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PERCEPTIONS OF PROJECT REPRESENTATIVES CONCERNING  
PROJECT SUCCESS AND PRE-PROJECT PLANNING EFFORT

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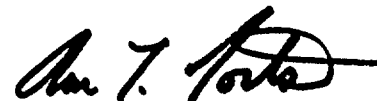
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**PERCEPTIONS OF PROJECT REPRESENTATIVES CONCERNING  
PROJECT SUCCESS AND PRE-PROJECT PLANNING EFFORT**

**by**

**ANIELLO LOUIS TORTORA, B.S.**

**THESIS**

**Presented to the Faculty of the Graduate School of  
The University of Texas at Austin  
in Partial Fulfillment  
of the Requirements  
for the Degree of**

**MASTER OF SCIENCE IN ENGINEERING**

**THE UNIVERSITY OF TEXAS AT AUSTIN**

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## **ABSTRACT**

### **PERCEPTIONS OF PROJECT REPRESENTATIVES CONCERNING PROJECT SUCCESS AND PRE-PROJECT PLANNING EFFORT**

by

**ANIELLO LOUIS TORTORA, MASTER OF SCIENCE IN ENGINEERING  
THE UNIVERSITY OF TEXAS AT AUSTIN, 1993**

**SUPERVISOR: G. Edward Gibson, Jr.**

This thesis is a part of an overall study sponsored by the Construction Industry Institute to assess the best practices for pre-project planning of industrial construction projects. Pre-project planning for a capital project can be defined as the process of developing sufficient strategic information for owners to address risk and decide to commit resources to maximize the chance for a successful project and develop a comprehensive framework for executing the project. Pre-project planning begins when a project concept has been identified during the business planning process and ends when a decision has been made whether or not to authorize funding for the execution of the project. This thesis contributes to the overall pre-project planning study by presenting an analysis of the perceptions of three key types of project participants in the owner's organization concerning project success and pre-project planning effort. These perceptions were collected from over 90 project, business, and operations managers during telephone interviews concerning specific industrial construction projects. The critical factors concerning project success and pre-project planning effort and the patterns and relationships that exist are identified using qualitative analysis methods. Conclusions and recommendations are presented based on the results of the analysis.

## TABLE OF CONTENTS

Section	Page Number
<b>1. INTRODUCTION.....</b>	<b>1</b>
1.1. Scope of the CII Pre-Project Planning Study.....	2
1.2. Purpose.....	4
1.3. Organization of Thesis.....	5
<b>2. BACKGROUND.....</b>	<b>6</b>
2.1 Literature Review.....	6
2.1.1. Project Success.....	6
2.1.2. Pre-Project Planning.....	7
2.1.3. Relation to this Study.....	8
2.2. Pre-Project Planning Conceptual Model.....	10
<b>3. METHODOLOGY.....</b>	<b>14</b>
3.1. Design of The Study.....	14
3.1.1. Definition of Project Success and Pre-Project Planning Effort.....	14
3.1.2. Data Gathering Strategy.....	16
3.1.3. Domain of the Study.....	17
3.2. Data Gathering.....	17
3.3. Data Analysis.....	19
<b>4. PRESENTATION OF DATA.....</b>	<b>21</b>
4.1. Sample Characteristics.....	21
4.2. Characterization of the Data.....	24
<b>5. ANALYSIS OF DATA.....</b>	<b>38</b>
5.1. Data Analysis.....	38

5.1.1. Analysis of Success Factors.....	38
5.1.2. Analysis of Improvement Areas.....	47
5.1.3. Analysis of Pre-Project Planning Effort Factors.....	53
5.1.3. Analysis of Pre-Project Planning Effort Factors.....	59
5.2. Analysis of Pre-Project Planning Effort and Project Success Ratings.	64
5.2.1. Correlation Analysis.....	64
5.2.2. Quadrant Analysis.....	66
<b>6. CONCLUSIONS.....</b>	<b>78</b>
<b>7. BEST PRACTICES.....</b>	<b>85</b>
<b>APPENDICES.....</b>	<b>87</b>
Appendix A: Success and Effort Categories Matrix.....	88
Appendix B: Request for Interviewee Data.....	92
Appendix C: Interview Notification Letter.....	94
Appendix D: Interview Instrument and Master List of Interview Questions.	96
Appendix E: Responses to Open Ended Interview Questions.....	111
<b>BIBLIOGRAPHY.....</b>	<b>141</b>
<b>VITA.....</b>	<b>143</b>

## LIST OF TABLES

Table	Page Number
Table 1. Example of Categorized Response.....	25
Table 2. What are your main reasons for the project's level of success?.....	28
Table 3. What, if anything, needs to be improved next time to make the project more successful?.....	31
Table 3a. Other Categories for Table 3.....	32
Table 4. What are your main reasons for your assessment of the level of effort expended on pre-project planning?.....	33
Table 5. What concerning pre-project planning effort needs to be improved next time?.....	36
Table 5a. Other Category for Table 5.....	37



## LIST OF FIGURES

Figure	Page Number
Figure 1. Influence and Expenditures Curve for the Project Life Cycle.....	1
Figure 2: Project Life Cycle Diagram.....	11
Figure 3. Node Tree for Pre-Project Planning Mode.....	12
Figure 4. Project Size.....	21
Figure 5. Project Type.....	22
Figure 6. Interviews Conducted.....	23
Figure 7. Interviews Per Project.....	24
Figure 8. Success Factors Identified by the Respondents.....	40
Figure 9. Success Factors Identified on Projects.....	43
Figure 10. Improvement Areas for Project Success.....	48
Figure 11. Improvement Areas for Projects Success Identified on Projects.....	49
Figure 12. Effort Success Factors of Pre-Project Planning.....	54
Figure 13. Effort Success Factors Identified on Projects.....	55
Figure 14. Improvement Areas for Pre-Project Planning.....	60
Figure 15. Pre-Project Planning Improvement Areas Identified on Projects.....	61
Figure 16. Pre-Project Planning Effort vs. Project Success.....	64
Figure 17. Pre-Project Planning Effort vs. Project Success (Representatives)...	67
Figure 18. Responses for Project 011.....	74

## 1. INTRODUCTION

In fulfillment of its on going research mission, the Construction Industry Institute (CII) has studied life cycle project costs versus the ability of project participants to influence these costs during the same time period. The current working hypothesis of the CII is that while project costs continue to accrue at an increasing rate during the life cycle of the project, the ability of the participants to influence these costs quickly diminishes as the project moves from conceptual activities towards the actual execution of the project. This hypothesis is illustrated graphically in Figure 1 by a series of two curves: one curve describes project expenditures, and the other describes the ability to influence expenditures over the various phases of the project life cycle.

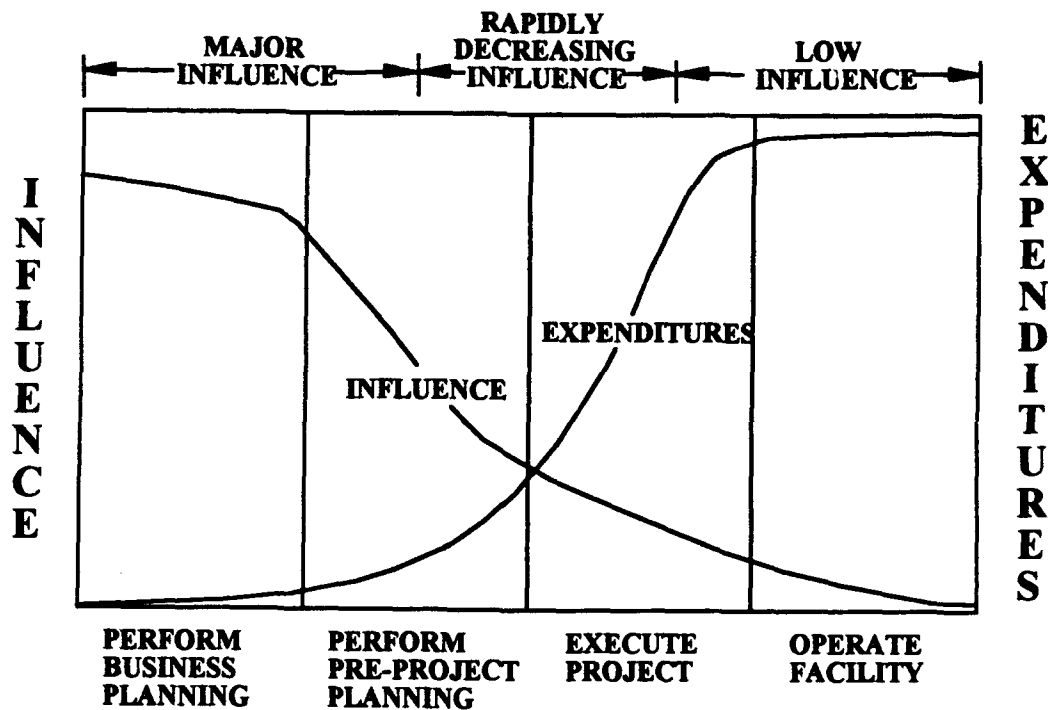


Figure 1: Influence and Expenditures Curve for the Project Life Cycle

As shown in Figure 1, the project life cycle is broken into four distinct phases: business planning, pre-project planning, project execution, and facility operation. As can be seen by the diagram, it is much easier and less costly to influence a project's outcome during the planning phases than it is to effect the outcome during project execution or operate facility phases. Experienced personnel within the construction industry believe that planning efforts conducted during the early stages of a project have significantly more effect on the success of the project than efforts that are undertaken after the project is well underway. It is for this reason that the CII has identified pre-project planning as an important area of research for the construction industry.

#### 1.1. Scope of the CII Pre-Project Planning Study

In order to investigate the potential for increased project success through improved pre-project planning, the CII commissioned Task Force 39. This task force is dedicated to studying pre-project planning and is comprised of representatives from owner, contractor, and academic organizations. The pre-project planning task force was given the following charter by CII:

*To find the most effective methods of project definition and cost estimating for appropriation approval*

The specific objectives developed by the task force are:

1. Prove the need for, and the value of, pre-project planning;
2. Describe the process or methodology for pre-project planning;
3. Identify the players, roles, and responsibilities for pre-project planning; and
4. Identify the resources required for pre-project planning.

To achieve the above objectives, an extensive research process was undertaken by the task force. By employing their experience and the use of a process mapping technique, the task force developed and validated a generic model of the pre-project planning process that applies equally to different project types and companies. The model describes the information flow between the various planning functions as well as the major players and controls for each process identified (Gibson et. al 1993).

In addition, the objectives were accomplished by studying 60 multi-million dollar capital facility construction projects submitted by CII owner-members. Data were collected by means of a project questionnaire and telephone interviews. The project questionnaire provided a means of obtaining historical data on project success and pre-project planning effort. Subsequent to receiving the project questionnaire, telephone interviews for each project were conducted. The telephone interviews were designed to obtain the subjective opinions on the level of project success and pre-project planning effort from three perspectives: business manager, project manager, and operations manager. The research methodology is discussed in more detail in Chapter 3.

The objectives of the pre-project planning research project are to produce:

1. A validated model of the pre-project planning process for capital facility construction projects.
2. Pre-project planning data analysis which will present relationships between pre-project planning and project success, and the perceptions of three groups of key project participants concerning project success and pre-project planning effort.

A secondary objective that later became important to the task force was to develop a pre-project planning handbook which will present a methodology for conducting pre-project planning.

The pre-project planning study can be broken into three parts: development of a conceptual model of the pre-project planning process; quantitative analysis of project success and pre-project planning effort; and qualitative analysis of industry experts' opinions concerning project success and pre-project planning effort. The focus of this thesis is on the qualitative analysis of the industry experts' opinions that were collected during telephone interviews.

### 1.2. Purpose

This is an exploratory research study since there has been no in-depth analysis to date of the opinions of industry experts regarding the topics of project success and pre-project planning effort. The purpose of this thesis is to contribute to the overall Pre-Project Planning Study by accomplishing several objectives:

1. Categorize the qualitative responses of project managers, business managers, and operations managers concerning project success and pre-project planning effort.
2. Analyze the qualitative data concerning success and pre-project planning effort in terms of stratification of responses, and identify themes and relationships within and across the groups of respondents.
3. Based on the analysis and classification of the responses, determine best practices regarding pre-project planning effort.

It is hoped that the findings of this study will support the conclusions of the quantitative analysis performed separately on the questionnaire. The results of the qualitative analysis conducted in this study should also contribute to the validation of the pre-project planning model as well as emphasize the overall importance and need

for pre-project planning. This study should identify areas of the pre-project planning process that, according to industry experts, require more emphasis for a project to be successful. In addition, the conclusions drawn from this study are intended to contribute to the development of a pre-project planning handbook. Finally, this study should contribute to the knowledge base of pre-project planning for construction projects as well as identify areas for future research efforts.

### 1.3. Organization of Thesis

The following six chapters provide the reader with the necessary background, description of the research methodology, presentation and analysis of the data, and conclusions and recommendations. This chapter, Chapter 1, provides an introduction to the subject, an overview of the CII pre-project planning study, and the purpose of this thesis. Chapter 2 provides background information, and it includes a literature review of the current work that is relevant to this study and a summary of the previous research completed in the CII Pre-Project Planning Study. Chapter 3 provides a detailed review of the study's methodology, and it includes information regarding the design of the study, the data collection process, and a description of the data analysis method. The characteristics of the study's sample and the data collected by the interviews are presented in Chapter 4. Data Analysis is included in Chapter 5. Chapter 6 presents the conclusions of the study. Finally, Chapter 7 presents recommendations and addresses best practices concerning pre-project planning.

## **2. BACKGROUND**

### **2.1. Literature Review**

This literature review briefly surveys previous research in the areas of project success and pre-project planning, and its relevance to the CII pre-project planning study. In addition, a summary of the pre-project planning conceptual model developed as part of the CII study is presented.

#### **2.1.1. Project Success**

A comprehensive review of the current relevant literature has revealed that project success has been the focus of many recent studies. Several studies have focused on identifying the critical factors that contribute to project success. These studies suggest factors, preconditions, procedures, and determinants for achieving project success (Jolivet and Batignolles 1986; Kothari 1986; Tuman 1986; Ashley, Jaselskis, and Lurie 1987; Pinto and Slevin 1988a; Freeman and Beale 1992; Sanvido et al. 1992).

In addition to the issue of success factors, many studies have concentrated on the challenge of measuring and defining project success. Several researchers have concluded that measuring project success in solely objective terms is an impossible task (de Wit 1986; Morris 1986; Stuckenbruck 1986). The complexity of objective measurement results from the many project objectives that change over time, the multitude of project participants/stakeholders with different objectives, and the subjective nature of many desirable project outcomes (de Wit 1986). There is general agreement among researchers that whether or not a project is a success depends on who is making the assessment and when the assessment is made. Thus, researchers

have attempted to measure project success in a more subjective manner from the various perspectives of project participants and at different times in the project life-cycle (de Wit 1986; Cleland 1986, 1988; McCoy 1986; Salaptas and Sawle 1986; Stuckenbruck 1986; Tuman 1986; Ashley et al. 1987).

Some research has been conducted in the area of project success using regression analysis methods. Success models have been developed using mostly subjective data to identify relationships between project success and the inputs to success.

Researchers have identified several relationships between certain factors and project performance (Ashley et al. 1987; Pinto and Slevin 1988b; Merrow 1990; Ashley 1991). All of these studies have identified project planning as a key factor that contributed to achieving project success.

#### 2.1.2. Pre-Project Planning

While project success has been the focus of many studies, the topic of pre-project planning has received little research effort. There have been very few definitive studies in the literature that have identified the important factors for measuring pre-project planning effort and the impact of these factors on project success. Hackney (1992) studied capital costs estimating and control which included research on the planning of industrial process plant projects. Hackney proposed a detailed checklist for project planning from which a definition rating for a project could be calculated. This definition rating could be used to improve on areas of uncertainty, estimate contingencies, and, to some extent, predict project performance.

One of the Rand Corporation's pioneer plants studies investigated the reasons for inaccurate estimates of capital costs and performance difficulties for first-of-a-kind



process plants. The study provided factors responsible for inaccurate cost estimate and poor plant performance. The study found that both performance problems and cost estimation error were associated with the technical and site characteristics of the project. These were characteristics that were known and developed early in the project development (Merrow et al. 1981).

There has been no research published which quantitatively establishes a correlation between the effort expended on pre-project planning and the success of a project. Furthermore, prior to this study, there has been only one published conceptual model of the pre-project planning phase of a construction project (Sanvido 1990). This model is primarily directed toward commercial projects and has limited validation.

#### 2.1.3. Relation to this Study

The literature review demonstrates that a wealth of information is available on project success while very little can be found concerning pre-project planning. Most of the current project success research has focused on identifying critical success factors and measuring project success. There is consensus among researchers that the definition of project success varies among different project participants and even among individuals based on when they are asked during the project life-cycle. Some of the authors in the literature conducted research by analyzing the opinions of project managers or other project participants collected through interviews and questionnaires. The majority of the authors, however, provide no evidence or data to support their conclusions. The studies are based more on personal experience and are prescriptive in nature.

The CII Pre-Project Planning Study is different from the previous research in many respects. Previous studies attempting to model construction project success have identified project planning as a factor that is correlated to project success. However, these studies failed to address in any detail the pre-project planning phase of construction projects. Some of the differences are listed as follows: 1) This study has concentrated on modeling the pre-project planning phase to identify all activities involved; 2) This study has focused on measuring project success and pre-project planning effort on capital facilities to determine if a positive correlation exists between them; and, 3) This study has incorporated the use of both subjective and objective variables in the research.

This thesis will contribute to the overall pre-project planning study by evaluating the perceptions of three key project participants in the owner's organization concerning project success and pre-project planning effort. These perceptions were collected from over 90 project, business, and operations managers in telephone interviews concerning specific industrial construction projects. The critical factors concerning project success and pre-project planning effort will be outlined as well as patterns and relationships identified through the interviews.

This will be the first study completed that examines industry experts' perceptions of pre-project planning, project success, and their interrelationship. Unlike previous studies, this study takes advantage of a large sample of the key participants involved in the pre-project planning, execution, and operation phases of projects. In addition, all the interviews were conducted at least two years after the projects were completed so that a specific time period in the project life cycle is analyzed. Based on the characteristics and size of the sample and the research approach used, this thesis

should provide a more representative view of the key factors involved for project success and pre-project planning effort.

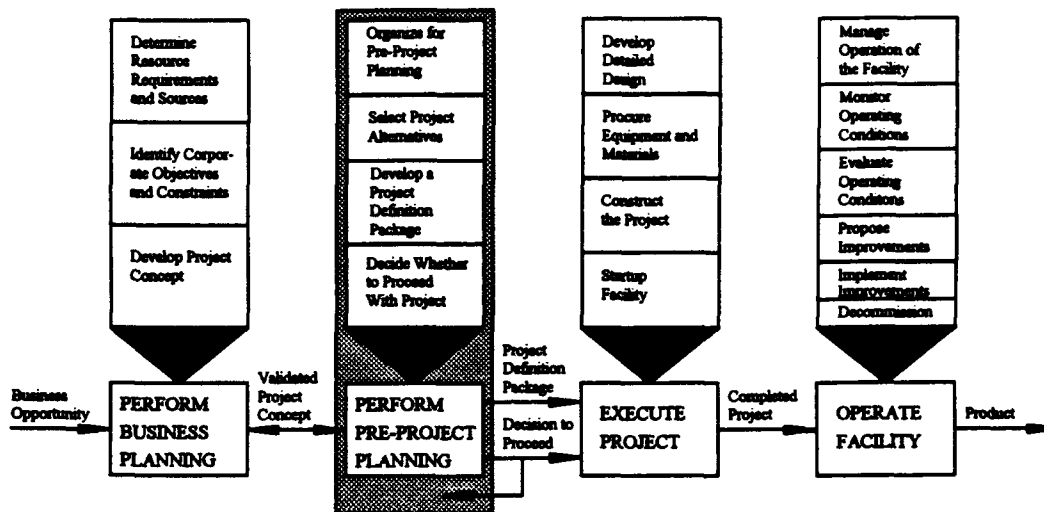
## 2.2. Pre-Project Planning Conceptual Model

The objectives of the CII Pre-Project Planning Task Force were discussed in the introduction. The pre-project planning conceptual model developed by the task force is particularly relevant to this thesis and satisfied one of the task force's objectives. It provides the basis for the initial categories used in the qualitative analysis of the opinion data gathered from the project representatives. In addition, it is expected that the perceptions of the project representatives concerning project success and pre-project planning effort will support the conceptual model and increase its validity.

The purpose of the conceptual model is to define the functions involved in the pre-project planning of capital facilities so that measures of effort and project success can be developed and their interrelationships analyzed. The task force has defined pre-project planning as the process of developing sufficient strategic information for owners to address risk and decide to commit resources to maximize the chance for a successful project (Gibson et al. 1993). The pre-project planning stage of the project begins once an initial idea for the project is identified; pre-project planning continues until the beginning of project execution, when design and construction actually commence.

Figure 2 shows the same four project life-cycle phases as the cost influence diagram (shown in Figure 1), but it includes a description of the major sub-processes required during each step of the project's life as defined by the task force. The four major sub-processes of the pre-project planning phase (organize for pre-project

planning, select project alternatives, develop a project definition package, and decide whether to proceed with project) are further decomposed as shown in the node tree for the pre-project planning model (shown in Figure 3).



**Figure 2: Project Life Cycle Diagram**

The conceptual model for the pre-project planning process was developed by the task force by employing their collective experience and the process mapping technique IDEF0 (Integrated Computer-Aided Manufacturing Definition) (Gibson et al. 1993). The members identified the information flow between the various planning functions, as well as the major players and the controls for each function. It was decided early in the development process that the model should not necessarily mirror a single company's planning procedures. Every attempt was made to keep the model as generic as possible so that it applies equally to different project types and companies. Therefore, the model refrains from going into so much detail that it becomes specific to one company or one type of organization.

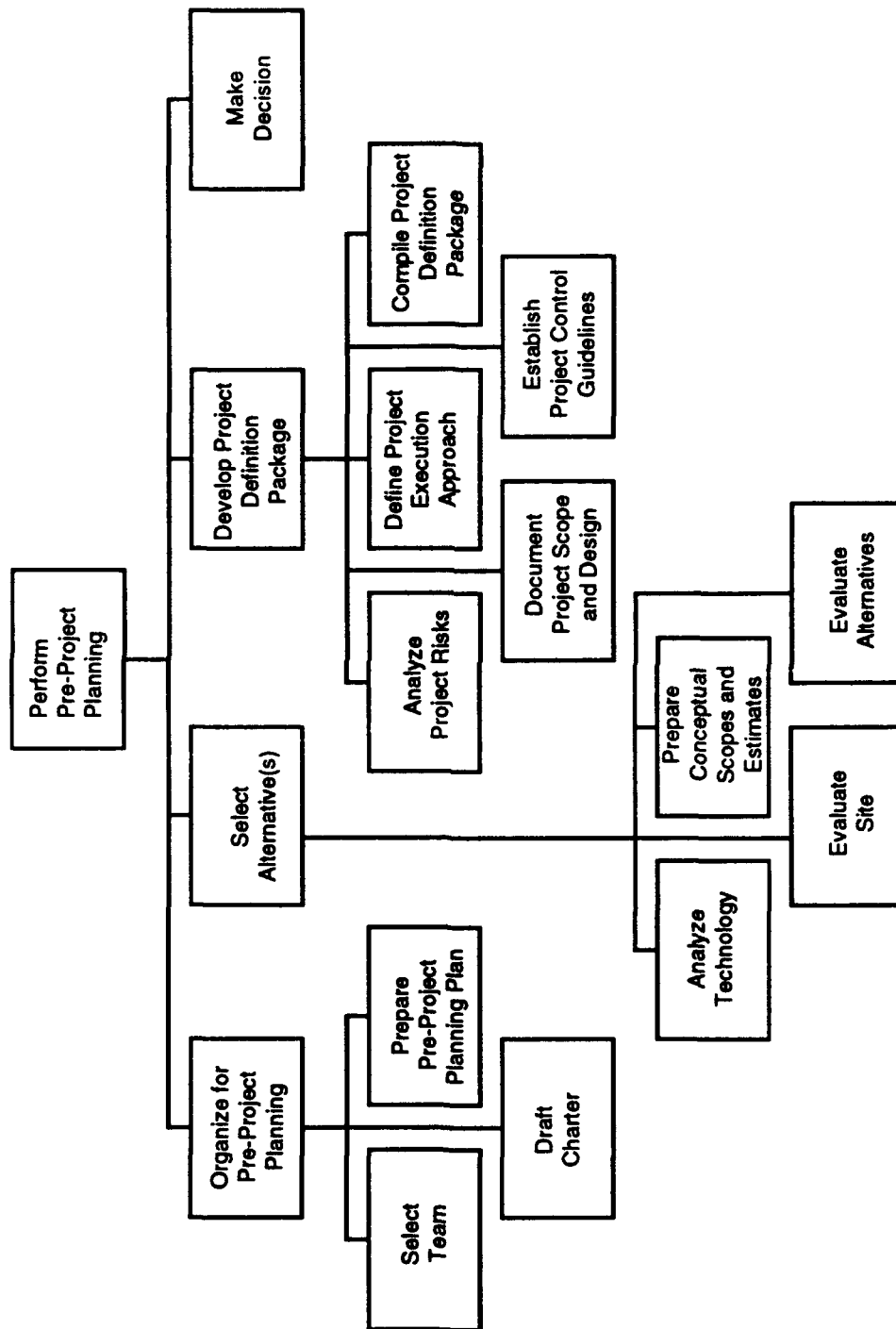


Figure 3: Node Tree for Pre-Project Planning Model

The task force also developed detailed checklists of the important steps in the pre-project planning effort. These checklists are tools that can be used to insure that all the important planning functions are performed prior to beginning detailed design or construction.

The researchers used three projects to validate how closely the model and the checklist represent actual construction industry procedures. The CII task force members provided these projects from their companies' job lists. The validation process consisted of interviews with project participants to determine the applicability of the model to pre-project planning efforts at each organization.

The next chapter will discuss the methodology used to meet the objectives of this thesis.

### **3. METHODOLOGY**

#### **3.1. Design of The Study**

The focus of this thesis is an analysis of the perceptions of business, project, and operations managers concerning project success and pre-project planning effort on projects with which they were associated. These perceptions were obtained through the use of telephone interviews. The sections that follow summarize the overall design of the CII Pre-Project Planning Study, the data gathering process, and the analysis of the qualitative data.

##### **3.1.1. Definition of Project Success and Pre-Project Planning Effort**

As discussed in the introduction, experienced personnel in the construction industry feel that project success and the effort expended in pre-project planning are correlated. A first step in determining this correlation was to define project success and pre-project planning. The review of the literature demonstrated that the definition of project success varied among different project participants and at what point they were asked during the project life-cycle. In addition, the literature review demonstrated that prior to this study little research effort has been expended on defining the pre-project planning phase of construction projects.

Because no clear definition of project success and pre-project planning effort existed for use in this study, the first step was to conceptualize these concepts. According to Babbie (1983), conceptualization is "a process whereby fuzzy and imprecise notions (concepts) are made more specific and precise". In the case of project success, the task force members combined a review of the literature with their

experience and the experience of their colleagues to produce four initial broad categories of success: business, project management, operations and social success.

The lack of prior study of the pre-project planning phase of construction projects made conceptualization of this concept particularly difficult. For the pre-project planning effort to be evaluated, a conceptual model of the pre-project planning phase was developed by the task force using a more structured approach. As described in Chapter 2, the task force modeled pre-project planning using the process mapping technique IDEF0. The conceptual model describes pre-project planning with three broad concepts: organization for pre-project planning, alternative selection, and developing the project definition package.

Through conceptualization, the general terms of project success and pre-project planning were more precisely defined. The next step was to define these concepts so they could be observed and measured. Babbie (1983) describes operationalization as the process of developing "concrete and specific definitions of something in terms of the operations by which observations are to be categorized." The concepts of project success and pre-project planning were further defined by the variables required for measuring them.

The task force specified exactly what needed to be observed and how the observation would be done. The initial four concepts of project success were further defined by nine categories. Each success category was broken down into specific, measurable variables. For pre-project planning, decomposition of the IDEF0 model was continued until a level of detail that provided measurable variables was reached (Gibson et al. 1993). This list of success and pre-project planning effort categories and variables is shown in the success and effort categories matrix (Appendix A). The



matrix shows the variables to be measured within each category and the expected source of data for each variable (business manager, project manager, operations manager, or historical data).

### 3.1.2. Data Gathering Strategy

Of the five modes of observation described by Babbie (1983) (experiments, field research, survey research, unobtrusive research, and evaluation research), survey research is the most feasible for this study. Experimental and evaluation research are not viable because of their intrusive nature and potential impact on the economic performance of construction projects. Because there is little existing data about pre-project planning, unobtrusive research, which relies on the availability of existing data, was not applicable to this research. Field research was employed to some extent by having task force members observe and report how pre-project planning was done in their firms. Survey research, which involves collecting data by asking people questions was the most cost and time efficient method available.

The three most common methods for data collection in survey research are personal interviews, telephone interviews, and questionnaires (Babbie 1983; Warwick and Lininger 1975). Because of the time constraints involved and distances between the locations of respondents, personal interviews were not feasible for use in this study. The pre-project planning study relied on questionnaires and telephone interviews as the primary methods for data collection.

The questionnaire and interview instrument were designed using the variables developed in the operational definition. The list of these variables is shown in Appendix A (Success and Effort Categories Matrix). A pre-test of the questionnaire

and interview was conducted to ensure all the questions would be understood by the respondents and would measure what they intended to assess. The task force members from owner companies provided projects and interviewees for the pre-test. As a result of the pre-test, minor changes were made to refine and improve the questionnaire and interview instrument so that they provided more valid and reliable data for analyses.

### 3.1.3. Domain of the Study

Based on the variables that were defined for measurement, the task force decided that data would need to be gathered on completed, industrial construction projects. In order to realize the objectives of this study, an initial project population of 150-200 projects was required. Each CII owner member company that was willing to participate was asked to nominate six to ten potential projects meeting the following criteria:

1. The project was an industrial construction project.
2. The final cost of the project exceeded \$5 million.
3. The project has been mechanically completed and in operation for at least two years.
4. The project was performed in North America.

### 3.2. Data Gathering

The first step in the data gathering process involved sending letters to members of CII owner companies requesting that they nominate six to ten projects meeting the criteria mentioned above. One-hundred five projects were nominated for the study,

which was below the initial target of 150. From this project population, a stratified, random sample was selected for study.

The second step was the completion of project questionnaires. The point of contact for each project selected was asked to complete an eighteen page questionnaire which was used to collect quantitative and historical project data on each project. The questionnaire asked also for the contact information for follow-up interviews with three project representatives:

1. Business unit representative: preferably the business manager who sponsored the project and had knowledge of its business implications.
2. Project management representative: preferably the project manager who was involved in the pre-project planning and execution phases of the project.
3. Operating unit representative: preferably the manager of the operating unit.

The request for interview data portion of the questionnaire is shown in Appendix B.

The third step was to send facsimile letters to each of the identified project representatives notifying them that they would be contacted by a researcher to schedule an interview. To insure that each of the interviewees provided data on the project being studied, the letter included a brief summary of the project's historical data. An example of the interview notification letter is shown in Appendix C.

The fourth and final step was to conduct the interview. Thirty minutes were scheduled for each interview, and the average duration has been approximately 25 minutes. The interviews were conducted by reading a brief introductory statement about the pre-project planning study and then asking questions exactly as they appear on the interview instrument.

The interview instrument is divided into two sections. The first section gathers opinions about the success of the project and the second section about pre-project

planning effort. Each section contains closed-ended questions organized into the project success and pre-project planning effort categories (see Appendix A for the list of categories). Each section is followed by open-ended wrap-up questions designed to obtain the representative's overall opinion of project success and pre-project planning effort. The qualitative data gathered from the open-ended questions were analyzed for this thesis. A copy of the master list of interview questions is included in Appendix D. Each group of representatives was asked certain questions from the master list as indicated in the Appendix, and all three groups were asked the same open-ended questions.

### 3.3. Data Analysis

To evaluate the subjective opinions of project representatives concerning project success and pre-project planning effort, qualitative analysis methods were used. Qualitative analysis involves the organization and interpretation of non-numerical data for the purpose of identifying important underlying meanings and patterns of relationships (Babbie 1983). The qualitative data to be analyzed were generated from four questions asked in the telephone interviews. The aim of these four open-ended questions was to obtain perceptions about:

- The important factors that contribute to project success
- The areas that need to be considered for improving project success
- The important factors involved in pre-project planning effort
- The areas that need to be considered for improving pre-project planning

The first step in the qualitative analysis was to organize the data. The verbatim responses for each project representative were entered into a computer file and organized by project number. A computer printout of the entire file was generated to facilitate categorization of the responses by the researchers. The entire data file of responses is shown in Appendix E and has been edited to preclude identification of the participants.

The second step was to categorize the data. The success and pre-project planning effort categories and subcategories developed by the task force were used for this categorization (see Appendix A for a list of the categories). The author and the primary investigator each read all the responses and assigned categories to them. This process was repeated several times by each researcher to increase the accuracy of the categorization. If a particular response emerged frequently from the data that did not fit into one of the initial categories, it was added to a list of new categories and subcategories. The list of new categories that was developed during the categorization process is also shown in Appendix A.

The final step was to use descriptive statistics to describe and synthesize the data thereby facilitating the interpretation of the qualitative data. This included the use of frequencies, percentages, stratification, and Pareto ordering of the most common responses. The researcher analyzed the data identifying underlying themes and patterns of relationships within and across the groups of project representatives concerning project success and pre-project planning effort. The results of the categorization and interpretation of the data follows in the next two chapters.

#### 4. PRESENTATION OF DATA

The previous chapter detailed the procedures that were used for data collection and qualitative analysis of the data. This chapter will describe the characteristics of the sample population and present the qualitative data received from the interviews with project representatives.

##### 4.1. Sample Characteristics

A total of 41 industrial construction projects were included in this study. These projects are categorized by size and type as shown in Figures 4 and 5. The total cost of the 41 projects combined was \$2,607,770,452. The final completion costs of the projects ranged from \$4,700,000 to \$565,800,000, with an average cost of \$63,604,000.

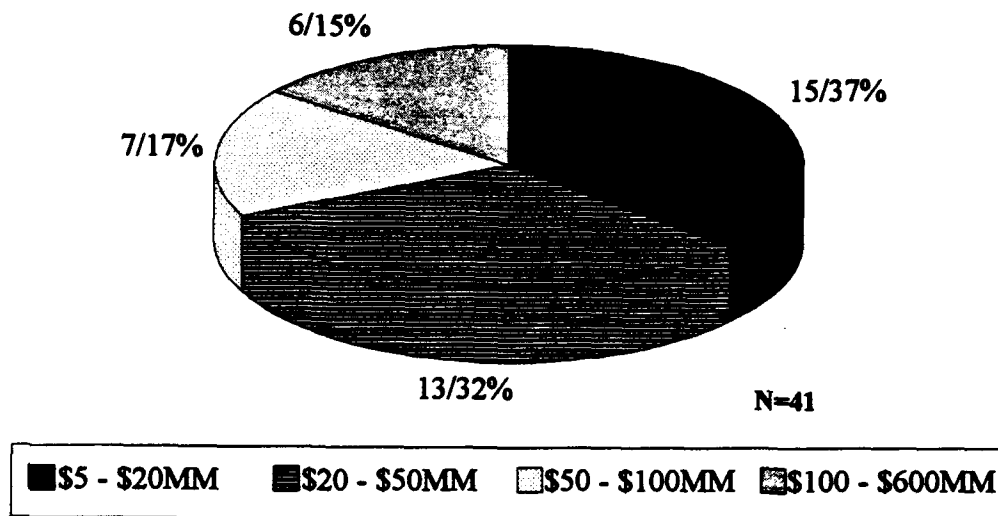
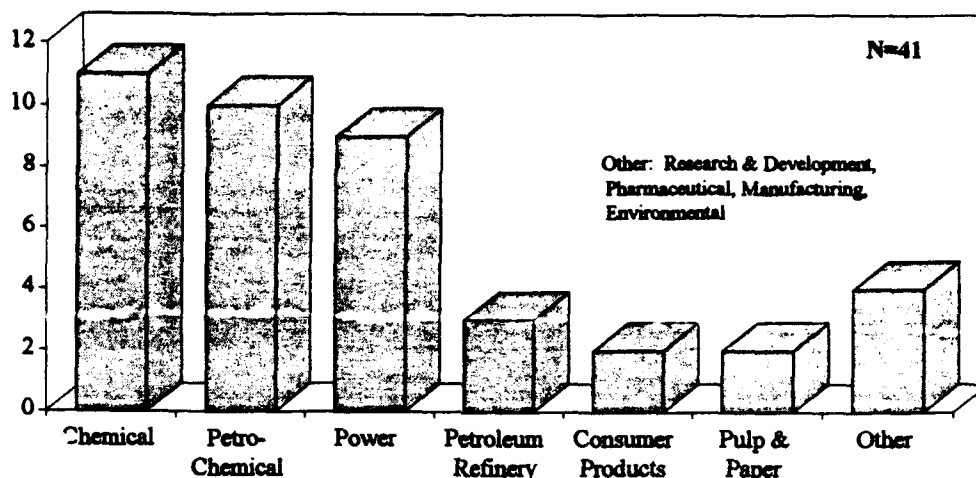


Figure 4. Project Sample Size



**Figure 5. Project Sample Type**

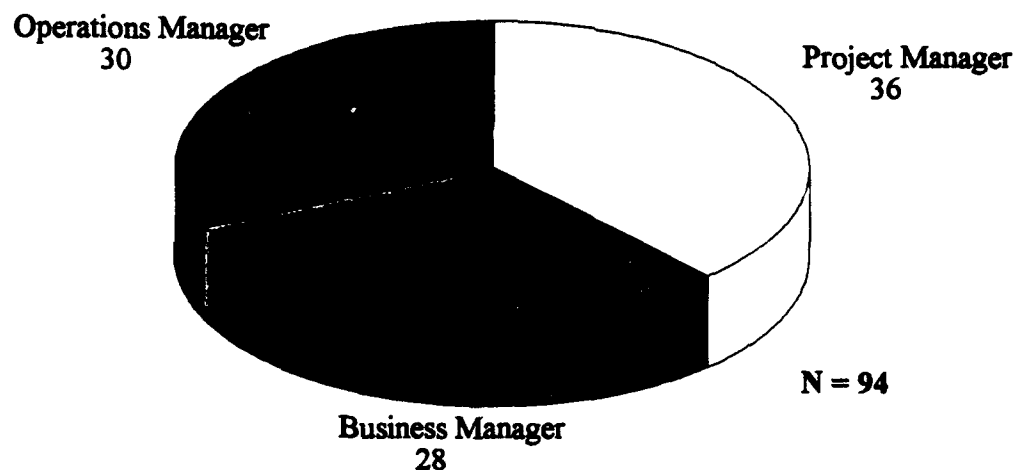
From these 41 projects a total of 94 interviews were conducted with project representatives. As discussed in the previous chapter, the researcher attempted to conduct an interview with each of three representatives associated with each project: (1) business manager; (2) project manager; and (3) operations manager. The ideal situation would be to conduct three interviews for each project, one with each representative. Unfortunately, three interviews per project were not feasible in all cases due to the unavailability of some project representatives. The projects under study have been completed for at least two years, and, in many cases, the representatives had left employment of the project owner or were out of the country during the interview period.

Even when three representatives were not available for each project, the ones that were available were still interviewed. Collecting interview data from only one or two of the representatives on a project instead of all three did not affect the results of this study. It was not the study intent to compare the perceptions of the three project representatives for each project. Rather, the focus of the study was to analyze and

compare the perceptions of the three groups of representatives concerning project success and pre-project planning effort. Therefore, all the available project representatives were interviewed in order to collect as much data as possible for each group.

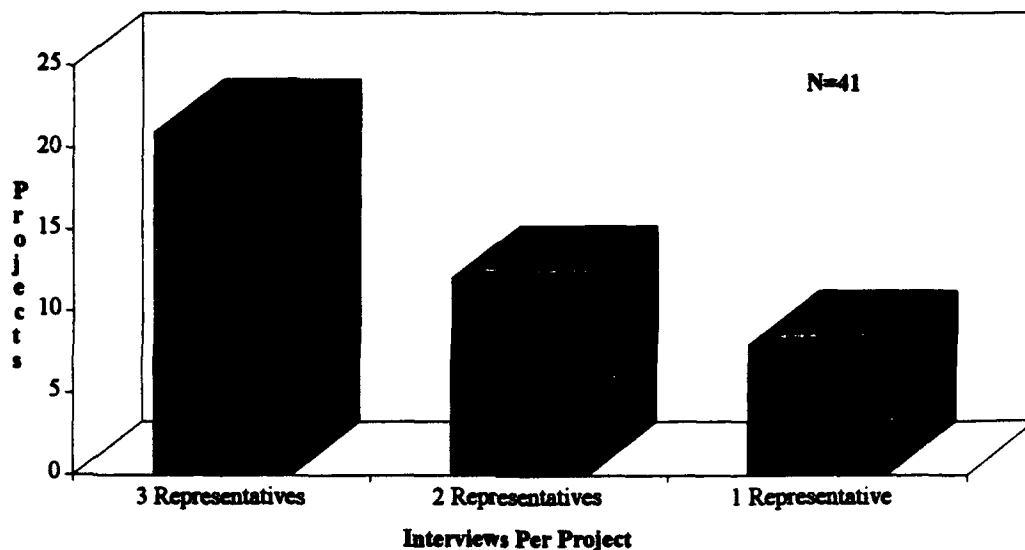
Figure 6 shows the number of interviews completed for each group of project representatives. Figure 7 shows the number of projects where all three interviews were conducted and the number of projects where only one or two representatives could be interviewed.

On two of the projects studied, one project representative performed as both the project manager and operations manager for the project. In this situation, the representative's responses were included in the data set for both the project and operations manager, since the representative was responding from both perspectives.



**Figure 6. Interviews Conducted by Type**





**Figure 7. Breakdown of Interviews Conducted Per Project**

#### 4.2. Characterization of the Data

The master interview instrument containing the questions used in the telephone interviews is shown in Appendix D. As described in the previous chapter, the open-ended questions (questions 10 and 14) concerning project success and pre-project planning effort generated the qualitative data for analysis in this study. The questions are as follows:

10. *Finally, we would like to know your opinion of how successful this project was overall, taking into consideration all the areas that we have just covered. On a scale of 1 to 5, with 1 being very unsuccessful and 5 being very successful, please provide us with your rating of the overall project?*

10a. *What are your main reasons for your assessment of the project's level of success?*

10b. *What, if anything, needs to be improved next time to make the project more successful?*

14. Finally, we would like to know your opinion of the overall level of effort expended on pre-project planning on this project. Using a scale of 1 to 5, with 1 representing very low and 5 representing very high, how would you characterize the overall level of effort that was expended on pre-project planning for this project?

14a. What are your main reasons your assessment of the level of effort expended on pre-project planning?

14b. In your opinion, what, concerning pre-project planning effort, needs to be improved next time?

The responses of each project representative to these questions are organized by project number and included in Appendix E. The data are categorized as described in the methodology (Chapter 3). The researcher and the study's primary investigator read the responses several times and assigned categories to them (see Appendix A for initial categories used and the new categories identified).

Since the questions were open-ended, representatives often gave multiple responses to be categorized. To account for multiple responses within a main category, the responses were assigned subcategories within the main categories. For example, the following response by a project manager to question 10a is categorized in Table 1:

*Teamwork on the project was excellent. Corporate guidance was clear and consistent. The project was well within budget and ahead of schedule; we had very minimal changes. Machinery operates very well and operators like it since it is easy to operate.*

**Table 1. Example of Categorized Response**

Main Category	Subcategory	Project Manager Response:
3	a	Teamwork on the project was excellent.
3	e	Corporate guidance was clear and consistent.
4	a and b	The project was well within budget and ahead of schedule;
4	d	we had very minimal changes.
8	a	Operates well, and operators like it since it is easy to operate.

Referring to the success categories and subcategories in Appendix A, the classification "3a" is quality management/teamwork effort; "3e" is quality management/guidance from management; "4a" is project control/budget achievement; "4b" is project control/schedule achievement; "4d" is project control/number of changes; and "8a" is operating characteristics/ease of operation. The sections that follow will explain the significance of each question, discuss the stratification of the data, and present the data that were collected.

#### 4.2.1. Data from Question 10a.

Question 10a: *What are your main reasons for the project's level of success?*

This question was asked in order to determine the perceptions of the project representatives about important factors or outcomes that, when present or absent, have a significant impact on project success. From the responses, the researcher could identify the success factors and outcomes important to each group of representatives. In addition, any differences or similarities concerning project success among the groups could be observed.

To facilitate the interpretation of the categorized data, the researcher stratified the data set of responses several ways. First, the number of responses in each main category were totaled for each group of representatives. In the example above, the project manager had two responses in category 3, three responses in category 4, and one response in category 8.

This method of stratification allowed the researcher to determine which categories were perceived as most important by examining the *frequency* of responses with which each category was mentioned. Note that the three groups' perceptions cannot be

compared using this method, since the number of representatives interviewed in each group are not equal. Thus, the project manager group, which has the largest number of interviews, will have more overall responses for categorization than the other two groups.

The method used for comparing the groups' perceptions was to count the number of representatives in each group (project manager, business manager, and operations manager) that identified a main category at least once on a project. In the example above the project manager identified categories 3, 4, and 8. The number of representatives in each group identifying a main category were totaled for each category. To normalize the data, the number of representatives of each group in a category was then divided by the total number of representatives of that group. Thus, the percentage of each group identifying each main category was derived. Through normalization of the data, the groups can be compared regardless of the minor differences in group size. In addition, the frequency with which each category is identified can be observed. This methodology was used for all four questions.

Table 2 presents the data received from question 10a. There were 94 total representatives responding to the question: 36 project managers, 28 business managers, and 30 operations managers. The categories identified in the responses are listed at the top of each column. These categories are defined at the bottom of the table by the subcategories that were identified within each main category. Note that only those subcategories identified in the representatives' responses to question 10a are included at the bottom of Table 2 (for a complete listing of the subcategories see Appendix A). The number adjacent to the subcategory is the total number of

**Table 2. What are your main reasons for the project's level of success?**

N= 94 Respondents	Quality Manage- ment	Project Control	Ease of E/P/C	Social	Construct/ Operation Transition	Operating Characteristics	Operations Input	Technology Evaluation	Market & Financial
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(10)	(11)
<b>Project (36)</b>	12	29	12	4	9	11	3	4	4
<b>Manager</b>	33%	80%	33%	11%	25%	30%	8%	11%	11%
<b>Business</b>	6	15	2	6	2	8	1	3	6
<b>Manager (28)</b>	21%	33%	7%	21%	7%	29%	4%	11%	21%
<b>Operations</b>	10	12	6	2	12	12	7	7	4
<b>Manager (30)</b>	30%	40%	20%	7%	40%	40%	23%	23%	13%
<b>Total (94)</b>	28	56	20	12	23	31	11	14	14
	30%	60%	21%	13%	24%	33%	12%	15%	15%
<b>Projects (N=41)</b>	20/49%	33/80%	18/44%	12/29%	18/44%	24/58%	10/24%	12/29%	11/27%

**Notes:**

**Quality Management:** Teamwork Effort(12), Customer Satisfaction(8), Guidance from Management(6), Personnel Turnover(3), Professional Performance/Experienced Personnel(4), Effective Communications(6)

**Project Control:** Budget Achievement(46), Schedule Achievement(34), Change Management(2), Number/Magnitude of Changes(4), Risk Management(3), Rework & Extent of Punchlists(4)

**Ease of Engineer/Procure/Construct(E/P/C):** Execution Strategy(12), Scope Definition(5), Basis of Design(4), Constructability(3)

**Social:** Safety & Health(6), Environmental(3), Community Relations(2), Labor Relations(1), Education/Training(1), Achieves Legal and Regulatory Compliance(1)

**Construction/Operation Transition:** Ease of Start-up(20), Ease of Turnover(3), Operator Training(2)

**Operating Characteristics:** Ease of Operation(16), Production Quality(9), Availability(6), Plant Utilization(3), Design Capacity(4), Performance(2), Unanticipated Retrofits(3), Maintainability(4)

**Operations Input:** Involving experienced operations personnel as part of the project team(11)

**Technology Evaluation:** Proper analysis, testing, and adoption of the technology to be used on the project(14)

**Marketing & Financial:** Capture/Maintain Market share(6), Enhance Future Position(3), Gain Competitive Advantage(4), Met Financial Authorization Objectives(4)

times the subcategory was identified by all three groups. Each column contains the number and percentage of representatives that identified a particular category. For example, under the category of quality management in column (2), 12 project managers out of 36, or 33% of the project managers identified this category in their responses.

The bottom row of Table 2 shows the number of projects for which each main category was identified. A project was included in a main category if at least one of the project representatives interviewed identified that main category. The category of quality management, for example, was identified by participants on 20 of the 41 projects in the sample.

Referring to question 10, the project representatives were asked to rate the project's level of success on a scale of 1 to 5 (with 1 being very unsuccessful and 5 being very successful). The researcher stratified the responses to question 10a by the success ratings the projects received. The projects rated 4 and 5 were considered more successful, and those rated 3 or lower were considered less successful.

Using this method for stratifying the data, the researcher attempted to determine if there were two sets of important success factors and outcomes. One set, for ratings of 4 and 5, would consist of important factors and outcomes contributing to their view of a successful project. The other set, for ratings of 3 or less, would consist of factors and outcomes that, if poorly executed or not existent on a project, could cause the project to be less successful. This stratification was performed to determine if the sets of factors and outcomes were similar or different. The data stratified by success rating are not presented here, but the results of this stratification will be considered in the analysis.

#### 4.2.2. Data from Question 10b.

Question 10b: *What, if anything, needs to be improved next time to make the project more successful?*

This question was asked to determine the perceptions of the project representatives regarding which factors require more emphasis in order for a project to be more successful. From the responses, the researcher could identify areas of improvement considered important by each group of representatives. In addition, any differences or similarities concerning improvement areas among the groups could be observed.

The data received from question 10b were stratified in the same manner as the data from question 10a. Table 3 presents the data received from question 10b. The same number of representatives responded to the question. As before, the categories identified in the responses are listed at the top of each column, and are defined at the bottom of the table by the subcategories that were identified within each main category. The number adjacent to the subcategory is the total number of times the subcategory was identified by all three groups. Each column contains the number and percentage of representatives that identified a particular category. The bottom row of Table 3 shows the number of projects for which each main category was identified.

The "other" category in column (10) of Table 3 consists of those categories identified only a few times by the project representatives in their responses to question 10b. Table 3a further describes the other category.

Table 3. What, if anything, needs to be improved next time to make the project more successful?

N = 94 Respondents	Quality Management	Project Control	Ease of E/P/C	Construct/ Operation Transition	Technology Evaluation	Emphasis on P3	Estimating	Front-End Engineering	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Project (36)	13	3	12	3	4	9	3	4	2
Manager	36%	8%	33%	8%	11%	25%	8%	11%	5%
Business (28)	6	4	5	0	6	7	4	2	8
Manager	21%	14%	18%	0	21%	25%	14%	7%	29%
Operations (30)	6	2	3	5	14	8	4	4	6
Manager	20%	7%	10%	17%	46%	27%	13%	13%	20%
Total (94)	25	9	20	8	24	24	11	10	16
	26%	9%	21%	8%	25%	25%	12%	11%	17%
Projects (N=41)	20/49%	7/17%	18/44%	7/17%	21/51%	16/39%	7/17%	7/17%	14/34%

**Notes:**

**Quality Management:** Personnel Turnover(10), Effective Communications(10), Teamwork Effort(6), Guidance from Management(3)

**Project Control:** Budget Achievement(3), Schedule Achievement(1), Change Management(2), Risk Management(2)

**Emphasis on Pre-Project Planning(P3):** Emphasis on pre-project planning and resources for pre-project planning(24)

**Technology Evaluation:** Proper analysis, testing, and adoption of the technology to be used on the project(24)

**Estimating:** Cost Estimating(11)

**Ease of Engineer/Procure/Construct(E/P/C):** Scope Definition(8), Execution Strategy(5), Basis of Design(1),

Constructability(4), Procurement (3)

**Front-End Engineering:** Amount and quality of design and engineering done up-front(10)

**Construction/Operation Transition:** Ease of start-up(4), In-general(2), Spare Parts Availability(2), Operator Training(1)

**Other:** See Table 2a



**Table 3a. Breakdown of "Other" Category for Question 10b**

<b>N = 94 Respondents (1)</b>	<b>Social (2)</b>	<b>Operating Characteristics (3)</b>	<b>Operations Input (4)</b>	<b>Market Forecast (5)</b>
<b>Project (36) Manager</b>	1 3%	0	1 3%	0
<b>Business (28) Manager</b>	2 7%	3 11%	1 4%	2 7%
<b>Operations (30) Manager</b>	0	1 3%	2 7%	3 10%
<b>Total (94)</b>	3 3%	4 4%	4 4%	5 5%
<b>Projects (N=41)</b>	3/7%	3/7%	5/12%	3/7%

**Notes:****Social:** Safety & Health(1), Environmental(2)**Operating Characteristics:** Ease of Operation(1), Performance(2), Flexibility(1)**Operations Input:** Involvement of operations personnel as part of project team and using their skills and experience in all phases(4)**Market Forecast:** Forecasting the market window for a product(5)**4.2.3. Data from Question 14a.**

**Question 14a:** *What are your main reasons for your assessment of the level of effort expended on pre-project planning?*

This question was asked to determine the perceptions of the project participants concerning important factors required for successful pre-project planning. From the responses, the researcher could identify the pre-project planning factors important to each group of representatives. In addition, any differences or similarities concerning pre-project planning among the groups could be identified.

The data received from question 14a were stratified in the same manner as the data received from previous questions and is shown in Table 4. Of the 94 project representatives interviewed, 91 responded to question 14a: 35 project managers, 27 business managers, and 29 operations managers. Three of the 94 project

**Table 4. What are your main reasons for your assessment of the level of effort expended on pre-project planning?**

<b>N = 91 Respondents</b>	<b>Time and Resources</b>	<b>Team-work</b>	<b>Evaluation of Alternatives</b>	<b>Project Definition Package</b>	<b>Customer Involvement</b>	<b>Corporate Guidance</b>
<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>
<b>Project (35)</b>	18	13	11	14	4	1
<b>Manager</b>	51%	37%	31%	40%	11%	3%
<b>Business Manager</b>	11	5	7	7	7	3
<b>(27)</b>	41%	18%	26%	26%	26%	11%
<b>Operations</b>	8	10	9	11	4	4
<b>Manager (29)</b>	27%	34%	31%	38%	14%	14%
<b>Total (91)</b>	37	28	27	32	15	8
	41%	31%	30%	35%	16%	9%
<b>Projects (N=41)</b>	26/63%	21/51%	17/41%	22/54%	12/29%	7/17%

**Notes:**

**Time and Resources:** Enough time and resources dedicated to pre-project planning(22); Team Skills and Experience (pre-project planning team had the skills required and experienced people)(16)

**Teamwork:** How well individuals worked together(11), Team Continuity(6), Team Building(2), Multi-disciplinary Team (personnel from all organizations in corporation and outside parties involved on pre-project planning team)(15)

**Evaluation of Alternatives:** Alternative selection concerning technology, site, etc. and analysis(16), Technology Evaluation (proper analysis, testing, and adoption of the technology to be used on the project)(9)

**Project definition Package:** Execution Approach(10), Control Guidelines(4), Risk Assessment(2), Quality Emphasis(2), Percent Design Complete(5), Appropriate Scope Definition with conceptual scopes and estimates prepared and cost estimating(19)

**Customer Involvement:** Customer of project (including operations personnel) involved in planning process.

**Corporate Guidance:** Guidance From Management(8)

representatives interviewed were not involved in the pre-project planning for their projects and therefore did not respond to these two questions concerning pre-project planning.

The categories identified in the responses are listed at the top of each column in Table 4. As before, the categories are defined at the bottom of the table by the subcategories that were identified within each main category. The number adjacent to the subcategory is the total number of times the subcategory was identified by any of the three respondents. Each column contains the number and percentage of representatives that identified a particular category. The bottom row of Table 4 shows the number of projects for which each main category was identified.

As was done in question 10a, the researcher stratified the responses to question 14a by the *pre-project planning effort* ratings received. Referring to question 14, the project representatives were asked to rate the overall level of effort expended on pre-project planning on a scale of 1 to 5 (with 1 being very low and 5 being very high). The projects rated 4 and 5 were considered to have more pre-project planning effort, and those rated 3 or lower were considered as having less effort.

Using this method for stratifying the data, the researcher attempted to determine if there were two sets of important pre-project planning factors. One set, for ratings of 4 and 5, would consist of factors that contribute to successful pre-project planning. The other set, for ratings of 3 or less, would consist of factors that, if not existent or executed poorly on a project, result in unsuccessful pre-project planning. This stratification was performed to determine if the sets of factors were similar or different. The data stratified by effort rating are not presented here, but the results of this stratification will be considered in the overall analysis.

#### 4.2.4. Data from Question 14b.

Question 14b: *What concerning pre-project planning effort needs to be improved next time?*

This question was asked to determine the perceptions of the project representatives about what areas of pre-project planning require more emphasis. From the responses, the researcher could identify areas of improvement for pre-project planning important to each group of representatives. In addition, any differences or similarities concerning improvement areas among the groups could be observed.

The data received from question 14b were stratified in the same manner as the data received from previous questions. Table 5 presents the data received from question 14b. Of the 94 project representatives interviewed, 91 responded to question 14b: 35 project managers, 27 business managers, and 29 operations managers. As discussed in the previous section, three of the 94 project representatives interviewed were not involved in the pre-project planning for their projects and therefore did not respond to questions concerning pre-project planning.

The categories identified in the responses are listed at the top of each column in the Table. The categories are defined in the notes at the bottom of the table by the subcategories that were identified within each main category. The number adjacent to the subcategory is the total number of times the subcategory was identified by any of the respondents. Each column contains the number and percentage of representatives that identified a particular category. The bottom row of Table 5 shows the number of projects for which each main category was identified.

Table 5. What concerning pre-project planning effort needs to be improved next time?

N = 91 Respondents	Team- work	Time and Resources	Customer Involvement	Communi- cation	Pre-project planning Methodology	Evaluation of Alternatives	Project Definition Package	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Project	11	11	6	7	6	4	14	4
Manager (35)	31%	31%	17%	20%	17%	11%	40%	11%
Business	5	5	6	3	3	6	10	3
Manager (27)	18%	18%	22%	11%	11%	22%	37%	11%
Operations	6	8	4	5	2	6	9	4
Manager (29)	21%	27%	14%	17%	7%	21%	31%	14%
Total (91)	22	24	16	15	11	10	33	11
	24%	26%	17%	16%	12%	11%	36%	12%
Projects (N=41)	18/44%	18/44%	8/19%	12/29%	9/22%	14/34%	24/58%	9/22%

**Notes:**

**Time and Resources:** Enough time and resources dedicated to pre-project planning(19), Team Skills and Experience (pre-project planning team had the skills required and experienced people)(4)

**Teamwork:** How well individuals worked together(11), Team continuity(10), Team Building(2), Multi-disciplinary Team (personnel from all organizations in corporation and outside parties involved on pre-project planning team)(6)

**Evaluation of Alternatives:** Alternative selection concerning technology, site, etc. and analysis(10), Technology Evaluation (proper analysis, testing, and adoption of the technology to be used on the project)(10)

**Customer Involvement:** Customer of project (including operations personnel) involved in planning process(16)

**Communication:** Quality of communication in an organization(15)

**Pre-Project planning Methodology:** Formal plan, road map, or documented method for pre-project planning

**Project Definition Package:** Execution Approach(3), Control Guidelines(3), Risk assessment(3), Percent Design Complete(7), Appropriate Scope definition with conceptual scopes and estimates prepared and cost estimating(21)

The other category included in column (9) of Table 5 consists of those categories identified only a few times by the project representatives in their responses to question 14b. Table 5a further describes the other category in Table 5.

**Table 5a. Breakdown of "Other" Category for Question 14b**

<b>N = 91 Respondents (1)</b>	<b>Corporate Guidance (2)</b>	<b>Market Forecast (3)</b>
<b>Project (35) Manager</b>	4 11%	0
<b>Business (27) Representative</b>	1 4%	2 7%
<b>Operations (29) Representative</b>	1 3%	3 10%
<b>Total (91)</b>	6 7%	5 5%
<b>Projects (N=41)</b>	<b>5/15%</b>	<b>4/10%</b>

**Notes:**

**Corporate Guidance:** Guidance from Management(6)

**Market Forecast:** Forecasting Market Conditions(5)

## **5. ANALYSIS OF DATA**

### **5.1. Data Analysis**

This chapter will discuss the analysis of the data presented in the previous Chapter. For the questions asked, the researcher examined the frequency with which each category was identified by each group. This was done to determine the perceptions of each group concerning the important factors and areas of improvement for project success and pre-project planning effort. The stratification of responses was analyzed to determine any significant trends within and across the groups of representatives. In addition, any relationship existing between project success and pre-project planning effort was analyzed using the project success and pre-project planning effort ratings received from questions 10 and 14.

For each of the questions 10a, 10b, 14a, and 14b, the results of the stratification of responses are displayed graphically. Figures 8, 8a, 8b, 10, 12, and 14 display the percentage of respondents from each group identifying each category. In addition, the percentage of total respondents identifying each category is included. The categories are arranged in descending order according to percentage of total respondents. Figures 9, 11, 13, and 15 display the number of projects for which each success category was identified by at least one project representative.

#### **5.1.1. Analysis of Success Factors and Outcomes**

Question 10a was asked in order to determine the perceptions of the project representatives about important factors and outcomes that, when present or absent, have a significant impact on project success. The researcher found that representatives

indicated both factors that impact on project success and desired success outcomes.

The following categories indicated by the representatives were classified as outcomes and factors by the researcher as follows:

<b>Outcomes</b>	<b>Factors</b>
• Project Control	• Quality Management
• Construction/Operation Transition	• Ease of E/P/C
• Social	• Operations Input
• Operating Characteristics	• Technology Evaluation
• Market and Financial	

A factor can be identified as those things performed during the project that *influence* success or failure of the project in terms of its objectives. Outcomes can be defined as the relative success or failure of the project in terms of its objectives.

Figure 8 shows the percentage of respondents identifying each project success category and includes both success factors and success outcomes identified. Figure 8a shows the percentage of respondents stratified by the critical success factors, and Figure 8b shows the percentage of respondents stratified by the critical success outcomes.

Figure 8a indicates that the factors perceived by the respondents to be most important for project success are quality management; ease of engineering, procurement and construction; technology evaluation; and, operations input. Thirty percent of the project representatives felt that quality management factors (teamwork effort, customer satisfaction, effective communications and guidance from management) impacted project success. E/P/C factors were identified by 21 percent of the respondents and include execution strategy, scope definition, basis of design, and constructability.



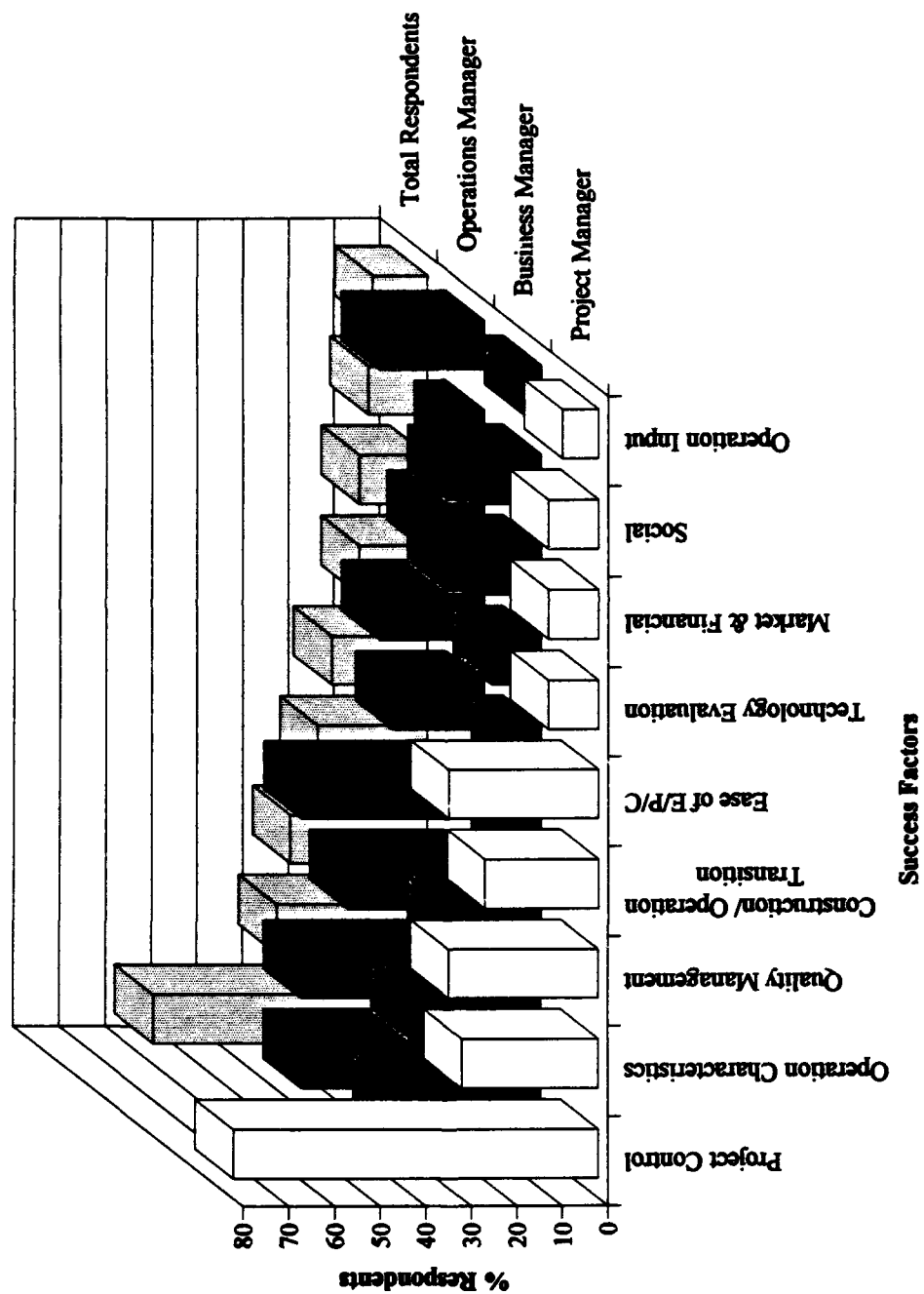
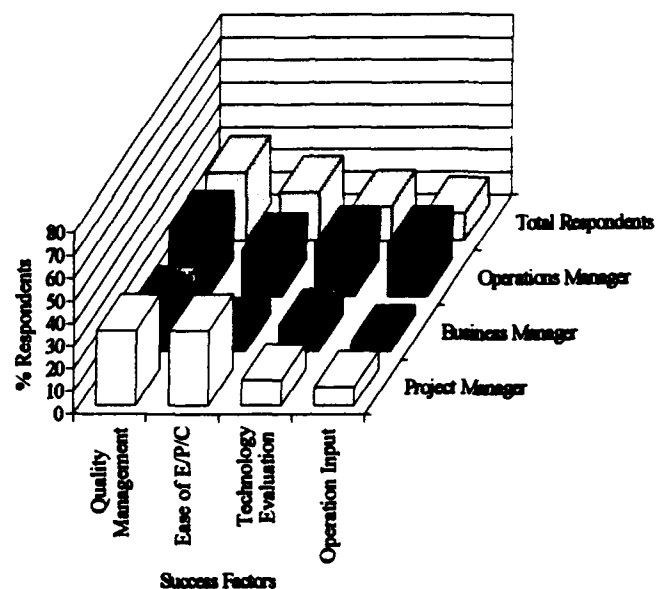
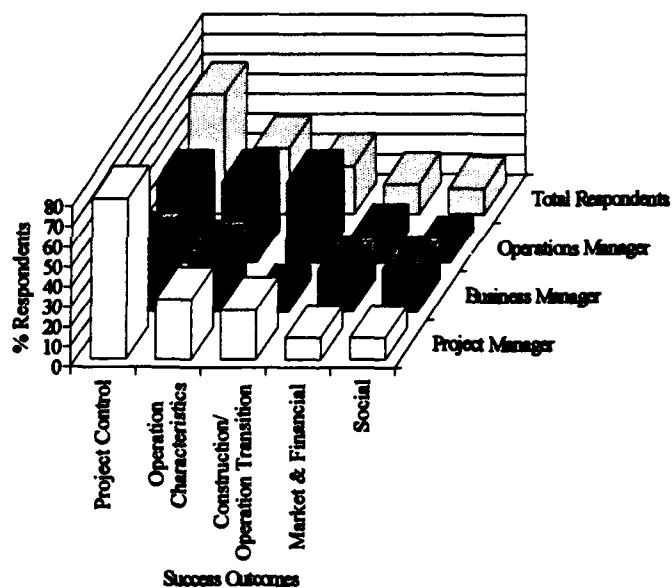


Figure 8. Success Factors and Outcomes Identified by the Respondents (N = 94)



**Figure 8a. Critical Success Factors Identified by the Respondents**



**Figure 8b. Critical Success Outcomes Identified by the Respondents**

Technology evaluation (identified by 15 percent of respondents) and operations input (identified by 12 percent) are new categories identified during the qualitative analysis that were not previously included in the project success categories developed by the task force. Technology evaluation is the proper analysis, testing, and adoption of technology to be used on the project. Operations input requires involving experienced operations personnel as part of the project team.

Figure 8b indicates the success outcomes considered most important by project representatives. More than one-half (60%) of the project representatives perceived that project control outcomes (cost, schedule, change management, number/magnitude of changes, and risk management) were important to their idea of project success. One-third (33%) of the project representatives indicated that operating characteristics (ease of operation, production quality, and availability) were important success outcomes. Construction/operation transition outcomes which include ease of start-up, ease of turnover, and operator training were identified by 24 percent of the project representatives. Market and financial outcomes were identified by 15 percent of the project representatives and social outcomes by 13 percent. Market and financial outcomes identified were: capture and maintain market share; enhance future position; gain competitive advantage; and meet financial authorization objectives. Social outcomes included: safety and health; environmental; community relations; labor relations; education and training; and legal and regulatory compliance.

Figure 8 indicates that, overall, the primary project success categories were project control, operational characteristics, and quality management. The same three primary project success categories were identified most frequently on the projects studied. Figure 9 shows that project control was identified by at least one respondent on 33

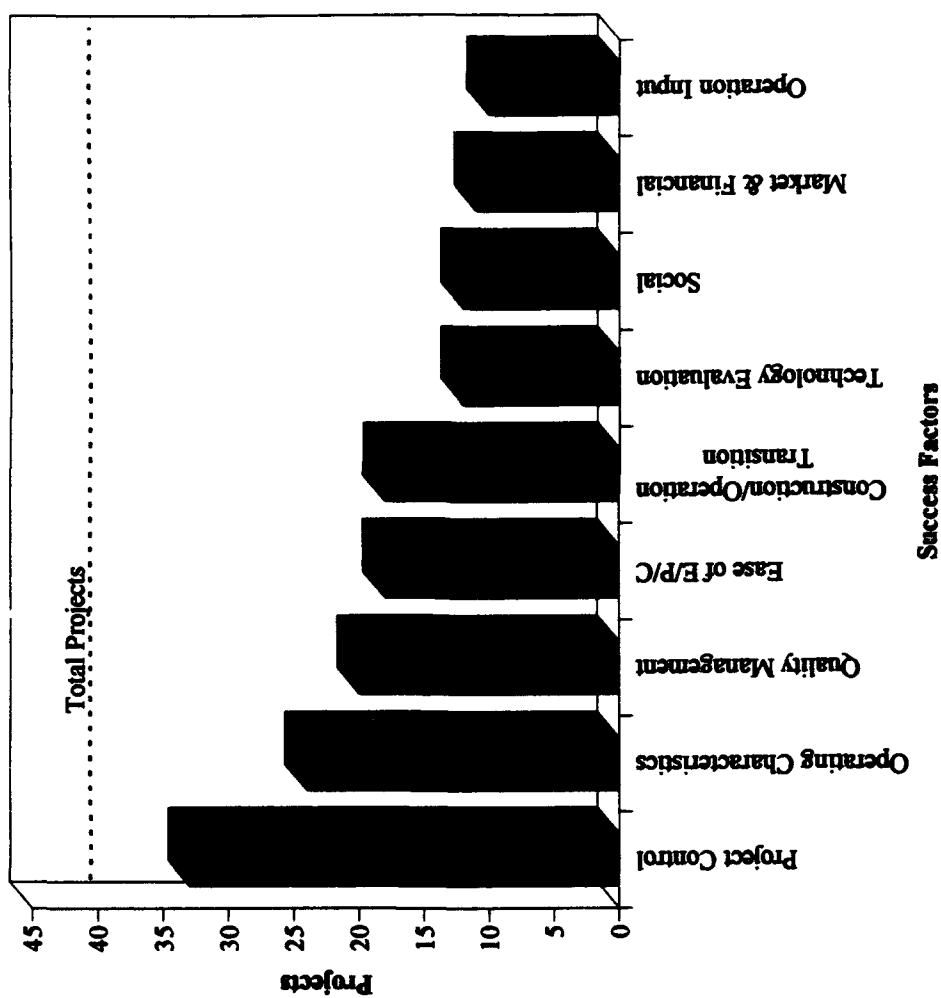


Figure 9. Success Factors and Outcomes Identified on Projects (N = 41)

(80%) of the 41 projects studied. Operating characteristics were identified on 24 (58%) projects, and quality management was identified on 20 (49%) projects.

While it is clear from Figure 8 that all three groups of project representatives are concerned with project control, it is also clear that the groups have some different opinions about project success. The difference of opinions appears less significant when comparing project managers and operations managers and appears more significant when comparing the opinions of these two groups with those of business managers.

The overwhelming concern of project managers was project control outcomes. Eighty percent of the project managers identified project control outcomes as important to their idea of project success. The next two most frequently mentioned success outcome categories were operating characteristics, identified by 30 percent of the project managers, and construction/operation transition, identified by 25 percent of the project managers. The project managers identified quality management (33%) and ease of engineering, procurement, and construction (E/P/C) (33%) as the most important success factors.

The project managers' focus for project success appears to be on the execution phase (design and construction) of the project. The project manager is also concerned with turning over the project to the operations manager. This emphasis on the execution phase of projects might be due to the project managers' normal association with construction projects. Project managers are assigned, sometimes with much of the planning already complete, to ensure a project is executed in a quality manner, within the budgeted cost, and on schedule. This emphasis may also be due to the fact that project managers are more often evaluated by their performance in these areas.

The operations managers were similar to the project managers in their concerns about project success, but with a few exceptions. Operations managers identified project control outcomes and quality management factors as important but to a lesser degree than project managers. Forty percent of operations managers identified project control outcomes and 30 percent identified quality management factors. The operations managers were more concerned than any other group with operating characteristics and the construction/operation transition categories. These two outcome categories were both identified by 40 percent of the operations managers as important project success outcomes.

The operations managers identified operations input and technology evaluation as important factors to project success much more frequently (27 percent) than the other groups of representatives. Less than 11 percent of the business managers and project managers identified these categories as important. Some representative responses identifying these two categories are as follows:

*One key thing was we had the engineers from the existing plant come out to be part of the engineering design group and remained on the project team through start-up. Once the expansion was complete they went back to work as plant engineers. (P047, Proj. Mgr.)*

*We started engineer and design before technology figured out; we had to redesign many facilities; if we had a clear idea of technology of the project up-front it would have been an extremely successful undertaking. (P025, Op. Mgr.)*

*New type technology used that was risky, but paid off with high product reliability and a best of its kind facility. We did lots of field testing and convinced ourselves this was feasible technology. (P020, Bus. Mgr.)*

*No communication or input from operators (or customer) was allowed, ... e.g., customer knew soil conditions but our engineers didn't listen to them. (P038, Op. Mgr.)*

It appears that operations managers are more concerned with the downstream results of the planning and execution phases of the project. Operations managers are

very interested in a successful transition between construction and start-up and a plant that operates as planned. As indicated in the above comments, many operations managers feel they should have more input during the planning of the project, especially when involving technology evaluation. Operations managers feel that their experience can be utilized during project planning.

The business managers identified project control outcomes (33%) as important to project success, but to a lesser degree than the project and operations managers. Twenty-nine percent of the business managers identified operating characteristics as important to project success. Social and market and financial outcomes were identified by 21 percent of the business managers, which is considerably more than the other two groups of representatives. Quality management factors were identified by 29 percent of business managers as the most important success factor. The business manager indicated very little concern, when compared to the other two groups, for ease of E/P/C factors and construction/operation transition outcomes.

The business managers perceptions about project success factors and outcomes might indicate that he/she is more concerned with the overall project from a "macro" level rather than how well it is executed (project manager) or how well it operates (operations manager). The business managers appear more concerned with success outcomes than with the factors that influence the outcomes. In other words, they seem to be more globally focused with emphasis on achieving an overall quality project that meets cost, schedule, and regulatory objectives, and is profitable for the company.

### 5.1.2. Analysis of Improvement Areas

Question 10b was asked in order to determine the perceptions of the project representatives regarding which factors require more emphasis in order for a project to be more successful.

The perceptions of project representatives as shown in Figure 10 indicate that there are many factors requiring more emphasis to improve project success, and to a lesser extent, some outcomes were identified for emphasis. While there are some areas that were identified more frequently than others, there are no areas that clearly stand out. The same conclusion can be drawn from Figure 11. The identical areas were identified on the projects with approximately the same level of frequency as in Figure 10. Again, there were no primary areas identified significantly more than others.

Quality management factors were identified by 26 percent of the respondents for improvement. Emphasis on pre-project planning and technology evaluation were each identified by 25 percent of the respondents as improvement areas for project success. Technology evaluation was identified on 21 (51%) projects and emphasis on pre-project planning on 16 (39%) projects. Emphasis on pre-project planning is a new category identified during the qualitative analysis that was not included in the original project success categories developed by the task force. Emphasis on pre-project planning is described as placing emphasis and dedicating resources to conducting thorough pre-project planning.

Two other new categories identified as improvement areas are closely related to emphasis on pre-project planning. Estimating was identified by 12 percent of the



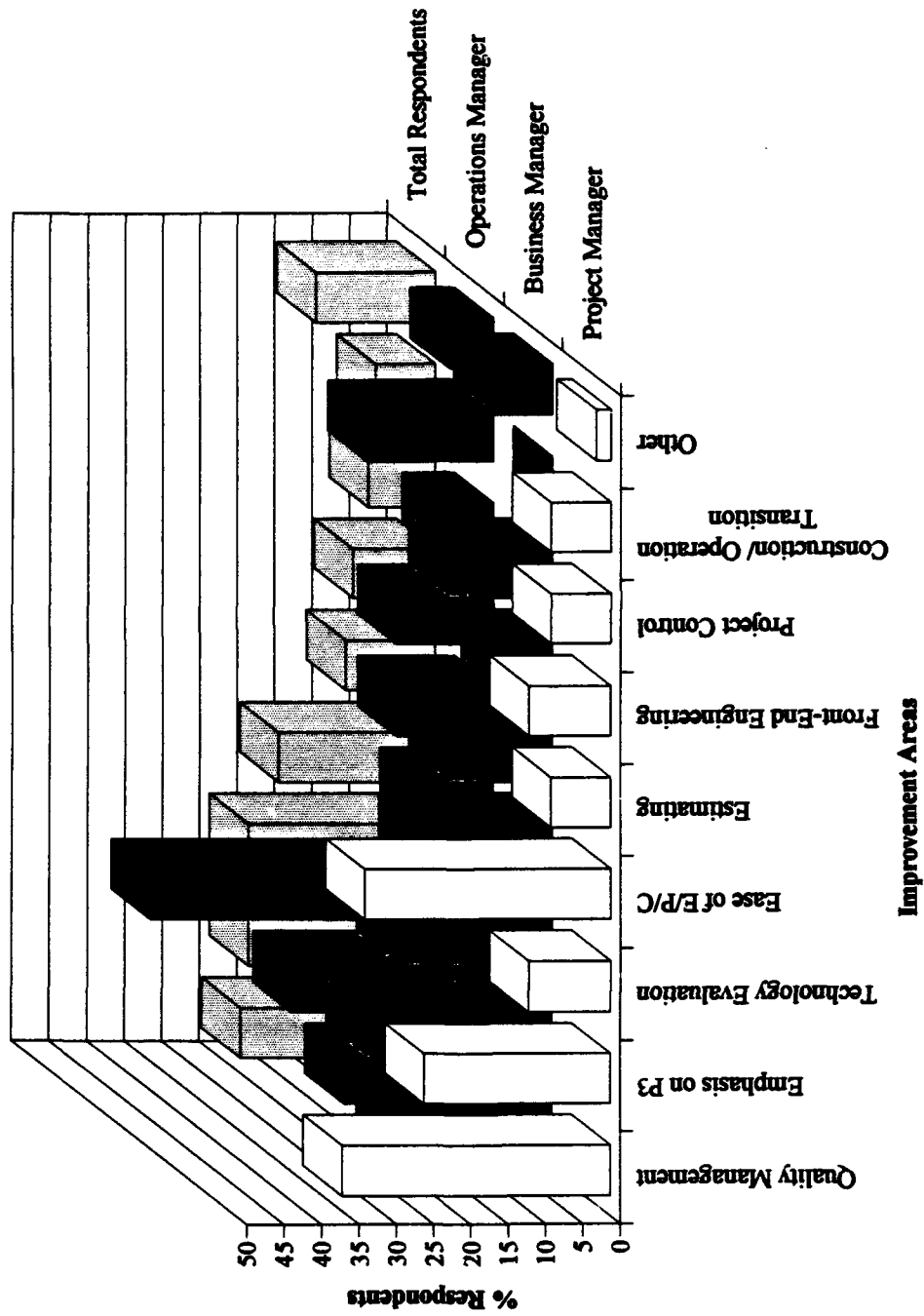


Figure 10. Improvement Areas for Project Success

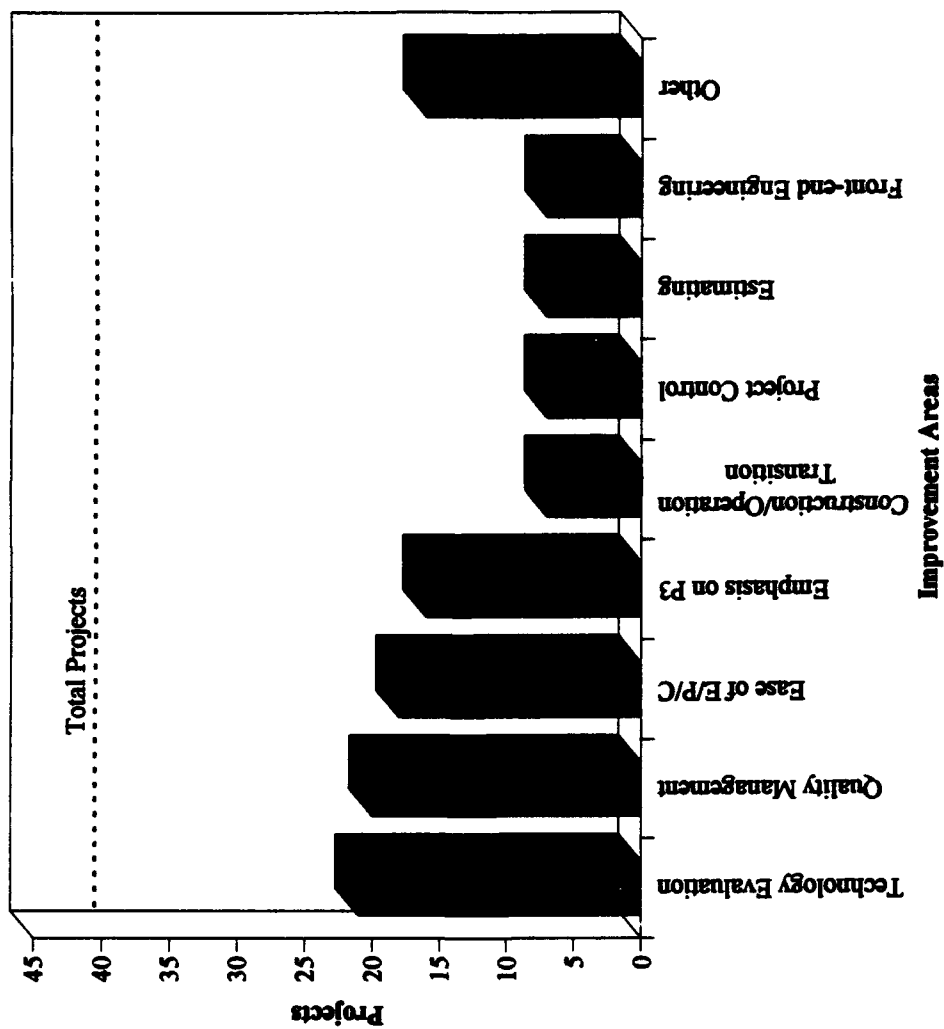


Figure 11. Improvement Areas for Projects Success Identified on Projects

respondents, and front-end engineering was identified by 11 percent. Both categories were identified on seven projects. Front-end engineering is the amount and quality of design and engineering done up-front or during project planning. These areas are functions of the pre-project planning process and were considered as improvement areas by project representatives. Some of the responses identifying these improvement areas are as follows:

*Took a huge risk committing to project with far too little front end engineering. Very poor estimate of cost; estimate kept changing. ... We have pledged to doing a lot more pre-project planning, engineering, and better cost estimating. (P008, Bus. Mgr.)*

*Area to improve is planning for engineering resources: (project engineers, process control, and process engineers), project took place during a very busy period—people stretched thin. (P017, Proj. Mgr.)*

*More design before authorization. Significant number of mechanical interferences; mechanical constructability checks. (P097, Proj. Mgr.)*

Also considered as improvement areas were ease of E/P/C (identified by 21 percent of respondents and on 18 (44%) projects), project control (18 percent of respondents and 13 (24%) projects), and the construction/operation transition (8 percent of respondents and 7(17%) projects). As previously identified in the responses to question 10a, project control and construction/operation transition are project outcomes that were indicated as needing emphasis.

The "Other" category in Figure 10 includes two project outcomes, social and operating characteristics, that were identified few times by project representatives as needing emphasis on a few occasions. Operations input and market forecast factors were also identified only a few times as needing improvement and were included in the "Other" category.

Figures 10 and 11 show that there are no improvement areas identified as most significant by all the respondents. However, there is some variation between the groups regarding the relative importance of each improvement area. Each individual group had improvement areas that they were more concerned with than other areas.

More than any other group, the project managers perceived that significant improvement could be made in the area of ease of E/P/C. Thirty-three percent of the project managers identified this as an improvement area. The project managers also felt that much improvement could be made in the area of quality management (identified by 25 percent of the project managers).

Twenty-five percent of the project managers identified the amount of emphasis placed on pre-project planning as an improvement area. However, the project managers had little concern for some of the more specific improvement areas related to pre-project planning such as technology evaluation, front-end engineering, and estimating. In addition, project managers were not as concerned with improving the construction/operation transition.

The improvement areas identified as more significant by the project managers corroborates the results of the previous analysis of success factors. The project managers were most concerned with improving areas related to the execution phase of the project. The project managers did feel that, in general, more emphasis on pre-project planning would contribute to project success. However, they did not identify with much frequency the specific areas related to pre-project planning, which again alludes to their focus on execution.

The operations managers were significantly more concerned than any other group with first, the improvement of technology evaluation and then, emphasis on pre-

project planning. Forty-six percent of operations managers identified technology evaluation and 27 percent identified emphasis on pre-project planning as improvement areas. These categories are closely related since technology evaluation occurs during pre-project planning. The operations managers described technology evaluation as a detailed analysis of new and existing technology to be employed in the facility and important during the planning of the project.

The operations managers were also more concerned than the other representatives with the construction/operation transition (17 percent identified this category). None of the business managers and only eight percent of the project managers identified the construction/operation transition as an improvement area.

As in the previous section analyzing success factors, the operations managers were again concerned with factors that relate to the operation of the facility. In this case, the operations managers were concerned with improving areas during project planning that will ultimately affect the operation of the facility. The operations managers felt that more emphasis on improving technology and front-end engineering during planning would contribute to a more successful project.

The business managers had no specific area that they were most concerned with improving. Twenty-five percent of the business managers identified emphasis on pre-project planning, and 21 percent identified technology evaluation. Another area related to pre-project planning identified by the business manager for improvement was estimating. Fourteen percent of the business managers indicated that poor estimating was a frustrating cause of exceeding budgets. Eighteen percent of the business managers identified ease of E/P/C as an improvement area, and eight percent

indicated that project control outcomes required emphasis. The business managers did not identify the construction/operation transition.

Analysis of the business managers improvement concerns reinforces the findings of the previous analysis regarding success factors. The business managers as a group seem to be more concerned with the overall project. They felt that emphasis on improving project planning especially in the areas of technology and estimating would contribute to a more successful project.

A significant conclusion of the analysis of the improvement areas is that most perceptions of the project representatives concerning project improvement relate to pre-project planning. The perception of project representatives seems to be that improving areas related to pre-project planning will produce more successful projects. Thus, in the opinion of project representatives, pre-project planning is needed and positively contributes to project success.

#### 5.1.3. Analysis of Pre-Project Planning Effort Factors

Figures 12 and 13 show that several categories emerged as important to the project representatives for successful pre-project planning. Two primary categories were identified more frequently than others. Time and resources was identified by 41 percent of the respondents and on 26 (63%) projects, and project definition package was identified by 35 percent of the respondents and on 22 (54%) projects.

Time and resources is a new category that was not originally identified as part of the pre-project planning success categories developed by the task force. It was defined by the project representatives as enough time and resources dedicated to pre-project planning and also included a team composed of appropriately skilled and

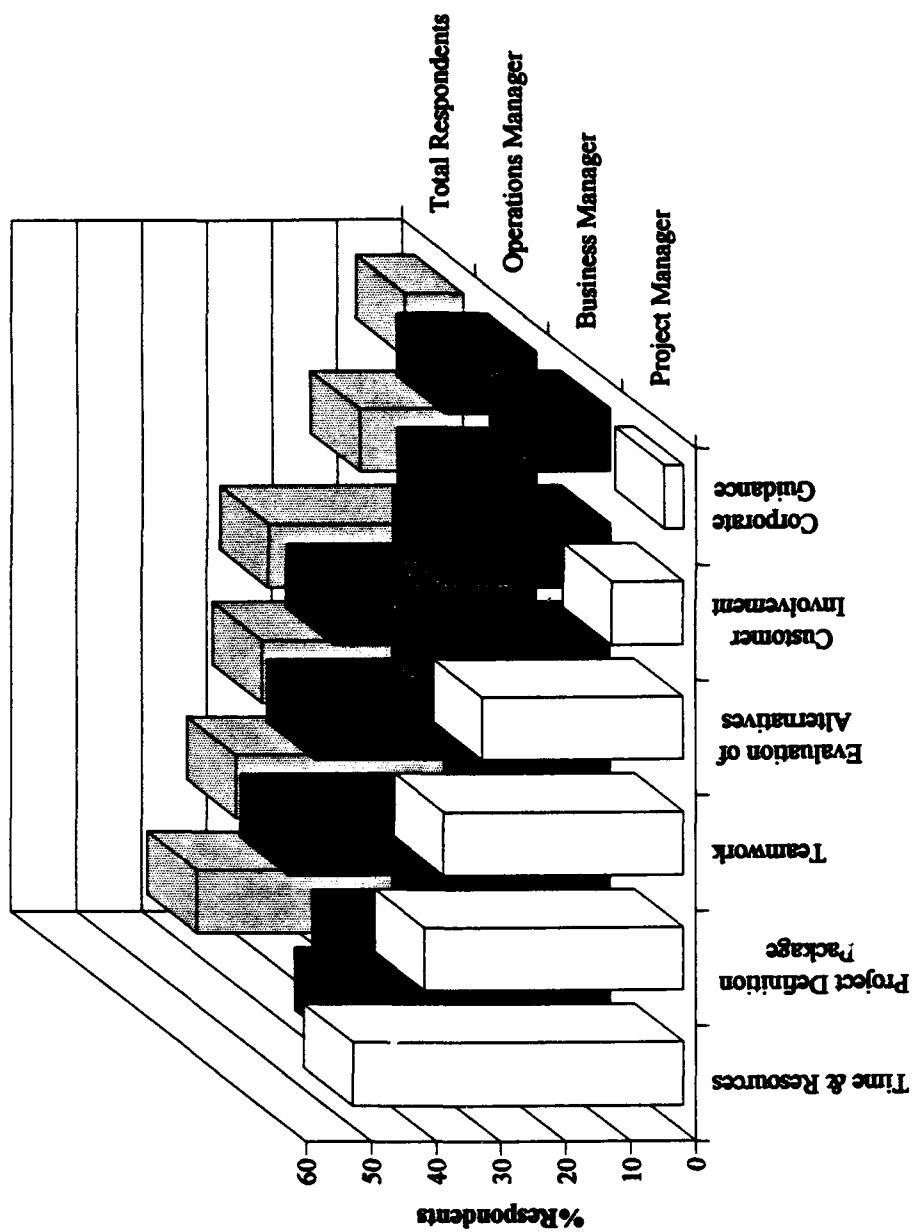
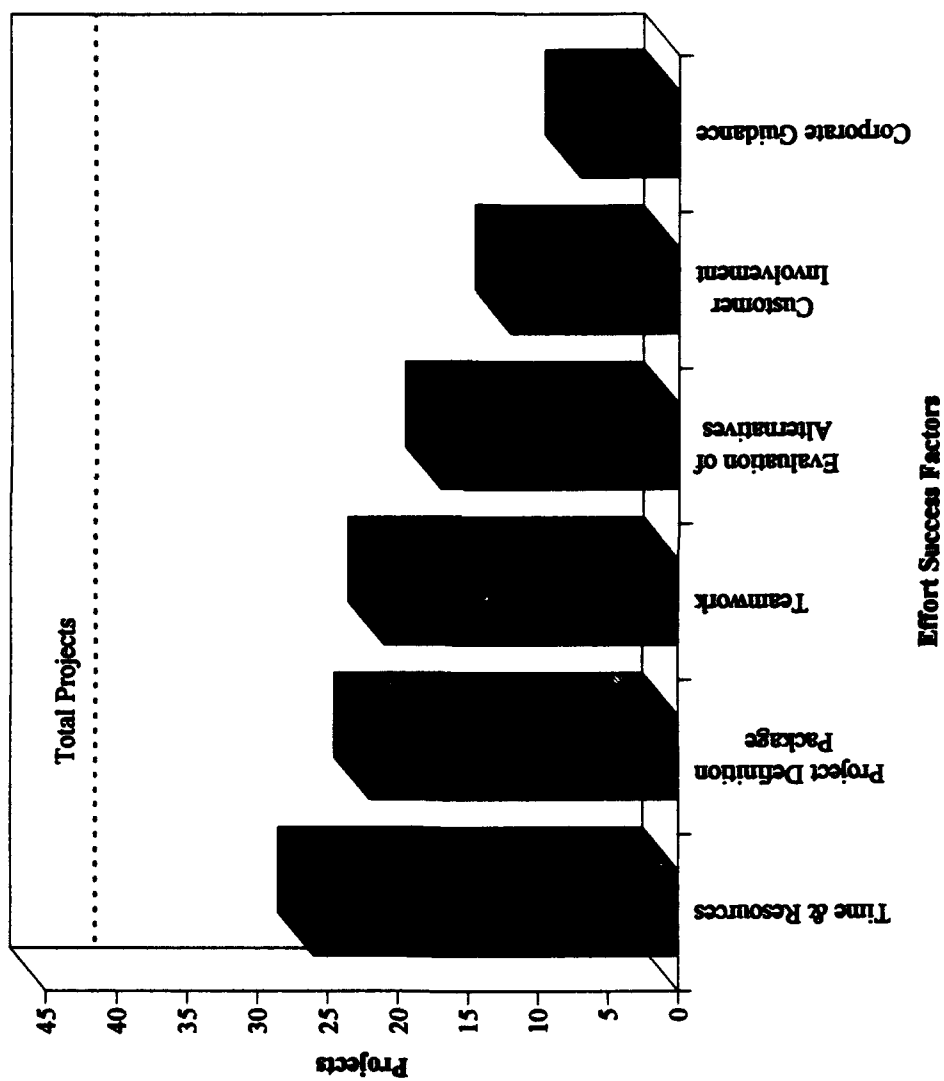


Figure 12. Effort Success Factors of Pre-Project Planning



**Figure 13. Effort Success Factor: Identified on Projects**



experienced personnel. Some of the representative comments identifying this category were as follows:

*Insufficient time was allocated to develop sound premises and definition. Simply allow time to do better job. (P008, Proj. Mgr.)*

*In my experience this was the best (project) I was involved with. ... All resources were made available and were not a problem. We didn't try to cut costs on this one: high public profile. (P034, Bus. Mgr.)*

*Number of participants from all the business areas: marketing, plant operations, R & D, etc. Participants were all top qualified and dedicated people. Lots of experience on team, and team was dedicated full-time to this project. (P035, Proj. Mgr.)*

*Team was limited by time, but lots of effort was put into pre-project planning and meeting the end date. However, just not enough time to do thorough evaluation of alternatives and get all the information needed. (P012, Op. Mgr.)*

Responses identifying the project definition package as important included such factors as execution approach, control guidelines, risk assessment, quality emphasis, percent design complete at authorization, and appropriate scope definition and cost estimating. This category is related to some of the improvement areas for project success discussed in the previous section. Front-end engineering, estimating, and ease of E/P/C all include functions related to the project definition package.

Teamwork was another category that all three project representative groups felt was important to successful pre-project planning. Teamwork was identified by 33 percent of the respondents and on 28 (71%) projects. Teamwork factors included how well individuals worked together, team continuity, team building, and multi-disciplinary team. Having a multi-disciplinary team was identified more often than any other teamwork factor and is defined as having personnel from all organizations within the corporation and from outside parties involved in pre-project planning. Some representative comments identifying the importance of teamwork were as follows:

*I feel that we did not have the teamwork that we could have had. ... Better teamwork would have helped earlier identification of technical problems. (P021, Bus. Mgr.)*

*There was the right quality and types of people involved and good effort. Good team work toward common objectives. Developed internal objectives: committed ourselves to doing things right. (P028, Proj. Mgr.)*

*Considerable amount on team building and total quality management. Real effort on these between owner, contractor, and all organizations involved. This paid off. (P033, Bus. Mgr.)*

*Extensive team building with the help of a consultant; we monitored the team process by measuring how well we were doing and got back on track if we were off-track ... excellent open atmosphere—good for input and teamwork on all issues. (P033, Op. Mgr.)*

Evaluation of alternatives was yet another category that all three groups felt important as criteria for measuring pre-project planning. This category was identified by 30 percent of the respondents and on 17 (41%) projects. The factors identified for this category were alternative selection concerning site or technology and technology evaluation. Technology evaluation was also identified earlier as a success factor and improvement area for project success.

The final two categories identified by all three groups for successful pre-project planning were customer involvement and corporate guidance. Customer involvement was identified by 16 percent of the respondents and on 15 (36%) projects. This is a new category that was not identified in the original list of pre-project planning success categories developed by the task force. The category was described by the project representatives as involving the customers of the project in the planning process. Corporate guidance was identified by nine percent of the respondents and on eight projects. It was described as the clear and consistent communication of corporate guidelines during the pre-project planning process.

There is some variation in the percentage of representatives identifying each category both within the groups of representatives and when comparing the groups.

All three groups were concerned with having adequate time and resources for successful pre-project planning. The operations managers and project managers were more concerned with the project definition package, teamwork, and evaluation of alternatives than other categories. With the exception of time and resources, the business managers did not identify any categories significantly more than others. In addition, the business managers were less concerned with the project definition package, teamwork, and evaluation of alternatives than the other two groups.

This appears to support the general trend that has been established in the previous analyses. The business manager maintains a more global view and is concerned with several areas for successful pre-project planning. The project manager and operations manager are more focused on specific pre-project planning success factors that will affect the execution and operation of the project.

The analysis of the factors identified for successful pre-project planning contribute to the validation of the pre-project planning model developed by the task force. The success factors identified by the project representatives are addressed within the major sub-processes outlined in the model. These sub-processes of the pre-project planning model are shown in Figure 2 (Project Life Cycle Diagram). The major activities are further decomposed into functions in Figure 3 (Node-Tree for Pre-Project Planning). For a detailed presentation of the pre-project planning model developed by the task force see Modeling Pre-Project Planning for the Construction of Capital Facilities (Gibson et al. 1993).

The perceptions of the project representatives were that adequate time, resources, and teamwork were important for successful pre-project planning. The model incorporates these categories under the sub-process of "organize for pre-project

planning". Project representatives felt that the evaluation of alternatives including technology evaluation were important during pre-project planning. These categories are included in the model within the "select alternatives" sub-process. The project representatives also stressed the importance of developing a timely and accurate project definition package which is included as a major sub-process in the model. In addition, the representatives indicated that customer involvement and corporate guidance were important to successful pre-project planning. These factors are stressed throughout the pre-project planning model.

#### 5.1.4. Analysis of Pre-Project Planning Improvement Areas

Question 14b was asked in order to determine the perceptions of the project representatives about what areas of pre-project planning require more emphasis. Figure 14 and 15 show that, according to the opinions of the project representatives, there are three primary areas of pre-project planning needing improvement: project definition package, time and resources, and teamwork. All three of these areas were also considered important for successful pre-project planning in the previous analysis. The project representatives agreed that the project definition package was the area requiring the most improvement. Project definition package factors were identified by 36 percent of the respondents and on 24 (58%) projects. Time and resources (identified by 26 percent of the respondents and on 18 (44%) projects) and teamwork (24 percent respondents and 18 (44%) projects) were also considered key improvement areas by all three groups.

Two new categories not previously identified that were considered improvement areas were communication and pre-project planning methodology. Communication

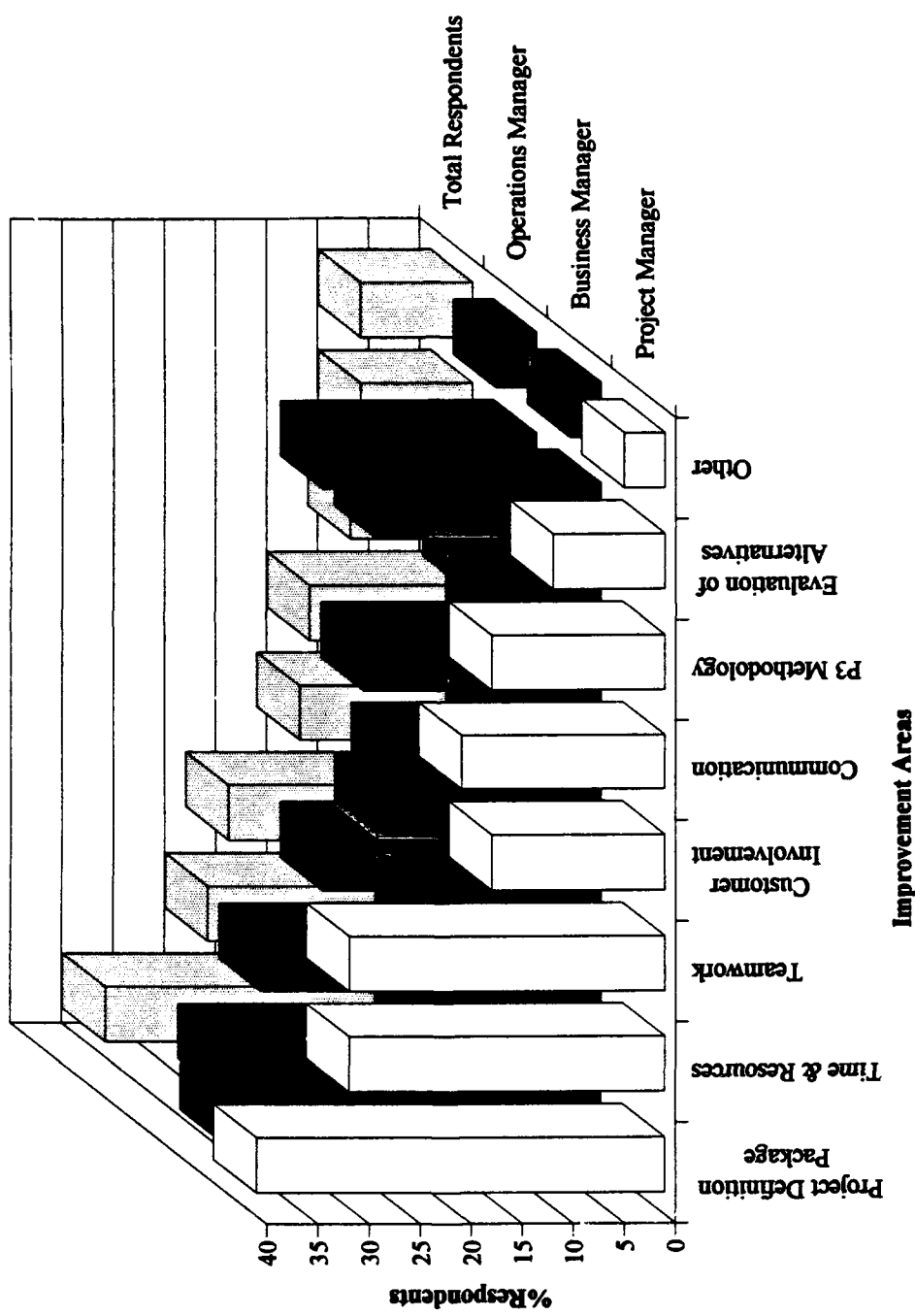


Figure 14. Improvement Areas for Pre-Project Planning

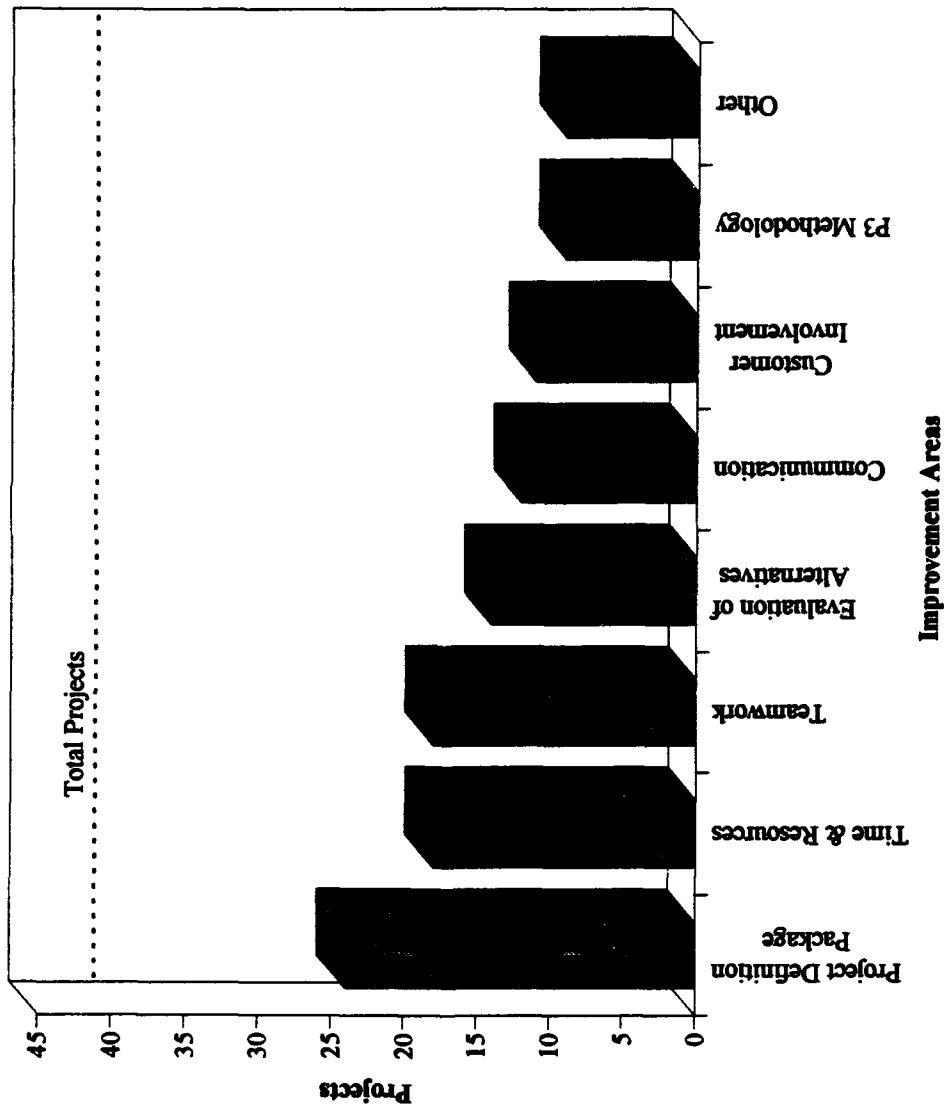


Figure 15. Pre-Project Planning Improvement Areas Identified on Projects

was identified by 16 percent of the respondents and on 12 (29%) projects. Many project representatives expressed the importance of quality communication throughout the organization:

*Not enough follow through by planners into design and construction phase. Planners don't stay with the project and there is not enough communication back and forth. (P041, Proj. Mgr.)*

*(Owner) is too autocratic and intimidating; this sometimes hampers communication of information. Better communication--this is improving; listen to input. (P043, Bus. Mgr.)*

*Good effort to ensure open/frequent/consistent communications: weekly meetings very helpful in resolving issues. (P024, Op. Mgr.)*

*Better communications and understanding to and from upper management so they understand the implications of what's developed. (P010, Proj. Mgr.)*

Pre-project planning methodology was identified by 12 percent of the respondents and on nine projects. This improvement area was defined by the representatives as a formal plan or road map to follow for conducting pre-project planning. Some project representatives expressed concern that their companies did not have a specific methodology for pre-project planning or did not follow the one they had:

*We are trying to change the method of authorization so that it is more defined, especially in area of risk; What investment can we tolerate? (P025, Bus. Mgr.)*

*Today, we have a formal pre-project planning method that involves all people and produces a project execution plan. This is a vast improvement. (P029, Proj. Mgr.)*

*We need to have documented guidelines for P3; need a road map to adhere to. (P043, Proj. Mgr.)*

Evaluation of alternatives and customer involvement were also identified as improvement areas. Customer involvement was identified by 17 percent of the respondents and on 16 (39%) projects. Evaluation of alternatives was identified by 11

percent of the respondents and on 14 (34%) projects. The "other" category consists of two improvement areas identified by less than eight percent of the respondents: corporate guidance and market forecast.

Based on the analysis of the pre-project planning improvement areas, there again appears to be general support for the trend that has been established in the previous analyses. The project managers and operations managers groups have approximately similar concerns about improvement areas for pre-project planning. Both project managers and operations managers appear to be concerned more with improving the project definition package, time and resources, teamwork, and, communication. With the exception of the project definition plan, the business managers did not identify any improvement areas more frequently than others.

One exception to the established general trend can be found in the category of evaluation of alternatives. In the previous analysis of pre-project planning success factors, the project manager and operation manager groups both identified this category with the same level of frequency. However, Figure 14 shows that the project manager is much less concerned with the evaluation of alternatives as an improvement area than both the business manager and operations manager. One possible explanation for this is that project managers were significantly more concerned with improving the project definition package since it will directly affect the execution phase of the project. The evaluation of alternatives contributes to the definition package, thus only indirectly affecting execution.

In addition, the project manager is more concerned than the other groups with improving communications and pre-project planning methodology. This might result from his responsibility for coordinating and conducting pre-project planning. It should



be noted, however, that some project managers expressed concern that they were not involved with some projects until after pre-project planning was completed.

The analysis of the improvement areas further supports the validation of the pre-project planning model developed by the task force. The areas identified as needing improvement are included within the major sub-processes of the pre-project planning model. In addition, the concern of project representatives for a formal methodology for conducting pre-project planning underscores the usefulness of the model. Owners can use the model as a basis for developing a pre-project planning process specific to their company.

## **5.2. Analysis of Pre-Project Planning Effort and Project Success Ratings**

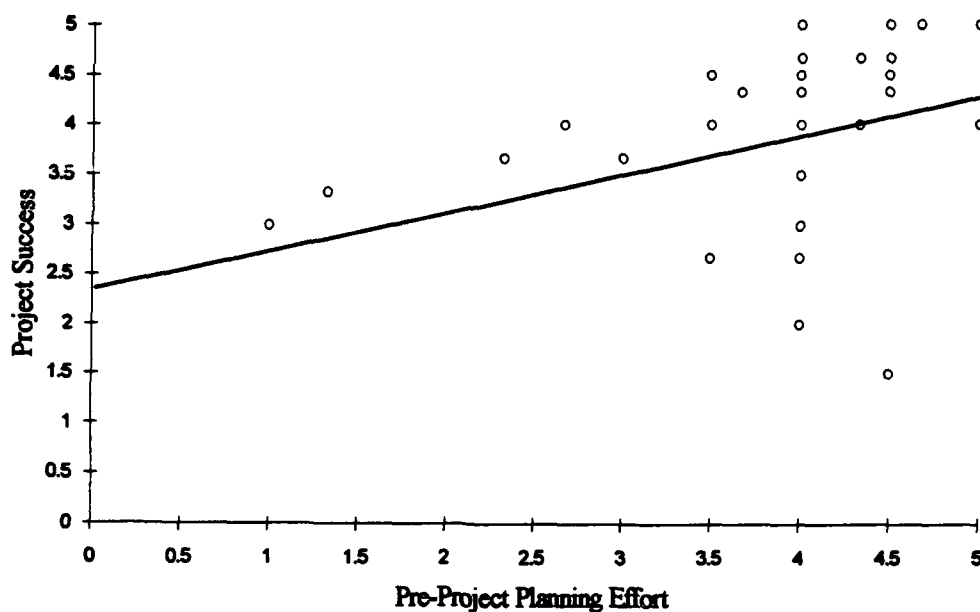
It can be concluded from the preceding qualitative analysis of the perceptions of project representatives that some relationship exists between pre-project planning and project success. Project representatives feel that more effort expended on pre-project planning will result in more successful projects. To investigate this relationship further, an analysis of the pre-project planning effort ratings and success ratings was conducted.

### **5.2.1. Correlation Analysis**

For each project, the representatives rated success and pre-project planning effort on a scale of 1 to 5. For success, a rating of 1 was very unsuccessful and a rating of 5 very successful. For pre-project planning effort, a rating of 1 was very low effort and a rating of 5 was very high. To assist in the analysis, the success and effort ratings of

the respondents for each project were averaged. The result was an overall pre-project planning effort and project success rating for each of the 41 projects.

The comparison of effort and success rating for each project is displayed graphically in Figure 16. The x-y plot, with pre-project planning effort on the x-axis and project success on the y-axis, shows that the majority of projects with a high effort rating also had a high success rating. The correlation coefficient (R) was calculated to be 0.38, indicating that a weak positive relationship exists.



**Figure 16. Pre-Project Planning Effort vs. Project Success (Project Average Ratings for N = 41)**

A possible explanation for the relatively weak relationship is the subjective nature of the questions asked. The scale for rating project success and pre-project planning effort is relative. Thus, what one representative considers successful may be considered unsuccessful by another. In addition, representatives may have a poor

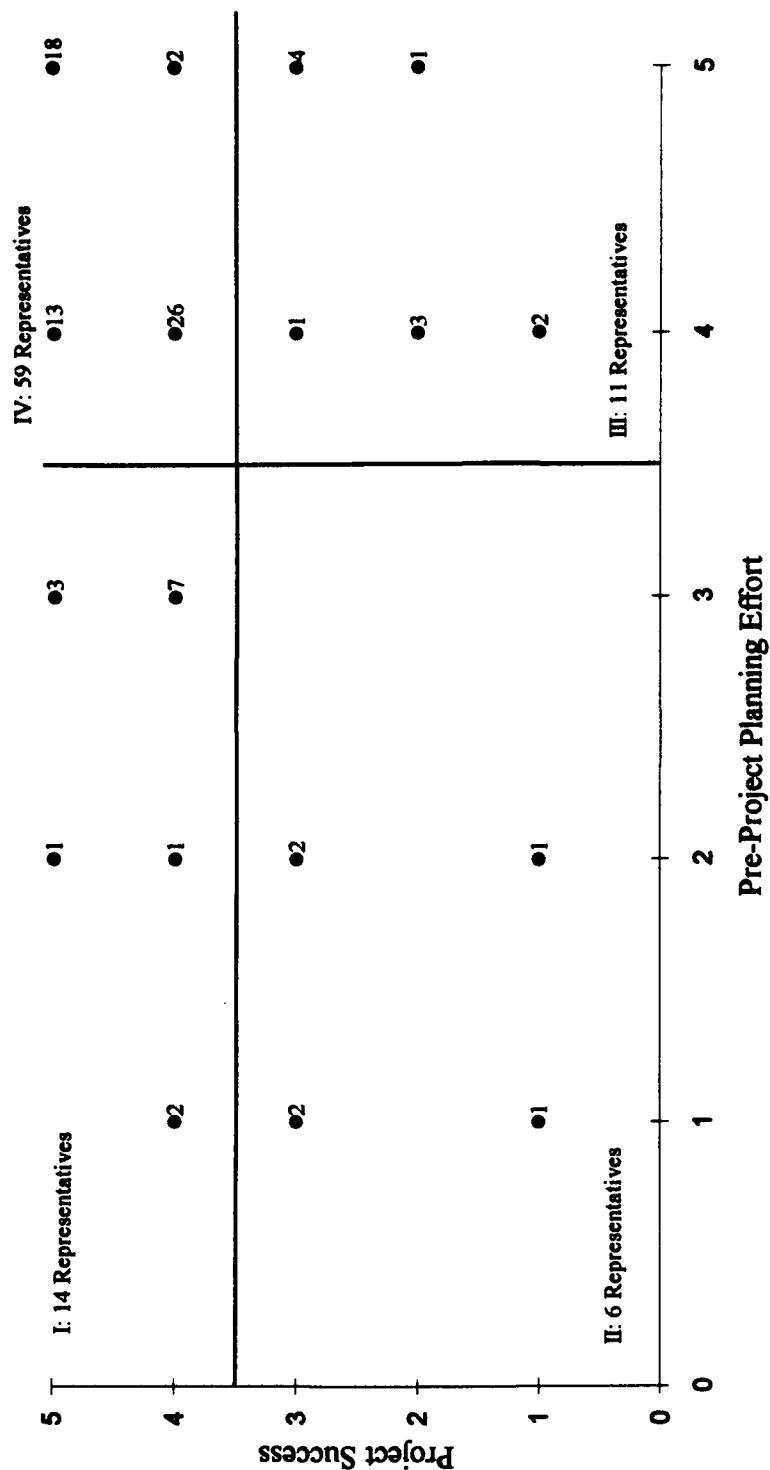
understanding or difference of opinion about what constitutes pre-project planning effort.

### 5.2.2. Quadrant Analysis

Another analysis conducted was to investigate further, on a case-by-case basis, the projects that did not follow the expected trend of high pre-project planning effort resulting in increased project success. Of particular interest were those projects rated low effort and high success, and those rated high effort and low success. An analysis of the project representatives' perceptions concerning effort and success on these projects might provide some explanation as to why they were exceptions to the established trend.

Of the 94 interviews conducted, 89 representatives gave project ratings for both pre-project planning effort and project success. As previously discussed, for this study projects rated 1 to 3 for success were considered less successful, while projects rated 4 or 5 were considered more successful. For pre-project planning effort, projects rated 1 to 3 were considered as having less effort, while projects rated 4 or 5 were considered as having more effort. The pre-project planning effort versus project success ratings of 89 project representatives are displayed graphically in Figure 17. A line was drawn along the 3.5 rating for both effort and success establishing four quadrants:

- Quadrant I: Low pre-project planning effort and high project success
- Quadrant II: Low pre-project planning effort and low project success
- Quadrant III: High pre-project planning effort and low project success
- Quadrant IV: High pre-project planning effort and high project success



Note: Many respondents gave identical ratings; therefore, one data point may represent more than one respondent. The number of representatives for each data point is annotated to the right of the data point.

Figure 17. Pre-Project Planning Effort vs. Project Success (Project Representative Ratings for N = 90)

When arranged into quadrants, the perception ratings of the project representatives seem to support the conclusion of previous analyses: more effort expended on pre-project planning will result in more successful projects. Of 70 representatives rating projects with high effort, 59 gave ratings of high success (quadrant IV). However, it would also be expected that projects having low effort ratings would be considered less successful. This was not always the case. Of 20 representatives characterizing projects with low effort, only six considered the projects to be unsuccessful (quadrant II). Thus, 14 representatives considered projects successful even though the projects were rated as having low pre-project planning effort (quadrant I).

To identify possible reasons why projects were exceptions to the high effort-high success relationship, a more detailed analysis of representatives' perceptions concerning these projects was conducted. In addition, perceptions of projects rated low effort and low success (quadrant II) were analyzed to determine possible causes of poor effort and the circumstances for project success.

#### 5.2.2.1 Analysis of Quadrant I

Fourteen of the project representatives indicated that 12 of the projects in the study had little pre-project planning effort, yet were still successful projects. It must be noted that other project representatives felt differently about the same projects. Some representatives agreed that there was little pre-project planning effort expended on the project, but they perceived the result was an unsuccessful project (quadrant II). Some representatives indicated the project had both high effort and high success (quadrant IV). In addition, on one of the 12 projects, a representative felt the exact opposite of his colleague indicating there was high pre-project planning effort, but low

project success (quadrant III). This underscores the previous discussion that project success is viewed differently by each project participant, and many project participants have a different understanding of what should occur during pre-project planning. Nonetheless, the perceptions of project representatives in quadrant I were analyzed to determine possible explanations why the projects were considered a success in spite of low pre-project planning effort.

Five of the projects were considered by representatives to be a success for marketing and financial reasons. These projects resulted in a good return on investment for companies by entering the market at the right time, providing a competitive advantage, or providing additional capacity to meet market demand.

Representatives also expressed some unsuccessful aspects of these projects that attributed to the poor effort expended on *pre-project planning*. Three of the projects had significant cost overruns. For example, one representative commented that as a result of a poor project definition package, the project budget was exceeded by 200 million dollars. Yet, this project was considered successful because of the return on investment it provided, and because it was determined from a benchmarking study that the project was actually under the industry average cost for similar projects. Two of the projects considered financial successes had schedule delays attributed to poor pre-project planning. One project involved the use of complex technology not evaluated thoroughly during pre-project planning. The technology had to be upgraded after start-up, delaying production. The other project was delayed by environmental regulations that were not complied with. This problem was attributed to poor technology evaluation and communication during pre-project planning. In spite of the

problems alluded to above, the projects were profitable and for this reason considered successful by the representatives.

Seven of the projects were considered successful by project representatives simply because they met most of the project objectives. Analysis of the representatives comments reveals that four of these projects were duplications of previous projects. These four projects used most of the same technology and were approximately of the same scope as previous projects. Thus, there was little pre-project planning expended on these projects since much of the planning work from previous projects was utilized.

Representatives from these projects cautioned, however, not to underrate the level of pre-project planning required for "copy projects." While the projects were duplications of previous efforts, there were some new problems encountered. Environmental considerations that were overlooked on two of the projects resulted in changes and rework. New technology that was not thoroughly evaluated on the other two projects resulted in numerous changes and cost overruns. Thus, the representatives noted that while less effort may be expended on duplicate projects, an appropriate amount of time and resources should still be allocated to work through the formal pre-project planning process.

The remaining three projects did not fit in any category. These projects were considered successful by all three project representatives interviewed for each project. However, there was disagreement about the level of effort expended on pre-project planning. For each project, two of the representatives felt there was high pre-project planning effort while one representative was dissatisfied with some aspect of the pre-project planning effort.

On one project, pre-project planning effort received a low rating from the operations manager because of failure to comply with environmental regulations. The approval of the project was delayed 15 years while environmental studies and public hearings were held. The operations manager on another project was particularly dissatisfied with the amount of personnel turnover on the pre-project planning team since he had to update each new member about the project. One project manager felt that not enough detailed design was completed, and the evaluation of alternatives was inadequate. According to this project manager, the result was numerous mechanical problems.

In summary, analysis of the perceptions of project representatives in quadrant I shows there are exceptions to the expectation that low pre-project planning effort will result in unsuccessful projects. According to project representatives, little pre-project planning effort can contribute to a project failing to meet cost, schedule, and other objectives. However, the same projects might still be considered an overall success if they meet or exceed financial or market objectives. This indicates there are other factors that have an impact on project success in addition to pre-project planning factors. On several projects, business planning conducted during the business planning stage of the project life cycle, or just plain luck, had a significant impact on project success in spite of poor pre-project planning effort.

Another exception is that some projects do not require as much pre-project planning as others. This is true of projects that are duplicates of previously completed projects. However, representatives cautioned that an appropriate level of formal pre-project planning is required even for duplicate projects. Finally, the analysis supports



the previous conclusion regarding disagreement among project representatives concerning what constitutes project success and pre-project planning effort.

#### 5.2.2.2 Analysis of Quadrant III

Eleven of the project representatives indicated that seven of the projects in the study had a high level of pre-project planning effort, yet were unsuccessful projects. As in the previous analysis, other project representatives felt differently about the same projects. Some representatives agreed there was high effort, but they perceived the result was a successful project (quadrant IV). Other representatives disagreed about the level of pre-project planning effort, indicating the projects had low effort and low success (quadrant II).

Three of the seven projects were considered unsuccessful for market and financial reasons. For these projects, the forecasted market never materialized for the product that was produced. A representative for one of the projects commented that the entire overseas market was lost to competitors who completed similar plants at approximately the same time. Representatives commented that the projects were well planned and executed, but that an inadequate business risk assessment was the cause for failing to meet financial objectives.

Two other projects were considered unsuccessful due to significant cost overruns and schedule delays. Yet, some of the project representatives felt there was a high degree of pre-project planning effort. On both these projects, representatives commented that the pre-project planning team relied on poor data in the planning process.

Representatives of one of these projects indicated that poor data for estimates, an inexperienced planning team, and pressure to meet an unrealistic target budget resulted in a 50 percent cost overrun. According to the business manager, this project would have never been authorized had there been a realistic cost estimate. Similarly, representatives for the other project noted that the pre-project planning team relied on poor maintenance data for existing generators and turbines. This resulted in major scope changes, cost overruns, and schedule delays late in the project execution.

The remaining two projects were interesting because of the considerable amount of disagreement among project representatives involved. To illustrate this disagreement, the responses to question 10 and 14 are shown below in Figure 18 for one project. All three representatives rated the project as unsuccessful (question 10), however the reasons for this rating vary. There is some agreement that cost and schedule were outcomes, but the representatives hold different views about other factors contributing to the project's lack of success.

The disagreement among project representatives is even more apparent when considering their perceptions about pre-project planning (question 14). The business manager and operation manager both rated the project as having high pre-project planning effort, but had contrasting opinions about the pre-project planning process. The business manager concluded that far too much time was spent on pre-project planning, especially in the area of technology evaluation, forcing the project a year behind schedule and leaving little time for design and execution. The operation manager, on the other hand, indicated there was not enough time allotted for pre-project planning and technology evaluation, resulting in a failure to meet project specifications. The project manager indicated that more time and resources were

**BUSINESS MANAGER**

10. 3

10a. -Blew schedule and budget; required a lot more resources than originally scheduled

-Project was not originally designed for the safer alternatives

-Too many risks taken; had huge overruns

10b. -Better and earlier communications between operators and designers; lots of problems could have been avoided; more communication is necessary between all parties

14. 5

14a. -By definition, we did a lot of P3; lots of time spent and full up testing of technology was done; as a result of the time spent in P3, this project fell a year behind schedule; I believe we had overkill in the area of P3; for example in the technology evaluation, we knew about all the proven technologies, yet we still tested everyone of them; too much testing

-Too much effort on P3 as opposed to detailed design

14b. -Tighten up the objectives and have more rigorous control over P3 schedule; take more risk considering technology that we already knew worked instead of testing everything to near perfect performance results

-Don't sacrifice engineering and detailed design for lots more testing; we fell way behind schedule, and we're still fixing problems today

**PROJECT MANAGER**

10. 3

10a. -We did not meet the scheduled in-service, had cost overruns, and commissioning difficulties

-One problem was that the operations organization never wanted this project and were never fully committed to it; it was a head office decision and people at the plant did not agree with it so there was no buy-in

-We committed to this project far too early, and there was little time for any good planning

10b. -Needed to do more P3; project was schedule driven and we didn't have any time for good planning

14. 2

14a. -Insufficient time and budget for P3; schedule driven project

-Not enough resources committed to the project; project was undertaken when manpower was stretched very thin

14b. -Need more P3; more time and resources need to be committed

**OPERATIONS MANAGER**

10. 3

10a. -Initial goals(load requirements) did not meet station needs; initial planning team did not have the right specs to plan by

10b. -If target dates were realistically set, we could allow more time for planning and execution; didn't have enough time to get information required for project; end date should not be the controlling factor for the project; Not enough time for testing technology

14. 5

14a. -Team was limited by time, but lots of effort was put into P3 and meeting the end date; however, just not enough time to do thorough evaluation of alternatives and get all the information needed

14b. -Realistic time table and keep the same team consistent; communication between major parties needs to be better

**Figure 18. Responses for Project 011**

required for pre-project planning, agreeing with the operations manager. However, the project manager rated the project as having low pre-project planning effort. The other project revealed similar contrasting views about project success and pre-project planning effort (see project 038, Appendix E). All three representatives agreed the project was unsuccessful, but for different reasons. As for pre-project planning, there were significant differences in the perceptions of the representatives. Not surprisingly, all of the representatives on these two projects mentioned that better communications would be required on future projects.

Analysis of the perceptions of project representatives in quadrant III again indicates that there are varying opinions about project success and different levels of understanding of the pre-project planning process. The analysis also supports the previous conclusion that there are other factors that impact project success. According to project representatives, high pre-project planning effort will not always result in a successful project. This is especially the case when pre-project planning is conducted based on unsound market forecasts and business strategies developed during the business planning stage. In addition, poor quality data utilized during the pre-project planning process can impact on the success of the project. Project representatives stressed the need for valid and verifiable data inputs to the pre-project planning process.

#### 5.2.2.3 Analysis of Quadrant II

Six of the project representatives indicated that six of the projects in the study had little pre-project planning, and the projects were unsuccessful. The perceptions of these six representatives were analyzed further to identify factors or

causes for poor effort and low success (quadrant II). The objective of this analysis was to determine if these factors were different than those identified for high effort and high success projects (quadrant IV).

The researcher found that the factors identified by representatives rating projects with low effort and low success were no different than those rated high effort and high success. These factors were discussed in Section 5.1.1. (Analysis of Success Factors) and 5.1.3. (Analysis of Pre-Project Planning Effort Factors). However, with only six representatives out of 89 rating the projects in quadrant II, this analysis is preliminary at best.

The data set was expanded by considering low pre-project planning ratings separately from low success ratings. As described in Chapter 4, the researcher stratified the responses to question 14a by the pre-project planning effort ratings received. Using this method for stratifying the data, the researcher attempted to determine if there were two sets of important pre-project planning factors. One set, for ratings of 4 and 5, would consist of factors that contribute to successful pre-project planning. The other set, for ratings of 3 or less, would consist of factors that, if not existent on a project or executed poorly, result in unsuccessful pre-project planning.

The researcher found that the factors identified in both sets were very similar, and the frequency with which they were identified was also similar. These factors were discussed previously in section 5.1.3. However, of the 91 representatives responding to question 14, only 20 rated the projects with a effort score of 3 or less. Again, it was difficult to determine from this small data set any significant trends on projects that were considered as having less pre-project planning effort.

For project success, the researcher stratified the responses to question 10a by the success ratings the projects received. Using this method for stratifying the data, the researcher attempted to determine if there were two different sets of important success factors. One set, for ratings of 4 and 5, would consist of important success factors contributing to a successful project. The other set, for ratings of 3 or less, would consist of factors that, if not addressed or not met on a project, could cause the project to be less successful.

The researcher found that the factors identified in both sets were similar, and the frequency with which they were identified was also similar. However, of the 94 representatives responding to question 10, only 16 rated the projects with a success score of 3 or less. Thus, it was difficult to determine from this small sample any significant trends on projects that were considered less successful.

In summary, the analysis of perceptions concerning successful and unsuccessful pre-project planning effort reveals only one set of important factors describing pre-project planning effort which were identified earlier in Section 5.1.3. According to project representatives, these factors contribute to successful pre-project planning. When these factors do not exist or are poorly executed, less than adequate pre-project planning may occur. Similarly, the analysis of perceptions concerning successful projects and unsuccessful projects reveals only one set of important success factors. According to project representatives, these factors are determinate of project success. When these factors are not addressed or not met, the result may be a less successful project.

## **6. CONCLUSIONS**

The purpose of this research was to analyze the perceptions of three key types of project participants from the owner's organization concerning project success and pre-project planning effort. The perceptions were collected during telephone interviews with 36 project managers, 28 business managers, and 30 operations managers from 41 industrial construction projects sampled in this study. The factors concerning project success and pre-project planning effort and the patterns and relationships that exist were identified using qualitative analysis methods. From the analysis, the following conclusions were drawn.

### **6.1. Project Success Factors and Outcomes**

According to project representatives, as a combined group, project control outcomes were most determinate of project success. The two project control outcomes considered most important were cost and schedule. Operational characteristics, especially ease of operation and production quality, were also identified as determinates of project success. In addition, teamwork effort and customer satisfaction were quality management factors considered important for project success.

While there was some agreement among project representatives that project control and operational characteristics were most determinate of project success, there were other success categories considered important such as: construction/operation transition; market and financial; and social. In addition to quality management, other

factors considered to influence project success were: ease of E/P/C; technology evaluation; and operations input.

There was considerable disagreement between the groups of project representatives concerning the relative importance of each success category. Not surprisingly, this disagreement indicates that each group of representatives had a different project focus. The *project managers* as a group were most concerned with the execution phase of the project and the project turnover. The *operations managers* were most concerned with the downstream results of the planning and execution phase of the project. In addition, *operations managers* were very concerned with having more input into project planning, especially in the area of technology evaluation. The *business managers* appeared to be more concerned with the overall project from a "macro" level rather than how well it was executed or operates. This overall difference in success emphasis may contribute to disagreement among project representatives over project objectives and can lead to communication breakdowns.

## 6.2. Improvement Areas for Project Success

Most of the perceptions of project representatives as a group regarding improvement areas relate to pre-project planning. The perceptions of project representatives seem to indicate that improving areas related to pre-project planning will produce more successful projects.

The project representatives indicated many areas that can affect project success improvement. There were no areas identified for improvement that stood out more clearly than other areas. Areas related to pre-project planning identified included: emphasis on pre-project planning; technology evaluation; ease of E/P/C factors (scope



definition, execution strategy, basis of design, and constructability); estimating; and front-end engineering. Other important improvement areas identified were: quality management, emphasis on project control, and the construction/operation transition.

While there were no improvement areas identified as most significant by all respondents as a group, there were again different view points between the groups concerning the relative importance of each improvement area. The *project managers* were most concerned with the execution phase and identified more frequently those areas directly related to improving execution. The *project managers* did mention, in general, that more pre-project planning was required. The *operations managers* were more concerned with areas related to facility operation, but also with improving areas during project planning that will ultimately affect the operation of the facility. As before the *business managers* as a group were more concerned with the overall project.

### 6.3. Pre-Project Planning Effort Factors

Project representatives as a group indicated that adequate time and resources are critical for performing pre-project planning. Many representatives indicated that adequate time and resources includes having an appropriately skilled team of experienced personnel to conduct pre-project planning. Another important area identified was the project definition package. According to project representatives, a timely and accurate project definition package was important for successful pre-project planning and positively impacts project success. Project representatives stressed the importance of teamwork and communication during the pre-project planning process. Other categories identified as important to pre-project planning

effort were the evaluation of alternatives (including technology evaluation), customer involvement (including operations personnel), and corporate guidance.

Again, there is some disagreement between the groups concerning which are the more important pre-project planning effort factors. Analysis of each group's concerns supports the trend identified earlier. The *project managers* and *operations managers* are more focused on specific pre-project planning effort factors that will have the most impact on the execution and operation of the project. The *business managers* seem to maintain a more global view and were concerned with several broad areas for successful pre-project planning.

The pre-project planning model developed by the task force is supported by the views of the project representatives. The success factors identified by the representatives are addressed by the major sub-processes of the model. The perceptions of the project representatives as a group were that adequate time, resources, and teamwork were important for successful pre-project planning. The model incorporates these categories under the sub-process of "organize for pre-project planning". Project representatives felt that the evaluation of alternatives including technology evaluation were important during pre-project planning. These categories are included in the model within the "select alternatives" sub-process. The project representatives also stressed the importance of developing a timely and accurate project definition package which is included as a major sub-process in the model. In addition, the representatives indicated that customer involvement and corporate guidance were important to successful pre-project planning. These factors are stressed throughout the pre-project planning model.

#### 6.4. Pre-Project Planning Improvement Areas

Project representatives as a group were most concerned with improving the project definition package for future projects. In addition, the perception of project representatives is that there was not enough time and resources, or teamwork in the pre-project planning process. Representatives again stressed that adequate time and resources included a skilled and experienced team. Representatives indicated that team building, team continuity, and multi-disciplinary teams were teamwork factors that need emphasis.

Good communications and customer involvement were also emphasized as areas for improvement. Other areas identified for improvement were the pre-project planning methodology and the evaluation of alternatives, which includes technology evaluation. Several representatives indicated that their companies have a formal pre-project planning methodology but that it is inadequate or not adhered to. Others stressed the need for a formal process or road map to conduct pre-project planning.

The perceptions of project representatives concerning improvement areas further supports the validation of the pre-project planning model developed by the task force. The areas identified as needing improvement are included within the major sub-processes of the pre-project planning model. In addition, the concern of project representatives for a formal methodology for conducting pre-project planning underscores the usefulness of the model. Owners can use the model as a basis for developing a pre-project planning process specific to their company.

### 6.5. Pre-Project Planning Effort and Success Ratings

Project representatives as a group perceived that emphasis on pre-project planning is correlated to project success and that poor pre-project planning may result in less successful projects. There were also exceptions to these perceptions indicating that other factors may impact project success without regard to the level of pre-project planning expended.

According to the project representatives, these other identified factors contributing to a project's success or lack of success were associated with the business planning stage of the project life cycle. Many projects that representatives identified as having had poor pre-project planning effort were still considered successful because they met or exceeded financial and market objectives.

Conversely, several projects identified as having had high pre-project planning effort were considered less successful because they failed to meet financial and market objectives. According to project representatives, these projects were considered less successful because the pre-project planning was conducted based on unsound market forecasts and business strategies or poor quality data was utilized during the pre-project planning process.

Project representatives indicated that projects which are duplications of previously completed projects do not require a high level of pre-project planning effort to be successful. Project representatives cautioned, however, that even for duplicate projects an appropriate level of formal pre-project planning is required.

Analysis of the projects that were considered exceptions to the effort-success relationship revealed that there was considerable disagreement among representatives concerning both the level of pre-project planning effort and the level of project

success. In addition, there appeared to be confusion over what constitutes pre-project planning.

The perceptions of the representatives that rated projects low effort or low success were analyzed to determine if there was a different set of factors that contribute to poor pre-project planning effort or less successful projects. The analysis indicated that the same factors that contribute to successful pre-project planning, when executed poorly, may also contribute to unsuccessful pre-project planning. Likewise, the same factors that impact project success, when not addressed or not met, may also contribute to perceptions of less successful projects.

## 7. BEST PRACTICES

### 7.1. Best Practices

Pre-project planning is vital to project success and is a best practice of corporate business organizations that perform capital facility construction projects. Based on the analysis of the project representatives concerning project success and pre-project planning effort, the following best practices are presented:

- It is important that the *corporate goals and guidelines* for pre-project planning, and the project, are *well defined*.
- *Teamwork and communication are critical* to the pre-project planning process.
- When organizing for pre-project planning, a *multi-disciplinary team consisting of appropriately skilled and experienced personnel*, to include the project customer, is required. This means that operations, business, project management/technical, and, if applicable, key consultant personnel must be closely involved in pre-project planning early in the process.
- For pre-project planning to be successful, *team continuity* is necessary, and the team must be cultivated through team building and open communication.
- The project, business, and operations managers need to understand that they *have different views* concerning project success and project objectives. These views need to be communicated, and project representatives *should agree on project objectives*. This agreement can be achieved through project objective setting exercises during pre-project planning that consider corporate guidance, and the views of project managers, business managers, and operations managers. Information on the process of managing, communicating, and agreeing upon project objectives can be found in the CII publication Project Objective Setting (Rawings 1989).
- Other factors such as poor business decisions, reliance on bad data, or other poor assumptions can also affect the success of the project. These factors should be addressed in pre-project planning if possible.

- Each company should *establish a formal process* for conducting pre-project planning. A good basis for this process is the model developed by the CII Task Force. This pre-project planning road map should be specific to each company's needs and should be adhered to in order to maintain uniformity. Through consistent application of a specific pre-project planning methodology, process performance can be measured and continuously improved.
- Companies need to *authorize adequate time and resources for pre-project planning* to be conducted successfully. Qualified teams of skilled and experienced personnel are required to verify inputs to the pre-project planning process, conduct analysis, and make recommendations to the decision makers.
- All pre-project personnel involved in the process need to *understand* what activities occur, and what their roles and responsibilities are in the process.

#### 7.2. Recommendations for Future Research

During the completion of this thesis, additional projects were received by the researchers for study. These projects provide an additional 38 project representatives to be interviewed. The additional data will be useful since it will further expand the sample size and possibly increase the validity of the findings. In addition, with more data available, further study concerning the pre-project planning and project success relationship may be conducted using the data from the interviews and the project questionnaires together.

The interview instrument contains numerous closed-end questions concerning project success and pre-project planning effort. The responses to these questions were not analyzed for this study. Further study into the relationship between pre-project planning effort and project success should be conducted utilizing these data and the data from the project questionnaire.

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## APPENDICES



### Appendix A: Success and Effort Categories Matrix

Success Categories		Expected Sources		
Factors and Outcomes		Business	Project Management	Operations
1. Marketing				
a. Capture/maintain market share	X			
b. Enhance future position	X			
c. Gain competitive advantage	X			
2. Financial				
a. Financial Authorization Objectives	X			
b. Owner Costs				
c. Owner Procured Equip/Matl				
d. Engineering Design Cost				
e. Engineer Procured Equip/Matl				
f. Construction Cost				
g. Commissioning & Turnover Cost				
h. Start Up Costs				
3. Quality Management				
a. Teamwork effort	X	X	X	
b. Customer satisfaction	X	X	X	
c. Project Personnel Turnover		X		
d. Professional Performance		X		
e. Guidance From Management	X	X		
f. Rework		X		
g. Effective Communications	X	X		
4. Project Control				
a. Budget achievement	X	X		
b. Schedule achievement	X	X		
c. Change management		X		
d. Number/Magnitude of Changes		X		
e. Extent of punchlists		X	X	
f. Risk Management		X		
5. Ease of E/P/C				
a. Basis of design		X		
b. Scope definition		X		
c. Execution strategy (actual vs. planned)		X		
d. Constructability		X		

**Success Categories****Expected Sources**

<b>Factors and Outcomes</b>	<b>Business</b>	<b>Project Management</b>	<b>Operations</b>
<b>6. Social</b>			
a. Achieves legal & regulatory compliance	X	X	X
b. Labor relations	X	X	X
c. Safety and health	X	X	X
d. Craft Labor Turnover		X	
e. Craft Labor Absenteeism		X	
f. Equal employment opportunity	X	X	
g. Environmental	X	X	X
h. Community relations	X	X	X
i. Noise		X	X
j. Education/Training	X		X
<b>7. Construction/Operations Transition</b>			
a. Ease of turnover		X	X
b. Ease of startup		X	X
c. Spare parts availability		X	X
d. Operator Training		X	X
e. Equipment documentation availability		X	X
<b>8. Operating Characteristics</b>			
a. Ease of Operation	X	X	X
b. Availability	X	X	X
c. Flexibility	X		X
d. Production Quality	X		X
e. Performance (cost to manufacture)	X	X	X
f. Plant Utilization			
g. Design Capacity	X		X
<b>9. Maintenance</b>			
a. Unanticipated Retrofits			X
b. Maintainability			X
<b>10. New Categories/Subcategories*</b>			
a. Operations Input			
b. Technology Evaluation			
c. Estimating			
d. Front-end engineering			
e. Emphasis on Pre-Project Planning			
f. Procurement			
g. Market Forecast			

\*Note: Original success factors developed are indicated in section one through nine. Additional success factors identified during the interview process are given in section 10.

## Effort Success Categories

## Expected Sources

Types of Pre-Project Planning Factors	Business	Project Management	Operations
<b>1. Organization</b>			
a. What organizations were represented			
b. How many organizations			
c. How were they represented			
d. How did individuals work together	X	X	X
e. What was the duration of the PPP effort			
f. Was there team continuity	X	X	X
g. Were there team skills	X	X	
h. Was there team building	X	X	X
i. How much time and money was spent	X	X	
j. Did the team have a charter			
k. Was a P3 plan developed			
l. Were corp. guidelines clearly communicated		X	
<b>2. Alternative Selection</b>			
a. Were alternative technologies analyzed	X	X	X
b. How many technologies were considered			
c. Were alternative sites analyzed	X	X	X
d. How many sites were considered			
e. Were appro. pers. asgnd. to eval. teams	X	X	X
f. Were conceptual scopes and est's prepared	X	X	
g. Formal Evaluation	X	X	
h. Were corp. tech. & site goals communicated	X	X	X
i. Conceptual Scopes & Estimates	X	X	

**Effort Success Categories****Expected Sources**

<b>3. Project Definition Package</b>			
a. Risks identified and Assessed	X	X	
b. Design complete at authorization			
c. Was an execution approach defined	X	X	X
d. Were control guidelines established	X	X	
e. Was a definition package compiled			
f. Was scope definition appropriate	X	X	
g. Emphasis on Quality	X	X	X
<b>4. New Categories/Subcategories*</b>			
a. Time and Resources/Multi-disciplinary Team			
b. Technology Evaluation			
c. Team Skills and Experience			
d. Customer Involvement			
e. Scope and Estimate			
f. Teamwork			
g. Pre-project planning controls			
h. Market Forecast			

\*Note: Original pre-project planning factors developed are indicated in section one through three. Additional pre-project planning factors identified during the interview process are given in section 4.

## Appendix B: Request for Interviewee Data

### Construction Industry Institute Pre-Project Planning Task Force Interviewee Data

To learn more about this project, the task force researchers would like to conduct short (15-25 minute) interviews with three people who were associated with this project during its pre-project planning, execution, and operating phases. We would like to talk to one representative from the business unit, one from project management, and one from the operating unit. To insure that all participants are providing data on the same project, we will be sending these people a summary of the data from sections 1.1 through 2.1 of the survey you have just completed, with the exception of the design capacity data from question 2.1.6. Upon selecting these people, we would appreciate your contacting them to assure that they will be available to be interviewed. After confirming their availability and willingness to be interviewed, please supply the following information so that we can contact them.

1. **Business Unit Representative** - preferably the person who sponsored execution of this project and has knowledge of its business implications.

- a. Name [ ]Mr. [ ]Ms. \_\_\_\_\_
- b. Title \_\_\_\_\_
- c. Company \_\_\_\_\_
- d. Address \_\_\_\_\_
- e. City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_
- f. Tel. No. \_\_\_\_\_ Fax No. \_\_\_\_\_
- g. Responsibility During Pre-Project Planning and Execution of this Project \_\_\_\_\_

2. **Project Management Representative** - preferably the project manager who was involved in the pre-project planning and execution stages.

- a. Name [ ]Mr. [ ]Ms. \_\_\_\_\_
- b. Title \_\_\_\_\_
- c. Company \_\_\_\_\_
- d. Address \_\_\_\_\_
- e. City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_
- f. Tel. No. \_\_\_\_\_ Fax No. \_\_\_\_\_
- g. Responsibility During Pre-Project Planning and Execution of this Project \_\_\_\_\_

3. **Operating Unit Representative** - preferably the manager of this operating unit.

- a. Name [ ]Mr. [ ]Ms. \_\_\_\_\_
- b. Title \_\_\_\_\_
- c. Company \_\_\_\_\_
- d. Address \_\_\_\_\_
- e. City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_
- f. Tel. No. \_\_\_\_\_ Fax No. \_\_\_\_\_
- g. Responsibility During Start-up and Operation of this Project \_\_\_\_\_

**Thank you very much for your participation in this survey!**

Please return this form along with the questionnaire in the stamped, pre-addressed envelope enclosed to:

**Dr. G. Edward Gibson, Jr.**  
**Department of Civil Engineering**  
**ECJ - 5.2**  
**The University of Texas at Austin**  
**Austin, TX 78712-1076**  
**PRE-PROJECT PLANNING INTERVIEWEE**  
**DATA**

**Appendix C: Interview Notification Letter**

**Facsimile Cover Sheet**

**To:** Jim Jones  
**Company:** AAA Enterprises  
**Phone:** 604-251-2444  
**Fax:** 604-251-4443

**From:** Edd Gibson  
**Company:** The University of Texas at Austin  
**Phone:** (512) 471-4522  
**Fax:** (512) 471-6316

**Date:** 10/28/93

**Pages including this cover**

**page:** 2

**Message:**

The Construction Industry Institute Pre-Project Planning Task Force is studying the effect that pre-project planning has on the success of capital construction projects in terms of the company's goals and objectives. The Refinery Unit Project has been chosen as one of the projects to be studied, and Mr. Joe Smith indicated to us that you are the **Project Management representative** for this project. As part of our research, we have already received information about this project via a questionnaire completed by members of your company, and portions of this information are summarized on the enclosed Project Data Sheet. In addition to this information, we are also interested in your opinion of this project. Consequently, we would like to conduct a telephone interview with you.

The interview will be conducted by telephone and will consist of a series of questions concerning various aspects of how successful the project was and how much effort was expended during pre-project planning. It should take about 20 to 25 minutes of your time to complete. Your answers will be held in strict confidence and will be known only to members of the research staff here at the University of Texas at Austin. They will, of course, be most helpful in the task force's research into this topic. A member of our staff will be calling you in the next few days to arrange a time when it will be convenient for you to participate in the interview. Thank you very much for your cooperation and time.

Sincerely,

G. Edward Gibson, Jr

**CII Pre-Project Planning Task Force****Project Data Sheet**

**Company:** AAA Enterprises

**Project Name:** Refinery Unit

**Project Location:** Smithtown, TN.

**Project Number:** EST 7994

**Type of Facility:** Petroleum Refinery

**Primary Products:** C3/C4 and stabilized Isomate

**Primary Raw Materials:** Light straight run feedstock

**Type of Site:** Grassroots

**Unique Features:** First-of-a-kind for this company

**Execution Contracting Strategy Employed:**

Conceptual Engineering- in house

Detailed Engineering- Cost-plus with fee

Procurement services- Cost-plus with fee

Lump sum Construction Contract

**Date of Major Funding Authorization:** 2-87

**Date of Construction Completion:** 12-90

**Date of Commercial Operation:** 12-90



## Appendix D: Interview Instrument and Master List of Interview Questions

### Project Data

Project Name \_\_\_\_\_

Project Location (City) \_\_\_\_\_ (State) \_\_\_\_\_

### Interviewee Data

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Phone \_\_\_\_\_ Fax: \_\_\_\_\_

Interview Schedule - Date \_\_\_\_\_ Time: \_\_\_\_\_

Revised Schedule - Date \_\_\_\_\_ Time: \_\_\_\_\_

Actual- Date \_\_\_\_\_ Time: \_\_\_\_\_

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This interview should take around 20 minutes. Will this be a problem for you at this time?  
Before we begin the interview I will read you a brief introduction and answer any questions that you might have.

This interview is being conducted on behalf of the Construction Industry Institute's (CII) Pre-Project Planning Task Force. The task force is studying various aspects of pre-project planning and how it relates to the overall success of a project. The task force has defined pre-project planning as the process of developing strategic information sufficient for owners to decide to commit resources and maximize the chance for a successful project. The task force has further stated that the process of pre-project planning constitutes a comprehensive framework for detailed project planning. It begins when a validated project concept has been identified during the business planning process and ends when a decision has been made whether or not to authorize funding for the execution phase of the project.

The \_\_\_\_\_ project has been chosen as one of the projects to be studied. Your name was given to us as the \_\_\_\_\_ representative for the project by \_\_\_\_\_. A project questionnaire has already been completed providing us with historical data about this project. For the purpose of this interview, however, we are interested in knowing your opinion of how successful this project was and how much effort was put into pre-project planning. Do you feel that your participation in this project was such that you will feel qualified and comfortable answering questions of this nature? *(If the answer to this is no, ask for another reference for this interview).*

The interview is divided into two sections. The first section is concerned with the success of the project and the second section relates to the pre-project planning effort. Each section is followed by an open ended, wrap-up question. The interview is structured such that I will first read a statement about the project. You then provide a response to the statement on a scale of 1 to 5, with 1 meaning you strongly disagree with the statement, 3 meaning you neither agree or disagree and 5 meaning you strongly agree with the statement.

In accordance with established CII procedures, your responses to the questions about to be asked will be known only to the researchers and will not be divulged to anyone else.  
Do you have any questions before we begin the interview?

Note:

DK= Don't Know and NA= Not Applicable

B= Business Manager, PM= Project Manager, and, OP= Operations Manager. Each representative is asked only the questions indicated by an "X" in the column under the B, PM, or OP. For example, only the business manager and project manager would be asked the question below.

- c. This project was characterized by competent and consistent guidance from management.

1 2 3 4 5

B	PM	OP
X	X	

### Master List of Interview Questions

1. The first set of statements concern the projects marketing objectives. On a scale of 1 to 5 please provide your opinion on the following:

- a. This project allowed your business unit to attain its market share objectives.

1 2 3 4 5 DK

B	PM	OP
X		

- b. Completion of this project allowed your business unit to attain its goals relating to future market positions.

1 2 3 4 5 DK

B	PM	OP
X		

- c. Completion of this project allowed your business unit to attain a competitive advantage for the primary products(s) produced by the project?

1 2 3 4 5 DK

B	PM	OP
X		

- d. Considering marketing as a whole, this project met or exceeded the marketing objectives of the company.

1 2 3 4 5 DK

B	PM	OP
X		

2. The second area of success we are interested in involves financial objectives. Please provide us with your opinion on the following statement:

- a Overall, this project met or exceeded the financial objectives of your business unit.

1 2 3 4 5 DK

B	PM	OP
X		

*Probe: Examples of financial measures are Return on Assets, Return on Equity and Cash Flow Management.*

3. The next set of statements are about the quality management objectives or objectives which relate to assurance of project quality. On the same scale of 1 to 5, with 1 meaning you strongly disagree and 5 meaning you strongly agree, please provide your opinion on whether or not this project met the following quality management objectives?

								B	PM	OP
a.	In general, project participants worked well together.	1	2	3	4	5	DK	X	X	X
	<i>Probe: Examples of project participants are owners, customers, contractors, and consultants. The participants worked together toward the common goal of successfully planning and executing the project.</i>									
b.	Key project personnel changed frequently during the execution of this project.	1	2	3	4	5	DK		X	
	<i>Probe: Key project personnel are those in leadership positions.</i>									
c.	This project was characterized by competent and consistent guidance from management.	1	2	3	4	5	DK	X	X	
d.	Emphasis was placed on identifying and satisfying the needs of the customer.	1	2	3	4	5	DK	X	X	X
e.	This project was characterized by high quality, professional performance by project participants.	1	2	3	4	5	DK		X	
f.	The amount of rework performed on this project was high.	1	2	3	4	5	DK		X	
g.	The amount of work appearing on punch lists was high.	1	2	3	4	5	DK		X	X
h.	Considering quality management as a whole, this project met or exceeded the quality management objectives of your organization.	1	2	3	4	5	DK	X	X	X

4. Another area of success we are interested in involves project control objectives. On the same scale of 1 to 5, with 1 meaning strongly disagree and 5 meaning strongly agree please provide your opinion as to whether or not the project met the following project control objectives?

	1	2	3	4	5	DK	B	PM	OP
a. The budget objectives of the project were met or exceeded.							X	X	
b. The schedule objectives of this project were met or exceeded.							X	X	
c. Project changes were generally well managed and minimally impacted the project.								X	
d. The magnitude of project changes was high.								X	
e. In general, project participants communicated effectively. <i>Probe: Examples of project participants are owners, customers, contractors, and consultants.</i>							X	X	
f. Potential risks were managed to minimally impact the project. <i>Probe: Examples of potential risks are differing site conditions, use of first of a kind technology, environmental concerns and use of fast track methods.</i>								X	
g. Overall, this project met or exceeded the project control objectives of your organization.							X	X	

5. The next set of statements are about the project E/P/C objectives. Again, on a scale of 1 to 5, with 1 meaning you strongly disagree and 5 meaning you strongly agree, please provide your opinion on the following:

								B	PM	OP
a.	The design basis contributed to the successful execution of the project.	1	2	3	4	5	DK		X	
	<i>Probe: Examples of design basis are a pilot plant, copy of existing facility and modification of existing technology.</i>									
b.	The project scope was defined to allow various phases of execution to proceed smoothly and with minimal change.	1	2	3	4	5	DK		X	
c.	The actual execution strategy matched the execution strategy that was planned at the time the project was authorized.	1	2	3	4	5	DK		X	
d.	Lessons learned from previous construction projects and other constructability assessments were incorporated into this project during the engineering and design phases.	1	2	3	4	5	DK		X	
e.	In general, this project met or exceeded your companies overall E/P/C objectives?	1	2	3	4	5	DK		X	

6. We are interested in the social objectives of the project. On the same scale of 1 to 5, do you agree or disagree with the following statements regarding the project's social objectives:

	1	2	3	4	5	DK	B	PM	OP
a. The legal and regulatory compliance requirements set prior to authorization were achieved.							X	X	X
b. In general, a harmonious relationship with labor was maintained during the construction of this project.							X	X	X
c. Safety and health goals were achieved or exceeded during the execution of this project.							X	X	X
d. This project achieved or exceeded its EEO goals. <i>Probe: Examples of EEO goals are MBE or DBE subcontract or direct hire of handicap or minority workers.</i>							X	X	
e. The project experienced frequent turnover of craft labor.								X	
f. Absenteeism at the craft level was high. <i>Probe: Based on your previous experience, the level of absenteeism of craft workers was high.</i>								X	
g. The goals to maintain or improve the quality of the environment were met or exceeded by this project. <i>Probe: Goals should include corporate and/or regulatory.</i>							X	X	X
h. This project met or exceeded its goals to improve the relationship between the company and the community.							X	X	X
i. Goals to reduce or minimize noise during the execution and operation of this project were met or exceeded.								X	X
j. Goals concerning the education and training of personnel were met.							X		X
k. All in all, the social objectives of this project were met or exceeded.							X	X	X

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B	PM	OP
	X	X

	X	X
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	X	X
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	X	X
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	X	X
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	X	X
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8. The next set of statements concern operating objectives. On a scale of 1 to 5, please tell us whether you agree or disagree with how well did this project met the following operating objectives.

								B	PM	OP
a.	The goals concerning ease of operation were met or exceeded.	1	2	3	4	5	DK	X	X	X
	<i>Probe: Examples of ease of operation goals are operating staff and overtime.</i>									
b.	This project met or exceeded its goals concerning the number of days it was available for operation in a year.	1	2	3	4	5	DK	X	X	X
c.	The project goals concerning turndown ratio or ease of change over from one product to another were met or exceeded.	1	2	3	4	5	DK	X		X
	<i>Probe: Turndown ratio is related to varying the output quantity of the product.</i>									
d.	The quality of the end product produced by this project met or exceeded the goals set when the project was authorized.	1	2	3	4	5	DK	X		X
e.	The unit cost to manufacture the end product met or exceeded the goals that were set when the project was authorized.	1	2	3	4	5	DK	X	X	X
f.	The output rate of this project met or exceeded the goals that were set at the time the project was authorized.	1	2	3	4	5	DK	X		X
	<i>Probe: An example off output rate is nameplate capacity.</i>									
g.	Overall, the planned operating objectives of this project were met or exceeded?	1	2	3	4	5	DK	X	X	X



9. The last set of questions in this section concerns **maintenance objectives**. On a scale of 1 to 5, please tell us whether you agree or disagree with the following statements regarding maintenance objectives?

								B	PM	OP
a.	There has been little need for any major, unplanned facility changes since completion of this project.	1	2	3	4	5	DK			X
b.	The goals concerning the ease of maintenance were achieved by the execution of this project.	1	2	3	4	5	DK			X
c.	Overall, the planned maintenance objectives of this project were met	1	2	3	4	5	DK			X

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This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.This image shows a single sheet of white paper with horizontal blue or grey ruling lines, typical of notebook paper. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

This completes the first section of the interview. The next section is designed to obtain your opinion of the effort that went in to pre-project planning on the project. As stated during the introduction, we have defined pre-project planning as the process of developing strategic information sufficient for owners to decide to commit resources and maximize the chance for a successful project. Before we begin the interview please give us a brief description of your involvement with the project during the pre-project planning phase.

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This section of the interview follows the same format as the previous section. For each of the following statements, please indicate how accurately they describe your opinion of the pre-project planning effort for this project. Please use the same response scale of 1 to 5 with 1 indicating that you strongly disagree with the statement, 5 indicating that you strongly agree and 3 indicating that you neither agree or disagree with the statement.

- |   |    |    |
|---|----|----|
| B | PM | OP |
| X | X  | X  |

- |   |   |   |
|---|---|---|
| X | X | X |
|---|---|---|

- Probe:** Key positions are those critical to the team functioning successfully. The execution phase of the project includes design and construction.

- |   |   |   |
|---|---|---|
| X | X | X |
|---|---|---|

- |   |   |  |
|---|---|--|
| X | X |  |
|---|---|--|

- |   |   |   |
|---|---|---|
| X | X | X |
|---|---|---|

- |  |   |  |
|--|---|--|
|  | X |  |
|--|---|--|

- Probe:** Top management communicated corporate guidelines to the team at the time the team was formed. Top management then monitored the team's work to insure that the guidelines were being implemented.

- |   |   |   |
|---|---|---|
| X | X | X |
|---|---|---|

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- |    |   |   |   |   |   |   |    | B | PM | OP |
|----|---|---|---|---|---|---|----|---|----|----|
| a. | Potential business risks were adequately identified and assessed during pre-project planning.   | 1 | 2 | 3 | 4 | 5 | DK | X | X  |    |
|    | <i>Probe: Risk analyses were complete enough for top management to understand the total project risk.</i>   |   |   |   |   |   |    |   |    |    |
| b. | The project execution approach was well defined during pre-project planning.  | 1 | 2 | 3 | 4 | 5 | DK | X | X  | X  |
|    | <i>Probe: Key team members participated in developing the project execution approach. Relevant strategies such as business needs, contracting approach, project controls, and scheduling were addressed in the approach.</i>  |   |   |   |   |   |    |   |    |    |
| c. | Project control guidelines were well defined during pre-project planning.   | 1 | 2 | 3 | 4 | 5 | DK | X | X  |    |
|    | <i>Probe: The methods to identify, collect, process, and disseminate that information which is needed to successfully execute the project, including planning and scheduling, cost information, management information systems, change management, etc., were defined by the pre-project planning team.</i> |   |   |   |   |   |    |   |    |    |
| d. | The scope of this project was well defined at the time the project was authorized.  | 1 | 2 | 3 | 4 | 5 | DK | X | X  |    |
|    | <i>Probe: The project scope was complete enough to provide a framework for detailed design and cost estimating.</i>   |   |   |   |   |   |    |   |    |    |
| e. | Project quality was emphasized during pre-project planning.   | 1 | 2 | 3 | 4 | 5 | DK | X | X  | X  |
|    | <i>Probe: The pre-project planning team emphasized project quality when making decisions.</i>   |   |   |   |   |   |    |   |    |    |
| f. | Overall, this project was well defined at the time the decision was made to authorize its execution.  | 1 | 2 | 3 | 4 | 5 | DK | X | X  | X  |

14. Finally, we would like to know your opinion of the overall level of effort expended on pre-project planning on this project. Using a scale of 1 to 5, with 1 representing very low and 5 representing very high, how would you characterize the overall level of effort that was expended on pre-project planning for this project?

1 2 3 4 5

14a. What are your main reasons your assessment of the level of effort expended on pre-project planning? \_\_\_\_\_

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14b. In your opinion, what, concerning pre-project planning effort, needs to be improved next time?

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This concludes the interview. Thank you very much for your efforts.

Interview End Time: \_\_\_\_\_

## Appendix E: Responses from Project Representatives

### Qualitative Data Set

#### Legend

PXXX = Research Project Number

#### Questions:

10. Rating of how successful the project was overall on a scale of 1 to 5 (1 being very unsuccessful and 5 being very successful).

10a. What are your main reasons for your assessment of the project's level of success? *(This question was designed to obtain the important factors that when present or absent have a significant impact on project success.)*

10b. What, if anything, needs to be improved next time to make the project even more successful? *(This question was designed to obtain the areas of improvement that need emphasis in order to achieve project success.)*

14. Rating of the overall level of effort expended on pre-project planning on a scale of 1 to 5 (1 representing very low and 5 representing very high).

14a. What are your main reasons for your assessment of the level of effort expended on pre-project planning? *(This question was designed to obtain important factors required for successful pre-project planning.)*

14b. What concerning pre-project planning effort needs to be improved next time? *(This question was designed to obtain the areas of pre-project planning that require more emphasis.)*

(Owner) indicates an owner company name that was deleted

(Contractor) indicates a contractor company name that was deleted

#### P001

##### BUSINESS MANAGER

10. 5

10a. -Every milestone set up in P3 met or exceeded

-Training program implemented; personnel highly motivated; team concept carried through operation; corporate personnel involved

10b. -No

14. 4

14a. -P3 done smarter, worked smarter not longer or harder, past mistakes examined prior to planning; environmental objectives identified early

-Training program implemented; personnel motivated; teams formed for operation; corporate personnel involved

14b. -Tight time schedule



**PROJECT MANAGER**

10. 5

10a. -Planned very well the execution of project; transition to operating went per plan; start-up phase relatively short

10b. -Engineering firm selected did not work in depth enough with owner's representatives  
-No partnering with design firms

14. 5

14a. -Full year spent on pre-project planning; land search extensive; technology tried at another plant first--prototype used

14b. -Transition between engineering and construction  
-Few key people started the project and remained until the end of start-up phase  
-Key reason for project success**OPERATIONS MANAGER**

10. 5

10a. -Goals: Create participative work environment--achieved; team member approach to problems; five times more successful on product production at one quarter waste

10b. -Spare parts and service issue; equipment providers should be made to deliver

14. 5

14a. -Alternatives explored thoroughly

14b. -Identify start-up and plant manager earlier; key: identification of people  
-Team selection: technical knowledge and people skills**P002****BUSINESS MANAGER**

10. 5

10a. -Under budget; ahead of schedule; quick start-up; operation goals exceeded

10b. -Plan for new products difficult; balance between flexibility and reality hard

14. 5

14a. -Due to dollar amount of project, formal documentation was required; P3 effort organized well  
-Market driven project14b. -Most difficult part was bounding the scope  
-New product development at the same time as engineering for project**PROJECT MANAGER**

10. 5

10a. -Planning very thorough; project team stayed together

10b. -Communication problems with corporate members  
-Matrix organization  
-Team objectives not always understood by all  
-Due to dollar amount, project required Board of Advisors input; not always easy to get

14. 5

14a. -Product evaluation thorough  
-Scope well defined; schedule stayed on line; 18 months P3

14b. -No comment

**OPERATIONS MANAGER**

10. 5

10a. -Start-up six weeks ahead of schedule

-Operator training extensive; operation personnel involved early on

10b. -No comment

14. 4

- 14a. -No comment
- 14b. -Sales and marketing forecast could be more accurate

**P003****PROJECT MANAGER & OPERATIONS MANAGER**

10. 4

- 10a. -Met budget, project underfunded by 1-2 million
  - Delays in project schedule beyond project control; delay in acquiring right-of-ways; upgraded existing technology
- 10b. -Start-up did not go well because of one piece of equipment; new technology
- 14. 4
- 14a. -Execution plan carried out
- 14b. -Draw in additional resources; planned in secrecy

**P004****BUSINESS MANAGER**

10. 5

- 10a. -Main reason was plant experiments (and/or experimental testing)(pilot projects); ran pilot unit tests on several sophisticated units. Also, had a test on a flaking unit in Germany; did pilot unit test in Germany; considerable design work demonstrated through pilot units
  - Second reason is assignment of experienced people to a project: (*owner*) assigns a division representative(overall coordinator) to interface between (*owner*) and the contractor and operations; this division representative is considered a key selection; for example, the skills of the person are considered in selection; for this project, a mechanical engineer (experienced and talented) was selected over a chemical engineer because of the nature of the sophisticated mechanical work; division representative is instrumental to success
  - Also, assigned an experienced line manager (15-20 years running a plant); must have experienced operations person on the project team; thus, key people were experienced mechanical engineer and operations person
  - This was a conscious strategy up front: a) pilot test, b) experienced division representative, and c) experienced operations representative
- 10b. -This project went so well, there is nothing to change from my view point
- 14. 5
- 14a. -Described earlier with respect to pilot unit
  - Basic unit testing done--very important from operations stand point; the key fundamental units tested; Detailed engineering was done after project authorized
- 14b. -Project went so well and we're super satisfied
  - Top line management responsibility--P3 adequate, on time, within budget, and good product
  - Very conscious effort not to take anything for granted; Because this was a new process technology--more emphasis
  - Customers didn't like previous technology because glycol caked; customers wanted free-flowing glycol so product worked well for customer

**PROJECT MANAGER**

10. 4

- 10a. -Customer was pleased with project; result was it brought them into range of main competition
- 10b. -Estimating; better equipment prices need to be established; this is why all available overrun was used up
- 14. 3
- 14a. -I was in on all of the P3

-Disagreed with some things that went on, but the company approach was adhered to because you can't get project approved without using company approach

14b. -Their needs to be a more practical approach for how to build rather than emphasis exactly on what it is trying to do

#### OPERATIONS MANAGER

10. 5

10a. -Met cost control, product quality, schedule and start-up date--big 3

-Also, well designed environmentally

10b. -Reach plant capacity sooner--took a while to reach because limited by purchased equipment; did not perform to specifications

-Better provisions for routine maintenance

14. 5

14a. -Performed multiple equipment tests to prove technology including several trips overseas

-Multiple product were done for customer suitability

14b. -Better cost estimation for entire project--infrastructure that goes on before equipment (e.g., underground equipment)

#### P008

#### BUSINESS MANAGER

10. 1

10a. -Unit was built, meets all specifications (environmental, product specifications, quality, etc.), but over cost by 200 million and over one year late, thus not overall successful; major financial problem for *(owner)*

10b. -Took a huge risk committing to project with far too little front end engineering

-Very poor estimate of cost; estimate kept changing; everybody believed would cost less than it did

-Contractor was terrible; cannot take risk again with contractor's estimates

-Have done some P3 analysis; we have pledged to doing a lot more P3 engineering and better cost estimating

-Committed to more detailed engineering not just process, but more mechanics

14. 1

14a. -Neither *(owner)* nor contractors (construction or design) had any idea of scope of project (i.e., missed concrete estimate by 75%, manpower estimate off by 100%)

-This is related to lack of effort up front

-Unit's purpose done accurately, but not enough homework done to figure out how to produce the unit in terms of cost and construction

-Bottom line: we know how not to do it

-Project was driven by time window

-Construction over a year late but contracts written for ethylene sales were still good; therefore, profit made, however we have 200 million of debt from project to deal with

14b. -Do more up front engineering (process and mechanical) and detailed cost estimating

#### PROJECT MANAGER

10. 4

10a. -We conducted a benchmarking (BM) study with outside company; BM with similar plants constructed and not realized; and we came in significantly lower in cost and schedule

-Also, we had a very successful start-up; operators said this was most successful start-up in the history of olefins industry; this size project normally has a much longer start-up period

-Not a five, because of cost/schedule overruns; in the end, when compared to other projects, it looked good

-Poor front-end loading--management/business driven

10b. -Better front-end loading

14. 1

14a. -Insufficient time was allocated to develop sound premises and definition; we had a time crunch due to market window of opportunity; the project involved outside financing that influenced time crunch

-Project was schedule-driven for business reasons

14b. -Simply allow time to do better job; we knew what had to be done, just needed more time

-We didn't follow our format for P3 because of time; we are defining our P3 format;

management must have discipline to give us enough time

OPERATIONS MANAGER

10. 5

10a. -Fast start-up

-Very successful on stream and high production first year

-Very good return on investment for first year project; also, for any project

10b. -Better cost estimating

-Better contractor control of labor; better project control of contractor by *(owner)*

-We should have built a plastic model; 3D CAD was a failure(millions of dollars in piping changes); also lived with many operator access problems that were too expensive to change after built

14. 2

14a. -Authorization was made when definition was very poor; did not follow *(owner)* own rules; initial economics, then authorization of expenditure for design, the P & IDS, and then authorization

-Tended to be an orphaned project; once project was authorized by corporate engineering, they washed their hands of the project hoping contractor would *do their thing*; poor leadership from corporate management

-(*Owner*) did not have in-house people to execute this size project; project manager not very capable--did not have support of *(owner)* instead trusted *(contractor)* and *(contractor)* to do their things; every key member on project team (project engineer, CM, everyone!) had to come out of retirement to do project; thus, people not very motivated; some very antagonistic and others went with the flow, not making waves;

14b. -Needs to be more thorough P3 and better project definition; e.g., no off-site requirements defined until project half built

**P010**

BUSINESS MANAGER

10. 2

10a. -Probably would not have authorized the project had we a better estimate of total cost; had to redefine the scope of the project to bring down cost--took some things out; significant start-up costs

10b. -Appears to be a number of changes in key personnel; lack of project accountability from the owner's side; no total recall on the issue

14. 4

14a. -All disciplines represented, lots of attention paid to items, met regularly; very thorough on all alternatives and estimates; problems in execution phase: had a blown estimate; estimate flawed by data used; lower productivity not expected

14b. -Can always improve; estimating techniques need work no matter how well scope defined; quality of estimating needs improvement

PROJECT MANAGER

10. 2

10a. -The major failure was budgetary--50% overrun; this was counterbalanced by successful

#### operation of facility

-Overwhelmed by the financial failure; most people view the project a failure

10b. -On budget, need to make a realistic cost estimate in planning stages; it was known that a target budget had to be met, so planners were under pressure to not estimate over that target--bad technique; bring bad news in early rather than later

14. 4

14a. -This project was one where a multifunction team was put together: research, operations, corporation engineer; 6-8 people full time; extensive effort for developing scope of project and developing alternative; however, team not very experienced; some cases first time assigned to project; individuals had few years experience

14b. -More rigorous development of scope; ensure that all areas that need to be developed are better developed--structured format/or checklist

-Better communications and understanding to and from upper management so they understand the implications of what's developed

#### OPERATIONS MANAGER

10. 4

10a. -Quality of product very high

-Transition went well

-However, overall the project cost much more than expected; the price went up every 6 months during the execution of project

10b. -Better and early definition of costs; biggest piece was problems with estimating, i.e., labor especially

-Abominable quality on electrical and instrumentation--poor supervision; this is where quality was a problem; everything else was good

14. 4

14a. -Somehow we missed the mark on estimating--don't really know how; we never had an estimate that was real

-We tried profit sharing for construction people, but was not administered well

-This project was caught in the middle of trying to standardize company-wide control system; took a long time to get a decision on proposed control system

14b. -Make sure corporate standardization efforts are nailed down early

-Estimating needs to be improved for next time

#### P011

#### BUSINESS MANAGER

10. 3

10a. -Blew schedule and budget; required a lot more resources than originally scheduled

-Project was not originally designed for the safer alternatives

-Too many risks taken; had huge overruns

10b. -Better and earlier communications between operators and designers; lots of problems could have been avoided; more communication is necessary between all parties

14. 5

14a. -By definition, we did a lot of P3; lots of time spent and full up testing of technology was done; as a result of the time spent in P3, this project fell a year behind schedule; I believe we had overkill in the area of P3; for example in the technology evaluation, we knew about all the proven technologies, yet we still tested everyone of them; too much testing

-Too much effort on P3 as opposed to detailed design

14b. -Tighten up the objectives and have more rigorous control over P3 schedule; take more risk

considering technology that we already knew worked instead of testing everything to near perfect performance results

-Don't sacrifice engineering and detailed design for lots more testing; we fell way behind schedule, and we're still fixing problems today

#### PROJECT MANAGER

10. 3

10a. -We did not meet the scheduled in-service, had cost overruns, and commissioning difficulties

-One problem was that the operations organization never wanted this project and were never fully committed to it; it was a head office decision and people at the plant did not agree with it so there was no buy-in

-We committed to this project far too early, and there was little time for any good planning

10b. -Needed to do more P3; project was schedule driven and we didn't have any time for good planning

14. 2

14a. -Insufficient time and budget for P3; schedule driven project

-Not enough resources committed to the project; project was undertaken when manpower was stretched very thin

14b. -Need more P3; more time and resources need to be committed

#### OPERATIONS MANAGER

10. 3

10a. -Initial goals(load requirements) did not meet station needs; initial planning team did not have the right specs to plan by

10b. -If target dates were realistically set, we could allow more time for planning and execution; didn't have enough time to get information required for project; end date should not be the controlling factor for the project

-Not enough time for testing technology

14. 5

14a. -Team was limited by time, but lots of effort was put into P3 and meeting the end date; however, just not enough time to do thorough evaluation of alternatives and get all the information needed

14b. -Realistic time table and keep the same team consistent; communication between major parties needs to be better

#### P013

#### PROJECT MANAGER

10. 4

10a. -Project well executed

10b. -Better development of technology before implementation

14. 4

14a. -Customer requirements well defined; equipment definition conceptually designed

14b. -Technology assessment; company took a chance on unproved technology

#### OPERATIONS MANAGER

10. 4

10a. -Three construction superintendent changeovers in eight months; two project engineer change overs

-Conflict in goals between project manager and operations: lowball price vs. safety and reliability

-Big punchlist; lots of little jobs undone

10b. -Conflict between project managers and project engineers could be solved if project engineers

could be made to operate plant

-Continuity of project personnel and more staffing

14. 4

14a. -We had a plan because the plant was an exact duplicate of previous plant

14b. -Realize that you can't duplicate everything; must be flexible

-More teamwork; cut through barriers with teamwork; we are doing more of this now

#### **P014**

##### **BUSINESS MANAGER**

10. 4

10a. -Well designed and built unit

-Main dissatisfaction was cost overrun

10b. -Pre-project cost estimate low; input at pre-project planning stage low

14. 3

14a. -Used (owner) Process Technology; corporation personnel thought they understood plant personnel's needs; After project started found out differently

14b. -More preliminary design; flow sheets 50-60% of preliminary design; get input from plant personnel

##### **PROJECT MANAGER**

10. 4

10a. -\$10,000,000 under industry average

-Difficult client; management involved—contributed to difficulties because of lack of decision making

-Held up by customer

-Company was going through extreme turnover

-PM grossly overloaded

10b. -Front end work; \$160,000 available; 3 months to define project; need more responsive client; micromanagement of project a problem

14. 1

14a. -Lack of funds; lack of time; common of (owner) at this point

14b. -No project concept to start with;

##### **OPERATIONS MANAGER**

10. 4

10a. -High degree of P3 involving the end customer in the beginning and throughout execution of the project

10b. -Overran original approved estimate; not enough detailed design work done; when we got into the project and looked at all the issues, mainly environmental, we overran the budget

14. 4

14a. -I was not involved in P3

14b. -More detailed design and more definition of design before approval

-It is common practice to include people from operations in the project; I was not involved in this one

#### **P017**

##### **BUSINESS MANAGER**

10. 4

10a. -Got additional capacity we were looking for; project was an improved duplicate of an existing unit; not a breakthrough project

10b. -Better understanding of how all different units fit together; we were not aware in advance of

what the new set of constraints would be when the new integrated unit was put into operation

14. 4

14a. -Work unit in place was already in place for a previous reactor, that was a source of information and established standard

14b. -No

#### PROJECT MANAGER

10. 5

10a. -Project met goals on schedule and budget

-This project was a copy job; that contributed to success

-Project had one technical problem to overcome and with a concerted effort this was overcome

10b. -Area to improve is planning for engineering resources: (project engineers, process control and process engineers), project took place during a very busy period—people stretched thin

-This project taught us, along with CII and Business Round Table studies, that we need better safety awareness; we started after this project to set safety goals and select contractors based more on safety performance

14. 4

14a. -Compared to other projects, this had more than average time put into but not as much as others; copy job—lots of same team from previous project; even with that—lots of effort went into P3

14b. -Project execution strategy was not considered much; labor market and resource availability for example was not considered adequately and should have been since it became a problem

-Also, we should look more in the area of project controls

#### OPERATIONS MANAGER

10. 4

10a. -The start-up and product quality was there at very beginning; execution on time, high product quality

-Person from plan involved in design effort, then came back to be in charge of start-up

10b. -Proper selection of materials; we didn't do a good job evaluating and selecting materials

14. 4

14a. -Goes back to developing sales plan; business goals very well defined; lots of time on developing business goals

-Team formed for estimating and that went smoothly; resources available

14b. -In general, we don't look at alternatives well enough; not enough evaluation of different methods; in this case, business team dictated what was to be used

#### P018

#### PROJECT MANAGER

10. 5

10a. -Done under budget, ahead of schedule, started up and ran as designed; little rework of anything

10b. -Get scope changes done before signing contract; project was authorized; after proceed order was given, it was shelved for 15 months; after 15 months, we looked it over again and made 90 changes after contract signed; so lots of scope changes

14. 4

14a. -Very detailed bid book put together; however, in 15 months shelf time, other projects were done at the site that impacted this project and caused us to make changes

-Very well defined scope before shelved for 15 months

14b. -Don't know



**P019****BUSINESS MANAGER**

10. 2

10a. -Economic forecast was made at a time when product was needed and prices were high; when plant was completed market conditions had changed drastically

-Asia plants opened eliminating a lot of export opportunities

-Project has been a success technologically

10b. -Authorize project earlier in business cycle

-Chemical plant; new technology; significant learning curve; some equipment problems

14. 5

14a. -High skill level, multidisciplined team; CPM scheduling techniques used for P3 effort

14b. -Main thing centers around marketing

-Market analyst transferred during P3 effort by (owner) executives; field marketing group downsized at the same time they were increasing plant production

**OPERATIONS MANAGER**

10. 1

10a. -Business standpoint; market overseas dried up; supply has much exceeded demand

10b. -Risk assessment (business) should be more thorough

-Forecast very favorable during good times

14. 4

14a. -Key people worked well together

14b. -Marketing and business strategy needed to be more thorough

**P020****BUSINESS MANAGER**

10. 4

10a. -Overall cost was roughly half of what similar projects had been done for; results of going with local resources (which was risky, and not usually done); accelerated the project by one year over what similar facilities take; new type technology used that was risky (local resources), but paid off with high product reliability; best of its kind facility; we did lots of field testing and convinced ourselves this was feasible technology; willing to take risk in-house that paid off

10b. -Glitch in permit process; Clean Air Act changing; if this could have been forecasted, would have saved some money, but instead we had to go back a year later and do a little more work; environmental regulations (permitting) always a big problem; never clear cut (gray areas); pain in neck; in future, more in-house personnel could be used since cheaper and talented; could not do the same project again because no in-house assets; we are creating an alliance with a major contractor that we'll do work for us

14. 4

14a. -Most projects of this nature don't consider operating costs, just cost estimates of project; no maintenance and long term outlook; we looked at project cost for total life-cycle; in fact, the option we chose cost more to build because we looked at operations and maintenance costs as well as all costs

14b. -Have never regretted anything out of this project; perhaps some more emphasis on environmental and regulatory requirements earlier so we had more detailed information up front

**PROJECT MANAGER**

10. 5

10a. -Operators very happy with product; very easy to operate

-Good communication between construction crews and design team; we had some surprises and were rushed a bit; worked well to have crews and designers working together

-Start-up very smooth; best they had seen in a while

10b. -One key person left the project and this caused lots of disruption (lead electrical designer)

14. 4

14a. -Great deal of effort for evaluating alternatives, developing estimates, and schedules

14b. -Problem was scope grew because we did not evaluate the as-built electrical system in existing plant

-We waited on funding from co-owners of oil fields; made us rush; if we had funding sooner, we could have started design earlier

-P3: process engineer group evaluates technology then if approval of conceptual work is given, then a project manager is assigned

#### OPERATIONS MANAGER

10. 5

10a. -Main reason: engineering and construction worked well with operations--good relationship up front

-We visited many other facilities to evaluate technology; talked to manufacturers and looked at their quality control

-Did not single source; able to get close to one million savings on bids for hydro cyclones

-Visit to North Sea platform that had similar operation in place was very beneficial; we learned how to reduce maintenance and operations time and costs; this reduced life cycle costs along with construction costs

10b. -Two phases: hydro cyclone and vapor recovery; we had engineer personnel changes in the middle of the two phases that we didn't like; we got good personnel in there, but we lost some continuity

-Vapor recover: maintenance--noise concerns for operations; we wanted a silencer--had to press the issue to get it put in

14. 5

14a. -Main reason--we tested new technology that had not been used on the North Slope before; hydro cyclones for example; good evaluation of this technology before we committed to it

-No problems with unit since we put it on line

-Engineering and construction and operations worked together; made project very successful--excellent teamwork

14b. -We should do teamwork like we did on this project on all projects; we don't usually get along so well

-Problems with training--change of personnel; the trainers were changed and that caused some disruption

#### P21

#### BUSINESS MANAGER

10. 4

10a. -I feel that we did not have the teamwork that we could have had; we had a teamwork problem and education people problem; this kept us from identifying the design/technical problems of the valves plugging up; better teamwork would have helped earlier identification of technical problems

10b. -Teamwork has been getting attention in the business and project organization for the company

-Ease of operation--new rotary valves used that kept plugging up; thus, we weren't meeting our capacity objectives and we didn't identify this early on; it took us too much time to figure this out

14. 4

14a. -We had a very detailed scope defined with a lot of exposure to each of the concepts to review and critique before approval; once technology was defined, we did a lot of detailed design before authorization

- 14b. -I felt P3 was good; Any changes would be more incremental than step change  
 -You can always do better

#### PROJECT MANAGER

10. 4

- 10a. -Met all the sponsors objectives: under budget and was able to cut schedule by two months  
 -Producing all products to the highest quality ever achieved  
 -Project controls were good; first estimate done (forecast, during detailed design) was within 2% of actual end price; thus we were able to free capital for other projects  
 -Excellent communications--no surprises  
 -Exceeded emissions goals on environmental; doubled reductions
- 10b. -Biggest thing was everything went great until start-up; start-up was almost taken for granted; this was similar to other jobs, but some differences; thus, some money was taken from budget for staff and operator training; did not get operator buy-in; this hurt us  
 -Type of product where one upset caused the whole line to shut down for a full day

14. 4

- 14a. -In development of scope and execution--very negligible changes  
 -Planning team developed a good plan initially; very strict window for project; able to meet without additional cost (means good planning)  
 -Senior piping people were taken away because of an incident at another plant; therefore, less experienced people working on piping design gave us some problems, but we had a plan and took corrective action early and met all objectives--at no additional cost and no increased man-hours  
 -(Owner) has recognized that the people on the P3 team may have never executed a project--sometimes they don't understand repercussions of some things when dealing with project management; that's why people didn't work well together; once consistent direction was given, it was very easy for the project team--no mixed signals; must have consistency from management; once machine gets going it is hard to turn on a dime

#### OPERATIONS MANAGER

10. 4

- 10a. -Good cooperation between project team, engineering and construction group  
 -Minimal scope changes  
 -On site engineering available during construction phase to address issues
- 10b. -Was not a smooth transfer between construction and operations because no good operator training program put together  
 -Construction schedule compressed from 15 to 10 weeks; therefore, we didn't have enough time to review drawings, thus, more field changes; these changes could have been eliminated with more thorough review  
 -Explosion at another plant took away a lot of engineer staff from this project that left a gap; caused us some disruption; compressed schedule wouldn't have been so bad, but coupled with this it made situation worse

14. 5

- 14a. -First time we actually had engineers (from partnership with (contractor)) close by in Houston where the project was; P3 was facilitated because we met weekly with everyone; in the past engineer not as available because he came from our technical center in Charleston; we only met monthly before, on other projects; we worked on this project more closely and frequently; one drawback (minor) with partnership is that twice as many people are overseeing everything ((contractor) and (owner)); this was more than offset by the advantage of face-to-face interaction on a weekly basis  
 -I had worked together with PM before, and we worked well together
- 14b. -P3 might not be changed that much

**P022****BUSINESS MANAGER**

10. 2

- 10a. -Capital expenditures and construction activities went fairly well, but
  - Ease of operation and maintaining quality specs caused many problems
- 10b. -Wish we had done much greater research on chemical process for the sum of dollars we were expended; some experiments done, but we got bit by the dumb ass
  - We were so anxious that overall schedule became target—not enough testing

14. 4

- 14a. -Project of the size and dollar amount—looked at many alternatives
  - Good job assessing what we need up-front
  - Economics of oil went bad at time we were building, but there was enough flexibility planned into account for market and price sensitive changes; able to easily adjust outcome
- 14b. -Recent project we didn't have a strict hierarchy—we had a pie chart for organization—everyone involved up-front: safety, PM, construction contractor, engineer design; everyone was a function manager; established a P3 plan project execution incentive sharing plan—distribute savings to workers and safety awards; Excellent incentive plan up-front (partnering); lots of unique things; finished one month ahead of schedule
  - Include construction contractor and engineer contractor up-front on team—key to success; also, treat them as they are integral—no standard hierarchy; hire for expertise and trust them; treat them well/trust them; did this recently—two contractors had to get along
  - Set a mission, plan, goal, make consensus decisions really helped; treat everyone as equal; really proud of recent project; established benchmarking from this project: safety incentive program, worker incentive programs; no set breaks on project; one time-keeper, one secretary, one trailer for everyone—great communications
  - Workers could take up gripes with any one team
  - No graffiti in portopotes
  - People treated as people not workers
  - Issued team effectiveness survey—before disbanded
  - Everyone had same hard hat—with logo
  - Foreman story: foreman found a backhoe rental cheaper than the one his company was providing him; so he called company and sent back his backhoe rented the cheaper one

**P23****BUSINESS MANAGER**

10. 4

- 10a. -Close to cost; ahead of schedule; right output/right specifications; no safety problems
- 10b. -Minor criticism rude shock when we got initial detailed estimate from contractor; in-house estimate was 15% lower; have taken some steps to improve estimating process
  - In effort to keep contractor staffed (5 year partnership), probably went to them a month or two earlier than we usually do; this wasted money; went to them with lower level of definition than desired; would like to go to contractor with more detailed definition;

14. 4

- 14a. -Had scope that was well defined when we went to appropriation—20% detailed design done; lot further down stream than normal; contractor used a very detailed estimating technique
- 14b. -Probably need to ensure that before we go to contractor we have a higher level of definition than we had; this will make things much smoother; we had a big delay in engineering after the first detailed estimate came out which was much higher (15-20%) than we expected; we took two months

to haggle over where to cut; detailed engineering had to stop until cost was back in line; the reason is we didn't give the contractor enough definition, so estimate was high

-Also, conflict of interest that resulted from partnership with contractor; their estimate is what ends up going into project for authorization; we felt it was high and perhaps a conflict since they are the ones building the project as well

-Engineering effort was 36% of project cost--normally 25-30% was normal; some of this has to do with conflict of interest; project team (owner) didn't agree with contractor forecast

#### OPERATIONS MANAGER

10. 4

10a. -Capacity objectives met

-Ahead of schedule

-Operability and maintainability good

-Downside, from business standpoint market growth for the product has not materialized--downturn in chemical industry; can't shift to another product

10b. -Painful to get a commissioning schedule that was reasonable enough to get operations on-line; pushed the engineer contractor too much; we needed to negotiate for more time; finally, we convinced engineer and contractor to give us three months commissioning; contractor wanted to work right up to the MC date so each system was piecemealed over the three month period; this helped with successful start-up

-Market forecast

14. 3

14a. -Evaluation of alternatives, technology, etc. all took about one year; when funding obtained project ready for detailed design; had enough time

14b. -We had a shift of project members between P3 and execution phase that was very disruptive when execution started; project engineer changeover as well as other engineer staff members; this was disruptive; need to stay the same for continuity; major effort on my part to bring them up to speed

-More R & D support for evaluating technology alternatives

#### P24

#### BUSINESS MANAGER

10. 4

10a. -Objectives of the project were to improve product consistency, improve quality, and a modest capacity increase

-Project did not originally work IAW objectives; much longer than normal start-up; lots of problems converting manual procedures to computer controlled; took over one year after mechanical completion to get on-line; originally, we had a capacity decrease; problems with hardware and software--most complex system that this technology has ever been used for; some things we wanted it to do exceeded the control systems capability; hardware and software were improved--we learned a lot, so did the manufacturer of the system

10b. -We needed to do more design and engineering work around how we translate manual procedures to computer coding--lots of up front engineering required

14. 3

14a. -We normally do a lot of P3; I feel it would have been hard to avoid the problems we had by doing anything different in P3

14b. -With this type of project, we need to learn to spend a lot more effort on translation from manual to computer code; this is an intensive effort that takes a lot of work

-We have, since this project, improved internal PM skills and our conceptual evaluation skills for this type of project

## PROJECT MANAGER

10. 5

10a. -Basically, achieved sponsors objective of replacing existing outdated controls to modern ones; resulted in increased on-stream time and more facilities for staff

-Done in cost effective manner and met schedule objectives; more important to minimize shutdown time--achieved

10b. -Turnover of the production representatives created some difficulty and some resource limitation (process people not fully available); initial funding approval delayed; took longer than expected to get approvals (3 month delay); business considerations caused some disruptions to engineering process

14. 4

14a. -The primary technology looked at and extensive studies done to select best control systems available; that was used as a basis for deciding scopes; therefore, very well defined scopes

14b. -I think there is a lack of direction from upper management as far as what the business directives and objectives really are; we don't get a clear direction of where we want to go; as a result, middle management ends up doing it, but then their objectives don't mesh with upper management; we spend a lot of time planning projects that have no chance of approval when we get to authorization phase; mainly, due to lack of communication of objectives and strategic directions for business areas; if corporate objectives were better communicated and clear, we would save lots of time planning and stand a better chance of approval for projects at authorization time

## OPERATIONS MANAGER

10. 4

10a. -Unfavorable--programming provided to us (new control system technology); we had no in-house experts: we jumped into new technology with no experience; for 2-3 years now, after mechanical completion, we have spent a lot of time working out the bugs

-On plus side--good cooperation between operations and construction to minimize downtime

-Good effort to ensure open/frequent/consistent communications: weekly meetings very helpful in resolving issues

10b. -Identify where in-house expertise doesn't exist--initial projects are the learning curve; in order to keep costs down, we didn't want to pay vendor to do programming; we tried to do it in-house

14. 4

14a. -Due to dollar size of project and no clear concrete ROC calculations; lots of homework was done to justify this project

14b. -Detailed scope could be better--lots of minute details get lost in weeds

-Alternative technologies--lots of time and effort put into looking at other company's and how technology works

P25

## BUSINESS MANAGER

10. 3

10a. -Cost was significantly higher than projected

-Positive side--these are developmental products--over the long haul this will be very positive for us; short term--project left a bad taste for everyone

10b. -Firmer definition of what we need before starting the project; we need to (lesson learned) have a better idea of scope; sponsor's objectives were not very thorough; we need to look at all areas for scope (maintenance, etc.); we didn't plan for certain areas and cost us more later; we surprised people with the real cost when we planned for everything

14. 1

14a. -Two goals of project--only one well defined; other not defined at all because we decided not to

pursue it; but later in execution phase, it became a major objective; reason for this refocus was management changed their mind midstream after project authorized and we had to reauthorize

14b. -More organized method; enough time to do it right

-We are trying to change the method of authorization so that it is more defined especially in area of risk; what investment can we tolerate?

-Communications: ensuring that upper management understand the implications of changes; too easy to say yes; what will change cost--management needs to understand this

#### PROJECT MANAGER

10. 4

10a. -Cost was high (very developmental): lots of rework and lots of wasted work due to changes in scope; devastating cost impact due to poor scope(factor of 3)

-Good execution in spite of changes; team worked well together; made it more successful

10b. -The scope needs to be finalized at an appropriate time

14. 2

14a. -Based on known technology--a couple of parts were just copying other projects; the other parts were virtually new technology

14b. -Important point--stay with original scope; management knew what they wanted; don't let cost authorizations drive the project; project was dictated by authorized amount; ended up having to pay more anyway; figure out what it costs first

-Scope of the job was well understood for business needs, but the estimates were very poor; scope so poorly defined; scope totally changed the job; we ended up adding a lot and taking some away; so, essentially went through whole P3 process a second time; we had already done a lot of design work

-Project team worked well together

#### OPERATIONS MANAGER

10. 4

10a. -Problems in early design phase; technology not well defined; once this got worked out; project team worked well together; construction well executed even though done in an operating unit; start-up went very well--on schedule

10b. -Biggest thing--clearly defined technology before beginning design phase

14. 4

14a. -I was part of P3 and aware of effort that went into the market studies, site selection; fairly big effort

14b. -We had commitment to execute the project before technology figured out; we started engineer and design before technology figured; we had to change horses mid-stream; we had to redesign many facilities; if we had a clear idea of technology of the project up-front it would have been an extremely successful undertaking

#### P026

#### PROJECT MANAGER

10. 5

10a. -The program that this was a part of was the most successful we ever executed

-Partnering relationship with suppliers was excellent; partnering with EPC contractor was excellent; good relations with subcontractors; competent people; excellent scope; philosophy--everyone wins; e.g., recovery supplier had some labor problems; was 3 months behind with 12 months to start-up; teamwork solved the problems

-One success has been our partnering meetings senior executives (VPs and presidents) at monthly meetings; all companies represented; all issues on the table; impact of all problems discussed; small problems addressed before they became big ones

-Big emphasis on safety; management truly committed to safety; work force performed better  
 10b. -One big problem from EPC supplier, they had an internal contracts that were all fixed price contracts; he was always battling change orders; internal conflicts within his organization made things difficult

-Strategy should have been cost reimbursable to suppliers

14. 5

14a. -More people and time involved in scoping and planning the recovery island than ever; operators, consulting, etc.

-Recognizing this was going to be an EPC contract we made all the decisions up front so smaller details are worked out; typically, we do cost reimbursement so details aren't as worked out

14b. -Truly understanding marketing aspects more; we don't do a good job looking at the end product with relation to marketing; we start a project before really understanding market and business

#### OPERATIONS MANAGER

10. 4

10a. -Producing what it is supposed to, availability is there; met or exceeded all original objectives

-Design flaws (metallurgical) caused us some renovation/fixing modifications

-Project requires more maintenance as a result of design flaws

10b. -More engineering up-front and benchmarking (looking at other projects)

14. 4

14a. -Project was successful, came in at cost; performed at 95% of expectations

-Major issues that have come up were resolved

14b. -More up-front time; need to benchmark more in critical areas; look at other similar projects

#### P028

#### PROJECT MANAGER

10. 4

10a. -The design, construction, and start-up were all within budget and schedule; we did spend some extra money on some things we did not plan for

10b. -More complete buy-in on the front end of all project participants: engineering, business, operations, etc.

-Could have used two more months of schedule

14. 4

14a. -There was the right quality and types of people involved and good effort; good team work toward common objectives

-Developed internal objectives: committed ourselves to doing things right

14b. -Proper setting of goals and objectives and getting buy-in

-Selling what you came up with to all levels of the company, whether it be an operator or chairman of the board

#### OPERATIONS MANAGER

10. 5

10a. -Was not new technology—copy and improved existing plant

-Lots of input from people from existing facility

10b. -Initial work must be planned better; construction and start-up went well

-Loss of continuity at the beginning due to turnover of lots of people, mainly on process-end, was painful

-Better process engineering supervision—all homework wasn't done especially on environmental requirements; we had to install a new scrubber after start-up

14. 3



14a. -Mainly, goes back to way we were organized in the beginning; no leadership from process engineer standpoint; we changed people a lot

14b. -Must start with same people, keep them on board; must have leadership; people have to be indoctrinated to corporate engineering; people have to know roles, responsibility and their requirements; overall, the process engineering could have been improved

#### **P029**

##### **BUSINESS MANAGER**

10. -Unknown, not involved after P3

10a. -No comment

10b. -No comment

14. 4

14a. -The P3 efforts were limited by time frames; 80% solution was achieved; sometimes it may be appropriate to expand P3 time frame to achieve more detail

14b. -Adequate time to assemble team, define goals, and evaluate alternatives

##### **PROJECT MANAGER**

10. 4

10a. -New technology was used and we have lots of problems with it; currently completing another job to fix it; the technology selected was cost-effective; saved \$30 million in capital cost, but a bitch to operate

-Construction and design was good, but technology selection was not

10b. -Better technology methods would have been best, but they cost a lot more

14. 4

14a. -Good job except for operating problems; difficult to operate; construction and design went well; there were few if any changes; a one month delay on schedule had no impact

14b. -The change that we have made that has improved P3 is that we now assign a PM up front, and give him a team to work with that includes all parties: construction, operations, etc.; team works well (teamwork); participation of all component players is better, biggest thing is communication of all interfaces is better

-Today, we have a formal P3 method that involves all people and produces a project execution plan; this is a vast improvement

#### **P032**

##### **BUSINESS MANAGER**

10. 4

10a. -Because of change of strategy we never did test the project fully; we changed primary product-one month after start-up

10b. -Everything as far as scope was well defined—an expansion project

14. -Not involved in P3

##### **PROJECT MANAGER**

10. 5

10a. -Met budget/schedule/ financial success—did what it was supposed to do

10b. -No comment

14. 5

14a. -Evaluation of alternatives was very thorough

-Scope and estimate very detailed

-Had people committed to teamwork and defining process—R & D, construction, engineering, and operations all involved

-Operations team at plant were very competent and experienced personnel; lots of participation

of operations people in constructability review--reduced field changes

-Used physical laboratory model of the reactor

14b. -I use this project as a model project

#### OPERATION MANAGER

10. 5

10a. -On time, on budget, minimal safety incidents

-People worked well together

-Start up was picture perfect

10b. -No comment

14. 4

14a. -Did not have many people on project; overall, money spent on P3 work was low; the few people that worked on it were very experienced

-Good experience on core team; built team early and had input from all project participants

-Took time to check technology with company technology experts; pooling these guys as a technology panel was helpful

-Also, we had a corporate engineering designer work with us during P3; he helped us to think about routing pipes, etc.; helped us make decisions during P3

14b. -Need quicker business decisions--some time lost on making decisions to commit money

-All in all, very successful--met timing and cost goals, and facility runs better than designed

#### P033

#### BUSINESS MANAGER

10. 5

10a. -This project is the most successful that I have been a customer of

-The production was badly needed; quality job that met schedule, and under budget

10b. -An excellent benchmark to exceed

14. 5

14a. -Lot of time for P3

-Considerable amount on team building and TQM; real effort on these between owner, contractor, and all organizations involved; this paid off

14b. -This was a bell weather project; we try to continually improve this methodology

#### PROJECT MANAGER

10. 5

10a. -Ran under budget \$10 million, two months early, smoothest start-up ever; severe shortage of acrylic acid, thus, completion two months early was a big benefit to the business

-Plant has been operating well and at full capacity since start-up

10b. -Management of change: we didn't have to spend as much money as we did

-Interaction between owner and engineering contractor could have been better; engineer contractor could have spent fewer hours on design

14. 5

14a. -Project team was put together at the P3 phase instead of during the detailed design phase; we were able to do considerably higher level of P3 than done before on other projects; we even brought the engineer contractor in at the beginning of the P3 process to help

14b. -More time should be spent selecting alternatives; there weren't a whole lot of alternatives to look at

#### OPERATIONS MANAGER

10. 5

10a. -Under budget, on schedule; very critical project; we committed to deliver a product and a quality product was delivered to customers on time

-Minimum conflict; very qualified people (experienced people) who knew their responsibilities; very well defined project responsibilities

-Machinery operates very well and operators like it: easy to operate, very reliable, little downtime

-End result—we are doing another project and the goal is to make it like this one

-Established good relationships with prime contractor, at the plant, we established a partnering atmosphere that is still good today

10b. -Used some new technology that caused us some challenge, but don't know how we would do it differently

14. 5

14a. -This project had a big effort to define what the priorities were and come up with detailed definitions of quality parameters

-Extensive team building with the help of a consultant; we monitored the team process by measuring how well we were doing and got back on track if we were off-track; used score cards to see how team was performing; experienced people; excellent open atmosphere—good for input and teamwork on all issues

-Brought resources from outside to look at our plan and give us an assessment

-This was a project that we had no experience in doing the things we wanted to; so we put a lot of emphasis on planning and this was the first time we brought together all the disciplines early (operations, contractor, consultant, R & D, engineering) and formed a good team

14b. No comment

#### **P034**

##### **BUSINESS MANAGER**

10. 5

10a. -It had a very corporate and public profile—the best resources available were put into it

-Started planning in 1972—very well defined scope

-Novel designs to achieve social benefits—single footing transmission tower, for example

-Initiated a bonus program for the public land owners and other programs to achieve cooperation; offered a bonus for early access (5-10% of final settlement); achieved much better cooperation of land owners in ROW; no protests or violence

10b. -More cost savings in some construction techniques; used lessons learned to reduce costs on future lines

-One of the most successful projects I've been associated with

14. 5

14a. -In the last few years of planning, \$40 million expended; went through lots of public hearings; in preparation for those we had to do a lot of environmental assessment and engineering

-Had a very high profile for corporation; lots of planning and resources went to planning it right; executives very involved—unlike other projects

14b. -In my experience this was the best I was involved with; the regulatory push and public profile drove us to do a good job; all resources were made available; resources were not a problem; we didn't try to cut costs on this one: high public profile (environmental—switch from coal burning to nuclear); payoff—\$1 million per week savings

##### **PROJECT MANAGER**

10. 5

10a. -All objectives met; budget, schedule, planning

-Good planning

-Innovative design and management techniques: used new type of foundation—built some of

prototypes before construction; what we learned was put into final design; management: used good scheduling and progress monitoring techniques

10b. -Very successful--nothing

14. 4

14a. -The success of the project reflects the amount of planning that went into it; results demonstrate planning was good

14b. -One problem was many decisions were politically motivated rather than being business or engineering evaluations of risk; political influence

-P3 cost: 15 years of planning and \$30 million was for extensive environmental studies; one condition is that everyone affected must be notified, then hearings are held; at the first hearing, it was ruled that proper notification was not given--this caused a delay of several years; we spent \$30 million and 15 years on approval (government) process

OPERATIONS MANAGER

10. 4

10a. -Went into operations quickly and no major problems with operating the project

10b. -Nothing major I can see

14. 3

14a. -I felt more participation from different groups within organization could have been better

14b. -Earlier involvement of P3 team before approval phase--more in conceptual phase

-Initial approval was overturned by court case then years later after large environmental study, we went for approval again

#### P035

PROJECT MANAGER

10. 5

10a. -Capacity attainment greater than 100% and on stream performance greater than expected; market conditions were better than expected so it was extremely successful--eleven month payout

10b. -Engineering missed one of the primary priority choices: minimize downtime due to construction; longer down time due to retrofit tie-ins; this was not expected

-Problem was clear communication of project objectives to everyone; for example, down to piping designers, to avoid downtime

14. 5

14a. -Number of participants from all the business areas: marketing, plant operations, R & D, etc.; participants were all top qualified and dedicated people; lots of experience on team, and team was dedicated full-time to this project

14b. -We probably could look more at project execution planning; we didn't look at fixed price and there might be an opportunity there

OPERATIONS MANAGER

10. 4

10a. -Bottom line--met objectives with respect to production and what we wanted to make; coordination between production and construction went extremely well to minimize shut down time and facilitate start-ups

10b. -Some technical issues that weren't thought through as well as they could have been; more up-front work was required; some changes made that did not work out as well as expected; more research needed to be done; we were in a time crunch and quick decisions had to be made; this could have been avoided with better planning

-Cost: within budget

14. 4

14a. -Good work on definition of project, but not enough effort put into technology evaluation,

mainly due to time crunch; lots of planning went into execution

14b. -Good evaluations should be made even prior to P3 because of a limited amount of time in P3 and due to capital constraints; if you haven't already prepared technology evaluations, you don't have enough time during P3 to do them

### P036

#### BUSINESS MANAGER

10. 4

10a. -Delivered in a timely fashion; not exactly on schedule, but close

-At or below budget

-Fast-paced project, yet still provided quality project

-Since start-up, no problems

10b. -Nothing significant

14. 4

14a. -People involved in P3 were experienced and had already done four similar projects

14b. -Perhaps better define the customer's needs, or help him define his needs better

#### PROJECT MANAGER

10. 4

10a. -Second of three modules; had experience with first one; same designers, but not same contractor; thus, since this was a copy job, we applied lessons learned

10b. -More design time

-Construction taking place before design was complete, and we had to do rework because of this

-Environmental concerns pushed us into starting construction before design was complete

14. 3

14a. -No comment

14b. -(Owner) did not assign construction people or project managers until after P3 is complete; construction people need to be involved from the beginning; we are starting to realize this and involving construction people on future projects; we have very young engineers and they could benefit from the construction input

### P038

#### BUSINESS MANAGER

10. 3

10a. -Economically, cost was way over; blew budget

-Technically, however, we accomplished the objectives of improving the quality of the station

10b. -Pre-planning stage. We needed more detailed planning; we did not scope the project well.

-Financial controls need to be improved; we didn't track well; we were out of control

14. 5

14a. -We spent a lot of time and came up with what we thought was best; however, after approval, we had to change everything because of an outside problem; our customer changed everything

14b. -We have to involve the outside organizations(customer) in P3 to the fullest extent possible; and get commitment from them in P3

-We have to investigate site more thoroughly; in this case the building was in the seismic zone and not seismically constructed; we found this out too late

#### PROJECT MANAGER

10. 3

10a. -On budget, very successful

-Operations and maintenance, and construction was very successful

-Very confined site in the downtown area; this was a rehab job so we had to

minimize downtime; we could not do good soils tests; found differing site condition and had to change foundations, thus cost a lot more

-We didn't foresee that we had to establish a temporary power source

10b. -Do not let contract until design and soils test are complete-major mistake; however we were pressed by customer to meet the in-service date; we had lots of changes as a result

14. 2

14a. -No P3 team looking at the project

-Squeezed by time limitations; we didn't talk enough to the operations people and didn't do enough planning for outages

-No team approach to the project; very limited time; we were rushed because this station provided power to some very important political customers

14b. -Not enough time and must have a team put together

OPERATIONS MANAGER

10. 2

10a. -The end product was very suitable; operators like the project; maintainability is very good

-However, designers designed in isolation; Design and planning was terrible; over budget by a factor of three

-No communication or input from operators was allowed; no input from customer was allowed, e.g., customer knew soil conditions but our engineers didn't listen to them

10b. -We are working toward project teams so that everyone is accountable, responsible and has input

P039

PROJECT MANAGER

10. 4

10a. -Involvement of local labor in construction

-Under budget, on schedule

-Client satisfaction with end product

10b. -Delay field construction until more engineer and procurement complete; we started construction at 50% design and procurement completion

-Construction staffing earlier; trouble getting CM on board at proper time; this hurt us schedule-wise

14. 4

14a. -Lot of client involvement as far as quality and performance objectives were concerned

14b. -Area that was lacking was the experience of personnel; no experience on execution of new construction; not experienced on grass roots projects

OPERATIONS MANAGER

10. 5

10a. -Under budget, on schedule, performing well

10b. -In efforts to reduce cost, material selection was for minimum quality; incorporate plant experience

14. 4

14a. -No comment

14b. -Early in the game, get people on board that understand project management

P041

BUSINESS MANAGER

10. 4

10a. -Done under budget (7%); no recordable accidents or lost times; we were able to do a lot of

work on-site with our own forces; industry not able to provide components so we provided much of them on our own

-First historical project where we inventoried and librated components from the old power house and put in storage for a museum; we had an industrial archeologist: very turned on by instruments

-Good community involvement; fund raisers for local communities; good partnership with community

10b. -Better communication and coordination between state and federal regulatory agencies; especially with environmental policies; we had some problems that better communications could have avoided

-Lots of problems with in-house design; need more time for engineering and design before construction began

14. 3

14a. -Evaluation was made and presented, but then shelved for three years because of management philosophy and economic viability

-The project became viable because we were having problems with our nuclear power availability

14b. -We dropped the ball on cultural heritage involvement; we didn't communicate the significance of the value of the old instruments to construction people; educational process of cultural heritage; building was on the natural register; had to use some slower techniques; delays due to all the recording needed

-More emphasis on project control tracking cost and schedule; integrating the schedules of all parties; had some confusion

#### PROJECT MANAGER

10. 3

10a. -Two major changes that caused problems with budget(25% increase) and schedule

-Some things were scoped very well, however we did a very poor job scoping the generators and turbines; we were missing the maintenance records for planning

-Otherwise met all objectives

10b. -Goes back to planning; needed more tests on generators to know its true condition; same with turbines; we didn't find out until late that we needed a lot more work on generators and turbines

14. 5

14a. -Very thorough economic analysis; weak point was the scheduling effort; we relied on data from the maintenance organization for turbines and generators, which was very poor

-We spent a lot more time on this project; no restrictions, all the time and resources we needed were given; overkill as far as effort; big budget and plenty of time; we don't ever get as much time any more

14b. -Scheduling must be improved

-Not enough focus on team building at that time; now teams are formed and trained

-Not enough follow through by planners into design and construction phase; planners don't stay with the project and there is not enough communication back and forth

-Now, we don't even have the resources we used to have and couldn't do pre-project planning as well; we have to contract for it

#### P042

#### PROJECT MANAGER

10. 4

10a. -Extremely difficult project because very new technology being installed in building; in

addition, we had a time constraint of two years to completion; most buildings like this take three years; we had lots of changes; however, we still occupied in 26 months and stayed within budget

-One thing that went well, we had a design competition; picked six design firms gave them each \$60 K to produce best design and then picked best firm and incorporated the best of other firms design

-Client on site and good communications at all times (people who would occupy and operate; good input from them during construction for changes)

10b. -GC switched the Project Manager on us to someone we hadn't worked with before; new PM spent too much time in office and not on-site; we didn't have a good relationship with him; bottom line—better job identifying appropriate GC and PM

-Schedule was too tight and budget was not adjusted to reflect shorter schedule; these unrealistic requirements created an adversarial relationship between us and the client; needed more realistic schedule and budget

14. 5

14a. -Lots of time put into it; concept was around for 4-5 years before this lab was authorized

-Design competition was done before we actually had approval to go ahead with the project

-Worked very closely with designer; team effort the whole way: client, construction manager (me) and designer; all experienced people who I worked with before

14b. -Not enough involvement, initially, with the actual occupants of facility (lab); planning was done at high level by people that didn't know need of the lab scientists; eventually, fixed this by getting them involved and made project more successful

-More care in selecting the contractor and his PM; the GC's PM was the one source of friction

#### P043

#### BUSINESS MANAGER

10. 5

10a. -Reliability of product (transfer substation)

-Many challenging problems overcome

-Good communication and openness of all parties

10b. No comment

14. 4

14a. -Lots of it done, but could have been more defined

14b. -(Owner) is too autocratic and intimidating; this some time hamper communication of information; better communication—this is improving; listen to input

#### PROJECT MANAGER

10. 5

10a. -Transmission line was very critical to customers

-Utilized unneeded equipment from a nuclear station (surplus); this gave us a big cost savings over buying new conventional equipment; we had to do some modifications, but I think it was successful

10b. -Need more time for execution phase; ran into land acquisition problem that pushed construction into winter months

-Better communications between different organizations

14. 3

14a. -At this time in our organization, we didn't do formal P3; we didn't follow a road map or have a documented method

-Project manager not involved in P3; assigned to the project after authorization

14b. -We need to have documented guidelines for P3; need a road map to adhere to

-Need more up-to-date cost information to compare with estimates; and need better material



## management methods

## OPERATIONS MANAGER

10. 1

10a. -Tried to use rehabilitated equipment that was no good; everybody in planning was told that to begin with; sub-station did not perform satisfactorily

-In the middle of planning to decommission the sub-station failure

10b. -Use satisfactory equipment: tried to use stuff left over from a nuclear plant; old model--not suitable for purpose used; no money saved at all

14. 2

14a. -Project was executed OK

-Let money override the quality factor; cost dictated quality

-Went for cheaper technology over quality

14b. -PM didn't listen to people in field; operations input rejected, especially on equipment

P044

## PROJECT MANAGER

10. 5

10a. -Customer needed us to move and build a new power station while maintaining power to the facility; we met all customer objectives

-Cooperation and communication was good

10b. -More individual dedication on the part of project participants: we put people from all disciplines full time on this project in one location; hard to do for a utility, but this increased success

14. 5

14a. -Had periodic meetings of project team all the way through the project; we had more teamwork and communication and improved a lot

14b. -More dedication of personnel full time to the project; people are carrying very heavy loads; could do one project better if dedicated to it full time

P045

## PROJECT MANAGER

10. 4

10a. -Exceeded schedule, in service on-time, cost within budget

10b. -Environmental controls need work, and we are improving in this area

14. 4

14a. -High priority project, with a large industrial customer moving into rate base; customer had a schedule for in service date and we wanted to meet it

-We have incentive to keep our good reputation concerning meeting customers in service time

14b. -Customer did not decide on his location for the sub-station when we started engineering; this could have caused us delays

-This was a pretty clean project; lots of concerted effort went into it

## OPERATIONS MANAGER

10. 4

10a. -Slight problem with transformers; manufacturer had to help us fix problem

-Under budget and ready for service before in-service date

10b. -Better quality material from vendors--this was our biggest problem

14. 4

14a. -We have a different organization that plans, designs, and constructs; when this is completely done, we test, accept, operate, and maintain

-Our opportunity for input comes during the planning, design, and construction stage; we get to

make very little input

-From our standpoint things went well: I rate it a 4

14b. -Improve on communications problems; even though we're not involved early on because of confidentiality; I need to be consulted more because of my experience in operations: this would save us a lot of headaches in construction and operations and maintenance

#### **P047**

##### **PROJECT MANAGER**

10. 5

10a. -The whole project was start-up driven, and start-up was done well; success to us was to be measured on how well start-up was done; the construction/operations transition was critical; we broke the project down into small pieces and start-up corresponded with the completion of these small pieces; thus, when the project was complete, start-up as complete; also. there was no follow-up engineering required

-Under budget and schedule

-Capacity rating was upgraded by 10% after facility complete

-One key thing was we had the engineers from the existing plant come out to be part of the engineering design group, and remained on the project team through start-up; once the expansion was complete they went back to work as plant engineers; we did the same thing with electronic technicians; worked for the plant, made available for construction and start-up; then returned to plant

10b. -Mechanical contracting-piping; more modularization as part of initial planning; look for better execution work methods, especially in area of pipe installation: perhaps smaller contracts or better isometrics

14. 4

14a. -Fact that the contractor and multiple engineering firms all participated in P3 made it very successful; all involved in scope and estimates

-30 to 35% design complete in P3

-Behavioral characteristics of the people selected were unique and team oriented

-Out of this project came a manual for transition team training(for transition through the project life cycle); bridges the gap between stages in the project life cycle

14b. -Team building: most significant, can never do too much

#### **P048**

##### **PROJECT MANAGER**

10. 4

10a. -Met schedule and product quality; met operating objectives

-Didn't meet budget

10b. -Cost 5% more than original estimate

-Pretty good from a general standpoint; could have used a better and earlier evaluation of total length of time it takes to produce the project

14. 4

14a. -Experienced people on P3 team who stayed together for execution of job

-Good technology development plan to determine how to make product

14b. -Initial capacity estimates and actual estimates need to be closer together; disagreement on how much actual project would cost

#### **P049**

##### **BUSINESS MANAGER**

10. 5

10a. -Was on time since it was schedule driven; within budget and full environmental compliance

-Exceeded performance expectations as far as unit is concerned

10b. No comment

14. 5

14a. -Very through planning for a project of this magnitude

-We overplanned a little; there was no stone left unturned

14b. -This project could have been studied a little less for decision making and could have saved some money

#### P095

##### BUSINESS MANAGER

10. 4

10a. -Cost wise- good; schedule- fair

10b. -Better knowledge of the customers real needs

14. 4

14a. -Message from customer was clear

14b. -No comment

##### PROJECT MANAGER

10. 4

10a. -Well under budget; delays on materials

10b. -Material delivery ordered sooner so it's on time

14. -Not involved in P3

##### OPERATIONS MANAGER

10. 5

10a. -Exceeded scheduled in-service date; under budget; rework at a minimum

10b. -Improve equipment delivery, spare parts availability, technical information on equipment

14. 5

14a. -Extensive planning to minimize delays; minimal rework; functional checks revealed very few problems

14b. -Initial communication between vendor and owner personnel

#### P096

##### PROJECT MANAGER

10. 3

10a. -Quality was very good; schedule was met; budget was not met

10b. -Change over of staff; scope documentation

14. 1

14a. Omissions in scope

14b. -Plan was to use existing building; project was authorized on this basis; after design was begun we found that equipment would not fit into existing building; a new building had to be designed

-Primary scope: electrical requirements were well defined over a 10 year period; secondary scope was how to implement primary scope, not well defined

-Frequent turnover of personnel

#### P097

##### BUSINESS MANAGER

10. 4

10a. -Project cost lower than estimated but higher than competitive installations; most quality and

operational goals were met

10b. -Cost to manufacture was higher than estimated

14. 4

14a. -Well front-end loaded with experienced technical and operations people

14b. -Attempts at new project management or technology approaches were not completely evaluated for benefit/cost

PROJECT MANAGER

10. 5

10a. -Construction and start-up were safe, on time, under budget; the product was immediately made

10b. -More design before authorization; significant number of mechanical interferences; mechanical constructability checks

14. 3

14a. -Evaluating of alternatives; Front-end loading was accomplished in two phases: phase 1 went well, phase 2 was poor

14b. -Put more effort into front end loading; do more detailed design before authorization; design was at about 3% when project was authorized

OPERATIONS MANAGER

10. 4

10a. -Project execution and scope went very well; difficulty in implementing the new technology

10b. -Clearer understanding(business) of expectations in cost to manufacture the product; look at business needs

14. 4

14a. -Appropriate expertise brought in early

14b. -Estimating effort was not adequate

#### **P098**

BUSINESS MANAGER

10. 3

10a. -Operating success or ability was somewhat offset by low profitability due to excess PP capacity since before project completion

10b. -Improve ability to project industry capacity utilization and net spread between product sales price and feedstock cost(i.e. spread is inversely proportional to capacity utilization)

14. 4

14a. -An established, well organized process for P3 was used; it worked well

14b. -Business organization and forecasting needs to be measurably improved; the business and marketing organizations were understaffed and not well organized before or after project implementation

PROJECT MANAGER

10. 5

10a. -Executed with minimal changes, under budget, and ahead of schedule; unit started up without problems and runs well

10b. -Engineering man-hour control

14. 4

14a. -This project avoided the complication of technology evaluation and focused more on project execution

-Keys to making this project a success were having technology pre-selected;

Engineering/construction procedures well defined; project standards agreed to in advance; existing unit to go by for design; In sum good infrastructure in place to execute an expansion

OPERATIONS MANAGER

10. 1

10a. -Doubling capacity of a new technology product over a short time period combined with inadequate marketing and technical service support and a poor economy impacted on overall success

10b. -Marketing and technical service support resources needed to be increased for capacity utilization; more time between expansion projects would have allowed better evaluation of equipment reliability and corrective actions; more time between projects would have also allowed opportunity for improved operator training, on-stream reliability, and quality

14. 4

14a. -Initial project evaluation, engineering, construction, commissioning, and start-up all were done well

14b. -Business risk analysis and the impact of doubling capacity of new technology without planning to provide adequate marketing and technical services resources could be improved next time

**P099**

**BUSINESS MANAGER**

10. 5

10a. -Ahead of schedule; met all major objectives

10b. -No comment

14. 4

14a. -No comment

14b. -No comment

**OPERATIONS MANAGER**

10. 5

10a. -Project itself was very successful; unit came on-line successfully; instrumentation currently being changed

10b. -No comment

14. 5

14a. -I was not exposed to the P3 effort

14b. -No comment

### Bibliography

- Ashley, D., Jaselskis, E., and Lurie, C.B. (1987). "The determinants of construction project success." Project Management Journal, 18(2), 69-79.
- Babbie, E. (1983). The Practice of Social Research. Wadsworth, Inc. Belmont, CA.
- Cleland, D.I. (1986). "Measuring success: the owner's point of view." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 6-12.
- de Wit, A. (1986). "Measuring project success: an illusion." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 13-21.
- Freeman, M., and Beale, P. (1992). "Measuring project success." Project Management Journal, 23(1), 8-16.
- Gibson, G.E., Kaczmarowski, J.H., and Lore, H.E. (1993). Modeling Pre-Project Planning for the Construction of Capital Facilities. A report to the Construction Industry Institute, The University of Texas at Austin, July, Source Document 94.
- Hackney, J.W. (1992). Control and Management of Capital Projects. McGraw Hill, Inc. New York, N.Y.
- Jolivet, F., and Batignolles, S. (1986). "The possibility of anticipating several years in advance, the success or failure of a project." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 35-39.
- Kothari, A.K. (1986). "Success in project management." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 240-246.
- McCoy, F.A. (1986). "Measuring success: establishing and maintaining a baseline." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 47-52.
- Merrow, E.W., and Yarross, M.E. (1990) "Assessing project control and schedule risk." AACE Transactions, 1990.

- Merrow, E.W., Phillips, K.E., and Myers, C.W. (1981). Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants. R-2569-DOE, RAND Corporation: Santa Monica, CA.
- Morris, P. (1986). "Research at Oxford into the preconditions of success and failure of major projects." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 53-66.
- Pinto, J.K., and Slevin, D.P. (1988). "Project success: definition and measurement techniques." Project Management Journal, 19(1), 67-72.
- Pinto, J.K., and Slevin, D.P. (1988). "Critical success factors across the project life cycle." Project Management Journal, 19(3), 67-75.
- Rawings, J. (1989). Project Objective Setting. A report to the Construction industry Institute, The University of Texas at Austin, April, CII Publication 12-1.
- Salapatas, J.N., and Sawle, W.S. (1986). Measuring success on utility projects past, present, and future." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 67-76.
- Sanvido, V.E., and Medeiros, D.J. (1990). "Applying computer aided manufacturing concepts to construction." Journal of Construction Engineering and Project Management, 116(2), 365-379.
- Sanvido, V., Grobler, F., Parfitt, K., Guvenis, M., and Coyle, M. (1992). "Critical success factors for construction projects." Journal of Construction Engineering and Project Management, 118(1), 94-111.
- Stuckenbruck, L.C. (1986). "Who determines project success?." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 85-93.
- Tuman, J. (1986). "Success modeling: A technique for building a winning project team." 1986 Proceedings, Project Management Institute. Montreal, Canada: Project Management Institute, 94-108.
- Warwick, D.P., and Lininger, C.A. (1975). The Sample Survey: theory and practice. McGraw Hill, Inc. New York, N.Y.

## VITA

Captain Aniello (Nello) Louis Tortora was born in Hollywood, Florida, on April 28, 1963, the son of Vincent and Gilda Tortora. After completing his work at South Broward High School, Hollywood, Florida, in 1981, he entered the United States Military Academy at West Point, New York. He was commissioned a second lieutenant in the United States Army and received the degree of Bachelor of Science from the United States Military Academy in May, 1985. From 1985 to 1988 he attended various military training schools and was assigned as a platoon leader and company executive officer in a combat heavy engineer battalion with duty at Fort Benning, Georgia, and Honduras, Central America. He was married to the former Karen Kay Lindell on September 21, 1988. From 1989 to 1992, Captain Tortora was assigned to the 16th Combat Engineer Battalion of the 1st Armored Division in Nuremberg, Germany. During his tour, he served as the battalion logistics officer, company commander, and assistant operations officer. He and his company were assigned to the 4th Battalion, 7th Infantry Regiment of the 1st Armored Division throughout the Persian Gulf War. In August, 1992, he entered the Graduate School of the University of Texas. Upon completion of graduate studies, he will proceed to an assignment in the Rocky Mountain Area Office, Omaha District of the United States Army Corps of Engineers.

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