sheet.

81. Rank the following base level IE responsibilities, 1-7, in order of importance to you, with number 1 being most important.

- \_\_\_\_\_ a. Management Consulting
- \_\_\_\_\_ b. BEAMS
- \_\_\_\_\_ c. Quality Control
- \_\_\_\_\_ d. Communication and Coordination Facilitator
- \_\_\_\_\_ e. Training and Testing
- \_\_\_\_\_ f. Real Property Accounting
- \_\_\_\_\_ g. Cost Accounting

82. What percent of the total man-hours available to IE are spent in the following areas?

- a. Management Consulting \_\_\_\_\_ %
- b. Quality Control \_\_\_\_\_ %
- c. BEAMS Consulting \_\_\_\_\_ %
- d. Facilitating Communication and Coordination \_\_\_\_\_ %
- e. Training and Testing \_\_\_\_\_ %
- f. Cost Accounting \_\_\_\_\_ %
- g. Real Property \_\_\_\_\_ %

The total should sum to: 100%

Please return the questionnaire and answer sheet to the Administrative NCO/Officer.

Your cooperation in completing this questionnaire is appreciated

The questions in this section are concerned with  
the following information and the effectiveness of the  
information in providing the services to you. Please use the  
following responses:

- 1. Extremely valuable and effective
- 2. Valuable and effective
- 3. Somewhat valuable and effective
- 4. Not too valuable or effective
- 5. Not valuable and extremely ineffective

If you would you rate the value and effectiveness of the  
information in providing the services to you in management development  
services and/or other training activities:

If you would you rate the value and effectiveness of the  
services in providing the services to you in management development  
services and/or other training activities:

The following questionnaire was sent to  
the Chief of Operations, Chief Engineering  
and Environmental Planning, and Chief of  
Resources and Requirements.

## SECTION I

The questions in this section are concerned with determining how you rate the value and effectiveness of the IE Branch in providing its services to you. Please use the following responses:

- a. Extremely valuable and effective
- b. Moderately valuable and effective
- c. Undecided
- d. Not too valuable or effective
- e. No value and extremely ineffective

1. How would you rate the value and effectiveness of the IE Branch in providing you with management consultant services and/or problem solving assistance?
2. How would you rate the value and effectiveness of the IE Branch in providing you with Quality Control services?
3. How would you rate the value and effectiveness of the IE Branch in providing you with BEAMS Consulting services?
4. How would you rate the value and effectiveness of the IE Branch as a Communication and Coordination Facilitator?
5. How would you rate the value and effectiveness of the IE Branch in providing you with Cost Accounting services?
6. How would you rate the value and effectiveness of the IE Branch in providing you Real Property Accounting services?
7. How would you rate the value and effectiveness of the IE Branch in providing you Testing and Training services?

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## SECTION II

The questions in the remainder of this questionnaire are concerned with determining factors which influenced how you rated the value and effectiveness of the IE Branch in providing its services to your Branch. Please use the following responses:

- a. Strongly agree
  - b. Agree
  - c. Undecided
  - d. Disagree
  - e. Strongly disagree
8. I feel the IE's quality control role is inconsistent with the IE's role as a management consultant.
9. I do not believe the same IE personnel who perform Quality Control inspections should also perform management consulting duties.
10. I know how to use the management consulting service provided by the IE Branch.
11. I know how to use the Industrial Engineer's expertise with BEAMS to enhance the management of my Branch.
12. I know how to use the Industrial Engineering Branch to facilitate communication and coordination.
13. I know how to use the Industrial Engineering Branch's Quality Control analysis.
14. I feel confident to implement solutions to problems generated by the IE Branch.
15. My confidence in the IE's solutions to problems allows IE to influence the manner in which I manage my own Branch.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

16. The IE Branch provides its clients good oral feedback concerning progress being made with solutions to their problems.

17. The IE Branch provides its clients good written feedback concerning progress being made with solutions to their problems.

18. My Branch supports (i.e., encourages) the IE's effort to increase productivity.

19. Attempts are made to gain recognition for the IE Branch.

20. The BCE rewards the IE Branch when it performs well.

21. Other Branch Chiefs acknowledge a job well done by the IE Branch.

22. The oral communication of the IE Branch is dynamic.

23. The oral communication of the IE Branch is accurate.

24. The oral communication of the IE Branch is effective.

25. The written reports provided to me by the IE Branch are clear and concise.

26. The written reports provided to me by the IE Branch are accurate.

27. The written reports provided to me by the IE Branch are complete.

### SECTION III

The questions in this section pertain to the BCE.

Please use the following responses:

- a. Strongly agree
- b. Agree
- c. Undecided
- d. Disagree
- e. Strongly disagree

- 28. The BCE is an effective organizer.
- 29. The BCE possesses the technical qualifications to do his job.
- 30. The BCE is trained in human relations.
- 31. The BCE allows employees to make decisions on their jobs.
- 32. The BCE likes employees to make decisions without checking with him first.
- 33. The BCE expects outstanding job performance from employees.
- 34. The BCE is an Authoritarian leader.
- 35. The BCE is a Democratic leader.
- 36. The BCE is a Laissez-Faire (hands-off) leader.

SECTION IV

Please answer the following question on the questionnaire instead of the answer sheet.

37. Rank the following base level IE responsibilities, 1—7, in order of importance to you, with number 1 being most important.

- \_\_\_\_\_ a. Management Consulting
- \_\_\_\_\_ b. BEAMS
- \_\_\_\_\_ c. Quality Control
- \_\_\_\_\_ d. Communication and Coordination Facilitator
- \_\_\_\_\_ e. Training and Testing
- \_\_\_\_\_ f. Real Property Accounting
- \_\_\_\_\_ g. Cost Accounting

Please return the questionnaire and answer sheet to the Administrative NCO/Officer.

Your cooperation in completing this questionnaire is appreciated

APPENDIX C

DESCRIPTIVE STATISTICS FOR THE DEPENDENT  
VARIABLES WHICH WERE FIRST SEVEN  
QUESTIONS ON ALL QUESTIONNAIRES

TABLE 52  
 BCE'S EVALUATION OF IE'S VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	28.0	50.7	2.7	16.0	2.7	4	3.853	1.087
02	16.0	36.0	10.7	24.0	13.3	4	3.173	1.329
03	38.7	37.3	12.0	9.3	2.7	5	4.000	1.065
04	9.3	46.7	21.3	20.0	2.7	4	3.400	1.000
05	46.7	45.3	5.3	2.7	0	5	4.360	0.710
06	56.0	37.3	2.7	2.7	1.3	5	4.440	0.793
07	4.0	28.0	24.0	33.3	10.7	2	2.813	1.087

NUMBER OF VALID CASES 75

TABLE 53  
 DEPUTY BCE'S EVALUATION OF IE'S VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	26.8	47.9	5.6	18.3	1.4	4	3.803	1.077
02	21.3	36.6	9.9	31.0	11.3	4	3.056	1.264
03	50.7	38.0	2.8	8.5	0	5	4.310	0.888
04	12.7	38.0	16.9	25.4	7.0	4	3.239	1.177
05	46.5	45.1	2.8	5.6	0	5	4.324	0.789
06	56.3	38.0	1.4	4.2	0	5	4.465	0.734
07	5.6	39.4	15.5	23.9	15.5	4	2.958	1.224

NUMBER OF VALID CASES 71

TABLE 54

IE'S EVALUATION OF HIS VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	36.1	45.8	6.0	10.8	1.2	4	4.048	0.987
02	10.8	33.7	9.6	32.5	13.3	4	2.964	1.283
03	71.1	27.7	0	1.2	0	5	4.687	0.539
04	21.7	43.4	22.9	8.4	3.6	4	3.711	1.018
05	67.5	28.9	3.6	0	0	5	4.639	0.554
06	67.5	26.5	4.8	0	1.2	5	4.590	0.699
07	6.9	30.1	24.1	22.9	16.9	4	2.855	1.201

NUMBER OF VALID CASES 83

TABLE 55  
 CHIEF OF ENGINEERING AND ENVIRONMENTAL PLANNING'S  
 EVALUATION OF INDUSTRIAL ENGINEERING'S VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	1.4	30.6	6.9	45.8	15.3	2	2.569	1.124
02	0	13.9	25.0	34.7	26.4	2	2.264	1.007
03	9.7	45.8	9.7	31.9	2.8	4	3.278	1.103
04	2.8	26.4	18.1	37.5	15.3	2	2.639	1.117
05	25.0	41.7	11.1	19.4	2.8	4	3.667	1.138
06	13.9	61.4	12.5	12.5	0	4	3.764	0.847
07	1.4	20.8	20.8	36.1	20.8	2	2.458	1.087

NUMBER OF VALID CASES 72

TABLE 56

CHIEF OF OPERATION'S EVALUATION OF IE'S VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	14.1	33.8	4.2	33.8	14.1	2	3.000	1.352
02	5.6	29.6	7.0	45.1	12.7	2	2.704	1.188
03	25.4	43.7	7.0	15.5	8.5	4	3.620	1.258
04	2.8	26.8	15.5	35.2	19.7	2	2.577	1.167
05	29.6	52.1	5.6	11.3	1.4	4	3.972	0.971
06	29.6	45.1	7.0	16.9	1.4	4	3.845	1.078
07	8.5	22.5	16.9	26.8	25.4	2	2.620	1.313

NUMBER OF VALID CASES 71

TABLE 57

CHIEF OF RESOURCES AND REQUIREMENT'S EVALUATION OF  
IE'S VALUE AND EFFECTIVENESS

VARIABLE	RESPONSES(%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
01	11.7	40.3	7.8	33.8	6.5	4	3.169	1.207
02	2.6	27.3	11.7	37.7	20.8	2	2.532	1.176
03	40.3	36.4	7.8	11.7	3.9	5	3.974	1.147
04	5.2	19.5	33.8	27.3	14.3	3	2.740	1.093
05	24.7	49.4	10.4	13.0	2.6	4	3.805	1.039
06	32.5	48.1	9.1	10.4	0	4	4.026	0.917
07	1.3	16.9	15.6	41.6	24.7	2	2.286	1.062

NUMBER OF VALID CASES 77

APPENDIX D  
DESCRIPTIVE STATISTICS FOR QUESTIONS WHICH  
PROVIDED INFORMATION ABOUT INDEPENDENT  
VARIABLES

Table 58

BCE's Response to Questions that Provide Information  
About the Independent Variables

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
8	16.0	30.7	9.3	36.0	8.0	2	3.107	1.279
9	14.0	28.0	16.0	30.7	10.7	2	3.053	1.272
10	38.0	53.3	8.0	0	0	4	4.307	0.615
11	24.0	53.3	12.0	9.3	1.3	4	3.893	0.924
12	18.7	42.7	26.7	9.3	2.7	4	3.653	0.979
13	20.0	56.0	20.0	2.7	1.3	4	3.907	0.791
14	32.0	50.7	5.3	10.7	1.3	4	4.013	0.111
15	21.3	45.3	9.3	20.0	4.0	4	3.600	0.133
16	38.7	50.7	2.7	8.0	0	4	4.200	0.838
17	21.3	52.0	17.3	8.0	1.3	4	3.840	0.901
18	14.7	40.0	16.0	26.7	2.7	4	3.373	1.112
19	9.3	26.7	14.7	38.7	10.7	2	2.853	1.205
20	8.0	45.3	16.0	26.7	4.0	4	3.267	1.070
21	28.0	50.7	8.0	10.7	2.7	4	3.907	1.016
22	9.3	42.7	21.3	22.7	4.0	4	3.307	1.052
23	33.3	53.3	8.0	5.3	0	4	4.147	0.783
24	32.0	56.0	6.7	5.3	0	4	4.147	0.766
25	5.3	24.0	22.7	33.3	14.7	2	2.720	1.146
26	28.0	33.3	10.7	22.7	5.3	4	3.560	1.265
27	21.0	49.3	13.3	12.0	4.0	4	3.720	1.060
28	5.3	26.7	29.3	30.7	8.0	2	2.907	1.055
29	4.0	24.0	30.7	34.7	6.7	2	2.840	1.001
30	28.0	56.0	10.7	5.3	0	4	4.067	0.777

Table 58 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
31	34.7	50.7	9.3	5.3	0	4	4.147	0.800
32	1.3	14.7	26.7	46.7	10.7	2	2.493	0.921
33	21.3	48.0	10.7	17.3	2.7	4	3.680	1.080
34	24.0	40.0	14.7	17.3	4.0	4	3.627	1.148
35	21.3	48.0	16.0	10.7	4.0	4	3.720	1.047
36	10.7	44.0	24.0	18.7	2.7	4	3.413	1.001
37	13.3	50.7	10.7	22.7	2.7	4	3.493	1.070
38	16.0	50.7	10.7	20.0	2.7	4	3.573	1.068
39	4.0	28.0	18.7	38.7	10.7	2	2.760	1.101
40	2.7	24.0	24.0	40.0	9.3	2	2.707	1.024
41	0	18.7	22.7	48.0	10.7	2	2.493	0.921
42	10.7	56.0	17.3	12.0	4.0	4	3.573	0.975
43	0	9.3	62.7	24.0	4.0	4	3.773	0.669
44	6.7	49.3	28.0	14.7	1.3	4	3.453	0.874
45	14.7	36.0	26.7	20.0	2.7	4	3.400	1.053
46	0	9.3	45.3	26.7	18.7	4	3.453	0.905
47	8.0	29.3	18.7	32.0	12.0	2	2.893	1.192
48	9.3	16.0	4.0	49.3	21.3	2	2.427	1.254
49	12.0	58.7	6.7	20.0	2.7	4	3.573	1.029
50	2.7	8.0	6.7	56.0	26.7	2	2.040	0.951
51	16.0	62.7	10.7	10.7	0	4	3.840	0.823
52	20.0	74.7	5.3	0	0	4	4.147	0.485
53	0	8.0	52.0	24.0	16.0	4	3.520	0.860
54	4.0	29.3	22.7	41.3	2.7	2	2.907	0.989
55	13.3	69.3	6.7	9.7	1.3	4	3.840	0.823
56	9.3	62.7	17.3	9.3	1.3	4	3.693	0.822

Table 58 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
57	21.3	54.7	9.3	12.0	2.7	4	3.800	1.000
58	18.7	58.7	13.3	6.7	2.7	4	3.840	0.901
59	16.0	53.3	13.3	13.3	4.0	4	3.640	1.035
60	28.0	54.7	14.7	1.3	1.3	4	4.067	0.777
61	38.7	42.7	0	12.0	6.7	4	3.947	1.218
62	40.0	53.3	1.3	5.3	0	4	4.280	0.745
63	50.7	46.7	0	1.3	1.3	5	4.440	0.702
64	21.3	61.3	5.3	8.0	4.0	4	3.880	0.972
65	53.3	42.7	0	4.0	0	5	4.453	0.703
66	2.7	2.7	52.0	33.3	9.3	3	2.560	0.809
67	0	9.3	7.7	16.0	4.0	3	2.853	0.630
68	1.3	4.0	42.7	37.3	14.7	3	2.400	0.838
69	1.3	8.0	69.3	18.7	2.7	3	2.867	0.644
70	1.3	5.3	44.0	32.0	17.3	3	2.413	0.887
71	0	4.0	70.7	17.3	8.0	3	2.707	0.673
72	1.3	2.7	57.3	32.0	6.7	3	2.600	0.717
73	0	0	32.0	48.0	20.0	2	2.120	0.717

NUMBER OF VALID CASES = 75

Table 59

Deputy BCE's Responses to Questions that Provide Information About the Independent Variables

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
8	15.5	22.5	9.9	46.5	5.6	2	2.958	1.247
9	12.7	25.4	12.7	40.8	8.5	2	2.930	1.234
10	31.0	62.0	5.6	1.4	0	4	4.225	0.614
11	28.2	54.9	7.0	9.9	0	4	4.014	0.870
12	16.9	42.3	22.5	12.7	5.6	4	3.521	1.094
13	18.3	60.6	12.7	2.8	5.6	4	3.831	0.956
14	25.4	31.0	19.7	18.3	5.6	4	3.521	1.217
15	14.1	40.8	8.5	28.2	8.5	4	3.239	1.247
16	35.2	50.7	2.8	11.3	0	4	4.099	0.913
17	26.8	40.8	14.1	16.9	1.4	4	3.746	1.079
18	22.5	40.8	11.3	22.5	2.8	4	3.577	1.155
19	15.5	21.1	21.1	26.8	15.5	2	2.944	1.319
20	15.5	40.8	11.3	25.4	7.0	4	3.324	1.216
21	35.2	50.7	4.2	5.6	4.2	4	4.070	1.005
22	11.3	47.9	18.3	15.5	7.0	4	3.408	1.103
23	40.8	53.5	5.6	0	0	4	4.352	0.588
24	35.2	53.5	5.6	5.6	0	4	4.183	0.780
25	8.5	23.9	18.3	32.4	16.9	2	2.746	1.239
26	35.2	23.9	9.9	22.5	8.5	5	3.549	1.392
27	33.8	50.7	5.6	7.0	2.8	4	4.056	0.969
28	9.9	31.0	26.8	25.4	7.0	4	3.113	1.115
29	9.9	29.6	22.5	29.6	8.5	2	3.028	1.158
30	28.8	53.5	14.1	4.2	0	4	4.056	0.773

Table 59 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
31	33.8	57.7	2.8	5.6	0	4	4.197	0.749
32	4.2	31.0	25.4	28.2	11.3	4	2.887	1.103
33	28.2	45.1	15.5	11.3	0	4	3.901	0.943
34	19.7	50.7	18.3	7.0	4.2	4	3.746	0.996
35	21.1	57.7	14.1	5.6	1.4	4	3.915	0.841
36	16.9	38.0	21.1	18.3	5.6	4	3.423	1.142
37	18.3	39.4	8.5	29.6	4.2	4	3.380	1.211
38	29.6	33.8	12.7	19.7	4.2	4	3.648	1.220
39	9.9	29.6	16.9	42.3	1.4	2	3.042	1.088
40	8.5	32.4	22.5	32.4	4.2	2	3.085	1.079
41	5.6	15.5	12.7	56.3	9.9	2	2.507	1.054
42	15.5	60.6	25.5	5.6	2.8	4	3.803	0.872
43	19.7	56.3	19.7	2.8	1.4	4	3.901	0.796
44	14.1	56.3	21.1	5.6	2.8	4	3.732	0.878
45	18.3	42.3	26.8	11.3	1.4	4	3.648	0.958
46	14.1	46.5	23.9	14.1	1.4	4	3.577	0.951
47	7.0	33.8	8.5	35.2	15.5	2	2.817	1.257
48	2.8	28.2	12.7	40.8	15.5	2	2.620	1.138
49	11.3	50.7	14.1	21.1	2.8	4	3.465	1.040
50	0	18.3	9.9	43.7	28.2	2	2.183	1.046
51	9.9	56.3	14.1	19.7	0	4	3.563	0.922
52	14.1	70.4	12.7	2.8	0	4	3.958	0.620
53	2.8	52.1	23.9	21.1	0	4	3.366	0.849
54	2.8	29.6	16.9	47.9	2.8	2	2.817	0.990
55	12.7	53.5	19.7	14.1	0	4	3.648	0.880
56	9.9	46.5	21.1	19.7	2.8	4	3.408	1.008

Table 59 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
57	18.3	57.1	7.0	16.9	0	4	3.775	0.944
58	21.1	54.9	14.1	8.5	1.4	4	3.859	0.899
59	16.9	50.7	11.3	18.3	2.8	4	3.606	1.062
60	22.5	56.3	16.9	4.2	0	4	3.972	0.755
61	36.6	43.7	8.5	8.5	2.8	4	4.028	1.028
62	31.0	59.2	7.0	2.8	0	4	4.183	0.683
63	29.6	66.7	2.8	1.4	0	4	4.239	0.572
64	14.1	64.8	9.9	9.9	1.4	4	3.803	0.853
65	28.2	53.5	7.0	9.9	1.4	4	3.972	0.941
66	1.4	8.5	53.5	36.6	0	3	2.746	0.670
67	1.4	11.3	81.7	5.6	0	3	3.085	0.470
68	1.4	7.0	42.3	43.7	5.6	2	2.549	0.771
69	1.4	5.6	77.5	15.5	0	3	2.930	0.516
70	1.4	4.2	36.6	45.1	12.7	2	2.366	0.815
71	1.4	2.8	76.1	19.7	0	3	2.859	0.515
72	1.4	2.8	54.9	26.8	14.1	3	2.507	0.826
73	4.2	1.4	42.3	36.6	15.5	3	2.423	0.921

Table 60

Chief of Industrial Engineering's Responses to Questions that Provide Information About the Independent Variable

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
8	30.1	21.7	9.6	33.7	4.8	2	3.386	1.351
9	22.9	27.7	14.5	27.7	7.2	2	3.313	1.297
10	24.1	36.1	4.8	12.0	22.9	4	3.265	1.523
11	36.1	44.6	1.2	9.6	8.4	4	3.904	1.236
12	56.6	32.5	2.4	4.8	3.6	5	4.337	1.003
13	15.7	28.9	9.6	36.1	9.6	2	3.048	1.296
14	16.9	32.5	9.6	31.3	9.6	4	3.157	1.302
15	30.1	54.2	8.4	7.2	0	4	4.072	0.823
16	10.8	42.2	21.7	19.3	6.0	4	3.325	1.094
17	36.1	48.2	8.4	7.2	0	4	4.133	0.852
18	36.1	54.2	3.6	6.0	0	4	4.205	0.777
19	36.1	20.5	15.7	15.7	12.0	5	3.530	1.426
20	6.0	28.9	16.9	38.6	9.6	2	2.831	1.135
21	21.7	53.0	9.6	14.5	1.2	4	3.795	0.985
22	8.4	28.9	28.9	22.9	10.8	3	3.012	1.142
23	13.3	26.5	26.5	26.5	7.2	2	3.120	1.162
24	25.3	57.8	7.2	9.6	0	4	3.988	0.848
25	26.5	53.0	10.8	9.6	0	4	3.964	0.876
26	7.2	16.9	15.7	36.1	24.1	2	2.470	1.233
27	43.4	51.8	3.6	1.2	0	4	4.373	0.619
28	48.2	48.2	1.2	2.4	0	4	4.422	0.646
29	41.0	50.6	4.8	3.6	0	4	4.289	0.725
30	19.3	37.3	14.5	22.9	6.0	4	3.410	1.210

Table 60 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					E	MODE	MEAN	STD. DEV.
	A	B	C	D					
31	18.1	31.3	15.7	25.3	9.6	4	3.229	1.281	
32	41.0	30.1	16.9	8.4	3.6	5	3.964	1.120	
33	21.7	48.2	19.3	10.8	0	4	3.807	0.903	
34	22.9	44.6	21.7	10.8	0	4	3.795	0.921	
35	31.3	47.0	13.3	8.4	0	4	4.012	0.890	
36	37.3	44.6	15.7	2.4	0	4	4.169	0.778	
37	24.1	42.2	15.7	16.7	2.4	4	3.699	1.079	
38	15.7	26.5	28.9	22.9	6.0	3	3.229	1.151	
39	6.0	48.2	2.4	37.3	6.0	4	3.108	1.158	
40	2.4	19.3	12.0	50.6	15.7	2	2.422	1.049	
41	4.8	28.9	9.6	44.6	12.0	2	2.699	1.155	
42	19.3	47.0	10.8	14.5	8.4	4	3.542	1.203	
43	8.4	38.6	27.7	18.1	7.2	4	3.229	1.074	
44	6.0	37.3	26.5	21.7	8.4	4	3.108	1.082	
45	9.6	38.6	14.5	22.9	14.5	4	3.060	1.262	
46	2.4	33.7	21.7	30.1	12.0	4	2.843	1.099	
47	8.4	41.0	16.9	21.7	12.0	4	3.120	1.204	
48	12.0	33.7	15.7	31.3	7.2	4	3.120	1.193	
49	32.5	30.1	7.2	19.3	10.8	5	3.542	1.391	
50	2.4	16.9	7.2	50.6	22.9	2	2.253	1.069	
51	16.9	61.4	15.7	4.8	1.2	4	3.880	0.787	
52	2.4	14.5	7.2	47.0	28.9	2	2.145	1.072	
53	20.5	51.8	14.5	10.8	2.4	4	3.771	0.979	
54	9.6	31.3	37.3	16.9	4.8	3	3.241	1.007	
55	6.0	44.6	20.5	22.9	6.0	4	3.217	1.060	
56	8.4	30.1	16.9	37.3	7.2	2	2.952	1.147	

Table 60 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
57	6.0	23.4	21.7	24.1	4.8	4	3.217	1.037
58	2.4	21.7	14.5	38.6	22.9	2	2.422	1.138
59	8.4	43.4	30.1	16.9	1.2	4	3.410	0.911
60	25.3	67.5	4.8	2.4	0	4	4.157	0.614
61	18.1	54.2	19.3	7.2	1.2	4	3.807	0.862
62	30.1	59.0	7.2	1.2	2.4	4	4.133	0.793
63	34.9	60.2	3.6	1.2	0	4	4.289	0.595
64	24.1	65.1	8.4	2.4	0	4	4.108	0.644
65	27.7	41.0	20.5	8.4	2.4	4	3.831	1.010
66	50.6	36.1	8.4	3.6	1.2	5	4.313	0.869
67	26.5	50.6	12.0	9.6	1.2	4	3.916	0.940
68	26.5	50.6	14.5	8.4	0	4	3.952	0.868
69	4.8	36.1	25.3	28.9	4.8	4	3.072	1.022
70	32.5	51.8	12.0	3.6	0	4	4.133	0.761
71	2.4	6.0	47.0	28.9	15.7	3	2.506	0.916
72	2.4	13.3	68.7	14.5	1.2	3	3.012	0.653
73	0	3.6	33.7	39.8	22.9	2	2.181	0.829
74	1.2	10.8	61.4	24.1	2.4	3	3.843	0.689
75	0	2.4	47.0	27.7	22.9	3	2.289	0.849
76	0	2.4	80.7	13.3	3.6	3	2.819	0.521
77	1.2	1.2	59.0	24.1	14.5	3	2.506	0.802
78	2.4	1.2	32.5	32.5	31.3	2	2.108	0.950
79	94.0	3.6	0	1.2	1.2	5	4.880	0.572
80	7.2	15.7	26.5	20.5	30.1	1	2.494	1.272

NUMBER OF VALID CASES = 83

Table 61  
 Chief of Engineering and Environmental Plannings' Responses to Questions  
 that Provide Information About the Independent Variables

QUESTIONNAIRE RESPONSE	RESPONSES (%)					E	MODE	MEAN	STD. DEV.
	A	B	C	D	D				
8	13.9	26.4	27.8	27.8	4.2	2	3.181	1.117	
9	13.9	31.9	23.6	25.0	5.6	4	3.236	1.144	
10	13.9	41.7	20.8	16.7	6.9	4	3.389	1.133	
11	15.3	55.6	9.7	15.3	4.2	4	3.625	1.054	
12	1.1	29.2	20.8	29.2	9.7	2	3.028	1.198	
13	5.6	33.3	27.8	23.6	9.7	4	3.014	1.094	
14	6.9	23.6	36.1	20.8	12.5	3	2.917	1.110	
15	2.8	13.9	31.9	33.3	18.1	2	2.500	1.035	
16	1.4	26.4	26.4	33.3	12.5	2	2.708	1.041	
17	2.8	30.6	29.2	26.4	11.1	4	2.875	1.061	
18	16.7	44.4	20.8	15.3	2.8	4	3.569	1.032	
19	5.6	38.9	26.4	22.2	6.9	4	3.139	1.052	
20	9.7	41.7	33.3	9.7	5.6	4	3.403	0.988	
21	5.6	36.1	40.3	13.9	4.2	3	3.250	0.915	
22	0	20.8	23.6	38.9	16.7	2	2.486	1.007	
23	2.8	51.4	23.6	15.3	6.9	4	3.278	0.996	
24	1.4	40.3	19.4	27.8	11.1	4	2.931	1.092	
25	5.6	30.6	34.7	20.8	8.3	3	3.042	1.041	
26	4.2	29.2	44.4	13.9	8.3	3	3.069	0.969	
27	4.2	31.9	40.3	12.5	11.1	3	3.056	1.033	
28	34.7	44.4	9.7	6.9	4.2	4	3.986	1.055	
29	44.4	44.4	5.6	5.6	0	4	4.278	0.809	
30	29.2	41.7	12.5	6.9	9.7	4	3.736	1.233	

Table 61 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
31	33.3	41.7	11.1	5.6	8.3	4	3.861	1.190
32	9.7	41.7	23.6	13.9	11.1	4	3.250	1.160
33	43.1	43.1	8.3	2.8	2.8	4	4.208	0.918
34	27.8	18.1	9.7	29.2	15.3	2	3.139	1.485
35	5.3	31.9	19.4	20.8	12.5	4	3.167	1.278
36	0	8.3	16.7	40.3	37.7	2	1.986	0.927

NUMBER OF VALID CASES = 72

Table 62  
 Chief of Operations' Responses to Questions that Provide  
 Information About the Independent Variables

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
8	14.1	19.7	14.1	45.1	7.0	2	2.887	1.225
9	14.1	22.5	11.3	45.1	7.0	2	2.915	1.239
10	23.9	57.7	15.5	1.4	1.4	4	4.014	0.765
11	35.2	49.3	8.5	7.0	0	4	4.127	0.844
12	12.7	33.8	28.2	22.5	2.8	4	3.310	1.050
13	19.7	57.7	9.9	11.3	1.4	4	3.831	0.926
14	15.5	31.0	25.4	19.7	8.5	4	3.254	1.192
15	7.0	26.8	11.3	33.8	21.1	2	2.648	1.277
16	7.0	31.0	7.0	38.0	16.9	2	2.732	1.264
17	9.9	26.8	11.3	38.0	14.1	2	2.803	1.261
18	26.8	52.1	12.7	7.0	1.4	4	3.958	0.901
19	7.0	50.7	16.9	22.5	2.8	4	3.366	1.003
20	8.5	46.5	31.0	8.5	5.6	4	3.437	0.967
21	7.0	42.3	29.6	16.9	4.2	4	3.310	0.980
22	1.4	23.9	15.5	40.8	18.3	2	2.493	1.094
23	4.2	42.3	19.7	29.6	4.2	4	3.127	1.027
24	1.4	36.6	18.3	38.0	5.6	2	2.901	1.016
25	8.5	49.3	11.3	23.9	7.0	4	3.282	1.136
26	5.6	40.8	26.8	23.9	2.8	4	3.225	0.974
27	5.6	32.4	19.7	38.0	4.2	2	2.972	1.055
28	35.2	47.9	8.5	7.0	1.4	4	4.085	0.922
29	45.1	42.3	1.4	8.5	2.8	5	4.183	1.019
30	42.3	39.4	12.7	4.2	1.4	5	4.169	0.910

Table 62 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
31	38.0	46.5	5.6	7.0	2.8	4	4.099	0.988
32	14.1	45.1	11.3	19.7	9.9	4	3.338	1.230
33	45.1	45.1	5.6	4.2	0	4	4.310	0.767
34	12.7	22.5	4.2	46.5	14.1	2	2.732	1.309
35	2.8	47.9	9.9	29.6	9.9	4	3.042	1.139
36	2.8	11.3	5.6	42.3	38.0	2	1.986	1.076

NUMBER OF VALID CASES = 71

Table 63  
 Chief of Resources and Requirements' Responses to Questions that  
 Provide Information About the Independent Variables

QUESTIONNAIRE RESPONSE	RESPONSES (%)					E	MODE	MEAN	STD. DEV.
	A	B	C	D					
8	13.0	11.7	15.6	50.6	9.1	2	2.688	1.195	
9	9.1	26.0	14.3	42.9	7.8	2	2.857	1.167	
10	18.2	64.9	9.1	7.8	0	4	3.935	0.767	
11	33.8	54.5	7.8	3.9	0	4	4.182	0.739	
12	7.8	28.6	32.5	27.3	3.9	3	3.091	1.015	
13	9.1	48.1	26.0	14.3	2.6	4	3.468	0.940	
14	10.4	33.8	22.1	27.3	6.5	4	3.143	1.132	
15	7.8	19.5	23.4	35.1	14.3	2	2.714	1.168	
16	10.4	27.3	13.0	41.6	7.8	2	2.909	1.194	
17	9.1	23.4	9.1	50.6	7.8	2	2.753	1.172	
18	20.8	51.9	16.9	9.1	1.3	4	3.818	0.914	
19	5.2	27.3	37.7	29.9	0	3	3.078	0.885	
20	6.5	39.0	35.1	19.5	0	4	3.325	0.865	
21	3.9	36.4	31.2	27.3	1.3	4	3.143	0.914	
22	3.9	19.5	11.7	53.2	11.7	2	2.506	1.059	
23	3.9	42.9	20.8	28.6	3.9	4	3.143	1.009	
24	1.3	36.4	19.5	37.7	5.2	2	2.909	1.002	
25	6.5	39.0	20.8	26.0	7.8	4	3.104	1.107	
26	7.8	42.9	20.8	22.1	6.5	4	3.234	1.087	
27	6.5	33.8	23.4	32.5	3.9	4	3.065	1.043	
28	35.1	50.6	6.5	7.8	0	4	4.130	0.848	
29	51.9	40.3	2.6	5.2	0	5	4.390	0.781	
30	36.4	45.5	15.6	1.3	1.3	4	4.143	0.823	

Table 63 (continued)

QUESTIONNAIRE RESPONSE	RESPONSES (%)					MODE	MEAN	STD. DEV.
	A	B	C	D	E			
31	44.2	41.6	5.2	7.8	1.3	5	4.195	0.946
32	23.4	46.8	15.6	11.7	2.6	4	3.766	1.025
33	50.6	54.2	1.3	3.9	0	5	4.416	0.714
34	13.0	23.4	9.4	39.0	15.6	2	2.792	1.321
35	10.4	42.9	13.0	24.7	9.1	4	3.208	1.196
36	2.6	10.4	11.7	32.5	42.9	1	1.974	1.100

NUMBER OF VALID CASES = 77

APPENDIX E  
DESCRIPTIVE STATISTICS OF THE RESPONDENTS  
RANKING OF EACH IE RESPONSIBILITY

Table 64

A Summary of the BCE's Ranking of Responsibilities  
Performed by Industrial Engineering

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE	7		
Management Con- sulting	42.7	13.3	5.3	17.3	8.0	1.3	1.3	10.7	7	5.027	2.325	
Beams	12.0	8.0	21.3	26.7	9.3	9.3	2.7	10.7	4	3.947	2.019	
Quality Control	4.0	5.3	12.0	16.0	17.3	16.0	17.3	12.0	1	2.853	1.929	
Communication & Coordina- tion Facili- tator	5.3	8.0	2.7	2.7	20.0	28.0	21.3	12.0	2	2.467	1.920	
Training & Testing	0	0	4.0	6.7	14.7	25.3	37.3	12.0	1	1.787	1.266	
Real Property	5.3	34.7	17.3	10.7	13.3	2.7	5.3	10.7	6	4.253	2.112	
Cost Accounting	20.0	20.0	26.7	8.0	5.3	5.3	2.7	12.0	5	4.547	2.250	

Table 65

A Summary of the Deputy BCE's Ranking of Responsibilities  
Performed by Industrial Engineering

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE			
Management Consulting	50.7	4.2	8.5	14.1	4.2	1.4	8.5	8.5	7	5.028	2.461	
Beams	9.9	19.7	21.1	18.3	15.5	5.6	1.4	8.5	5	4.254	1.933	
Quality Control	0	8.5	5.6	16.9	25.4	15.5	18.3	9.0	3	2.718	1.700	
Communication & Coordination Facilitator	2.8	7.0	7.0	5.6	16.9	33.8	16.9	9.9	2	2.549	1.779	
Training & Testing	4.2	2.8	5.6	4.2	11.3	25.4	38.0	8.5	1	2.141	1.743	
Real Property	7.0	38.0	14.1	19.7	7.0	5.6	0	8.5	6	4.592	1.909	
Cost Accounting	22.5	11.3	29.6	12.7	9.9	1.4	4.2	8.5	5	4.606	2.087	

Table 66

A Summary of the Industrial Engineer's Ranking  
of Responsibilities He Performs

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE			
Management Con- sulting	61.3	11.4	3.8	13.9	5.1	0	2.5	0	7	6.038	1.531	
Beams	13.9	24.1	19.0	26.6	12.7	3.8	0	0	4	4.886	1.387	
Quality Control	0	2.5	6.3	15.2	21.5	24.1	29.1	1.3	1	2.494	1.386	
Communication & Coordina- tion Facili- tator	2.5	7.6	8.9	8.9	35.4	26.6	8.9	1.3	3	3.114	1.511	
Training & Testing	2.5	1.3	0	2.5	7.6	29.1	54.4	2.5	1	1.709	1.262	
Real Property	11.4	26.6	31.6	13.9	12.7	2.5	1.3	0	5	4.975	1.349	
Cost Accounting	13.9	24.1	26.6	21.5	6.3	7.6	0	0	5	4.949	1.404	

Table 67

A Summary of the Chief of Engineering and Construction's Ranking of Responsibilities Performed by Industrial Engineering

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE			
Management Consulting	24.3	7.1	11.4	15.7	11.4	14.3	12.9	2.9	7	4.086	2.225	
Beams	15.7	15.7	21.4	22.9	8.6	4.3	10.0	1.4	4	4.471	1.863	
Quality Control	4.3	4.3	7.1	11.4	20.0	18.6	31.4	2.9	1	2.657	1.760	
Communication & Coordination Facilitator	4.3	10.0	10.0	15.7	21.4	15.7	20.0	2.9	3	3.186	1.836	
Training & Testing	2.9	7.1	11.4	12.9	18.6	27.1	17.1	2.9	2	2.986	1.715	
Real Property	24.3	32.9	15.7	4.3	11.4	5.7	5.7	0	6	5.143	1.804	
Cost Accounting	21.4	22.9	22.9	12.9	5.7	10.0	4.3	0	5	4.943	1.752	

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AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL--ETC F/G 13/8  
THE VALUE OF THE BASE LEVEL INDUSTRIAL ENGINEER.(U)

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Table 68

A Summary of the Chief of Resources and Requirements' Ranking of  
Responsibilities Performed by Industrial Engineering

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE			
Management Con- sulting	41.9	10.8	8.1	12.2	8.1	10.8	8.1	0	7	5.014	2.136	
Beams	35.1	24.3	16.2	13.5	8.1	2.7	0	0	7	5.568	1.434	
Quality Control	1.4	8.1	12.2	10.8	28.4	17.6	20.3	1.4	3	3.027	1.638	
Communication & Coordina- tion Facili- tator	1.4	8.1	13.5	9.5	10.8	29.7	25.7	1.4	2	2.811	1.741	
Training & Testing	1.4	6.8	8.1	12.2	16.2	18.9	36.5	0	1	2.622	1.677	
Real Property	4.1	17.6	25.7	17.6	17.6	9.5	8.1	0	5	4.122	1.621	
Cost Accounting	10.8	25.7	20.3	23.0	9.5	9.5	1.4	0	6	4.716	1.522	

Table 69  
 A Summary of the Chief of Operations' Ranking of Responsibilities  
 Performed by Industrial Engineering

RESPONSIBILITY	RESPONSES (%)										MEAN	STD. DEV.
	A	B	C	D	E	F	G	H	MODE			
Management Con- sulting	44.9	10.1	2.9	18.8	4.3	11.6	7.2	0	7	5.087	2.126	
Beams	27.5	23.2	27.5	8.7	5.8	4.3	2.9	0	5	5.333	1.559	
Quality Control	2.9	15.9	15.9	20.3	14.5	18.8	11.6	0	4	3.696	1.718	
Communication & Coordina- tion Facili- tator	2.9	5.8	8.7	11.6	15.9	23.2	31.9	0	1	2.710	1.707	
Training & Testing	2.9	2.9	10.1	11.6	31.9	14.5	26.1	0	3	2.855	1.565	
Real Property	4.3	18.8	17.4	11.6	17.4	20.3	10.1	0	2	3.797	1.795	
Cost Accounting	14.5	23.2	17.4	17.4	10.1	7.2	10.1	0	6	4.522	1.868	

APPENDIX F

SIX SPEARMAN'S CORRELATION COEFFICIENT TABLES,  
ONE FOR EACH KEY MANAGER'S  
RELATIONSHIPS

Table 70

Correlation ( $\rho$ ) Between BCE's Evaluation of the IE's Value and Effectiveness and BCE's Responses to Questions that Provide Information About the Independent Variables

BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	-.0486	*-.3664	-.1019	-.0033	-.1108	*-.1610	*-.2907
09	*-.2189	*-.3883	-.0736	*-.1848	-.0108	-.1140	*-.3500
10	*.3468	.1388	.0547	.0379	-.1302	*-.1508	-.0897
11	*.2221	-.0441	*.3894	.0929	.0375	.1126	-.0489
12	*.2383	.1310	.0574	*.5236	*.1637	-.0105	*.2469
13	*.2846	*.2848	*.2299	.0025	.0885	.1048	.1269
14	*.6199	*.3772	*.3748	*.3835	.0802	.1044	*.2069
15	*.4572	*.2250	*.3485	*.2003	.1055	*.2137	*.0733
16	*.2817	*.2716	*.3990	*.2043	.0389	.0922	*.1534
17	*.3547	*.2532	*.2292	*.2022	.1369	.0787	*.1609
18	*.3639	*.2384	*.2013	*.3647	*.2560	*.2842	*.2923
19	*.4868	*.2850	*.1923	*.2516	.1255	.1487	*.3134
20	*.4690	*.2350	*.2682	*.2200	.1246	.0986	*.3618
21	*.2250	*.0670	*.5778	*.2408	*.2876	*.2383	*.2015
22	*.3044	*.5326	.1422	*.2277	*.2465	*.1830	*.4743
23	*.0510	.1400	-.0009	-.0256	*.2657	*.4258	*.1673
24	*.0019	.1060	.0976	.0065	*.4987	*.2822	*.1970
25	*.4225	*.2707	*.3250	*.4121	*.2474	.1048	*.3483
26	*.0760	.1135	-.0496	-.0236	-.1246	.0869	-.0794
27	*.2494	.1515	*.5409	*.2309	*.3102	*.2940	*.2213
28	*.2545	*.4348	.0579	.1414	*.2412	.1134	*.3248
29	*.2551	*.2703	.1303	*.4756	.1362	.1241	*.2325
30	*.0525	*.2110	.1137	.0555	*.4700	*.2588	.1157

Table 70 (continued)

BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
31	.1287	.2312	.0455	-.0107	* .3243	* .3967	* .1763
32	* .2291	* .3645	.1233	* .3266	.1361	.0612	* .4289
33	* .3519	* .3290	* .1571	* .4965	* .1731	.1458	* .4208
34	* .3871	* .2845	* .2022	* .4201	* .2077	.1391	* .3376
35	* .4202	* .3022	* .1986	* .4565	* .2213	* .2228	* .3688
36	* .5654	* .3599	* .3629	* .5026	* .2657	* .1783	* .3654
37	* .5140	* .2890	* .2596	* .3712	* .3054	* .2096	* .3336
38	* .5782	* .4125	* .2613	* .3981	.0807	.0410	* .3387
39	* .4878	* .1567	* .0762	* .2416	* .2033	* .1515	* .1714
40	* .3369	* .2399	* .2069	* .2385	* .2357	* .1774	* .2238
41	* .4074	* .3076	* .2020	* .3109	* .2386	.0897	* .2407
42	* .2832	* .1956	.1142	* .1640	* .2675	.1422	* .1605
43	* .2352	* .2154	* .2355	* .1818	.0462	* .2974	* .2157
44	* .2027	* .1546	.0394	.0214	.1182	.1287	* .2426
45	* .5146	* .3959	* .2628	* .3810	.1363	.1022	* .2893
46	* .5610	* .3387	* .3044	* .2743	.0922	* .1551	* .2740
47	* .3775	* .1776	* .1586	* .2386	.0388	.0327	-.1375
48	-.0669	.0747	.0271	-.1239	-.0816	-.0436	.0725
49	.0720	.0680	-.0398	* .1735	* .1593	.1057	* .1667
50	-.1055	.0180	-.0404	-.0069	.0105	.0077	.0543
51	* .2764	.1322	* .1932	* .2897	-.0041	-.0670	.0005
52	* .3365	.0800	.0845	.1069	* .2640	-.0557	-.0988
53	* .2710	.1346	* .1598	* .2563	.0797	-.0347	-.0105
54	* .3375	* .1657	* .1839	* .1785	.1321	.0239	.0655
55	* .4410	* .1877	* .4005	* .2126	* .1585	* .2014	* .1553
56	* .5520	* .1964	* .3907	* .2966	* .2796	* .2319	* .2588
57	* .5454	* .3491	* .2925	* .2672	.1101	* .2069	* .2413

Table 70 (continued)

BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
58	* .4892	* .3504	* .3747	* .2765	.1123	* .2453	* .2958
59	* .5929	* .3609	* .3511	* .3799	.1338	.2321	* .3451
60	-.0044	.0163	-.0633	.0047	.0875	-.0331	*-.2171
61	-.0264	* .1945	.0241	-.0786	.1009	-.0224	*-.1574
62	.0580	.1094	.0428	-.0725	.0523	-.0704	-.1321
63	-.0292	-.0184	-.0840	-.1068	.0789	-.0667	*-.1945
64	.0282	.0066	.0417	-.0271	-.0227	-.0378	-.1051
65	.0917	* .1708	.0451	.1193	.1374	-.0545	.0986
66	*-.2468	-.0220	.0574	.0453	.0803	-.0651	-.0552
67	-.0598	-.0211	.1146	.0438	* .1951	* .1698	-.1087
68	*-.1562	-.0484	.0450	-.1256	.0595	-.0661	-.1267
69	-.0604	-.0924	.0098	.0534	* .1724	.1287	.0874
70	*-.1503	.0290	-.0211	.0310	* .1680	* .1794	.0771
71	.0690	.0502	* .3573	.0682	* .2162	* .2507	* .2027
72	*-.1703	-.1190	-.0313	* .1516	.0363	.0466	.0625
73	.1463	.1210	.0149	* .1760	-.1177	-.0286	* .3754
74	* .2867	.0734	.0409	.0600	-.1339	-.1235	-.0360
75	-.0648	-.0936	* .3643	-.1012	-.0230	.0590	-.0355
76	.0090	* .1992	-.1687	*-.1823	*-.2302	*-.2552	-.1388
77	.0687	.0970	-.0204	* .1571	* .2104	-.0968	.0671
78	.0163	-.0644	.0654	-.1024	-.0983	*-.2049	* .1646
79	*-.1559	*-.1545	.1156	*-.2964	-.0026	* .2043	-.0775
80	*-.1506	-.0843	.1030	-.0949	.1361	* .1030	-.0151

\* = Significant at or above .90 level.

Table 70 (continued)

BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
For 75 Case:	.99	.95	.90	.80	.70	.60	.50
$\rho \pm$ :	.3350	.1965	.1500	.0900	.0595	.0305	.0001

Table 71

Correlation ( $\rho$ ) Between Deputy BCE's Evaluation of the IE's Value and Effectiveness and the Deputy's Responses to Questions that Provide Information About the Independent Variables

Deputy BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	-.1062	*-.1657	.0613	-.0171	-.0143	*-.1554	-.0405
09	-.1114	*-.1649	*.1504	*-.2195	-.1322	-.1389	*-.2235
10	*.5381	*.3046	*.2882	*.5330	*.3041	*.0284	*.3580
11	*.2846	*.2859	*.5468	*.3463	.1325	.0816	*.3359
12	*.2185	*.4213	.1274	*.7298	*.3707	*.2066	*.4823
13	*.4567	*.4863	.1315	*.4159	*.2210	*.0161	*.3813
14	*.6574	*.4034	*.4151	*.5568	*.3379	*.2657	*.3340
15	*.6608	*.3911	*.2840	*.5575	*.4344	*.3237	*.3038
16	*.3611	*.2545	*.4455	*.5679	*.3362	.1453	*.3410
17	*.4905	*.3557	*.3118	*.6135	*.2469	.1465	*.3577
18	*.3797	*.3370	*.2350	*.5436	*.3443	.1424	*.2163
19	*.5785	*.3969	*.2374	*.4978	*.2728	.1389	*.4251
20	*.5846	*.4958	*.2989	*.4345	*.2940	.1063	*.3390
21	*.1869	*.3331	*.5017	*.3632	*.4247	*.2055	*.3777
22	*.2826	*.5232	*.4855	*.3540	*.3337	-.0482	*.4862
23	-.0136	*.2199	.0444	*.2059	*.5175	*.4744	.1406
24	*.2032	*.2999	.0944	*.2225	*.5399	*.4128	*.2052
25	*.4999	*.4123	*.2758	*.5752	*.3684	*.1616	*.5082
26	*.3703	*.2372	.1055	*.2275	.0131	*.0349	*.3049
27	*.2688	*.2641	*.5204	*.4033	*.4004	*.2002	*.3583
28	*.2892	*.5641	*.4341	*.3098	*.3762	*.0791	*.3672
29	*.4102	*.5310	*.3274	*.7040	*.4753	*.2313	*.5183
30	*.1543	*.3910	*.1908	*.2788	*.5720	*.2873	*.3435

Table 71 (continued)

Deputy BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
31	.0402	* .2434	.1230	* .2098	* .5209	* .4301	* .2186
32	* .2259	* .4499	* .1503	* .4014	* .3825	* .1717	* .6880
33	* .4687	* .3241	.1448	* .3975	* .3624	* .2463	.1204
34	* .5001	* .2672	.1066	* .4033	* .3520	* .3357	.1237
35	* .3540	* .2546	.0698	* .3657	* .3265	* .2636	.0256
36	* .5598	* .4205	* .3013	* .5936	* .3263	* .2129	* .3808
37	* .6051	* .3422	* .2610	* .5150	* .4401	* .2659	* .3134
38	* .5230	* .2437	* .2870	* .4436	* .3289	* .1498	* .2652
39	* .5407	* .5032	* .3357	* .5471	* .2503	* .0838	* .3225
40	* .4102	* .2834	.0641	* .4463	* .2183	* .0934	* .3144
41	* .5289	* .3316	* .1821	* .3726	* .2496	* .1368	* .2831
42	.0891	* .2923	* .2997	* .2676	* .2698	* .1207	* .3476
43	* .4605	* .3491	* .2870	* .4680	* .1882	* .0432	* .3022
44	* .2981	* .4181	* .3242	* .4066	* .3663	* .2002	* .3705
45	* .5149	* .4774	* .2671	* .3957	* .2661	* .2661	* .2872
46	* .3568	* .4027	* .3477	* .4546	* .1672	* .1834	* .2334
47	* .2802	-.0737	* .1730	* .3188	-.1410	.0122	* .2647
48	.1325	* .1421	* .2216	* .2726	.0808	.0054	* .1885
49	* .2521	* .2021	* .3909	* .3471	.0211	-.0797	* .2336
50	* .3778	-.0655	-.0158	.1246	-.0391	-.0469	-.0299
51	* .3778	* .5251	* .3561	* .3603	.0244	.0802	* .3692
52	* .2273	* .2881	* .1626	* .2631	* .2160	.0027	* .3076
53	* .2877	* .1616	* .2348	* .3111	* .1515	.1232	.1238
54	* .5787	* .4869	* .2484	* .5066	* .1879	.0212	* .3234
55	* .4914	* .4099	* .4406	* .4421	* .4532	* .3099	* .3419
56	* .5535	* .2322	* .3584	* .4403	* .3679	* .2939	* .2960
57	* .3634	* .2499	* .3689	* .4243	* .3822	* .2767	* .3455

Table 71 (continued)

Deputy BCE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
58	* .4198	* .3227	* .3947	* .3713	* .4643	* .3777	* .2855
59	* .4643	* .3393	* .3200	* .4046	* .4711	* .3270	* .3300
60	* .3527	* .3100	* .1696	* .2376	* .2701	* .2229	* .3044
61	* .2532	* .1379	-.0095	* .0956	* .1567	* .2327	* .0687
62	* .2797	* .2115	* .1147	* .2235	* .1075	* .2283	* .0992
63	* .1955	* .0956	-.0749	* .0946	* .1111	* .2133	* .0799
64	* .1925	* .0019	* .0107	* .0852	* .0269	* .0863	* .1437
65	* .1722	* .1431	-.0111	* .0597	-.0269	* .2104	* .1231
66	* .2112	-.1368	* .2278	-.0997	-.0656	* .2153	* .1518
67	* .0336	-.1424	* .0162	-.0167	* .0112	* .2083	* .0077
68	* .0952	* .1479	-.0020	-.0414	* .1063	-.0792	-.0809
69	-.0608	-.1097	-.1428	-.0545	* .1239	* .0087	-.0885
70	* .0954	* .0969	-.0025	-.0100	-.0058	-.1268	-.1219
71	* .1285	-.1010	* .1373	-.0012	-.1191	* .3078	-.1028
72	-.0854	* .0675	-.1290	* .1870	-.0555	-.1270	* .1289
73	-.1259	* .0457	* .1661	* .0803	* .0006	-.1456	* .0745
74	* .5151	* .3159	* .1634	* .3521	* .0127	-.0227	* .2273
75	-.0059	-.1008	* .2350	-.0276	-.1021	* .0106	* .0663
76	-.0273	* .0959	-.0639	-.1258	* .1607	-.0801	-.1210
77	* .0021	-.1073	* .0558	* .0536	-.0430	* .0017	-.1081
78	* .1093	-.0210	* .1298	-.1429	-.0005	* .1073	* .0349
79	-.0980	* .3472	* .2404	* .0007	* .1567	* .1271	-.1461
80	* .2128	* .4739	* .2164	* .2030	* .0293	* .0659	* .1605

\* = Significant at or above .90 level.



Table 72

Correlation ( $\rho$ ) Between the IE's Evaluation of His Value and Effectiveness and the IE's Response to Questions that Provide Information About the Independent Variables

IE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	-.0282	*-.5638	-.0466	-.0808	.0912	-.0498	*-.1555
09	-.0854	*-.3911	-.0823	-.1105	.1245	.0175	*-.1984
10	*.4187	-.0086	*.2070	*.3169	*.2321	.1359	*.2555
11	*.4010	*.2603	*.3055	*.4246	*.2479	.1377	*.2923
12	*.2202	.0691	.0972	.0945	.0710	.0068	.0916
13	*.5030	.1275	*.3492	*.3747	*.3151	*.3299	*.3557
14	*.3591	*.1578	*.3262	*.3116	*.3178	*.2045	*.3036
15	*.2153	*.1613	*.2738	*.2754	*.1980	*.2259	*.3268
16	*.1766	*.5742	*.3814	*.3257	*.1887	.0894	*.3524
17	*.2709	.0580	*.1992	*.2993	*.2631	*.4887	*.2709
18	*.2039	.1197	*.3636	*.2838	*.4905	*.3125	*.2719
19	.0734	.1275	.0280	.0623	.1215	*.1450	.0686
20	*.5425	*.2506	*.4213	*.3827	*.3648	*.3137	*.4812
21	*.2582	*.2549	*.3013	*.3209	*.2155	*.2102	*.3524
22	*.1952	*.5187	*.2912	*.2552	*.1955	.1368	*.3493
23	*.4235	*.2912	*.2893	*.5993	*.1727	*.1444	*.4490
24	*.3088	*.1759	*.3303	*.3209	*.4426	*.3117	*.3959
25	*.2419	*.1942	*.2468	*.3078	*.2183	*.3969	*.4353
26	*.4401	*.2910	*.3100	*.3651	*.2084	*.2313	*.6844
27	*.4061	.0943	*.4510	*.4243	*.3699	*.1912	*.3800
28	*.3027	.0106	*.4137	*.3668	*.3522	*.2369	*.3126
29	*.4121	.0380	*.4005	*.3807	*.3435	*.3164	*.2942
30	*.5404	*.1661	.1302	*.3383	*.1587	*.1843	*.3294

Table 72 (continued)

IE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
31	* .4703	* .1798	* .2185	* .2923	* .1454	* .1682	* .3260
32	* .4399	.0355	.1136	.1112	.1307	.0548	* .1855
33	* .5126	.0892	* .2386	* .5486	* .2489	.1179	* .3975
34	* .4193	.0813	* .2046	* .4135	* .2566	* .2027	* .2771
35	* .5308	* .1761	* .2374	* .5169	* .2559	* .2583	* .3897
36	* .3804	.0408	* .2221	* .3370	* .2670	* .2874	* .2387
37	* .5185	* .2572	* .2373	* .4584	* .2092	.1380	* .4029
38	* .5033	* .3292	.1002	* .4531	* .2509	* .1524	* .4062
39	* .4514	* .1463	* .3159	* .4250	* .1980	* .2594	* .3384
40	* .2132	* .1539	* .3024	* .1680	* .2820	- .0027	* .2417
41	* .3811	* .2184	* .2854	* .3073	* .2670	.1314	* .1718
42	* .3719	* .0009	* .2646	* .7096	* .1844	* .0347	* .2122
43	* .4673	* .2787	* .2276	* .2840	* .1004	* .1454	* .3966
44	* .4265	* .2162	* .3612	* .3671	* .1798	.0846	* .4318
45	* .4661	.1620	* .2048	* .3762	* .0954	* .1735	* .3105
46	* .3803	* .1007	* .0000	* .2069	* .1731	.0762	.0005
47	* .6066	* .2436	* .3067	* .3147	* .1969	* .1424	* .3538
48	* .5811	* .1915	* .2744	* .2279	* .1631	.0743	* .3302
49	* .5419	- .0122	* .2922	* .3435	* .2575	- .1301	* .2894
50	- .1171	* .1013	* .1752	* .3527	- .0863	- .0016	- .0913
51	* .2608	* .1563	* .1705	* .2893	* .1661	* .2234	* .2507
52	- .0956	.0605	.0963	* .2105	.0656	.0118	- .1178
53	* .2830	* .0989	.1399	* .3290	.1274	- .0275	* .1695
54	* .3282	.1394	* .2277	* .3170	.0793	.0193	* .1963
55	* .3889	* .1796	* .1640	* .2758	.0817	.0798	* .3425
56	.0447	* .0874	* .0346	.1214	.0984	* .2342	.1232
57	* .1800	.0640	.0630	- .1352	.0851	* .1474	.0411

Table 72 (continued)

IE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
58	*-.3123	.0075	-.0447	*-.2920	-.1090	-.0567	*-.1604
59	*.3344	.1056	*.1560	*.3987	*.1864	*.1747	*.2864
60	*.3885	.0841	*.1724	*.5298	*.2268	*.2638	*.2881
61	*.4946	*.2331	*.3165	*.5217	*.2960	*.2833	*.3342
62	*.4369	*.0501	*.2939	*.4892	*.3343	*.1710	*.2265
63	*.2702	.0134	*.2043	*.4770	*.1981	*.1724	.1120
64	*.4346	.0635	*.2356	*.4061	*.1859	*.2481	*.2186
65	*.3725	.1105	*.0185	*.1412	*.0441	.1301	*.1584
66	*.2366	.0626	*.0157	*.2119	*.1540	.0257	-.0025
67	*.2373	.0934	-.0505	-.0232	.0914	-.1052	-.1207
68	*.2784	.0245	.0801	.0514	.1132	.0329	.0912
69	-.0191	.0986	-.0922	-.0356	-.0129	.0487	-.0709
70	*.3144	-.0261	.1192	*.2230	*.1902	*.1592	.0864
71	-.0529	.0120	*-.1413	-.0593	.0786	.0833	.0615
72	-.1118	.0384	-.0981	.1080	.0460	.0493	.0199
73	.0496	-.0232	-.0135	-.0561	.1029	-.0557	*.1512
74	-.1030	-.0610	*-.2076	.0441	.0300	*.1510	.0229
75	.0540	*.2084	*-.1563	.0988	-.1064	.0390	*.2738
76	-.0676	.1220	-.0635	-.0148	-.1279	-.0637	-.0311
77	-.0539	.0088	-.0383	.0451	-.0637	*-.2956	.0842
78	*.2345	.0009	.0796	.0995	.0633	-.0047	*.2898
79	*-.2268	*-.1678	*-.1610	*-.2451	*-.1744	*-.1737	*-.1525
80	.0613	.0747	.0026	.0607	-.1045	.0528	.1336
81	*.1778	.1190	.0087	*.1494	-.0076	*.1887	*.2807
82	-.1276	*-.1503	.1351	-.1199	-.0785	-.0546	-.0425
83	*-.2794	*.4105	-.1314	*-.3058	*-.1640	-.0717	*-.1687
84	.0917	*-.1995	.0046	*.2441	.0767	-.0265	-.0084

Table 72 (continued)

IE's Questionnaire Response	Dependent Variable						
	01	02	03	04	05	06	07
85	* .2043	*-.2792	* .2331	* .2127	* .1641	.0099	.0521
86	.0439	-.0158	-.1172	.1389	-.0172	.0319	-.0069
87	.1322	-.1091	-.0273	-.0221	.1051	.0205	-.1081
No. of Valid Cases = 83							
	<u>Significant Level</u>						
$\rho \pm$	.999	.95	.90	.80	.70	.60	.50
	.3225	.1740	.1410	.0940	.0600	.0280	.0001

\* = Significant at or above .90 level.

Table 73

Correlation ( $\rho$ ) Between Chief of Engineering and Environmental Planning's  
 Evaluation of the IE's Value and Effectiveness and the Chiefs  
 of E and E Responses to Questions that Provide Information  
 About the Independent Variables

DEE's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	-.1047	-.0057	-.1199	-.0699	*-.1744	-.0674	.0449
09	*-.2457	-.0974	-.1267	*-.2130	*-.1946	.0209	-.0317
10	*.2930	.0991	.1434	*.3382	.0202	-.0686	.1343
11	.0812	-.0524	*.3791	*.2651	.1274	.0152	-.0550
12	*.2983	.0266	.1041	*.4111	.0738	.0596	.1506
13	.0684	-.0211	-.0148	.1299	.0072	.1179	.0611
14	*.4230	*.2390	.1054	*.3384	*.3262	.0220	*.2845
15	*.4722	*.4207	.0963	*.4207	.1236	*-.1751	*.3943
16	*.5037	*.4483	*.2444	*.4247	*.3136	.0019	*.3090
17	*.5062	*.4994	*.3104	*.5103	*.3133	.0110	*.3700
18	-.0290	.0614	.1184	.0128	.0167	*-.1817	.1460
19	*.2379	*.2564	.0394	*.2435	.0995	.0650	.0859
20	-.0308	.0850	-.0422	.1158	*.1844	*.1596	-.0383
21	*.2338	*.2113	-.0309	.1010	.1137	*.1560	.0961
22	*.5848	*.4186	.1524	*.4997	*.3053	.0343	*.3106
23	*.4780	*.3312	*.2179	*.4845	*.1799	*-.1716	*.4787
24	*.6318	*.4808	*.3123	*.5762	*.2412	-.0705	*.3690
25	*.5403	*.4195	*.3047	*.5735	*.3218	.0307	*.4246
26	*.5574	*.3761	*.2112	*.6011	*.3391	.0237	*.3988
27	*.4676	*.2878	*.2229	*.5441	*.3159	.0019	*.2927
28	-.0209	.0997	-.0311	*.2043	*.2912	*.2362	*.0488
29	*-.1638	-.1387	-.1015	-.0180	.0220	*.2315	-.0502

Table 73 (continued)

DFE's Questionnaire Response	Dependent Variables							Significant Level
	01	02	03	04	05	06	07	
30	-.1005	.0118	.1418	.1206	* .2771	.1011	-.0047	
31	*-.2042	-.0724	* .1571	-.0283	* .1844	.0863	*-.1700	
32	-.0880	.1360	* .1814	-.0415	* .3491	.0101	-.0551	
33	.0447	.0640	.1233	.0861	.1398	.1267	-.0167	
34	* .3053	.1463	-.1365	.0576	*-.2240	.0057	.0661	
35	*-.1625	.0646	.0818	.1183	* .2702	* .2395	.0883	
36	-.1043	-.0493	*-.1675	-.0444	-.0189	.0655	.0321	
37	.1413	* .2287	* .2101	* .2358	* .1568	.0074	.1320	
38	.0550	-.0886	* .2636	*-.1745	*-.1656	*-.2425	.0283	
39	* .1948	* .2711	.1100	-.0817	.0245	.0574	* .1997	
40	* .2489	.0874	.0998	* .3141	.1187	* .2480	* .1467	
41	.0820	.0276	.1116	.1009	-.0138	.0405	* .3169	
42	*-.2984	* .2517	-.1133	-.1484	*-.1698	.0490	*-.3028	
43	-.0257	.0524	*-.1952	-.0833	* .2115	.0584	*-.3017	
No. of Valid Cases = 70								
	.999	.95	.90	.80	.70	.60	.50	
$\rho \pm$ :	.3500	.1930	.1550	.1010	.0630	.0308		

\* = Significant at or above .90 level.

Table 74

Correlation ( $\rho$ ) Between Chief of Operations' Evaluation of the IE's Value and Effectiveness and the Chief of Operations' Response to Questions that Provide Information About the Independent Variables

DEM's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	.0771	*-.2270	*.1550	.0325	.1130	*-.1517	-.0499
09	-.0184	*-.1872	.0568	-.0117	.0298	-.0449	-.0212
10	*.1865	.0563	.0284	*.1950	.0990	*-.1531	*.1923
11	*.2040	.1050	*.2279	*.2791	*.1580	-.0142	*.1381
12	*.1638	.1241	.0781	*.4287	*.1658	.0157	*.2249
13	.0982	.0874	-.0591	*.2577	.1151	.0190	*.2656
14	*.3768	*.2528	*.1751	*.4116	*.2406	.1018	*.1795
15	*.5152	*.3809	.1453	*.4119	*.1871	*.2396	*.4047
16	*.6393	*.4665	*.4809	*.5474	*.3176	*.2887	*.3403
17	*.6059	*.4330	*.4950	*.5711	*.3571	*.3933	*.4281
18	*.2640	*.2773	*.1770	*.2413	*.3562	.0819	*.3898
19	*.1841	*.1906	*.1901	*.2331	.0857	.0080	*.2537
20	-.0471	.1310	-.0461	-.0095	.0484	.0317	*.1818
21	.0907	*.1928	.0496	*.1778	*.2073	*.1934	*.3395
22	*.5317	*.4479	*.3228	*.5030	*.2296	*.3340	*.4319
23	*.5122	*.3999	*.5877	*.4664	*.2500	*.2244	*.2902
24	*.6166	*.5225	*.5316	*.5383	*.2704	*.2894	*.4272
25	*.5993	*.4322	*.4165	*.5260	*.3824	*.3482	*.4596
26	*.5295	*.3923	*.4751	*.4315	*.2238	*.3101	*.3134
27	*.5683	*.4904	*.4792	*.4820	*.3252	*.3524	*.3667
28	*.0671	.0991	.1002	-.0158	.0324	*.2205	.1502
29	*-.1600	-.0224	.0522	-.1532	-.0332	.1086	.0327

Table 74 (continued)

DEM's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
30	-.0261	-.0554	.0214	-.1026	-.0317	.0452	-.0867
31	.1006	.0538	-.0060	-.0583	-.0488	-.0354	-.0372
32	.1058	.1044	-.0497	.0724	-.0352	.0299	.1522
33	.0942	.1140	*-.2121	-.0363	-.0142	-.0704	-.0532
34	-.0182	.0612	.0446	-.0167	.0795	.0989	.1049
35	*.2106	.1102	*.2353	*.1648	.0360	-.0074	.1019
36	-.0480	.0321	-.0871	-.0975	.0232	.0706	.0252
37	*.1857	-.0416	-.0589	.1100	.0239	*-.2094	.1452
38	-.0484	.0211	*.2633	.1369	-.0288	.0424	-.0491
39	.0819	*.2927	-.0976	.0873	-.0461	.1265	.1687
40	.0033	-.0378	-.0069	.1355	.0912	-.0822	-.0374
41	-.0799	.0309	.1334	.0156	.1328	.0982	*.2385
42	-.0813	-.1257	-.0565	*-.2172	-.0775	.0151	*.2734
43	-.1244	-.0918	-.1464	*-.2276	-.0551	.0877	*-.1739
No. of Valid Cases = 69							
	.999	.95	.90	.80	.70	.60	.50
$\rho \pm$	.3500	.1950	.1540	.1026	.0590	.0305	
* = Significant at or above .90 level.							

Significant Level

Table 75

Correlation ( $\rho$ ) Between Chief of Resources and Requirements' Evaluation of the IE's Value and Effectiveness and the Chief of RR's Responses to Questions that Provide Information About the Independent Variables

DEMR's Questionnaire Response	Dependent Variables						
	01	02	03	04	05	06	07
08	.0173	-.0157	.0460	.1363	.0918	* .1689	.0454
09	-.0981	-.1277	.0962	.0584	.0215	.1227	-.1392
10	* .2452	-.0593	* .1892	.0695	.0836	.0663	-.0922
11	* .2061	-.1267	* .5586	.1424	* .1829	* .2729	.0245
12	.0067	-.0363	.0169	* .2438	.1061	.0081	-.0105
13	.0537	* .2300	* .1859	.0161	-.0759	.0327	.0240
14	* .4683	.0953	* .3598	* .5590	* .4566	* .3032	* .1635
15	* .4715	* .2100	* .5198	* .4121	* .4875	* .3838	* .3720
16	* .6395	* .3270	* .5324	* .5758	* .3562	* .2686	* .2664
17	* .5997	* .3087	* .4264	* .5463	* .3721	* .3736	* .2448
18	* .2016	.0006	.1473	* .1933	* .2090	* .2312	.0679
19	.1296	.0482	* .2311	* .1612	.0247	.1331	* .1639
20	.0613	.0114	.1182	* .2249	-.0073	-.0082	* .1614
21	* .3652	.1017	* .2974	* .3613	* .1602	.1217	* .1449
22	* .6291	* .3506	* .5080	* .5672	* .3686	* .3234	* .4110
23	* .4270	* .3411	* .3570	* .5147	* .5592	* .4013	* .2163
24	* .6330	* .3811	* .3542	* .5267	* .4159	* .3191	* .3894
25	* .5553	* .3689	* .2606	* .5748	* .4540	* .3835	* .3189
26	* .5332	* .2807	* .3019	* .5457	* .5126	* .3703	* .3016
27	* .6074	* .2579	* .2813	* .5523	* .4478	* .2953	* .3557
28	-.0650	* .2223	-.0103	.0513	.0502	.0573	* .1554
29	.1185	* .1975	.0240	.0675	.0359	.0975	* .0348
30	.0295	.1332	-.0349	-.0975	-.1453	* -.1689	* .1207

Table 75 (continued)

DEMR's Questionnaire Response	01	02	03	04	05	06	07
31	.0887	.0869	.1171	.0642	.0790	-.0023	* .1861
32	* .1873	* .2092	.0198	-.0076	* .2359	* .1899	* .2222
33	.0353	.0744	* .2375	.1292	* .2701	* .1360	.1307
34	-.1122	-.2233	-.0260	* .1762	-.0362	.0872	-.0910
35	* .1485	.2037	.0869	.0552	.1371	.1219	-.0208
36	-.0585	.0749	-.0771	.0180	-.0667	-.1405	.0042
37	.1365	.0307	.0297	.1050	* .2367	.0051	.0107
38	* .2373	-.1255	* .2211	-.1266	* .1711	-.0779	* .2218
39	-.0108	.1120	-.1390	-.1248	* .2160	* .1749	.0505
40	-.0978	-.0890	* .1760	* .2175	-.0025	-.0393	-.1089
41	-.0707	-.0962	-.0617	-.0838	.0618	.0218	* .2115
42	.0791	.1138	* .2055	-.0467	-.1083	* .1663	.1112
43	.0057	.0738	.0155	-.0495	.0153	.0016	-.0716
No. of Valid Cases = 74							
	<u>Significant Level</u>						
$\rho \pm$	.999	.95	.90	.80	.70	.60	.50
	.3370	.1920	.1550	.0925	.0605	.0310	

\* = Significant at or above .90 level.

APPENDIX G  
COMPUTER PROGRAMS

THIS PROGRAM USED TO PUT DATA IN A MATRIX

```
05 INTEGER TEMP,DOOR,FMATRIX
10 DIMENSION TEMP(72,87)
20 DIMENSION DOOR(72)
30 DIMENSION KEY(72)
40 DIMENSION LOCK(72)
50 DIMENSION FMATRIX(72,87)
60 CALL ATTACH(12,"79A04/IDEIB;",1,0,,)
70 CALL ATTACH(11,"79A04/IDEIF;",1,0,,)
80 CALL ATTACH(13,"79A04/OKDEI;",3,0,,)
90 CALL ATTACH(14,"79A04/RDEIB;",1,0,,)
100 DO 10 IROW = 1,72
110 READ(11,999) LOCK(IROW),(FMATRIX(IROW,I),I = 1,62)
120 DO 50 I = 1,72
130 READ(12,993) KEY(I),(TEMP(I,J),J = 63,80)
140 IF (LOCK(IROW).EQ.KEY(I)) GO TO 45
150 GO TO 50
160 45 DO 111 J = 63,80
161 FMATRIX(IROW,J) = TEMP(I,J)
172 111 CONTINUE
170 50 CONTINUE
180 DO 70 ID = 1,72
190 READ(14,881) DOOR(ID),(TEMP(ID,JD),JD = 81,87)
200 IF(LOCK(IROW).EQ.DOOR(ID)) GO TO 46
210 GO TO 70
220 46 DO 112 J = 81,87
221 FMATRIX(IROW,J) = TEMP(ID,J)
223 112 CONTINUE
230 70 CONTINUE
240 WRITE(13,888) LOCK(IROW),(FMATRIX(IROW,JALL),JALL = 1,87)
242 REWIND 12
243 REWIND 14
250 10 CONTINUE
260 999 FORMAT(I6,62I1)
280 993 FORMAT(I6,18I1)
300 881 FORMAT(I6,18X,7I1)
340 888 FORMAT(I6,40I1,47I1)
350 STOP
360 END
```

THESE TWO PROGRAMS PERFORMED THE  
STATISTICAL ANALYSIS

```
1000##S,R(SL) : ,8,16;; ,16
1100$: IDENT:WP1189,AFIT/SLG BUDDY CAPLES 879-0624
1200$: SELECT:SPSS/SPSS
1300RUN NAME;NONPARAMETRIC STATISTICS
1400VARIABLE LIST;V1 TO V80
1500INPUT FORMAT;FIXED(6X,40F1.0,/,40F1.0)
1600N OF CASES;79
1700INPUT MEDIUM;CARD
1750FREQUENCIES;GENERAL=ALL
1775STATISTICS;ALL
1800OPTIONS;1
3000READ INPUT DATA
3100$: SELECTA:79A04/OKDEI
3500FINISH
3600$: ENDJOB
```

```
1000##S,R(SL) : ,8,16;; ,16
1100$: IDENT:WP1189,AFIT/SLG BUDDY CAPLES 879-0624
1200$: SELECT:SPSS/SPSS
1300RUN NAME;NONPARAMETRIC STATISTICS
1400VARIABLE LIST;V1 TO V80
1500INPUT FORMAT;FIXED(6X,40F1.0,/,40F1.0)
1600N OF CASES;79
1700INPUT MEDIUM;CARD
1870NONPAR CORR;V1 TO V7 WITH V8 TO V80
1800OPTIONS;1
3000READ INPUT DATA
3100$: SELECTA:79A04/OKDEI
3500FINISH
3600$: ENDJOB
```

SELECTED BIBLIOGRAPHY

#### A. REFERENCES CITED

1. AIIE Long-Range Planning Committee. "The Emerging Role of Industrial Engineering," *Journal of Industrial Engineering*, Vol. 12, No. 2, Part 2, March-April, 1961.
2. Babalamente, Major Richard V., USAF, and Major Thomas D. Clark, Jr., USAF. "Spinning Our [Information] Wheels: A Look at the Maintenance Data Collection System." Unpublished technical report, LSTR 1-78, AFIT/SL, Wright-Patterson AFB OH, February 1978.
3. Department of the Air Force. *Economic Analysis and Program Evaluation for Resource Management*. AFR 178-1. Washington: Headquarters U.S. Air Force, 1973.
4. Department of the Air Force. *Resources and Work Force Management*. Civil Engineering AFR 85-1. Washington: Headquarters U.S. Air Force, 1978.
5. Emory, William C. *Business Research Methods*. 1st ed. Homewood IL: Richard D. Irwin, Inc., 1976.
6. Farineau, Captain Mark J., USAF, and Captain Alan E. M. Tucker, USAF. "The Role of Industrial Engineering Within Base Civil Engineering." Unpublished master's thesis. LSSR 20-77A, AFIT/SL, Wright-Patterson AFB OH, June 1977. ADA 045214.
7. Grant, Eugene L., and W. Grant Ireson. *Principles of Engineering Economy*. 5th ed. New York: The Ronald Press Company, 1970.
8. Gray, Miles. Industrial Engineer, Management Branch, Operations and Maintenance Division, Directorate of Engineering Services, Air Force Civil Engineering Center, Tyndall AFB FL. Telephone interviews conducted intermittently from 1 July 1978 to 15 October 1978.
9. Jarvis, William L. Chief, Personnel Systems Management Section, AFIT Personnel Office, Wright-Patterson AFB OH. Personal interview. 20 November 1978.

10. Kennedy, Captain James R., USAF. *Industrial Engineering Management Brochure*. Wright-Patterson AFB OH: Air Force Institute of Technology, 1978.
11. Kerlinger, Fred N. *Foundations of Behavioral Research*. New York: New York University, 1965.
12. Mitchell, Terence R. *People in Organizations: Understanding Their Behavior*. New York: McGraw-Hill, 1978.
13. Nie, Norman H., and others. *Statistical Package for the Social Sciences*. 2d ed. New York NY: McGraw-Hill Book Company, 1975.
14. Rathe, Alex W., and Frank M. Gryna. *Applying Industrial Engineering to Management Problems*. New York: American Management Association, Inc., 1969.
15. Wonnacott, Thomas H., and Ronald J. Wonnacott. *Introductory Statistics*. New York: John Wiley and Sons, Inc., 1969.

#### B. RELATED SOURCES

- Aitkin, Hugh G. T. *Taylorism at Watertown Arsenal: Scientific Management in Action 1908-1915*. Cambridge MA: Harvard University Press, 1960.
- Albers, Henry H. *Principles of Management*. New York: John Wiley and Sons, 1969.
- Allen, Roy L. "On Our Twenty-Fifth Anniversary," *Industrial Engineering*, August, 1973.
- Atherton, R. M. "Centralization Works Best When Managers; Jobs Are Improved," *Human Resources Management*, Summer, 1977, pp. 17-20.
- Baker, Captain J. T. "How to Effectively Use the Industrial Engineer," *Air Force Engineering & Services Quarterly*, November, 1975.
- Cohen, Harry. *The Demons of Bureaucracy: Problems of Change in a Government Agency*. Ames IO: The Iowa State University Press, 1965.
- Costler, Dan L., and Ralph Todd. *Human Relations in Organizations*. San Francisco: West Publishing Company, 1978.

- Department of the Air Force. *Aerospace Speechmaking Guide*. AFP 190-39. Washington: Secretary of the Air Force, 1969.
- Department of the Air Force. *Civil Engineering Management Review*. AFM 85-38. Washington: Government Printing Office, 1971.
- DeWitt, Frank. "Productivity, and the Industrial Engineer," *Industrial Engineering*, January, 1976.
- Dimock, Marshall E. *Administrative Vitality: The Conflict With Bureaucracy*. New York: Harper and Brothers, 1959.
- Drucker, Peter F. *Management: Tasks, Responsibilities, Practices*. New York: Harper and Row, Publishers, 1973.
- Ehrlich, Eguene, and Daniel Murphy. *The Art of Technical Writing*. New York: Thomas Y. Crowell Company, 1969.
- Ellis, Colonel G. E. "CESMET . . . In Support of the Mission and People," *Air Force Engineering & Services Quarterly*, August, 1975.
- Fox, David J. *The Research Process in Education*. Holt, Rinehart, and Winston, Inc., 1969.
- Hollander, Edwin P. *Principles and Methods of Social Psychology*. New York: Oxford University Press, 1976.
- Hutchinson, John G. *Management Strategy and Tactics*. New York: Holt, Rinehart and Winston, 1971.
- Kalogeras, C. M. "Centralized vs Local DP Organizations," *Journal of Systems Management*, March, 1977, pp. 28-31.
- Kast, Fremont E., and James E. Rosenzweig. *Organization and Management: An Analysis of Management Functions*. New York: McGraw-Hill, 1964.
- Lefrancois, Guy R. *Psychological Theories and Human Learning: Konger's Report*. Monterey CA: Brook/Cole Publishing Company, 1972.
- Leimbkuhler, Ferdinand F. "The Future of Operations Research and Industrial Engineering," *Industrial Engineering*, March, 1968.
- Lorch, Jay W., and Paul R. Lawrence. *Studies in Organization Design*. Homewood IL: Irwin and Dorsey Limited, 1970.

- Maynard, Harold B. *Industrial Engineering Handbook*. 2d ed.  
New York: McGraw-Hill Book Company, Inc., 1963.
- McConkey, Dale D. *MBO for Nonprofit Organizations*.  
New York: American Management Associations, 1975.
- Newsome, Robert W. "The Industrial Engineer Moves Up To  
the Driver's Seat," *Management Review*, March, 1972.
- Perrow, Charles. "Bureaucratic Paradox: The Efficient  
Organization Centralizes in Order to Decentralize,"  
*Organizational Dynamics*, Spring, 1977, pp. 3-14.
- Posner, Major General Jack I. Director, Manpower and  
Organization DCS/P&R, HQ USAF. Letter, subject:  
Restructuring of Base Civil Engineering (BCE) Organi-  
zation, to all MAJCOM Manpower and Organizations/Engi-  
neering and Services, 7 April 1977.
- \_\_\_\_\_. *Pulse Points for Managers*. Unnumbered Air Force  
Civil Engineering and Services Brochure, Washington DC,  
1 September 1976.
- Reitz, Joseph H. *Behavior in Organizations*. Georgetown,  
Ontario: Richard D. Irwin, Inc., 1977.
- Riggs, James L. *Economic Decision Models for Engineers  
and Managers*. New York: McGraw-Hill, 1968.
- Rimm, David C., and John C. Masters. *Behavior Therapy  
Techniques and Empirical Findings*. New York: Academic  
Press, 1974.
- Rogers, Carl R. *On Becoming A Person*. Boston: Houghton  
Mifflin Company, 1961.
- Rosenberg, Seymour L. *Self-Analysis of Your Organization*.  
New York: AMACOM, 1974.
- Sayles, Leonard R., and Margaret K. Chandler. *Managing  
Large Systems, Organizations for the Future*. New York:  
Harper & Row, 1971.
- Staff of Commerce Clearing House. *Labor Law Course*.  
Chicago IL: Commerce Clearing House, 1976.
- Stamm, George W. "Management Opportunities for IEs,"  
*Industrial Engineering*, April, 1973.
- "Trial By Fire--and Other Snags," *Industrial Engineering*,  
September, 1973.

Vaughn, Richard C. *Introduction to Industrial Engineering.*  
2d ed. Ames IO: The Iowa State University Press, 1977.

Wolfe, J. N. *Cost Benefit and Cost Effectiveness: Studies  
and Analysis.* London: George Allen And Unwin Ltd.,  
1973.