



CCIS



**OWNER/CONTRACTOR  
ORGANIZATIONAL CHANGES  
PHASE II REPORT**

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CENTER FOR CONSTRUCTION INDUSTRY STUDIES

REPORT No. 2

The University of Texas at Austin

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A Report of

Center for Construction Industry Studies

The University of Texas at Austin

Under the Guidance of the

Owner/Contractor Organizational Changes Thrust Team

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## EXECUTIVE SUMMARY

This document is a progress report for the second phase of work conducted by the Owner/Contractor Organizational Changes Study Team of the Center for Construction Industry Studies (CCIS) funded by the Alfred P. Sloan Foundation. The primary purpose of the study team's research is to understand the changing nature of the owner/contractor relationship for capital facility projects and how these changes affect the outcomes of projects and the human resource practices of owner and contractor firms.

During Phase II of its work, the study team accomplished two major tasks:

1. Continued analysis of CII's Benchmarking and Metrics Database, which consisted of:
  - A detailed examination of trends in owner outsourcing over the past five years;
  - A quantitative characterization of the outsourcing profiles of 31 owner organizations and an exploration of the effectiveness of these profiles.
2. Conducted in-depth telephone interviews and site visits at two owner firms. In total, the study team conducted 42 interviews with 37 individuals. In some cases, the team visited multiple geographic locations for a single owner.

This document outlines the findings from these tasks. Chapter 1 provides background information and discusses the research methodology in detail. Chapter 2 examines trends in outsourcing and discusses the effectiveness of various outsourcing profiles. Chapter 3 describes key characteristics of owner/contractor relationships and discusses preliminary answers to the five research questions identified in Phase I. Chapter 4 identifies two models of the owner/contractor relationship and discusses the strengths and limitations of each model. Chapter 5 provides conclusions and recommendations for future study.

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# CHAPTER 1: BACKGROUND AND SUMMARY OF ACTIVITIES

## 1.1 Background

This report discusses the results of the second phase of research conducted by the Owner/Contractor Work Study Team of the Center for Construction Industry Studies (CCIS) funded by the Alfred P. Sloan Foundation. During the first phase of the research, the study team accomplished several objectives:

1. Gained an understanding of the organizational structure of large capital construction projects throughout all phases;
2. Documented how the organizational structure of large capital construction projects differs across type of business;
3. Gained an understanding of the major changes in the organization of large capital construction projects that have occurred over the past five years;
4. Outlined the key challenges in the delivery of these projects, with a particular emphasis on owner-contractor issues;
5. Identified specific questions and methods for further research.

These objectives were accomplished through:

- A thorough literature review on the use of contractors;
- Twelve initial interviews with representatives from eight companies;
- One corporate site visit;
- Initial analysis of the Construction Industry Institute (CII) Benchmarking and Metrics Database;
- Conducting a workshop at the November 1997 CII Board of Advisors Meeting.

### 1.1.1 *Purpose of Phase II*

The purpose of Phase II was twofold:

1. To obtain some initial answers to the research questions identified in Phase I and to further refine those research questions;
2. To develop a detailed methodology to address the research questions identified in Phase I.

Developing a detailed methodology required:

- Collecting additional background data about owner-contractor relationships and work structures;
- Developing specific survey items related to the research questions;
- Identifying potential sources of data other than future surveys or interviews.

### **1.1.2 Research Questions Addressed in Phase II**

The research questions addressed in Phase II were:

1. What constitutes a successful owner/contractor relationship? Do owners and contractors have different definitions of success? If so, how do these different definitions affect the success of the relationship? What are the attributes of successful owner/contractor relationships? In other words, what individual behaviors and methods of managing the relationship lead to relationship success? Do the attributes of successful relationships vary with the nature of the capital facility project?
2. Does structuring a relationship as an alliance increase the probability that a relationship will be successful? Given that there are many types of alliances, which of the type(s) are most likely to be associated with successful projects? Do alliances work better in some phases of capital construction (e.g., purchasing) than in others (e.g., detailed design)? If so, why?
3. Have owners outsourced too many aspects of capital facility projects? Would project success be enhanced if owners developed additional in-house competencies in some areas? If so, what should those areas of competence be? How can owners and contractors deal with the following issues related to the skills of their engineers and managers:
  - Identifying which competencies should be retained in-house and which should be performed by contractors;
  - Developing the new skills required to manage and work within owner/contractor relationships (as opposed to relationships strictly between owner employees); and

- Replacing current and expected near-term losses in engineering expertise, particularly in owner firms.
4. How do owner firms insure appropriate knowledge transfer to contractors (i.e., protecting proprietary information while transferring knowledge required to complete the project)?
  5. What issues of outsourcing in the global arena are particularly difficult? How can these issues be overcome successfully?

### **1.1.3 Research Design for Phase II**

Phase II had two major components:

- A detailed analysis of 274 projects from the Construction Industry Institute's (CII) Benchmarking and Metrics Database. This analysis is a followup to the preliminary analyses performed in Phase I.
- An in-depth study of two owner firms in different industries. The owner firms were studied in three subphases:
  1. In Phase II-A, telephone interviews were conducted with two representatives in each owner firm: (a) a key contact person knowledgeable about the owner's capital construction activities and about the owner's use of contractors, and (b) a representative of human resources knowledgeable about staffing, training, and career paths of engineering personnel in the owner firm.
  2. In Phase II-B, visits were made to the owner's site for the purpose of conducting individual and group interviews.
  3. Phase II-C (to be completed) will consist of follow-up visits to each owner site for the following purposes: (a) clarifying issues discovered in Phase II-B; (b) pretesting survey instruments; and (c) examining archival project records.

## **1.2 Summary of Phase II Activities**

The research team conducted two sets of activities during Phase II. First, the analysis of CII's Benchmarking and Metrics Database, which consisted of:

- A detailed examination of trends in owner outsourcing over the past five years;
- A quantitative characterization of the outsourcing profiles of 31 owner organizations;

- An exploration of the effectiveness of various outsourcing profiles.

Second, the research team conducted telephone interviews and site visits at two owner firms. Because data gathered during the Phase I site visit were relevant to the research questions, those data were used to reach the conclusions outlined in this report. Thus, the conclusions in this report are based on site visits conducted at three firms.

In total, the study team conducted 42 interviews with 37 individuals employed by these three owners. In some cases, the team visited multiple geographic locations for a single owner. Five of the interviews were telephone interviews, 17 were individual interviews, and 20 were conducted in small groups.

Because Phase I indicated that individuals in different jobs were likely to have very different experiences with and perceptions of the owner-contractor relationship, the study team intentionally interviewed individuals in a wide range of positions. The following table identifies the roles of the individuals interviewed:

**Table 1.1 Organizational Roles of Interviewees**

<b>Organizational Role</b>	<b>Owner Firm A</b>	<b>Owner Firm B</b>	<b>Owner Firm C</b>
Human Resources	-	1	1
Purchasing	-	2	2
Plant Engineers	-	-	4
Project Engineers	3	4	5
Project Managers	1	3	3
Corporate Engineering Staff	1	3	-
Engineering Managers	-	1	1
Engineering Director/VP	-	1	1
Total	5	15	17

### **1.2.1 Brief Descriptions of Participating Firms**

The three firms on which the conclusions of this report are based were selected because they take very different approaches to the owner-contractor relationship. It is important to note that the conclusions reached here apply only to the type of firms studied during this Phase of the research. Firms with very different outsourcing strategies or with an extremely different project mix from those studied here may have different experiences than the firms described in this report. A brief description of each firm and its owner-contractor work structures is included below.

**Owner Firm A (OFA):** This firm operates in the chemical industry. The firm is involved in a variety of construction projects including both new chemical processing facilities and the expansion and retrofitting of existing facilities.

OFA has historically maintained a very large central engineering staff. Over the past 8 years, the central engineering staff has been pared from 7000 engineers to approximately 1100 engineers, 500 of which work on capital projects. The majority of engineers assigned to capital projects (56%) are located in OFA's corporate office. The remaining engineers are located on construction sites (24%) or in regional offices (20%) and act as project managers. The engineers interviewed for this study are project managers located in a small regional office.

Projects appear to be run in a highly decentralized manner. Project managers at the plant or at regional offices are responsible for interfacing with contractors. The OFA interface typically consists of a single OFA project manager who is co-located at the contractor's office several days per week. This project manager may consult with other OFA project managers in the regional office. OFA also maintains a small staff of contract engineers in the regional office that support project managers. Specialty contractors may be called in when specific problems are beyond the expertise of the project manager or the primary contractor.

OFA has formal alliances with two major engineering contractors. Each of these alliances is governed by a written contract, however these contracts do not specify what type of work each contractor performs. In general, the distribution of work between alliance partners is according to plant site and strategic business unit, with the same alliance partner performing most or all of the work for a particular plant site or business unit. Each alliance partner keeps a core staff of personnel dedicated to OFA. Reassignment of these contractor personnel to other clients' projects is generally infrequent.

**Owner Firm B (OFB):** This firm operates in the pharmaceutical industry. This firm undertakes a variety of construction projects including manufacturing facilities, R&D laboratories, and administrative facilities; however, the majority of projects are manufacturing facilities.

Prior to 1993, OFB maintained a relatively large central engineering staff that they downsized during the middle 1990s. The downsizing was accomplished by reassigning personnel and did not involve layoffs. In 1993, the central engineering staff was about 225. It is currently about 33.

Projects appear to be run in a highly centralized manner. Even relatively small projects (e.g., under \$5 million) are run out of the Small Projects Group at OFB's corporate headquarters. The link between OFB and its contractors is typically a single OFB project manager. This project manager may call on OFB engineers from a Technical Support Center who work on an hourly basis and are billed to the project.

OFB has two formal alliances with major engineering contractors; each contractor specializes in a specific type of facility. Each of these alliances is governed by a written contract that specifies that the alliance partner will design and build all facilities of a certain type. Each alliance partner provides a manager who co-locates at OFB's corporate headquarters and who is responsible for managing the alliance. OFB works closely with the contractors to keep them informed about future capital construction requirements.

**Owner Firm C (OFC):** This firm operates in the chemical industry. This firm's construction projects consist primarily of expanding or retrofitting existing production facilities, although the firm also builds some greenfield facilities.

OFC has maintained a relatively stable central engineering staff of about 7 people for many years. However, OFC employs about 125-150 U.S. based engineers that work on major capital projects. Most of these engineers are located in plants.

Projects appear to be run in a highly decentralized manner. Project managers at the plants take primary responsibility for interfacing with contractors. The OFC interface with the contractors consists of a cross-disciplinary team including the project manager and relevant "discipline" engineers (e.g., piping, process engineering, instrumentation/electrical, etc.). The size of these teams varies with the size of the project (about 5-15 engineers for most projects).

OFC has made a conscious decision not to have formal alliances with contractors. However, OFC has preferred provider relationships with two contractors (one of these contractors works exclusively on smaller projects). These preferred provider relationships seem to be relatively stable (the preferred providers are used for most projects). However, each project is bid separately, and the preferred providers are not guaranteed the bid and have, in fact, lost some major bids.

## CHAPTER 2: CII BENCHMARKING AND METRICS ANALYSIS

### 2.1 Purpose

This chapter summarizes a two-part analysis that illustrates trends in owner outsourcing over the last five years and provides a quantitative characterization of 31 owner organizations based on a data sample of 274 projects from the Construction Industry Institute's (CII) Benchmarking and Metrics Database. The objective of the trend analysis is to quantitatively determine the trends in outsourcing over the last five years for three project-specific functions: pre-project planning, design, and procurement. (Construction outsourcing was not considered since it is almost always outsourced.) The 31 CII owners were characterized and compared in terms of their level of outsourcing, project attributes, and project performance. Both analyses were accomplished by looking at the data sample as a whole and then by industry sector.

### 2.2 The Data Sample

The sample for this analysis consisted of 274 projects representing over \$10 billion of capital facility expenditures. Project data were gathered using three questionnaires, designated as Version 1.0, 2.0, and 3.0, completed by CII owner companies over the past three years. The following table demonstrates the distribution of projects by industry sector and year:

Table 2.1 Data Sample Breakdown

INDUSTRY/SECTOR	1994	1995	1996	1997	1998	TOTAL	\$BILLIONS
Heavy Industrial (HI)	17	40	45	50	10	162	7.20
Light Industrial (LI)	1	6	10	14	1	32	1.32
Buildings (BLDG)	3	13	22	17	8	63	1.68
Infrastructure (INFRA)	2	3	7	2	3	17	0.24
<b>COMBINED</b>	<b>23</b>	<b>62</b>	<b>84</b>	<b>83</b>	<b>22</b>	<b>274</b>	<b>10.4</b>

Within each industry sector the data sample is further characterized by project type as illustrated in Table 2.2.

**Table 2.2 Data Sample Project Types within Industry Sectors**

<b>Infrastructure</b>		<b>Light Industrial</b>	
Electrical Distribution	4	Auto. Assembly/Mfg.	4
Marine Facilities	2	Consumer Product Mfg.	10
Water/Wastewater	10	Foods	8
Airports	1	Pharmaceuticals Mfg.	10
<b>Total</b>	<b>17</b>	<b>Total</b>	<b>32</b>
<b>Heavy Industrial</b>		<b>Buildings</b>	
Chemical Mfg.	52	Dormitory/Hotel	5
Electrical(Generating)	19	High-rise Office	3
Environmental	4	Hospital	2
Metals Ref./Processing	12	Laboratory	9
Natural Gas Processing	6	School	7
Oil Exploration/Production	4	Low-rise Office	21
Oil Refining	46	Maintenance Facilities	8
Pipeline	1	Parking Garage	1
Pulp and Paper	16	Restaurant/ Night Club	1
Other	2	Warehouse	4
		Other	2
<b>Total</b>	<b>162</b>	<b>Total</b>	<b>63</b>

As Tables 2.1 and 2.2 indicate, heavy industrial projects comprise approximately 60% of the data sample. These 274 projects represent a total of 31 owner companies with most having projects in at least two of the four industry sectors.

## **2.3 Outsourcing Trend Analysis**

### **2.3.1 Methodology**

The trend analysis consisted of compiling and sorting completed project data from the CII Benchmarking and Metrics database and then graphing the data to see what trends would emerge. The following table contains the specific data that was used to develop the trend analysis:

**Table 2.3 Relevant Project Data from CII BM&M Owner Questionnaires**

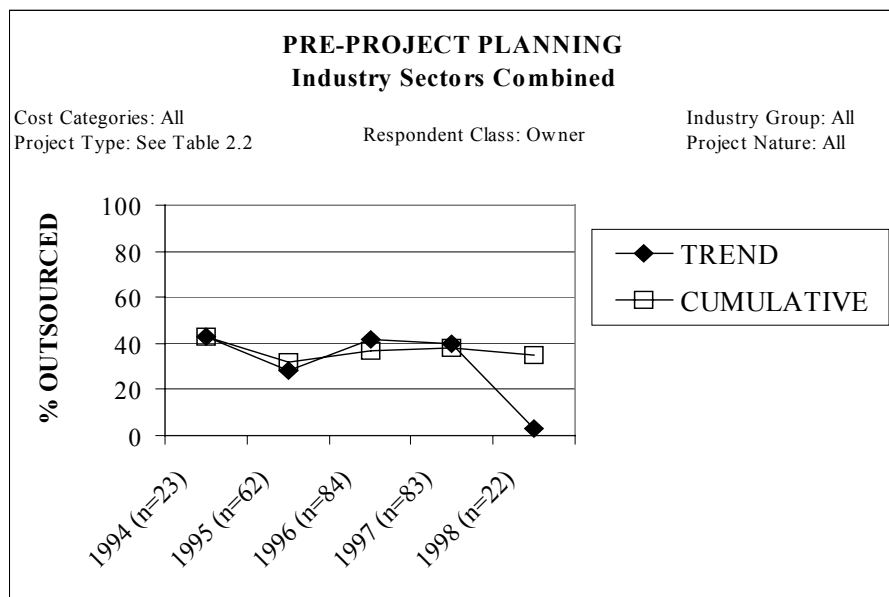
Question No.	Relevant Project Information
1	CII Owner Company Name
7	Project Type and Industry Sector (e.g., Chemical Mfg., Heavy Industrial)
8	Project Nature (e.g., Grass Roots)
10	Project Participants and Percent of Project Function Performed by Each
10	Owner/Contractor Relationship Score (Version 3.0 only)
11	Total Project Budget
12	Total Project Actual Cost
13	Project Phase Costs (Pre-Project Planning, Design, Procurement, Construction)
14	Planned and Actual Project Schedule
15	Net Cost and Schedule Impacts of Changes
17	Project Complexity (Version 2.0 and 3.0 only)

The analysis first involved calculating the percent of each function outsourced for each project. The average percent outsourced and the cumulative average percent outsourced for each year was then computed and plotted on a line graph.

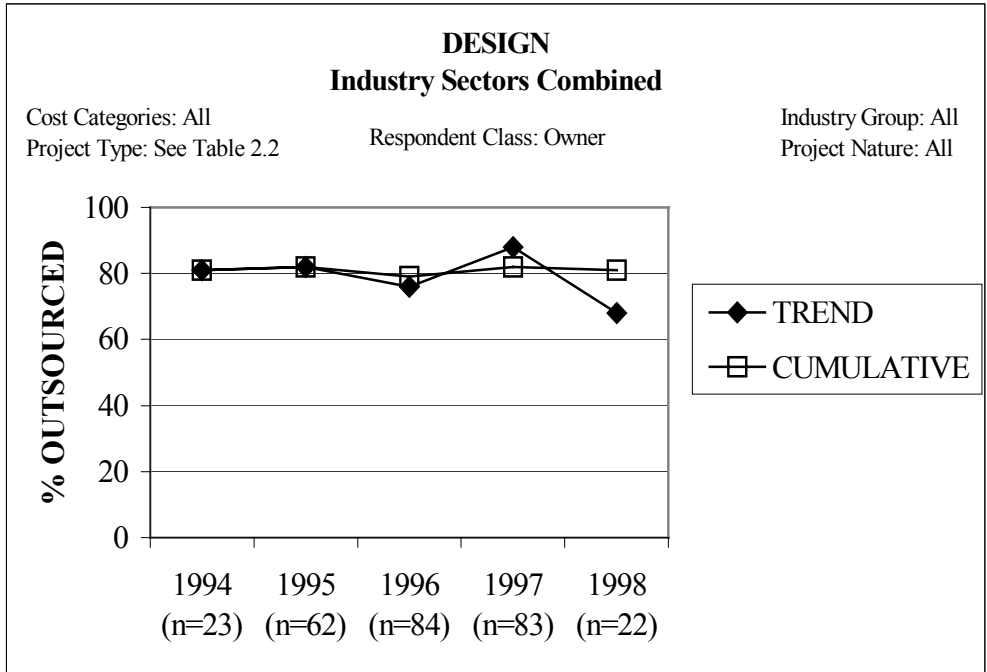
Four types of line graphs were plotted for the data sample:

- Percent of Pre-Project Planning (PPP) Outsourced Trend (1994-1998)
- Percent of Design Outsourced Trend (1994-1998)
- Percent of Procurement Outsourced Trend (1994-1998)
- Percent of PPP, Design, and Procurement Outsourced Trend (1994-1998)

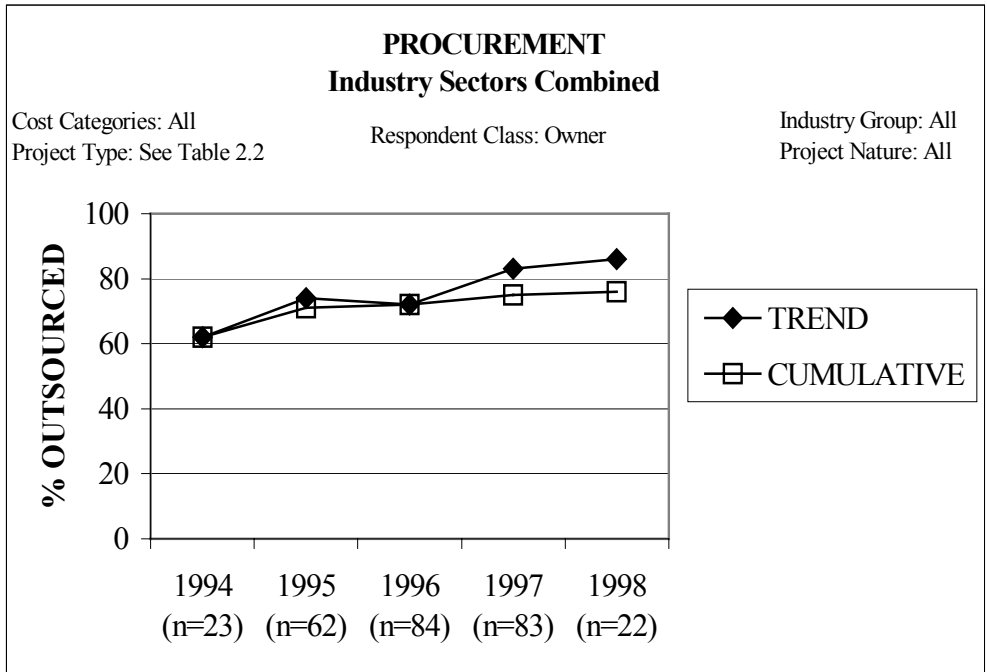
The first three graphs are shown below in Figures 2.1, 2.2, and 2.3 respectively.



**Figure 2.1 Percent of PPP Outsourced: Industry Sectors Combined**

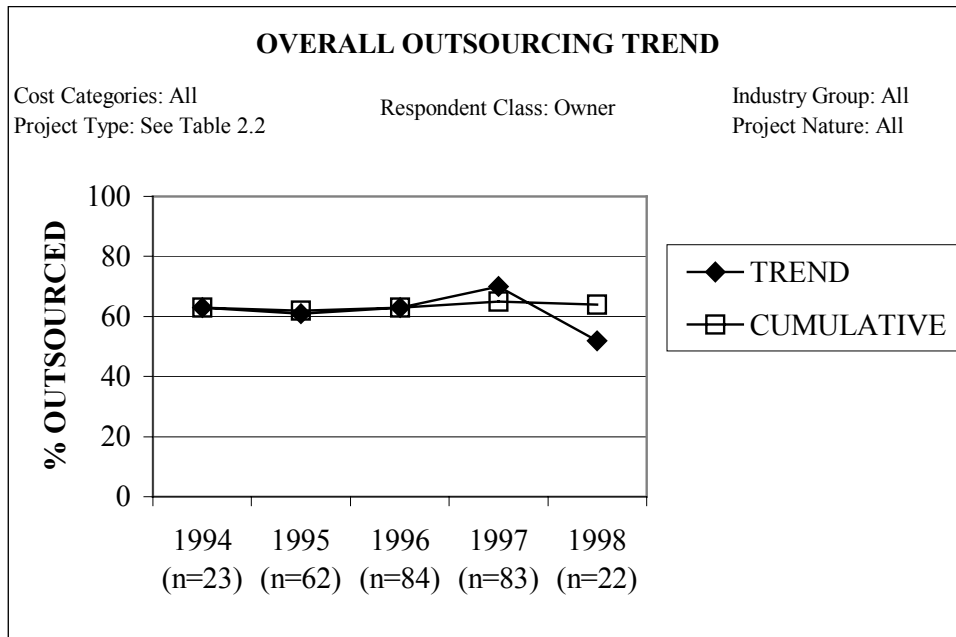


**Figure 2.2 Percent of Design Outsourced: Industry Sectors Combined**



**Figure 2.3 Percent of Procurement Outsourced: Industry Sectors Combined**

Figure 2.4 combines the three project functions into a “roll-up” graph showing the overall percentage outsourced over the last five years.



**Figure 2.4 Overall Owner Outsourcing: Industry Sectors Combined**

Evaluation of the trend graphs provides some insight into the level of owner outsourcing from 1994 through 1998. Figure 2.4 indicates that CII owners outsourced a combined 62 percent of their pre-project planning, design, and procurement over the period of 1994 through 1996 and increased this to 70 percent in 1997. In contrast, this level of outsourcing drops from 1997 to 1998 by almost 20 percent, which reflects similar trends previously displayed by the individual project functions of Pre-Project Planning and Design. Based on the data sample, the last five years were characterized by a general tendency to outsource, which peaked in 1997, with the exception of this past year, which reveals a decline in CII owner outsourcing (although this represents a fairly small subsample).

In addition to the trend analysis for the data sample as a whole, each industry sector was “broken out” and analyzed separately. The same four types of graphs were plotted for each sector as discussed above. Figure 2.5 consolidates the “Percent of PPP” graphs for each industry sector into one chart below.

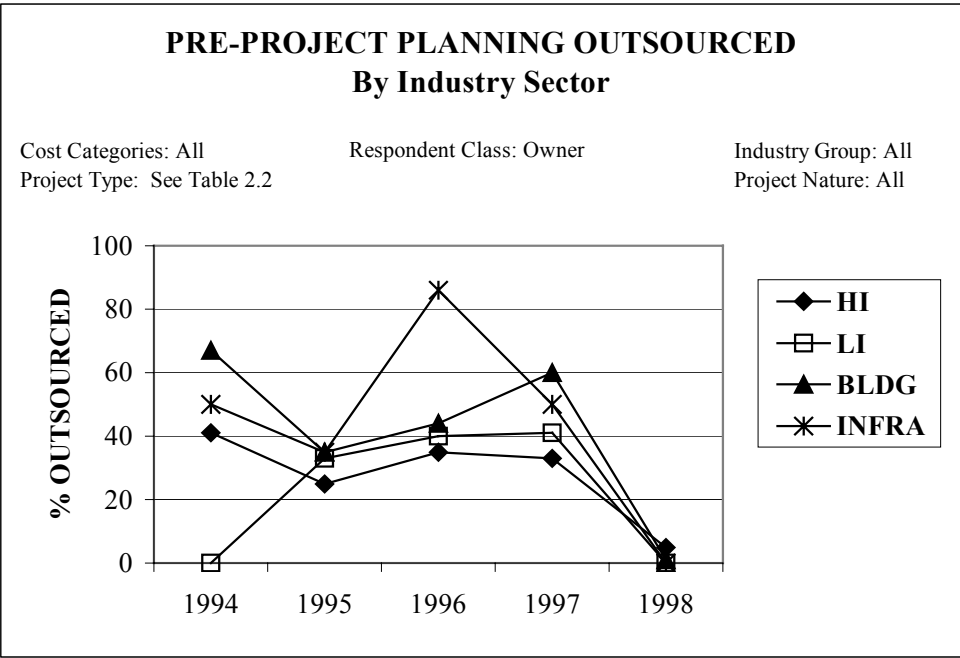


Figure 2.5 Percent of Pre-Project Planning Outsourced: By Industry Sector

Figure 2.6 groups the “Percent of Design Outsourced” graphs together in the chart below.

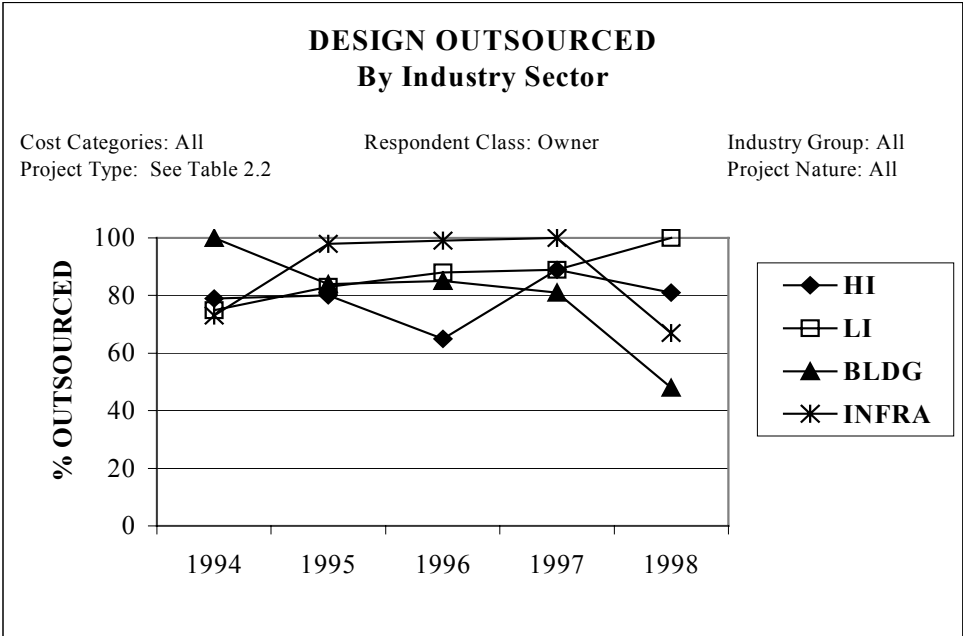


Figure 2.6 Percent of Design Outsourced: By Industry Sector

Figure 2.7 below provides a visual comparison of the percent of procurement outsourced in each of the four industry sectors.

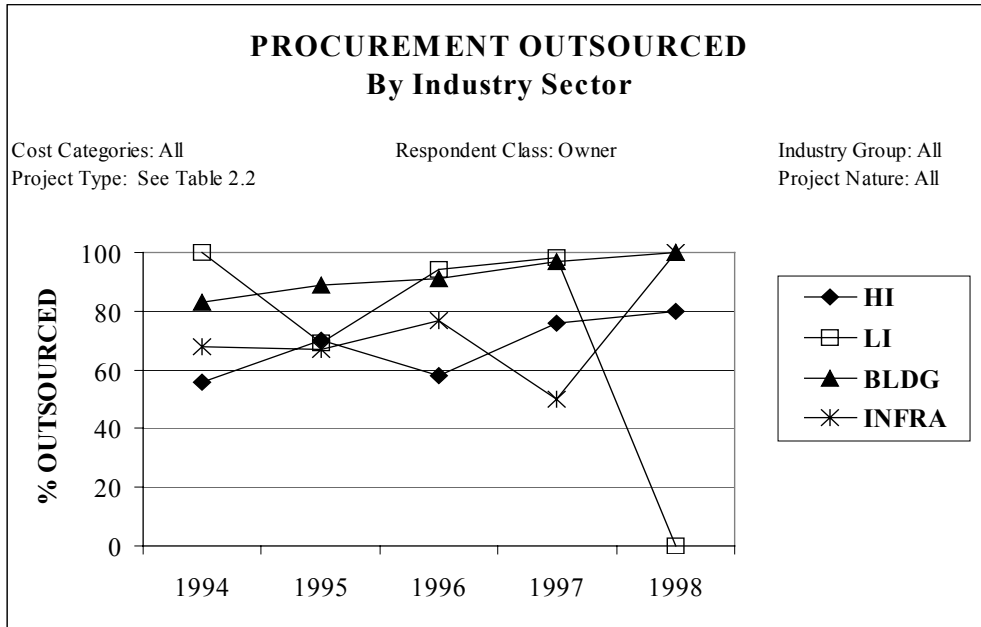


Figure 2.7 Percent of Procurement Outsourced: By Industry Sector

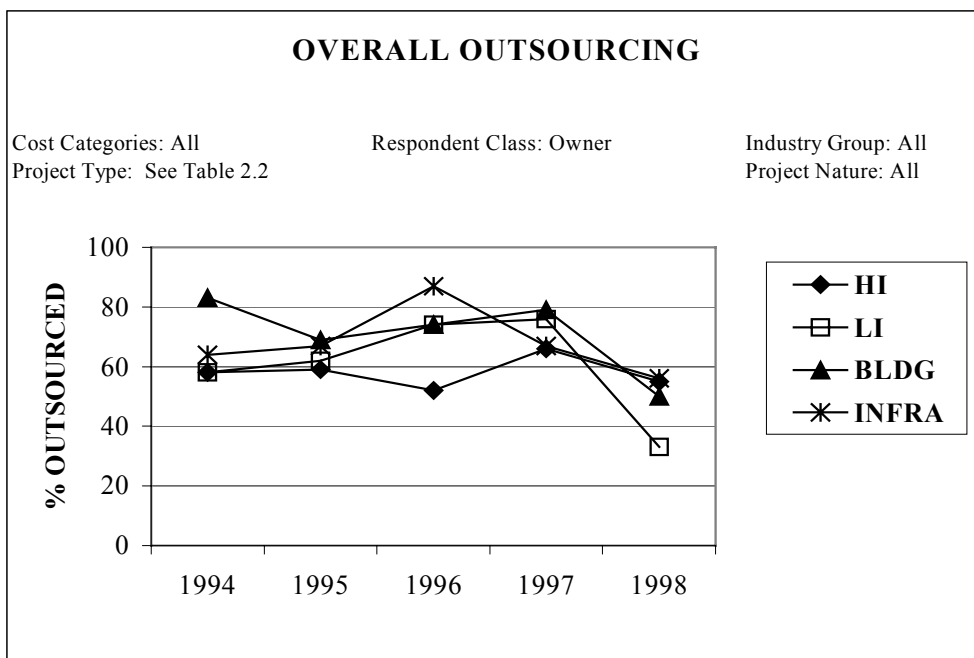


Figure 2.8 Overall Owner Outsourcing By Industry Sector

### 2.3.2 Findings from the CII Owner Outsourcing Trend Analysis

Table 2.4 provides a summary of outsourcing trends given in this data sample. It is significant to note the extent of outsourcing for these project functions and changes that have occurred in this sample over the past five years.

**Table 2.4 Summary of Outsourcing Trends**

Function	Combined	H.I.	L.I.	GEN BLDG	INFRA
PPP	General Decrease from 1994-98	General Decrease from 1994-98	Slight Increase from 1995-97	Steady Increase from 1995-97	Steep Increase from 1995-97
Design	Fairly Constant thru 1996; 8% jump in 1997; 20% drop in 1998	Fairly Constant from 1994-98; slight drop in 1996	Slight Increase from 1995-97	General Decrease from 1994-98; fairly constant from 1995-97	Slight Increase from 1995-97
Procurement	Steady Increase from 1994-98	Steady Increase from 1994-98	Steady Increase from 1995-97	Steady Increase from 1994-98	Fairly Constant thru 1996; 30% jump in 1997
Roll-up	Fairly Constant thru 1996; 7% jump in 1997; 18% drop in 1998	Fairly Constant from 1994-98	Steady Increase from 1995-97	Slight Increase from 1994-97 (83-94%)	Steady Increase from 1994-97 (63-100%)

The findings from this summary and from the previous graphs are given as follows:

1. Owner outsourcing of pre-project planning and of procurement has generally decreased over the last five years.
2. Heavy industrial owner outsourcing of pre-project planning has generally decreased over the last five years.
3. Both CII owner outsourcing of design and overall owner outsourcing were fairly constant through the first half of the last five years and then peaked in 1997 followed by a decline in 1998.
4. Of particular interest, in addition to the apparent increase in owner outsourcing through 1997 and the subsequent decline in 1998, are the large percentages of outsourcing indicated for each project function for the period between 1995 and 1997.

Approximately 80% of the projects in the data sample come from the Heavy Industrial and General Building sectors, and the sub-sample analyses for these two sectors reveal their combined influence over the overall trend in CII owner outsourcing for the last five years. The Light Industrial and Infrastructure sub-samples are relatively small and, therefore, possibly not

representative of CII owners in those two sectors. However, they do contribute to the 1997 peak in overall owner outsourcing and the drop in 1998 as illustrated in Figures 2.5 through 2.8 and summarized in Table 2.4.

## **2.4 Owner Outsourcing Characterization and Comparison**

The quantitative characterization and comparative analysis was accomplished by tabulating the 31 CII owners (coded for confidentiality) and the extent to which each owner is leveraged towards outsourcing against five different categories of project attribute information and four project performance metrics. As a vehicle for performing this analysis, Tables 2.5 and 2.6 were constructed and sorted in descending order by the combined extent of pre-project planning, design, and procurement each owner has outsourced on average. Each owner's "Average Percent Outsourced," is based on the number of projects they have in the data sample. Once sorted, the 31 companies were separated into three "outsourcing" tiers consisting of a top tier of 11 owners represented by 105 projects, and a middle and bottom tier of 10 owners each represented by 102 and 67 projects respectively.

### **2.4.1 "Three-Tier Owner Outsourcing – Project Attributes Comparison"**

Table 2.5 characterizes and compares the 31 CII owners in three outsourcing tiers in terms of the number of projects that each owner has in the data sample and five project attributes: alliance partnering, owner/contractor relationship, project complexity, project cost, and the average number of contractors per project.

Where the acronym "NA" occupies a cell in any of the attribute columns, the owner answered the relevant question with either "not applicable," "unknown," or simply neglected to provide a response.

Table 2.5 Three-Tier Comparison: Owner Outsourcing ↔ Project Attributes

Tiers	CII Owner	Projects/ Owner	Avg. % * Outsourced	Percent Alliance	OCR Rating	Avg. Proj. Complexity	Average Project	Avg. No. of Contractors
<b>Top</b>		<b>9.5</b>	<b>76%</b>	<b>47%</b>	<b>4.0</b>	<b>6.4</b>	<b>\$58.7M</b>	<b>3.3</b>
1	O6	23	91	87	4.7	6	24.4M	4
2	O17	3	79	NA	NA	NA	76.8M	2
3	O24	7	79	NA	NA	NA	109M	5
4	O1	3	76	33	4	6	100M	2
5	O25	13	76	100	3.8	6	24.2M	3
6	O27	5	75	NA	NA	NA	27.9M	2
7	O2	12	73	50	3.5	8	40.1M	6
8	O26	10	73	0	4.5	7	20.2M	3
9	O22	3	72	NA	NA	NA	146M	2
10	O18	16	71	56	3.9	7	15.3M	3
11	O30	10	71	0	3.7	5	61.3M	4
<b>Middle</b>		<b>10.2</b>	<b>66%</b>	<b>55%</b>	<b>4.2</b>	<b>6.25</b>	<b>\$33.0M</b>	<b>2.9</b>
12	O10	12	69	20	4.4	7	38.8M	4
13	O28	8	69	43	4.3	7	35.8M	4
14	O19	19	68	13	3.8	6	25.4M	2
15	O13	6	68	NA	NA	NA	62.3M	4
16	O8	4	67	100	NA	7	26.2M	4
17	O5	13	66	0	4.5	6	11.8M	3
18	O29	15	65	80	3.8	7	67.6M	2
19	O3	10	65	83	4	6	16.0M	2
20	O14	2	63	NA	NA	NA	33.7M	2
21	O9	13	60	100	4.3	4	12.7M	2
<b>Bottom</b>		<b>6.7</b>	<b>41%</b>	<b>36%</b>	<b>4.3</b>	<b>5.7</b>	<b>\$36.7M</b>	<b>2.9</b>
22	O23	10	56	80	NA	NA	23.6M	3
23	O31	6	56	33	3.7	7	17.9M	2
24	O16	4	55	NA	NA	NA	19.7M	5
25	O4	4	54	0	NA	6	22.5M	2
26	O15	6	48	67	4.7	6	54.3M	2
27	O12	8	40	25	4.6	5	65.4M	2
28	O11	4	34	NA	NA	NA	9.9M	2
29	O21	10	32	50	NA	4	40.3M	2
30	O20	10	29	0	4.2	6	101M	4
31	O7	5	4	NA	NA	NA	13.1M	5

\* PPP, Design and Procurement combined

The column labeled “Projects/Owner” signifies the number of capital facility projects completed by each owner and included in data sample of 274 projects. This column provides the number of projects from which the “Average Percent Outsourced” value in the adjacent column was calculated. Therefore, if an owner has only three projects in the data sample, then its “Average Percent Outsourced” value may not represent the owner’s true outsourcing practices as much as it would for an owner with 10 projects in the data sample.

The first attribute column, “Percent Alliance” indicates the percentage of projects that the owner completed using an alliance relationship with one or more contractors for pre-project planning, design, and/or procurement.

The second attribute column, “OCR Rating”, signifies the owner’s perception of the success of its working relationship with each contractor (Owner/Contractor Relationship), which was asked of CII owner companies in Version 3.0 of the Benchmarking and Metrics questionnaire. Respondents were asked to rate the success of their working relationship with each contractor for every project they submitted to CII on a scale from “1” to “5”, with a “5” denoting a “very successful” owner/contractor work relationship. Each OCR value in the table is an average of the corresponding owner’s individual project OCR ratings.

The next attribute, “Average Project Complexity,” is based on a rating provided by the respondents to Versions 2.0 and 3.0 of the Benchmarking and Metrics owner questionnaire. The owners were asked to place a mark on a horizontal scale from “Low Complexity” to “High Complexity.” A project of low complexity is defined as one involving proven construction methods and technology, simple processes, small facility size or process capacity, or the use of an existing facility layout. A project of high complexity denotes one in which new construction methods, unproven technology, lengthy processes, and new facility configurations are used. The responses were converted to a number scale as they were entered into the Benchmarking and Metrics Database, with “1” and “10” representing the lowest and highest levels of complexity respectively.

The attribute, “Average Project Cost,” provides the average total installed cost for each owner.

Finally, the last project attribute signifies the total number of contractors hired on average to execute a capital facility project for the owner. These contractors consist of designers, engineers, consultants, procurement contractors, and construction contractors, with many firms performing more than one of these functions.

Comparison of the three outsourcing tiers in Table 2.5, in conjunction with a statistical analysis (F-test) performed to determine the statistical significance of the difference between tier averages, reveals the following significant relationships between outsourcing and project attributes:

1. Variation between tier averages suggests that the middle tier of owners is more prone to alliance partnering than the top and bottom tiers, but this variation is not statistically significant.
2. One might expect the top tier owners (i.e., most outsourced) to exhibit a higher percentage of alliance projects than the middle tier, but they do not.
3. The least outsourced owners appear more satisfied in general with the work relationship they have with contractors than the owners most leveraged towards outsourcing.
4. Owners who are most leveraged towards outsourcing tend to view their projects as higher than average in complexity.
5. Owners do not tend to outsource more just because a project has a complex scope or multiple contractors.

#### **2.4.2 “Three Tier” Outsourcing - Cost/Schedule Performance Comparison**

Table 2.6 lists the same three tiers of owners as in Table 2.5 and compares them in terms of four project performance metrics. The equations for the cost and schedule performance metrics are as follows:

$$\text{Project Cost Growth} = \frac{\text{Actual Total Project Cost} - \text{Initial Predicted Project Cost}}{\text{Initial Predicted Project Cost}}$$

$$\text{Project Budget Factor} = \frac{\text{Actual Total Project Cost}}{\text{Initial Predicted Project Cost} + \text{Approved Changes}}$$

$$\text{Project Schedule Growth} = \frac{\text{Actual Total Project Duration} - \text{Initial Predicted Project Duration}}{\text{Initial Predicted Project Duration}}$$

$$\text{Project Schedule Factor} = \frac{\text{Actual Total Project Duration}}{\text{Initial Predicted Duration} + \text{Approved Changes}}$$

**Table 2.6 Three-Tier Comparison: Owner Outsourcing  $\leftrightarrow$  Cost/Schedule Performance**

<b>Tier</b>	<b>CII Owner</b>	<b>Projects Per Owner</b>	<b>Avg. % Outsourced</b>	<b>Avg. Cost Growth</b>	<b>Avg. Budget Factor</b>	<b>Avg. Schedule Growth</b>	<b>Avg. Schedule Factor</b>
<b>Top</b>		<b>9.5</b>	<b>76</b>	<b>-0.03</b>	<b>0.93</b>	<b>0.09</b>	<b>1.12</b>
1	O6	23	91	-0.15	0.82	0.62	1.59
2	O17	3	79	-0.01	0.99	-0.04	0.96
3	O24	7	79	0.04	0.99	0.07	1.03
4	O1	3	76	0.07	0.99	0.03	NA
5	O25	13	76	0.01	0.95	0.06	1
6	O27	5	75	-0.05	0.95	-0.23	NA
7	O2	12	73	-0.05	0.89	-0.01	0.95
8	O26	10	73	0.02	0.93	0.22	1.29
9	O22	3	72	-0.14	0.86	-0.11	0.89
10	O18	16	71	-0.03	0.91	0.24	1.22
11	O30	10	71	-0.05	0.9	0.18	1.16
<b>Middle</b>		<b>10.2</b>	<b>66</b>	<b>0.00</b>	<b>0.97</b>	<b>0.11</b>	<b>1.21</b>
12	O10	12	69	-0.03	0.94	0.13	1.09
13	O28	8	69	0.03	0.99	-0.01	0.98
14	O13	19	68	0.05	1.02	-0.06	0.90
15	O19	6	68	0.02	0.93	0.25	1.24
16	O8	4	67	-0.02	0.98	-0.06	0.94
17	O5	13	66	0	0.96	1.14	2.29
18	O29	15	65	-0.01	0.95	0.11	1.18
19	O3	10	65	-0.03	NA	0.06	NA
20	O14	2	63	-0.02	0.98	-0.54	NA
21	O9	13	60	0.04	0.99	0.11	1.04
<b>Bottom</b>		<b>6.7</b>	<b>41</b>	<b>-0.02</b>	<b>0.96</b>	<b>-0.08</b>	<b>1.00</b>
22	O23	10	56	0.04	1.02	-0.11	0.89
23	O31	6	56	0.1	1.04	-0.37	1.23
24	O16	4	55	-0.13	0.87	-0.08	0.92
25	O4	4	54	-0.02	0.96	-0.02	0.9
26	O15	6	48	0.01	1.01	-0.3	0.81
27	O12	8	40	-0.09	0.88	-0.11	0.90
28	O11	4	34	0.00	1.00	0.13	1.13
29	O21	10	32	-0.04	0.94	-0.04	0.95
30	O20	10	29	-0.07	0.87	-0.06	1.14
31	O7	5	4	0.01	1.01	0.12	1.12

A statistical analysis of owner outsourcing versus each of the four project performance metrics was conducted to test the validity of conclusions that might be drawn from initial observations of Table 2.6. This statistical verification was accomplished in the form of an analysis of variance (ANOVA), specifically an F-test, using the owner data in Table 2.6 and a bivariate regression analysis using the 274 projects in the data sample.

The comparative characterization in Table 2.6 and supporting statistical analysis yield the following observations:

1. The owners that are most and least leveraged towards outsourcing (i.e., the top and bottom tiers respectively) seem to benefit from better project cost and schedule performance than those in the middle tier.
2. The least outsourced owners (i.e., bottom tier) are more involved in their projects and, therefore, command better control over project schedule.
3. The owners most leveraged towards outsourcing (i.e., top tier) seem to have the best project cost performance, but this cannot be attributed to the extent of outsourcing alone.
4. The fact that the middle tier of owners are not very close to either end of the outsourcing spectrum possibly bars them from reaping the cost benefits that the most outsourced owners receive and achieving the kind of schedule control that the least outsourced owners seem to maintain.
5. These findings do not disprove an early hypothesis that a CII owner's average project cost and schedule performance is independent of the extent to which the company is leveraged towards outsourcing. However, they do suggest the possibility that an outsourcing strategy combined with best practices and other project factors can influence project outcomes. Based on the data sample, a strategy of extensive outsourcing is more cost-efficient for the owner and, therefore, can lead to better cost performance especially when combined with strong project management oversight by the owner and quality contractor performance. A strategy of minimal outsourcing with more execution by the owner can positively impact schedule performance if its in-house workforce exercises effective time management.
6. Heavy industrial owners predominate in the data sample and, therefore, have a significant impact on the comparative analysis results.

A closer look at the heavy industrial owners as well as the general building and light industrial owners is provided in Section 2.4.3.

### 2.4.3 Industry Sector Characterization and Comparative Analysis

A comparison of industry sector averages listed in Table 2.7 yields several significant observations.

**Table 2.7 Industry Sector Comparison**

<b>Industry Sector</b>	<b>Avg. Percent Outsourced</b>	<b>Percent Alliance</b>	<b>OCR Rating</b>	<b>Avg. Project Complexity</b>	<b>Average Project Cost (\$millions)</b>	<b>No. of Contractors</b>
HI	57%	50%	4.3	5.8	\$48.0M	2
BLDG	69%	26%	4.0	6.8	\$31.0M	2
LI	72%	57%	3.9	7.0	41.3M	4

1. CII light industrial owners are the most leveraged towards outsourcing and demonstrate the highest tendency to execute their capital facility projects through alliances.
2. Owners in the heavy industrial sector seem the most satisfied with their owner/contractor working relationships, whereas the light industrial owners seem to be the least satisfied.

The findings from both the trend analysis and quantitative characterization of CII owner outsourcing are enlightening and show the potential for future use of the CII Benchmarking and Metrics database as more data are collected in the future. With these findings in mind, it is important to understand the details of these relationships as outlined in the next chapter.

## **CHAPTER 3: KEY FINDINGS ABOUT OWNER/CONTRACTOR RELATIONSHIPS**

This chapter first describes the features of owner-contractor relationships that are most important for understanding how these relationships work. Then, the chapter discusses the study team's findings about the five research questions identified in Phase I.

### **3.1 Features of Owner/Contractor Work Structures**

Owner-contractor relationships were managed quite differently at each of the sites the team visited. The data collected during the site visits suggests that there are some key, defining features of owner-contractor work structures that determine how the relationship works and the difficulties that are likely to be encountered in managing the relationship. In most cases, these features varied across the sites we visited; however, there were also a few, universal features that appeared to characterize all of the relationships but that were not universally recognized by owner personnel.

#### **3.1.1 *Purposes of Owner/Contractor Relationship***

The owner-contractor relationship appears to have many purposes, not all of which are fully recognized by owners. The basic purpose of the relationship is to allow the owner the flexibility to access the skills of large numbers of engineers as needed without retaining those engineers on the payroll. Many interviewees referred to this general phenomenon as “leveraging” the skills of the contractor. However, the precise meaning of leverage differed both across the firms we studied and across people within the same firm. Some of the meanings of leverage include:

- numerical leverage—ability to access large numbers of engineers and related personnel only when they are needed;
- functional leverage—ability to access the specialized skills of personnel that owners may only need occasionally. The contractor can employ a variety of highly skilled functional specialists that it assigns to projects for many owners. In this way, owners get the benefit of deep functional expertise that they could not afford to maintain in their own workforces;

- managerial leverage—ability to access the project management skills of the contractor. Owner personnel disagreed widely about how well contractors were able to provide this skill (and, in fact, whether contractors were able to provide it at all);
- learning leverage—ability to take knowledge from past project(s) completed with a particular contractor and apply that knowledge to the current project.

One of the things that makes managing the owner-contractor relationship difficult is that the kinds of leverage the owner firm expects are often not made explicit and may not even be agreed on within the owner firm. A structured process to address this issue prior to beginning the relationship could help.

### **3.1.2 *Level of Goal Conflict***

A critical, but often unrecognized feature of the owner-contractor relationship is goal conflict. Simply put, owners and contractors have different and sometimes conflicting goals. Although there were many attempts by owner firms to minimize the existence of this conflict (for example, by stating that both parties shared the common goal of having both the owner and the contractor be profitable), examples of goal conflict were numerous. For instance, owner firms desired continuity of contractor personnel across projects while contractors often desired to move key personnel into new projects with different owners. Similarly, owners wanted contractors to be flexible and to adapt with ease to design changes made by owners while contractors wanted the design thoroughly specified up front with very few changes during the design process.

The most common complaint that owners voiced about contractors was that contractors “don’t think like owners.” This lack of goal congruence was seen by many owner personnel as a symptom of difficulty with the contractor or with the owner-contractor relationship. In fact, goal conflict may not be a symptom of difficulty but may be instead a natural outgrowth of the fact that owners and contractors have different business objectives. Many owner personnel appear to be working from the assumption that owners and contractors have common goals that both are trying to achieve and that a good relationship is one that achieves those common goals. However, it may be more fruitful to recognize that owners and contractors have fundamentally different goals and that the owner-contractor relationship needs to be structured so that each party can meet their separate goals.

### **3.1.3 *Level of Owner Involvement***

Another defining feature of the owner-contractor relationship was the level of owner involvement in projects. We observed several different models of owner involvement that could probably be arrayed along a continuum. At one extreme, the owner determines only the economic viability and key design features of the project. At this point, the owner basically turns the project over to the contractor. While the owner maintains oversight of the project, owner personnel are not involved in day-to-day decisions made by contractor personnel. At the other extreme, owner personnel maintain active involvement with the contractor throughout all phases of the project. This model was described by one interviewee as a “salt and pepper organization.” Owner and contractor personnel co-located for the duration of the project and owner personnel actively checked on the work of contractors, sometimes bypassing the contractor chain of command in order to do so.

### **3.1.4 *Structure of Contractor Involvement***

Another defining feature of the owner/contractor relationship was the way in which the contractor’s involvement with the owner was structured. Again, models of contractor involvement could be arrayed along a continuum. At one extreme, the owner and the contractor have a formal, written, highly specified alliance that is agreed upon and managed at fairly high levels in both firms. Such an alliance specifies many features of the owner/contractor relationship including mechanisms for sharing information about future construction needs with the contractor, methods for allocating work between different contractors, and payment and incentive plans that apply across projects. This highly structured arrangement provides consistency across projects but it also means that individual project managers must sometimes work within constraints that are not well suited to their projects. For example, according to the terms of their alliance, one of Owner Firm B’s (OFB) two contractors was to build all production facilities for a specific type of product. When OFB decided to build a manufacturing plant overseas, the project manager was required to work with the alliance partner specified in the contract despite the fact that this alliance partner had no experience working in the country where the facility was to be built and OFB’s other alliance partner had extensive experience operating in that country.

The other extreme model of contractor involvement consists of the owner getting bids for the design or construction of each facility and giving the contract to the low bidder (other factors

being equal). (Note that this model is widely applied for construction in public contracting.) Although none of the owners we talked to were currently using this system, OFB had used it in the past. OFB interviewees reported that, although this system gave the appearance of obtaining the lowest price for the design of each facility, two factors tended to drive up the long-run cost of this type of bidding system. First, contractors were unwilling to invest in developing owner-specific knowledge that could be used to reduce costs over time. Second, OFB interviewees reported that, in reality, factors other than price affected which contractor was awarded the contract. According to one OFB interviewee, the bidding system functioned much like a queue. Whatever contractor the owner was least frustrated with was at the head of the queue and tended to be awarded the contract. Contractors who had recent disagreements with the owner merely entered the end of the queue and waited until the owner had worked its way through the other contractors in the queue.

An intermediate form of contractor involvement is the preferred provider relationship. In this method of organizing, the owner tends to work with the same small number of contractors over time and to develop good working relationships with those contractors. However, the owner has no long-term contractual obligation to any of the contractors and may, in fact, put every job out for bid. This was the practice at Owner Firm C.

One thing that is important to note is that there is little consistency within the industry in the use of terms such as “alliance” and “preferred provider relationship.” Different interviewees used the same term (e.g., “alliance”) with very different meanings. In part, these differences in meaning may be due to the fact that the industry still appears to be a in stage where experimentation with various forms of contractor involvement is common.

### **3.1.5 *Coordination Between Owner and Contractor***

The Phase I report briefly discussed the idea that owners and contractors use a wide variety of formal and informal coordinating mechanisms including co-location of owner and contractor personnel, maintaining continuity of owner and contractor personnel across several projects, purchase orders and project scope definitions, detailed monthly reports, regularly scheduled meetings, periodic project reviews, and a variety of informal contacts between owner and contractor personnel. Although the firms studied in Phase II used many, if not all, of these mechanisms of coordination, communication difficulties between owner and contractor were the most commonly cited problem in the owner/contractor relationship. Thus, it appears that

existing coordination mechanisms are not sufficient to meet communication needs. Although increasing dependence of owners on contractors means that good communication between owners and contractors is more critical than ever, there appears to be little systematic attention by owner firms to designing coordination mechanisms that fully meet their communication needs.

### **3.1.6 *Monitoring and Evaluating Contractor Performance***

Monitoring and evaluating contractor performance is another area where work structures have not kept pace with the changing nature of the owner/contractor relationship. Owners generally have some clear metrics for evaluating the success of *projects* (e.g., performance against budget and schedule objectives, rework in the field). In some cases, owners have simply taken the metrics that they used to evaluate projects when the owner did most of the design and applied those same metrics to contractors. In other cases, owners have invested substantial effort in developing detailed metrics that track many aspects of project performance. Although owners have at least some metrics for project performance, we found few instances where owners had clear metrics that could be used to assess the performance of *relationships*. Many owners are developing long-term relationships with contractors and thus have an interest in knowing not only how the contractor performs on a specific project but also how the contractor performs activities that affect the quality of the relationship (e.g., ensuring continuity of contractor personnel across projects, documenting and using learning from past projects). Although owners could identify a number of features of a successful relationship, most people we interviewed reported that relationships were assessed “holistically” and without the use of specific criteria or metrics. Developing methods for assessing relationship success appears to be an important future challenge for owners.

### **3.1.7 *Learning from the Owner/Contractor Relationship***

Many of the owner personnel we interviewed identified the ability to learn from contractors and to transfer learning between projects as an important benefit of longer-term relationships with contractors. However, owner firms differed widely in the extent to which they attempted to learn from contractors and also in the extent to which their attempts were successful. Some project managers held formal debriefing sessions after each project. These sessions included both owner and contractor personnel and attempted to document the “lessons

learned” from the project that could be carried forward to future projects. These debriefing sessions were most likely to be held in situations where continuity of contractor personnel was high from project to project. In these situations, the individuals who participated in the debriefing sessions were likely to be involved in future projects with the owner and thus to be able to implement suggestions that arose during the debriefing sessions. Regular project debriefing sessions in situations with high personnel continuity were among the most successful learning mechanisms we observed.

In some situations, owner personnel attempted to transfer knowledge between owner and contractor personnel, but their efforts were hampered by other parts of the organization that were interested in preventing information from crossing organizational boundaries. For example, the owner’s information systems personnel sometimes resisted giving contractors access to the owner’s E-mail system because of concerns about proprietary information stored on the owner’s intranet. Owner accounting personnel sometimes engaged in similar resistance to integration of financial information between owners and contractors.

The study team encountered many examples of attempts to increase knowledge sharing and learning between owner and contractor personnel. However, like coordination and monitoring, the area of learning is one where owner firms’ work structures have not kept pace with the demands of new kinds of owner/contractor relationships. Although owners desire to learn from contractors and cite increased learning as an important benefit of alliance and preferred provider relationships, owner firms still do not have systematic structures for assessing and documenting their learning from contractors.

### **3.1.8 Skills Required by Owner Project Personnel**

Owner personnel were unanimous in their view that changing owner/contractor relationships require owner personnel to have new skills. The detailed skills required by owner personnel may be affected by the way, in which the owner/contractor relationship is structured. However, owner personnel we interviewed felt that their firms had not yet addressed how owner personnel were going to develop even the basic skills required to operate successfully in the changing world of owner/contractor relationships. The area of skill development of personnel is a critical challenge for owner firms. Later, this report provides a detailed discussion of the basic skills required by owner personnel.

### 3.2 Attributes of Successful Owner/Contractor Relationships

Although our respondents identified many specific attributes of successful owner-contractor relationships, these attributes can be grouped into seven basic categories. These categories are described in the table below. The attributes in the table are organized roughly in order of importance and frequency of mentions. It is interesting to note that, from the owners' perspective, many of the attributes of a successful relationship are attributes that the contractor brings to the table. There was relatively less emphasis on attributes that the owner and the contractor work together to develop during the course of their relationship.

**Table 3.1 Attributes of a Successful Owner-Contractor Relationship: the Owner Perspective**

<b>Attribute</b>	<b>Definition</b>
Contractor meets owner's project objectives	The project is delivered on or ahead of schedule and budget targets with minimal rework in the field. Startup is smooth.
Contractor understands owner's business	Contractor personnel understand owner's business objectives and operating systems and procedures
Integration of owner and contractor personnel	Owner and contractor work together repeatedly, using many of the same personnel from project to project. Owner and contractor develop effective communication structures, a shared vocabulary, and a common project culture. Owner and contractor systems are integrated to the extent possible. Trust develops between owner and contractor personnel. Multiple levels of personnel are involved in both the owner and contractor organization
Contractor responsiveness to changing conditions	Contractor responds quickly and effectively to owner needs. Contractor informs early as early as possible about upcoming difficulties
Contractor willingness to innovate	Contractor is willing to challenge owner ideas, recommend improvements, and take risks.
Operating for mutual benefit	The relationship benefits both owner and contractor. Gains made through a productive relationship, such as cost savings, are shared between owner and contractor.
Learning from the relationship is documented and used	Owner and contractor explicitly discuss and document the lessons learned from each project. If possible, these lessons are integrated into systems and procedures that can be reused on subsequent projects.

### 3.3 Impact of Alliance on Owner/Contractor Relationships

It is clear that individuals use the term "alliance" to mean many different things. The term encompassed everything from a regular pattern of doing business together to a written contractual agreement with formal structures surrounding the alliance (e.g., an alliance manager). It is impossible to answer the question of whether alliances are beneficial without specifying in more detail the specific structure of the alliance and the behaviors that underlie the alliance. One thing is clear: simply calling a relationship an alliance does not increase the probability of relationship success.

The effects of alliances are very different at different levels in the organization. At the corporate level, alliances are a source of potential benefits (e.g., joint planning). However, at the project level, alliances are generally a constraint. This constraint can occur in at least two ways. First, an alliance may require the alliance partner to be selected for a specific project even when, for that particular project, another contractor has superior expertise. Second, although one of the assumed benefits of an alliance is the ability to leverage contractor expertise, having an alliance means that the project manager must draw from only one pool of contractor personnel (the alliance contractor's personnel). Given a fixed number of qualified/desirable contractor personnel, an alliance may actually force different owner projects to compete for these personnel. Although the allocation of personnel would be an issue even if owners performed all engineering work in-house, in this scenario, the owner retains control over the distribution of personnel across projects and can make those allocations according to the owner's priorities. However, when multiple owner projects are competing for contractor personnel, the contractor's allocation of personnel across projects may not align with the owner's interests.

It was striking that it was difficult for our respondents to clearly articulate why an alliance is better than a preferred provider relationship. If there are benefits to an alliance, they may be somewhat vague (e.g., information sharing that may or may not actually materialize) and not typically measured. Perhaps it is difficult to articulate these benefits because the specific benefits to be expected from the alliance have not been described in measurable terms. Although individuals discussed the idea that alliances can create common interests between owners and contractors and improve information flow, there were no methods of documenting whether these benefits actually occurred.

While individual project managers in each firm tracked a variety of detailed project metrics, projects as a whole were only evaluated in a very holistic sense. Except for assessment of cost, schedule, and rework, projects were typically evaluated in very general terms (e.g., whether the project met the owner's overall expectations). The performance of alliance partners as partners did not appear to be systematically evaluated. Thus, owners are in the difficult position of facing clear, perhaps measurable, costs of alliances (e.g., lack of flexibility) while being less clear about alliance benefits.

It is important to note that a successful relationship and successful projects are two different things. A successful relationship overall may still have projects with a variety of

outcomes. Also, it is possible that having an alliance may affect the way that project outcomes are viewed (i.e., the same outcomes may be viewed more favorably if they are generated by an alliance partner than if they are not). It also needs to be noted that a history of good project outcomes is likely to lead to the formation of alliances. Thus, one may find an association between alliances and project outcomes, but the causal direction is unclear.

### **3.4 Skills and Careers of Owner Project Personnel**

It is fairly widely recognized in owner firms that the skill set required to manage and work on projects from the owner's side has changed dramatically (e.g., more "soft" skills are important; deep technical knowledge is less important). However, owner firms are doing little to address this issue. Generally, owner firms expect engineers to pick up these skills on the job and have given relatively little thought to how to hire, train, and develop personnel to work effectively with contractors.

The issue of skill development of owner personnel is perhaps the most important difficulty facing owner firms. The vastly increased reliance on contractors has required new methods of structuring and managing projects. These new methods cannot be implemented without adequate skill and preparation of owner personnel. No matter how beneficial the owner-contractor relationship may be in theory, these benefits cannot be realized unless owner personnel are prepared to manage these relationships. Below, we discuss the traits, skills, and development opportunities that are likely to be required by owner personnel.

#### **3.4.1 *Traits Required by Owner Project Personnel***

To work effectively with contractors, owner personnel require a number of traits that are not easily developed after hiring. Owners may wish to consider assessing these traits as part of their hiring process (shown in Table 3.2). If owner personnel operated in a carefully controlled environment where their behavior was shaped by starting "at the bottom" with very little responsibility and taking on gradually increasing amount of responsibility over the years, selection based on these traits would be less important. However, given that owner personnel may now have few peers to shape their behavior and operate autonomously from an early stage in their careers, selection based on these traits may be more essential.

**Table 3.2 Traits to Consider during Selection of Owner Personnel.**

<b>Trait</b>	<b>Definition</b>
Agreeableness	Ability to get along with others and be open minded to new ideas.
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.
Conscientiousness	Perseverance, responsibility, and thoroughness in completing tasks.
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.

### **3.4.2 New Skills Required by Owner Project Personnel**

It is widely recognized that, in order to work effectively in an environment where contractors are used extensively, owner personnel must possess a variety of skills. These skills can be grouped into six categories and are listed in the Table 3.3.

We should note the role of technical skills for the owner firm engineers can be problematic. As the technical skills required of project managers decline, individual project managers become less able to evaluate and question contractor work products. We observed three different mechanisms for coping with this problem. First, the current generation of project managers collectively knows "who to ask" about technical questions inside the owner firm. However, current project managers developed this knowledge and social networks under a far different career system than currently exists. Earlier, owner employees moved through a series of roles with increasing responsibility and met and worked with a variety of owner personnel during that process. It is unclear how the next generation of project managers will develop this knowledge and these networks. Second, owner firms can create technical support centers to answer specific questions for project managers. Because these centers are an overhead expense that represents an additional charge to the project (if used), project managers are likely to limit use of these centers to only the most critical issues. Project managers are not likely to seek technical advice on issues that would benefit the owner firm but that are not critical. Third, owner firms can use project teams make the depth and breadth of the technical knowledge of the project manager less critical.

**Table 3.3 Skills Required by Successful Owner Project Personnel**

<b>Category of Skills</b>	<b>Examples of Skills</b>
Business Skills	Writing and managing contracts Negotiation Managing budgets and schedules
Communication Skills	Coordination/liaison Conflict management Cultivate broad network of relationships
Influence Skills	Mentoring Motivating Change management
Managerial Skills	Team building Delegating Politically aware/see big picture
Problem Solving Skills	Continually analyze options/innovation Planning Consider both sides of issues, risk management
Technical Skills	Understand entire construction process Multi-disciplined (knowledge of several areas of engineering) Information technology skills

### **3.4.3 Skill Development of Owner Project Personnel**

Although the skill set required of owner personnel has changed radically, owner firms have invested relatively little systematic effort into methods for ensuring that their personnel have the required skill sets. There is relatively little investment in formal training (either from the owner’s training organization or from outside providers); owners rely almost exclusively on on-the-job training. However, there is little benefit to owner personnel of providing mentoring or on-the-job training, reducing the likelihood that such training will be effective.

Currently, the full impact of this lack of training has not affected owner firms. Owner firms currently rely on the few experienced personnel that they have retained in-house. However, these personnel in owner firms are nearing retirement. Figure 3.4.3 displays the organizational tenure of the owner personnel we interviewed. This tenure distribution appears to be representative of the firms in general. As is evident in the Figure, the distribution is heavily skewed toward individuals with more than 15 years of experience and reflects very limited hiring during the past five years. As the current cadre of long-tenured individuals retires and needs to be replaced, the effects of lack of training will become more critical.

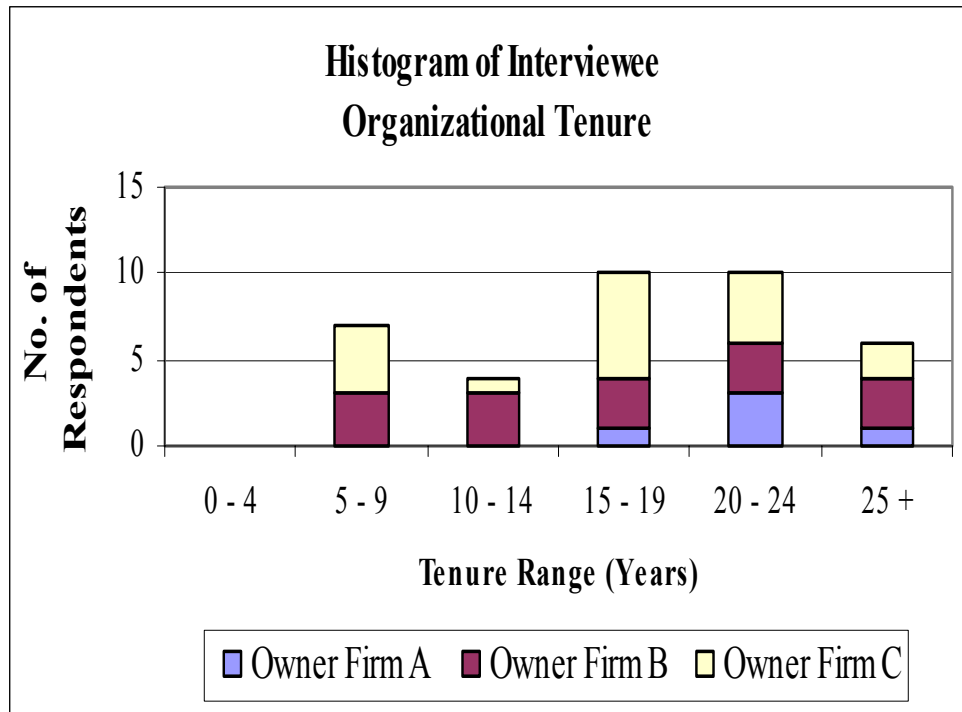


Figure 3.1 Histogram of Interviewee Organizational Tenure

#### 3.4.4 Careers of Owner Project Personnel

At most owner firms, hiring of new engineers has been relatively limited. Thus, owner firms have had little chance to experiment with developing new career paths to train the next generation of project managers. Currently, the role of project manager within an owner organization is quite problematic from a career perspective. It is unclear what career path and set of experiences lead to the project manager role, which makes future staffing of this role quite difficult. Similarly, there does not appear to be a career path out of the role, which may lead to problems with both burnout and retention.

It is important to note that the role of plant engineering as a source for future project managers is in transition. Formerly, plant engineering served as an important training ground for engineers involved in capital facilities projects. However, with the outsourcing and downsizing of much of plant engineering, there are fewer plant engineers available to move up the hierarchy and those who are available are less broadly trained than in the past.

#### 3.5 Knowledge Transfer Between Owners and Contractors

In this section, we consider two types of knowledge transfer: appropriate knowledge transfer of information required to successfully complete projects, including learning from past

projects, and preventing leakage of proprietary information. Of these two issues, ensuring appropriate knowledge transfer appears to be much more serious and pressing.

In order for an owner-contractor relationship to work optimally, information needs to flow freely across organizational boundaries. However, there are many barriers outside of the engineering function to this free flow of information (e.g., resistance of IT personnel). Even formal alliances do not necessarily improve this difficulty. This issue illustrates how a formal agreement at the corporate level can be insufficient to overcome the lower-level operational difficulties that prevent the benefits of the agreement from being realized. Ensuring appropriate flow of information between the owner and its contractors is an important priority for owner firms.

Although leakage of proprietary technology from owners to contractors is a theoretical possibility, there appear to be serious social and normative barriers to the leakage of proprietary technology. For example, contractors or contractor personnel who engaged in this behavior would not be able to work again for the owner, or perhaps ever again in the industry. However, despite this fact, there were wide differences in the amount of security (other than standard nondisclosure agreements) used on different projects. This may be an area where owners want to consider how they are investing their resources. If minimal barriers are sufficient to prevent technology leakage, it is not clear that investing in additional security is worth the cost.

Information leakage did appear to be an issue in countries without well established laws and norms about intellectual property (e.g., developing nations). In those situations, additional safeguards seem warranted.

### **3.6 Owner/Contractor Relationships in the Global Arena**

Using contractors did not appear to ease difficulties associated with building facilities overseas. Even if contractors had a good track record in the U.S., their overseas offices may be less proficient than their U.S. operations. Thus, owners did not appear to be able to systematically leverage contractor knowledge about doing business overseas. Also, as noted above, safeguarding intellectual property is an important issue overseas.

## **CHAPTER 4: TWO MODELS OF THE OWNER-CONTRACTOR RELATIONSHIP**

### **4.1 Models of the Owner-Contractor Relationship**

Chapter 3 described a variety of features of the owner/contractor relationship. Although, in theory, an owner firm could put together these features in any number of possible ways, in practice, we observed two very distinct models of the owner/contractor relationship. Below, we briefly describe these models and their associated benefits and limitations.

#### **4.1.1 Model 1: Single Person Guidance**

In Model 1, the owner firm has a relatively low degree of involvement in the project. The project is conceptualized and then “handed off” to the contractor. The owner firm exercises guidance and oversight through a single owner project manager who is the one point of contact for the contractor. Although the owner’s project manager may request formal or informal technical assistance from other owner personnel, that assistance is limited to specific technical issues. No owner personnel other than the project manager take ongoing responsibility for the success of the project.

In our experience, the single person guidance model was accompanied by some type of alliance relationships with contractors. These alliances allowed senior management to achieve control over all capital project initiatives by structuring the overall parameters of the relationships with contractors and then allowing project managers to work within those parameters. Project managers often experienced the alliances as less than useful constraints rather than helpful points of leverage.

Because the single person guidance model depended on one owner project manager to represent all of the owner’s interests in the project, measurement of contractor performance tended to be limited to a few, very tangible project outcomes. Overworked project managers had very little time to contemplate, much less measure, more subtle aspects of their relationships with contractors. Methods for promoting long-term learning from contractors also tended to be limited.

#### **4.1.2 Model 2: Team Guidance**

In Model 2, the team guidance model, the owner maintains a relatively high level of involvement throughout the project. This involvement is accomplished by having a team headed by an owner project manager and composed of owner project personnel with different engineering skills take responsibility for the ongoing guidance and evaluation of the project. The high level of project involvement can be a source of friction between owner and contractor personnel because owner personnel can become involved in daily decisions that contractors would prefer to retain for themselves. With more owner personnel involved in the project, coordination between the owner and the contractor becomes more complex and difficult to manage. Also, higher levels of owner involvement also means that the owner is more likely to recognize and make changes during the design process, causing the contractor to lose time in adjusting to the owner's new expectations.

Although Model 2 can operate in the presence of an alliance, the relatively high level of owner control exercised by the project team means that an alliance that sets overall parameters for the owner/contractor relationship is not necessary in order for the owner to retain control of projects. Finally, the Model 2 teams we observed were more likely to have formal project assessment meetings that assessed "soft" aspects of the owner's performance and that documented the lessons learned from a project. However, integrating this learning into the next project was somewhat dependent on the owner team remaining together for future projects.

#### **4.2 Model 1: Benefits and Limitations**

This section of the report describes the key benefits and limitations of the single person guidance model. Model 1 raises three important issues for owner firms. Below, we describe each of these issues and discuss the impact of each issue on the effectiveness of the owner/contractor relationship.

##### **4.2.1 Leveraging Owner Resources**

Model 1 achieves minimum owner staffing levels and maximum leverage of owner personnel. The availability of formal and informal engineering consultation within the owner firm means that project managers' needs for expert technical advice can be met without the expense involved in assigning additional personnel to the project.

Relying on one project manager to represent the owner's interest in a project on an ongoing basis means that the project manager must have the necessary abilities, skills, traits, and experience to ensure project success. Given that the owner's human resources are maximally leveraged, it is vital that each of the owner's project managers be of the highest quality. Minimizing the total number of owner personnel working on projects increases the importance of each person the owner employs.

Perhaps the most critical challenge that owner firms using Model 1 face is recruiting and training the "next generation" of project personnel, particularly project managers. This challenge has several dimensions:

- Many current project managers have several years of experience with their current employer and will be retiring over the next 10 to 15 years. It is unclear where the "next generation" of project managers will come from. Current project managers learned their roles through a series of increasingly responsible assignments, but the jobs that provided training to the current project managers often either no longer exist or have very few incumbents.
- The lack of a clear training ground for project managers is important because being an effective project manager requires both engineering and project management knowledge and knowledge about how to most effectively use the owner's other resources (e.g., engineering consultants). Because the skills and abilities of any single project manager are necessarily limited, it is vital that project managers develop trusted sources of information throughout the company. Knowing whom to call about a specific problem is a critical skill that can only be gained through experience. Project managers who enter the job without a network of contacts that they can rely on are likely to have difficulty performing their roles effectively.
- If Model 1 is combined with alliances, project managers must have new skills that were not as vital in non-alliance relationships. Examples of these skills include building trusting long-term relationships, communicating effectively with contractor personnel who may "speak a different language" than the owner, and negotiating so that inevitable differences in points of view between owner and contractor personnel can be resolved effectively.

In summary, Model 1 effectively contains the cost of engineering personnel and achieves maximum leverage of the owner's human resources. However, Model 1 brings with it the challenge of developing the skills required for success in a high leverage environment.

#### **4.2.2 *Assessing Contractor Effectiveness***

As discussed above, owners that follow Model 1 often invest substantial time and other resources in building and managing long-term relationships with a few alliance partners. These relationships, if managed effectively, create important benefits that may be difficult to quantify but that increase the effectiveness of the owner's capital construction efforts. For example, increased responsiveness of the contractor to the owner's needs, increased trust and more effective communication between the owner and its alliance partners, and an emphasis on not sacrificing the long-run well-being of both firms for short-run monetary gains are all very important gains from alliances.

The challenge for Model 1 owners is assessing whether the benefits of these alliance relationships actually occur. The very lean staffing structure of Model 1 owners means that few additional human resources are available to devote to the task of assessing alliance effectiveness. However, developing measures of alliance effectiveness is important for two reasons. First, these measures will allow the owner to evaluate whether the benefits hoped for from alliances are actually occurring. Second, as each alliance relationship matures, it is vital to understand how well the relationship is working and whether it should be replaced with another relationship. Owners using Model 1 might benefit from addressing two issues: (1) what benefits it hopes to gain from alliance relationships; and (2) how these benefits might be measured.

#### **4.2.3 *Maximizing Learning from Contractors***

One of the most important potential benefits of alliance relationships (as opposed to changing contractors from project to project) is the potential to work with alliance partners to document learning from each project and to use this learning in future projects. This benefit takes on increased importance in Model 1 highly leveraged staffing patterns. When owners used more of their own personnel on each project, learning from projects was captured by the collective experiences and memories of owner personnel. Given reasonable rates of personnel retention, learning from projects remained within owners along with their personnel. This

learning is important because knowledge gained from past projects forms the foundation for improvements in future projects.

The highly leveraged staffing patterns that characterize Model 1 represent both an opportunity and a threat to project learning. If owners can learn effectively from their contractors, they have the opportunity to capture and use more of the learning that occurs as a result of doing projects than they did when they relied only on owner personnel to record and remember what was learned on each project. However, with the opportunity to learn from contractor personnel also comes the threat that valuable owner-specific knowledge about how to manage projects will migrate toward contractors and will not be reclaimed by the owners.

In order to capitalize on the opportunities for learning from contractors, owners using Model 1 need to pay careful attention to how new knowledge gained by doing a project is transferred back to the owner and made permanent so that a variety of owner personnel can access it. Model 1 firms may face several barriers to knowledge transfer between themselves and their contractors. The most important of these include:

- Most organizational systems are designed to protect information, not share information and knowledge. Current policies about access to information systems, documentation, and financial records can inhibit beneficial information flow between the owner and its contractors.
- Substantial learning resides in contractor personnel who often experience high turnover rates (they leave the owner's jobs with some frequency even if they are still employed by the contractor). Turnover of contractor personnel limits learning from project to project and also knowledge transfer between the owner and its contractors. Thus, ensuring at least some stability of contractor personnel from project to project is an important element in transferring knowledge between contractors and owners.
- The firm may not have developed structured mechanisms to capture project-specific learning and make it reusable in future projects (e.g., formal documentation of lessons learned from each project, especially those that might apply to future projects).

#### **4.3 Model 2: Benefits and Limitations**

This section of the report describes the key benefits and limitations of the team guidance model. Model 2 raises three important issues for owner firms. Below, we describe each of these

issues and discuss the impact of each issue on the effectiveness of the owner/contractor relationship.

#### **4.3.1 *Maintaining Owner Control over Projects***

The practice of assigning several owner personnel to a project team and having the team maintain high levels of oversight over contractor personnel maximizes owner control over project processes and outcomes. If owner personnel have extensive project experience and good project processes, they are likely to be able to detect and correct errors before they become costly and difficult to correct. Also, owner personnel are in a good position to detect opportunities for change and innovation that will benefit the owner. Similarly, owner personnel are able to detect and make tradeoffs that a contractor may be unable or unwilling to make. For example, in some cases owner personnel are in a much better position than contractor personnel to determine whether a potential design improvement is worth a delay in project completion.

The use of a project team to guide each project means that the owner's interests are extremely well represented. However, using an owner project team means that contractor resources are sometimes used inefficiently. Although members of the owner project team are supposed to follow the chain of command when dealing with contractor personnel (e.g., make requests through the contractor's project manager), in reality, owner personnel may bypass the chain of command and have discussions directly with contractor personnel. Thus, contractor personnel can experience multiple points of supervision and conflicting demands from various owner personnel. Multiple points of contact between owner and contractor personnel can lead to increased understanding between the two groups. However, these multiple contacts can also create a lack of clarity about the chain of command and about roles of owner and contractor personnel. This lack of clarity can create unnecessary changes and lead to delays in accomplishing tasks. The challenge for Model 2 firms is to use the owner project team in a way that best represents the owner's interests while making efficient and effective use of the owner's resources.

#### **4.3.2 *Assessing Effectiveness of Long-Term Relationships with Contractors***

Like Model 1 firms, Model 2 firms face the challenge of systematically weighing the benefits and drawbacks of their relationships with contractors. Most Model 2 owners have measures of project success (e.g., budget, schedule); however, they have not yet developed many

measures of relationship success. Developing these measures is important for two reasons. First, these measures will allow owners to evaluate whether contractor relationships are yielding important benefits. Second, it is important to understand how well each contractor relationship is working and whether it should be replaced with another relationship.

Because Model 2 owners rely on their own project teams to bring order and stability to each project, they may be less likely to use formal alliances than Model 1 firms. It is important to note that lack of alliances may limit opportunities for long-term learning from contractors and for building trust between owner and contractor personnel. Without the formal commitments involved in an alliance, both the contractor and the owner may be unwilling to make the kinds of long-term investments that lead to systematic learning from project to project. If long-term relationships are a custom not a commitment, there is little emphasis on assessing the benefits from the relationship and the limitations created by not making the relationship more formal and committed. An important challenge for Model 2 owners is to try to systematically assess the benefits of long-term contractor relationships in order to determine what is the best method of structuring these relationships.

#### **4.3.3 *Managing the Skills and Careers of Project Personnel***

Using project teams and retaining in-house expertise in key functional areas of engineering improves the owner's ability to control project outcomes, evaluate contractor performance, and make informed decisions about contractor selection. Retaining this expertise in-house means that the owner is not dependent on just one person for the success of a project. Thus, the owner's ability to complete projects is not dependent on specific project staff staying with the owner for an extended period of time.

Although the owner is not dependent on any single person, having skilled project personnel is necessary in order to form effective project teams. At many Model 2 owners, it is unclear how the "next generation" of project personnel will be selected, trained, and retained. The challenge of finding and training the "next generation" of project personnel has several dimensions:

- In many Model 2 firms, project personnel have many years of experience with the company, and many highly experienced project staff will be retiring over the next 10 to 15 years. It is unclear where the "next generation" of project managers and discipline engineers will come from. The current project managers and discipline engineers learned

their roles through a series of increasingly responsible assignments, but the jobs that provided training to the current project managers either no longer exist or have very few incumbents.

- The lack of a clear training ground for project personnel is important because being an effective project team member requires both engineering and project management knowledge and knowledge about how to most effectively obtain information from people in various parts of the company. Knowing whom to call about a specific problem is a critical skill that can only be gained through experience. Project personnel, particularly project managers, who enter the job without a network of contacts that they can rely on are likely to have difficulty performing their roles effectively. It may be useful for Model 2 owners to think about how the “next generation” of project personnel will develop the informal network of contacts that are essential to their effectiveness.
- Closer working relationships with contractors require that project personnel have new skills that were not as vital when relationships with contractors tended to be strictly short-term. Examples of these skills include building trusting long-term relationships, communicating effectively with contractor personnel who may “speak a different language” than the company, and negotiating so that inevitable differences in points of view between the company and contractor personnel can be resolved effectively.

## CHAPTER 5: CONCLUSIONS AND PATH FORWARD

### 5.1 Conclusions

In Phase II of the Owner/Contractor Organizational Changes study, we conducted a two-phased investigation. The CII Benchmarking and Metrics database of 274 projects representing 31 owner companies were analyzed. An in-depth evaluation of two owner firms, consisting of 42 interviews and three site visits, was conducted. This data collection is in addition to earlier interviews and site visits conducted in Phase I. The conclusions that can be reached from the investigation to date are as follows:

- Across the represented industry segments, outsourcing of pre-project planning, procurement, and design stands at approximately 62 percent of total effort for these functions in the studied projects. By industry segment, the outsourcing rates vary from an average of 57 percent to 72 percent. The building and infrastructure segments appear to have outpaced the other industry sectors in their rate of outsourcing of each of these functions over the last five years.
- We found a wide difference in the amount of outsourcing from owner to owner. It appears that owners who leverage the most (top tier) of these functions, on average, have the best project cost performance versus estimate. The owners who leverage the least tend to have better schedule performance. The middle tier owners do not do as well in terms of cost or schedule as their counterparts.
- Light industrial project owners are the most leveraged in terms of their outsourcing and seem the least satisfied with their working relationships.
- The owner/contractor working relationship appears to have many purposes, not all of which are recognized by owners. Some of the meanings of leveraging include:
  - numerical leverage
  - functional leverage
  - managerial leverage
  - learning leverage
- A critical, but often unrecognized, feature of the owner/contractor relationship is goal conflict. Owners and contractors inherently have different and sometimes conflicting

goals. Many owner personnel fail to recognize this fact and take no actions to overcome the problems it entails.

- We observed several different models of owner project involvement that could be arrayed along a continuum. At one extreme, the owner determines only the economic viability and key design features of the project. At this point, the owner basically turns the project over to the contractor. The owner maintains oversight of the project, but relegates the day-to-day decisions to the contractor personnel. At the other extreme, owner personnel maintain active involvement with the contractor throughout all phases of the project.
- Another defining feature of the owner/contractor relationship was the way in which the contractor's involvement with the owner was structured. Again, models of contractor involvement could be arrayed along a continuum. At one extreme, the owner and the contractor have a formal, written highly specified alliance that is agreed upon and managed at fairly high levels in both firms. The other extreme model of contractor involvement consists of the owner getting bids for the design of each facility and giving the contract to the low bidder (other factors being equal). An intermediate form of contractor involvement is the preferred provider relationship. In this method of organizing, the owner tends to work with the same small number of contractors over time and to develop good working relationships with those contractors. Each relationship approach has its advantages and disadvantages as outlined in this report.
- Monitoring and evaluating contractor performance is another area where work structures have not kept pace with the changing nature of the owner/contractor relationship. Owners generally have some clear metrics for evaluating the success of *projects* (e.g., performance against budget and schedule objectives, rework in the field). Although owners have at least some metrics for project performance, we found few instances where owners had clear metrics that could be used to assess the performance of *relationships*. Since the relationship is more important than any single project, developing methods for assessing relationship success appears to be an important future challenge for owners.

- Many of the owner personnel we interviewed identified the ability to learn from contractors and to transfer learning between projects as an important benefit of longer-term relationships with contractors. However, owner firms differed widely in the extent to which they attempted to learn from contractors and also in the extent to which their attempts were successful.
- Owner personnel were unanimous in their view that changing owner/contractor relationships require owner personnel to have new competencies. However, owner personnel we interviewed felt that their firms had not yet addressed how owner personnel were going to develop even the basic competencies required to operate successfully in the changing world of owner/contractor relationships. Within the required competency set a further distinction could be made between required traits and skills.

To work effectively with contractors, owner personnel require a number of *traits* that are not easily developed after hiring. Owners may wish to consider assessing these traits as part of their hiring process:

- Agreeableness
- Assertiveness
- Confidence
- Conscientiousness
- Judgment
- Trustworthiness

It is widely recognized that, in order to work effectively in an environment where contractors are used extensively, owner personnel must possess a variety of *skills*. These skills can be grouped into six categories:

- Business Skills
- Communication Skills
- Influence Skills
- Managerial Skills
- Problem Solving Skills
- Technical Skills

We should note the role of technical skills for the owner firm engineers could be problematic. As the technical skills of owner project managers' decline due to the narrowing of

career paths within owner firms, individual project managers become less able to evaluate and question contractor work products. It is unclear how the next generation of project managers will develop this knowledge.

- Currently, the full impact of this lack of training has not affected owner firms. Owner firms rely on the few experienced personnel that they have retained in-house. However, many of these personnel are nearing retirement and there is an age gap between the young, inexperienced project managers and experienced project managers. At most owner firms, hiring of new engineers has been relatively limited. Thus, owner firms have had little chance to experiment with developing new career paths to train the next generation of project managers. Currently, the role of project manager within an owner organization is quite problematic from a career perspective. It is unclear what career path and set of experiences lead to the project manager role, which makes future staffing of this role quite difficult
- Although our respondents identified many specific attributes of successful owner-contractor relationships, these attributes can be grouped into seven basic categories:
  - Contractor meets owner's project objectives
  - Contractor understands owner's business
  - Integration of owner and contractor personnel
  - Contractor responsiveness to changing conditions
  - Contractor willingness to innovate
  - Operating for mutual benefit
  - Learning from the relationship is documented and used
- It is clear that individuals use the term "alliance" to mean many different things. The term encompassed everything from a regular pattern of doing business together to a written contractual agreement with formal structures surrounding the alliance (e.g., an alliance manager). It is impossible to answer the question of whether alliances are beneficial without specifying in more detail the specific structure of the alliance and the behaviors that underlie the alliance. Although individuals discussed the idea that alliances can create common interests between owners and contractors and improve information flow, there were *no methods of documenting* whether these benefits actually occurred.

- It is important to note that a successful relationship and successful projects are two different things. A successful relationship overall may still have projects with a variety of outcomes. It also needs to be noted that a history of good project outcomes is likely to lead to the formation of alliances. Thus, one may find an association between alliances and project outcomes, but the causal direction is unclear.

*From this study, our overall view of owner organizations is that in many cases their relationship structure with contractors has changed significantly over the past several years, while the corresponding work processes and resources needed to manage these changes have been slow to catch up. This situation will likely continue to lead to frustrated business relationships and a further of eroding of capital facility expertise within certain owner organizations, at least in the near term.*

In addition, the path forward to effective and efficient evaluation of owner organizations in terms of their organizational structure has been identified and developed. We envision that the developed methodology can lead to in-depth owner organizational evaluations with a minimum of disruption. A path forward outlining this methodology is given below.

## **5.2 Path Forward**

The study team plans to complete Phase II of this research in early 1999. The purposes of Phase II-C are:

- Follow up on issues that are still unclear after the Phase II-B site visits;
- Develop and pretest a survey instrument and detailed interview protocols that will be used during Phase III of this research. The tentative plan for Phase III is for the study team to conduct 8-10 one day site visits in various owner firms. During these site visits, the team will systematically assess important facets of the owner/contractor relationship in each firm in order to clarify, amplify, and gain additional confidence in the Phase II findings. In order to gather the maximum amount of data in one day, it will be necessary to develop highly structured data collection tools (e.g., survey instruments and detailed interview protocols). These tools will be used and refined during Phase III. Ideally, one outcome of Phase II will be structured survey instruments than owners can use to assess the effectiveness of their relationships with contractors.

The first part of Phase II-C will involve follow-up interviews with some of the individuals interviewed during Phase II-B. These interviews may be conducted either over the telephone or at the owner's site. The purpose of these interviews is to refine the team's existing interview protocols to eliminate unnecessary questions and to clarify ambiguous questions. After the interviews are conducted, the team will pretest a set of survey instruments (currently being developed) to be used in Phase III. The tentative design for these instruments is:

1. Project managers will fill out a survey on which they report on a single project. They will be asked to report on:
  - Project structures (e.g., the structure of contractor involvement)
  - Project processes (e.g., working relationships between owner and contractor personnel)
  - Project outcomes (e.g., budget, schedule, learning from the project)
  - Project personnel

Ideally, this survey will be completed prior to the site visit.

2. Using the list of project personnel identified by the project manager, the team will ask other owner personnel who worked on the project to fill out a survey in which they report on project processes and outcomes for the same project described by the project manager.
3. In a separate survey, a human resources manager will report on career systems for engineering personnel within the owner firm.

We hope to complete Phase III in the summer of 1999. In addition to the ongoing owner study, we will continue to evaluate CII Benchmarking and Metrics data. We have also begun a similar interview/site visit based study with contractor organizations (currently in the pilot stage). We are also working to validate the previously developed CII Owner / Contractor Work Structure processes through a series of workshops and on-site interviews with owner and contractor organizations.

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