



CCIS



**OWNER OUTSOURCING TRENDS
AND THEIR AFFECTS ON
PROJECT PRACTICES AND PERFORMANCE**

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CENTER FOR CONSTRUCTION INDUSTRY STUDIES

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The University of Texas at Austin

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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

In the past several years, changes in the industry have led to the reorganization of many capital facility owner groups. In hopes of gaining a competitive edge in the new, global economy, these owners, through reevaluating their core competencies, have begun to change their organizations by outsourcing a larger percentage of their work to specialized contractors.

This study examines the outsourcing trends of a sample of owner organizations during the period 1994 to 1998, using the Construction Industry Institute's (CII) Benchmarking and Metrics Database. Three project phases, pre-project planning, design, and procurement, were analyzed, along with a rollup metric that is a combination of the three phases. It is shown that the outsourcing trends of these owners in the project phases remained steady or slightly increased during the first four years, with a decline in 1998.

This report also examines owner project practices and attributes in regard to their level of outsourcing for the sample of 365 capital projects representing over \$18.3 billion in capital expenditures. Through a "three-tier" analysis, owners are compared on the basis of three project phases, five project attributes, five CII performance metrics, contract type selection, and three CII practice use indices. Some of the conclusions that are drawn from this analysis include:

1. Design is highly outsourced by most owners;
2. Owners using a combination of in-house work and outsourcing have the best relationships with their contractors;
3. Owners that outsource the most view their work as more complex;
4. The most outsourced owners have the least schedule control;
5. Less outsourced owners are less affected by project changes;
6. The general building sector outsources more work than the other two sectors, heavy industrial and light industrial;

7. The heavy industrial sector outsources the least amount of work, and has the highest averages across all three CII Practice Use Indices, pre-project planning, constructability, and project change management.

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13. The general building sector outsources more work than the other two sectors, heavy industrial and light industrial;

14. The heavy industrial sector outsources the least amount of work, and has the highest averages across all three CII Practice Use Indices, pre-project planning, constructability, and project change management.

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Chapter 1: Introduction

Over the past decade, changes in industry have led facility owners to reevaluate the core competencies of their organizations. Intense competition in an increasingly international marketplace has forced many of them to restructure their work processes. These changes lead some to believe that project functions are being outsourced to function-specific contractors more and more. Project functions such as planning, design, procurement, and construction, which were handled entirely by an owner's engineering or construction division in the past, are now being performed by outside contractors. The impact of this increased outsourcing trend could have a wide range of implications for owner companies, as well as their capital facility contractors.

Over the last few years, researchers have begun to look at these changes. This report adds to the previous studies performed to track the trends in outsourcing, as well as to provide a basis for which facility owners can change their practices in order to adapt to today's business environment. It summarizes research that has been done during the past 2 years including the tracking of outsourcing trends over a five year period, and a characterization of owners and their outsourcing practices. Through this study, the impact of the outsourcing of certain project phases is quantified.

1.1 Background

This report is part of an ongoing study, a collaborative effort between the Center for Construction Industry Studies (CCIS) and the Construction Industry Institute (CII).

This study is being conducted in order to evaluate the changing relationships between owners and contractors in capital facility projects, and how these changes affect project outcomes, as well as the human resource practices of both the owner and contractor firms (Davis-Blake et al. 1999 and Gibson et al. 1998).

The Owner/Contractor Organizational Changes thrust area of CCIS has been focused on the changing relationships between owner and contractor companies in capital facility projects. These relationships have shifted in recent years, due to the industry-wide downsizing of capital facility owners' project management staffs. The thrust area study team is interdisciplinary, with members from such diverse areas as engineering, project management, and human resources.

There are five studies currently, or recently, being pursued by the owner/contractor organizational changes thrust area:

- Owner Organizational Changes Study
- Benchmarking and Metrics Study
- Owner/Contractor Work Structure Process Study
- Contractor Organizational Changes Study
- Owner/Contractor Demographic Study

The owner organizational changes study was the first study to be undertaken by the thrust group. This study investigated the issue of relationship changes from the owner's perspective. The benchmarking and metrics study uses CII database information to characterize owner companies in outsourcing trends and their level of outsourcing. The owner/contractor work structure process study investigated the key processes that are involved in determining the core competencies of a company. The contractor

organizational changes study, is much like the owner organizational study, but it provides information from the contractor's perspective. The newest study is characterizing the changing demographic make-up of CII owners and contractors during the past 10 years. From these studies, six different CCIS publications have been completed. (Anderson et al., 2000a, Anderson et al. 2000b, Davis-Blake et al. 1999, Gibson et al. 1998, Gibson and Ryan 2000, and Hui et al. 2000).

1.2 Objectives

The material reported in this document relate to CII Benchmarking and Metric data evaluation. There are three main objectives for this research study, which are as follows:

1. To gain further knowledge of the outsourcing trends of the CII owner companies over the five-year period from 1994 to 1998
2. To further examine the 43 owner companies, both as a whole and by their respective industry sectors, with regard to the owner's level of outsourcing.
3. To provide a means for owners to examine their outsourcing practices, and to use the conclusions set forth in this report as a benchmark for their work approach in the future.

1.4 Report Structure

The remainder of this report is broken down into four chapters. Chapter Two outlines the formulation of the data sample from the CII Benchmarking and Metrics Database. Chapter Three covers the study of the outsourcing trends throughout the five-year study period. The fourth chapter relates to the work performed in order to characterize the forty-three owner companies in regard to their outsourcing trends. Finally, the fifth chapter presents the overall conclusions from this study.

Chapter 2: Methodology

This chapter describes the step-by-step research methodology that was used to complete the research described in Chapters 3 and 4. The primary data collection for this report has come through the owner project data sample that makes up the Construction Industry Institute's Benchmarking and Metrics Database.

2.1 The CII Benchmarking and Metrics Database

CII has been compiling a database of project performance and practice use data from its member companies since 1996. Currently, CII is collecting project data on the fourth version of its questionnaire. There are over 800 CII projects currently in the database, with completion dates between 1991 and 1999. In addition to the CII projects in the database, over 100 projects that have been added from ECI, the European Construction Institute, during 1997, 1998, and 1999. The CII Benchmarking and Metrics Database is used for a wide range of construction industry studies, and allows the institute to publish documentation showing the "best practices" of its members, as well as performance metrics.

The breakdown of the total projects from both owners and contractors is shown in Figure 2.1 at the time of this study. The sample consists of 906 projects, totaling approximately \$50 billion of capital projects work. These data has been evaluated by three researchers over the last three years (Rodriguez 1998, Graham 1999, Jantz 2000)

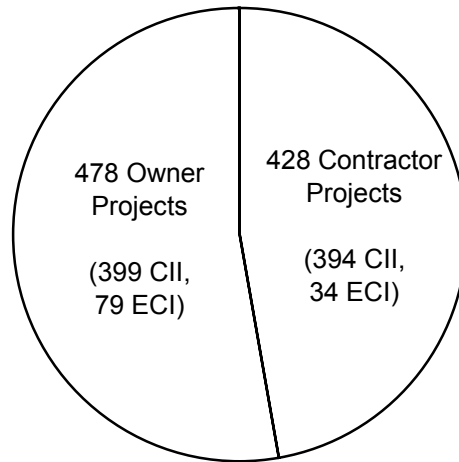


Figure 2.1 CII Database Projects

2.2 Development of Data Sample

All of these projects were not used in this analysis. There were several steps taken to arrive at the final data sample used in the analysis presented in the following two chapters. First, due to the study focus, owner projects were the only projects that were used in the study. This factor immediately eliminates roughly half of the sample.

Next, projects were analyzed in order to determine whether all of the necessary information needed for evaluation was present. Projects without actual project costs, a designated owner organization (owner anonymous), or with questionnaires that were improperly answered were dismissed. The relevant data needed in order for a project to be considered for the final data sample pertained to the CII questions outlined in Table 2.1. Projects also had to fall within the five-year period of the study, 1994-1998.

Table 2.1 CII Questionnaire: Relevant Questions

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, Constr.)
14	Planned and Actual Project Schedule
15	Net Cost and Schedule Impacts of Changes
17	Project Complexity (Version 2.0 and 3.0 only)

There was a hope to perhaps add 1999 data to the study sample, however, there were too few 1999 projects (only 3) to gain any real conclusions from that project year. Likewise, the samples from 1991-1993 were small as well. While the first wave of ECI projects held the necessary project owner information, the 1998 and 1999 ECI surveys did not include this information (specifically organizational identity), due to confidentiality reasons. Therefore, these two sub-samples could not be used in the final project data sample used for tier analysis; however, they could be used in the European trending analysis given in Chapter 3. The final count for projects included in the data sample for this report was 365 owner projects.

These 365 projects come from a variety of project sectors and represent a wide array of project types. Table 2.2 displays the counts of projects, both by year and by industry sector. The four industry sectors of the CII database are heavy industrial, light industrial, general building, and infrastructure. This table is further illustrated in Figure 2.2.

Table 2.2 Data Sample Breakdown

Sector / Completion Year	1994	1995	1996	1997	1998	Total
Heavy Industrial (HI)	18	48	62	75	22	225
Light Industrial (LI)	1	7	11	19	1	39
General Building (BLDG)	4	16	25	26	11	82
Infrastructure (INFRA)	2	3	9	2	3	19
Combined	25	74	107	122	37	365

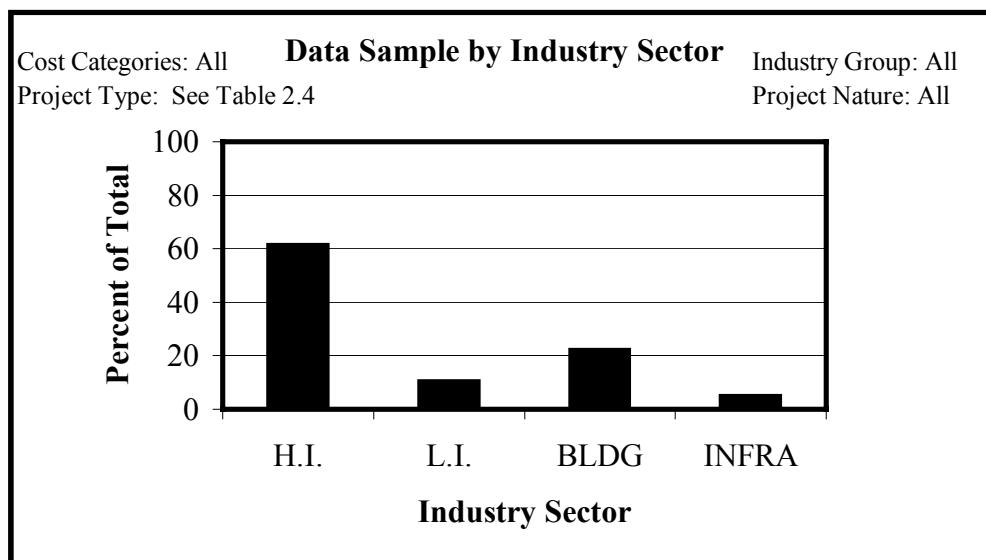


Figure 2.2 Data Sample by Industry Sector

As can be seen from the table and graph, the heavy industrial sector dominates the data sample. The same can be said for the CII database as a whole. This fact will obviously skew the data sample towards the trends in outsourcing of this industry sector.

The four industry sectors can be broken down into project types within each sector. Table 2.3 characterizes the industry sectors by project type.

Table 2.3 Data Sample Project Types

Heavy Industrial		General Building	
Chemical Mfg.	60	Dormitory/Hotel	5
Electrical (Generating)	30	Highrise Office (3+ floors)	7
Environmental	6	Hospital	2
Metals Refining/Processing	19	Laboratory	11
Mining	1	Lowrise Office (< 3 floors)	28
Natural Gas Processing	11	Maintenance Facilities	10
Oil Exploration/Production	14	Other	3
Oil Refining	61	Parking Garage	1
Other	2	Residential	1
Pipeline	1	Restaurant/Nightclub	1
Pulp and Paper	20	School	7
Total	225	Warehouse	6
		Total	82
Light Industrial		Infrastructure	
Automotive Assembly	4	Airport	1
Consumer Products Mfg.	11	Electrical Distribution	4
Foods	12	Marine Facilities	2
Light Industrial	2	Pipeline	1
Pharmaceuticals Mfg.	10	Water/Wastewater	11
Total	39	Total	19

The data sample also was characterized by project nature. CII defines three different projects natures: additions, grass roots, and modernizations. An addition is a project that adds to an existing facility. Grass roots are projects that are completely new facilities, and modernizations are updates and modifications to existing projects. Figure 2.3 shows that modernizations dominate the project sample, almost doubling the number of addition projects.

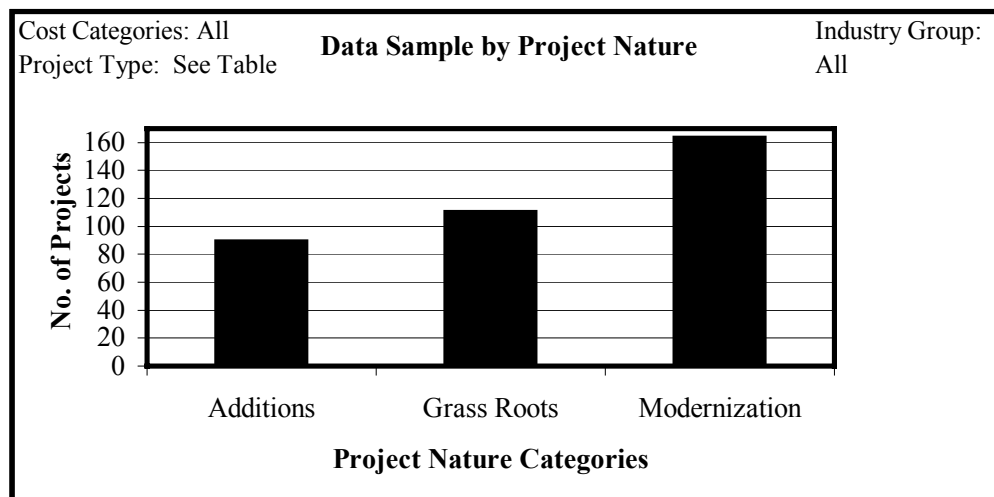


Figure 2.3 Data Sample by Project Nature

Another characterization can be made on the basis of project cost. There are four different categories of project cost used by CII in its Benchmarking and Metrics effort. The first includes projects with an actual total project cost of less than 15 million dollars, the second includes projects in the 15 to 50 million dollar range, the 50 to 100 million dollar range makes up the third category, and projects costing more than 100 million dollars fall into the last category. Figure 2.4 shows that a majority of the projects lie in the “below \$15 million” range, with relatively few costing more than \$50 million. The total cost of the entire sample was approximately \$18.3 billion.

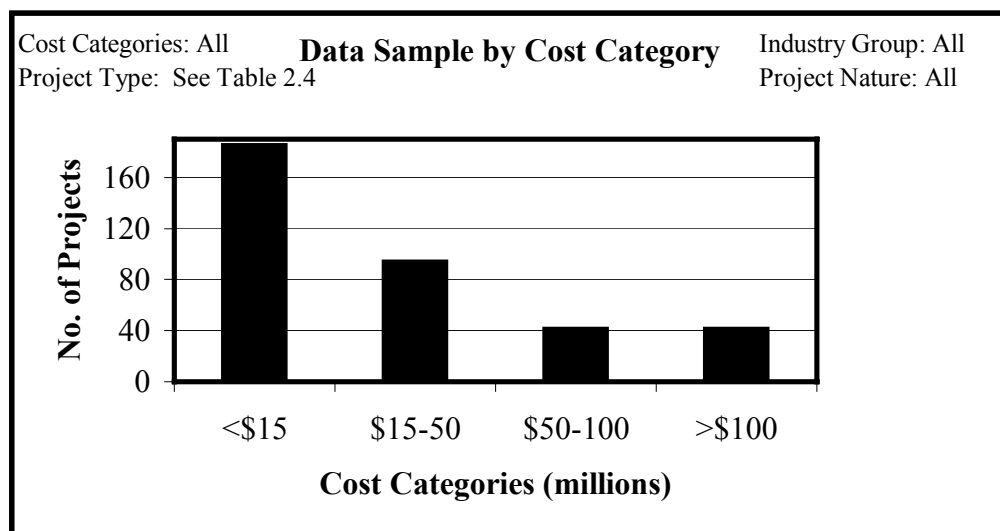


Figure 2.4 Data Sample by Cost Category

Chapter 3: Owner Outsourcing Trends

In this chapter, outsourcing for the sample owners over a five-year period, 1994-1998, is analyzed in order to determine trends in outsourcing over that time period. The evaluated outsourcing trends included the overall outsourcing, as well as outsourcing for three project functions: pre-project planning, design, and procurement. The trend analysis is further broken down in order to show trends in each of four industry sectors for the sample: Heavy Industrial, Light Industrial, General Building, and Infrastructure. In addition to this analysis of the projects belonging to the 43 sample owners, European Construction Institute information was used in order to document the outsourcing differences that exist between North America and European counterparts in the sample.

3.1 Overall Outsourcing Trends

Overall outsource trending was determined through compiling the outsourcing information for three project functions, as well as overall outsourcing, for each of the 43 companies in the study sample. From this data sample, four different trend graphs were generated in order to show both the yearly outsourcing trend and the cumulative outsourcing trend.

Figure 3.1, the first of four trend graphs, shows the pre-project planning outsourced for all industry sectors in this sample. This figure shows that the overall outsourcing trend for pre-project planning started at 14 percent in 1994, and rose steadily until 1997, where it peaked at 34 percent. In 1998, outsourcing of pre-project planning sharply declined to only 6 percent. However, the 1998 sub-sample is still much smaller

than the samples from the three previous years. The cumulative trend line indicates slight decline from 1997 to 1998.

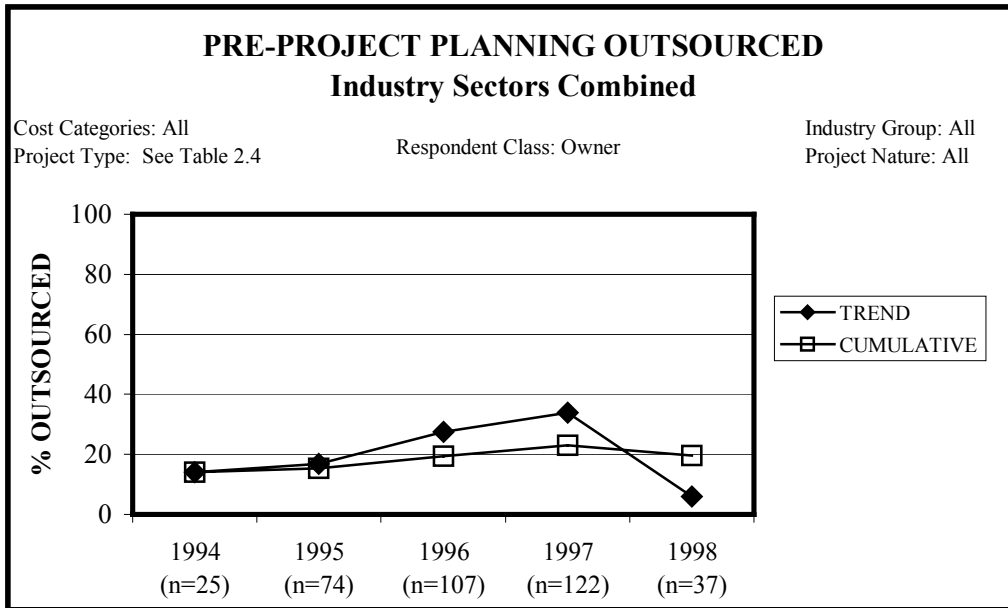


Figure 3.1 Percent of PPP Outsourced, Industry Sectors

Figure 3.2 shows the percentage of design outsourced for the combined industry sectors in the sample. The percentage of design outsourced remains steady at about 80 percent for the first 4 years of data, before falling off to 65 percent in 1998. This drop is consistent with the pre-project planning results reported earlier.

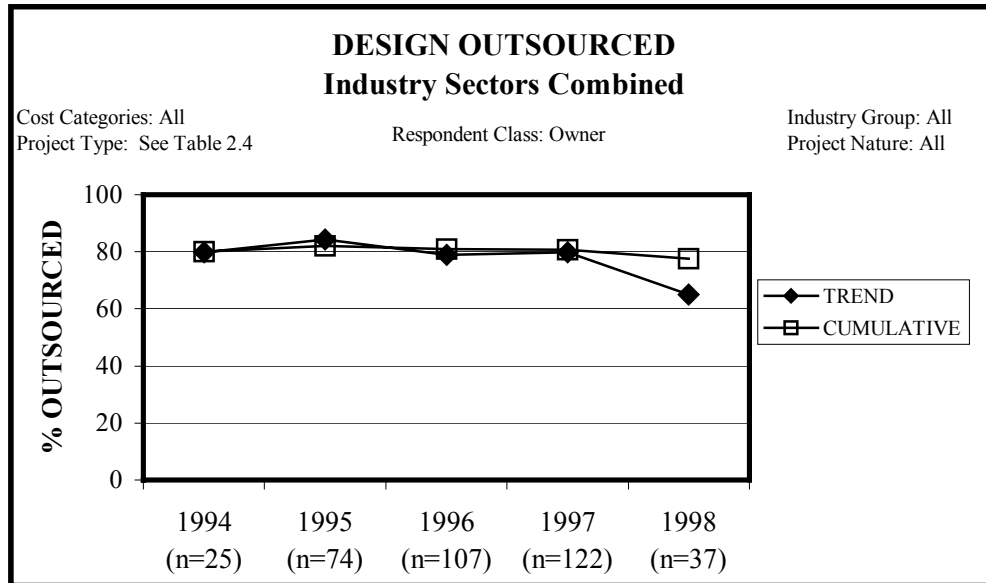


Figure 3.2 Percent of Design Outsourced, Industry Sectors Combined

Figure 3.3 shows the percentage of procurement outsourced across all industry sectors for the sample. This graph shows a steady rise in the outsourced percentage from 1994-1997, from 75 to 93 percent, followed once again by a drop in 1998, to 84 percent. The fall in procurement, although noticeable, is not as severe as those in the other two project functions, as the 1998 percentage is not the lowest in the five-year evaluation period.

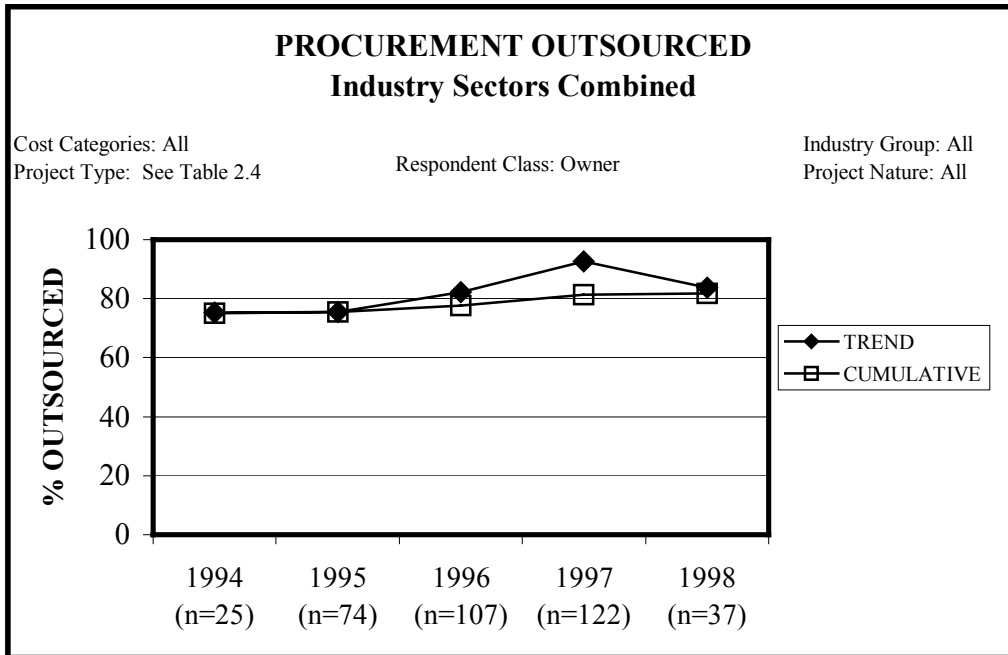


Figure 3.3 Percent of Procurement Outsourced, Industry Sectors Combined

Figure 3.4 shows the cumulative industry sectors, and is a roll-up of the three project functions, combining outsourcing of pre-project planning, design, and procurement. The outsourcing trend for these three functions shows a rise over the first four years, from 56 to 68 percent, with a drop off to 52 percent in 1998. Obviously, this graph follows the trends set forth in Figures 3.1 through 3.3. It is important to note that an average of approximately 60 percent of the work in these three functions is outsourced for the entire sample.

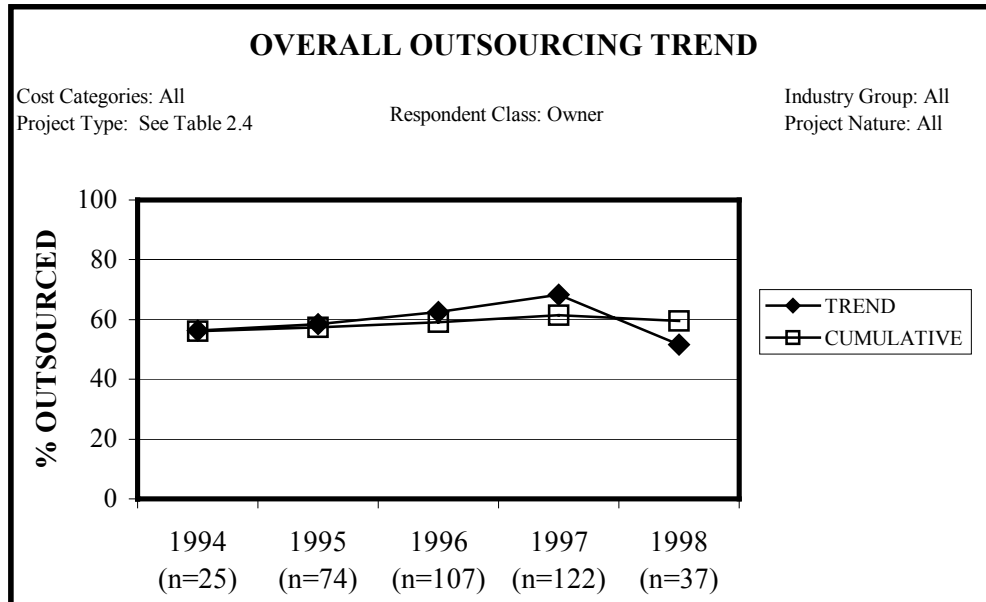


Figure 3.4 Overall Outsourcing Trend, Industry Sectors Combined

3.2 Outsourcing Trends by Industry Sector

The trends in outsourcing were analyzed further in order to identify differences that might exist between the four industry sectors: Heavy Industrial, Light Industrial, General Building, and Infrastructure. Figures 3.5 through 3.8 were developed to show the four sectors' outsourcing practices for the years 1994 to 1998.

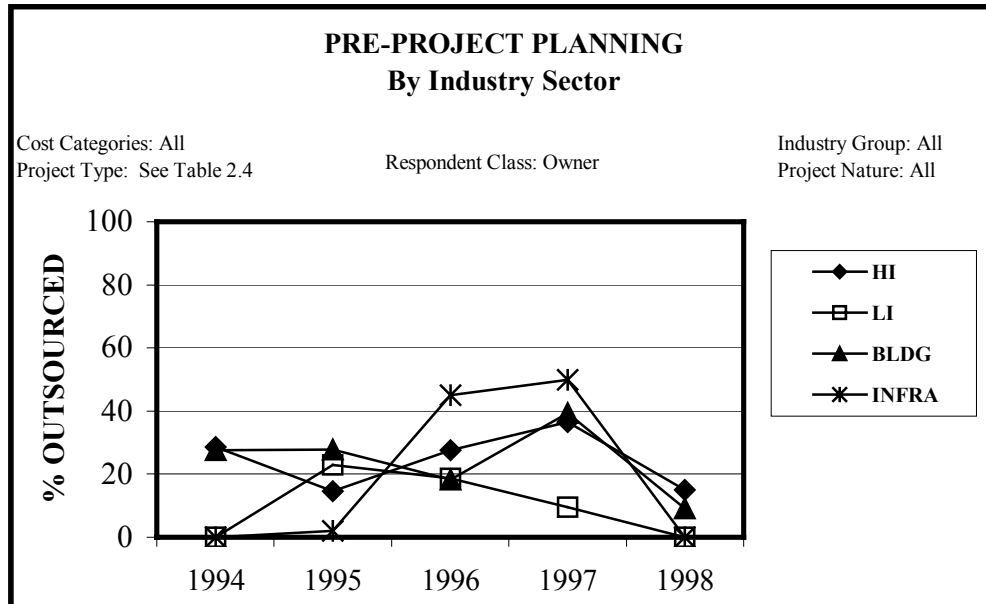


Figure 3.5 Percent of Pre-Project Planning Outsourced, by Industry Sector

Figure 3.5 shows the trend of the four sectors with respect to the outsourcing of pre-project planning. From this graph, it can be seen that Heavy Industrial projects, the largest industry sector represented in the project sample, has displayed an up and down trend over the specified time period. Heavy Industrial projects outsourced 29 percent of pre-project planning in 1994, dropped to 15 percent in 1995, and rose to a high of 34 percent in 1997 before falling back to 15 percent in 1998.

Light Industrial projects rose from zero percent in 1994 to its high of 23 percent in 1995, before dropping back down to zero percent in 1998. This drop to zero percent may be due to the small number of Light Industrial projects that are present in the data sample, with only one project in each of the years that the total pre-project planning outsourced is equal to zero percent.

Pre-project planning outsourced in the General Building sector can be characterized as being similar to that of the Heavy Industrial sector, in that there is an up and down trend. In 1994, the sector began by outsourcing 28 percent of its planning,

dropping to 18 percent in 1996, jumping to almost 40 percent in 1997, and finally dropping again in 1998.

Infrastructure project owners outsourced only a small percentage of planning in 1994 and 1995, about 50 percent in 1996 and 1997, and zero percent in 1998. This sharp contrast probably can be explained by a lack of Infrastructure projects (only 19) that are present in the project sub-sample.

In general, outsourcing of the pre-project planning function is less than the other functions studied in this thesis.

Figure 3.6 displays the outsourcing trends of the four industry sectors with regard to design. It generally illustrates the high amount of design that is outsourced in all four industry sector sub-samples.

The Heavy Industrial sector sub-sample maintains the highest overall amount of design that is performed in-house among the four sectors. This sector began the five-year span at 74 percent, fell off to 59 percent in 1996, rose to a high of 80 percent in 1997, and dropped 16 percent in 1998. The Light Industrial sector sub-sample outsourced in a similar range to Heavy Industrial, keeping much of its design in-house when compared to the other sectors. Light Industrial's highest rate of design outsourcing occurred in 1995, at 83 percent, before starting a diminishing trend, and ending at 50 percent in 1998.

In contrast to the two industrial segments, the General Building sector sub-sample displayed a consistently high rate of design outsourcing throughout the study period. The year 1994 showed a high of 98 percent of outsourced design for the sector, and the percentage fell consistently to a low of 72 percent in 1997. In 1998, outsourced design bounced back to 77 percent for buildings. Infrastructure showed a sharp rise to 98

percent in 1995, followed by two more years of nearly 100 percent, before falling in 1998. Again, each of these sectors had fairly small sub-sample sizes.

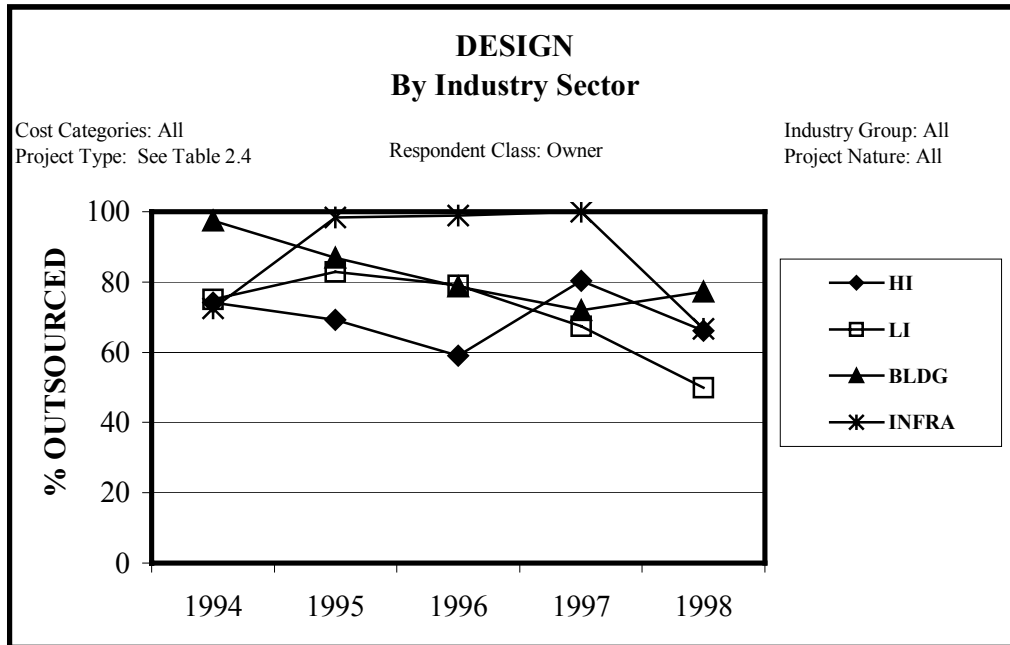


Figure 3.6 Percent of Design Outsourced, by Industry Sector

The last of the three studied functions, procurement, is characterized in Figure 3.7. The percentage of procurement outsourced for the Heavy Industrial sector rose from a low of 58 percent in 1994 to a high of 90 percent in 1997 and fell off slightly to 85 percent in 1998. The Light Industrial sector starts off at a high of 100 percent and fell to 74 percent the following year. In the next two years, outsourced procurement was back up to the low 90-percentile range, before dropping to 50 percent in 1998.

The Building sector was consistently in the 90-100 percent range after starting the study period at 75 percent. Infrastructure began in the high 60 percent range, and consistently increased to 100 percent in 1998.

Overall, procurement was the most-outsourced of the three project functions studied.

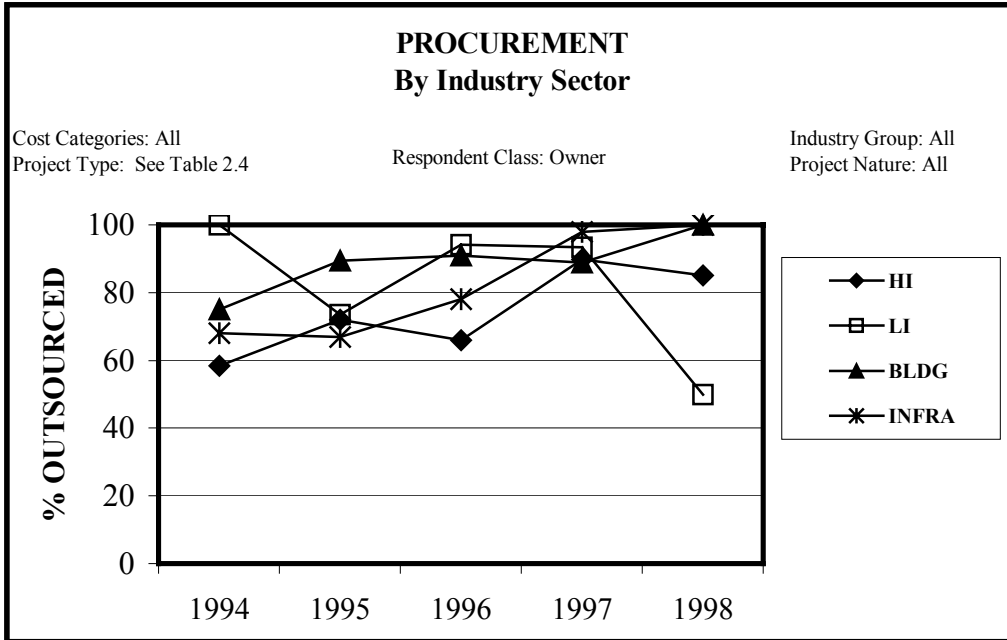


Figure 3.7 Percent of Procurement Outsourced, by Industry Sector

As in the first section of this chapter, the three project phases are rolled up into Figure 3.8, which shows the overall outsourcing for each of the industry sectors.

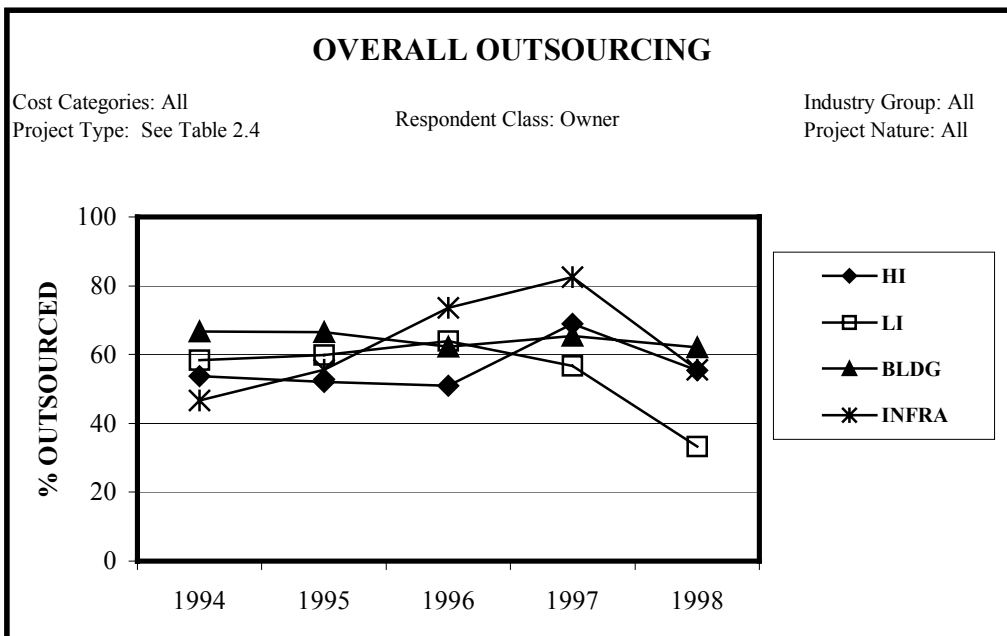


Figure 3.8 Percent of Overall Outsourcing, by Industry Sector

This graph shows that, overall, the four sectors generally follow the initial trends set forth in the first section of Chapter 3, with either consistency or overall gains in

outsourcing over the first four years, followed by a reduction in 1998. In the Heavy Industrial sector, the trend followed a consistent rate in the low 50 percent range, with a large gain in 1997 to almost 70 percent outsourced, followed by a drop to 55 percent in 1998. The Light Industrial sector maintained a consistent rate of about 60 percent in the first four years before falling to 33 percent in 1998. The General Building sector sub-sample was consistently between 60 and 70 percent during the entire five year period. The Infrastructure sub-sample had gains from 47 percent to 83 percent over the first four years, before falling to 56 percent in 1998.

3.3 Outsourcing Trends: North America vs. Europe

In addition to the trending that has been presented in the first two sections of this chapter, the availability of additional European projects from the European Construction Institute (ECI) allowed a comparison between the outsourcing trends in North America and in Europe for this sample. As discussed previously, due to the fact that the specific owners of these European projects cannot be determined, these new projects could not be included in the 43 owners that make up the data sample used in previous analysis but were aggregated for the purposes of this analysis.

Figures 3.9 and 3.10 show the pre-project planning outsourced in the North American and European samples, respectively.

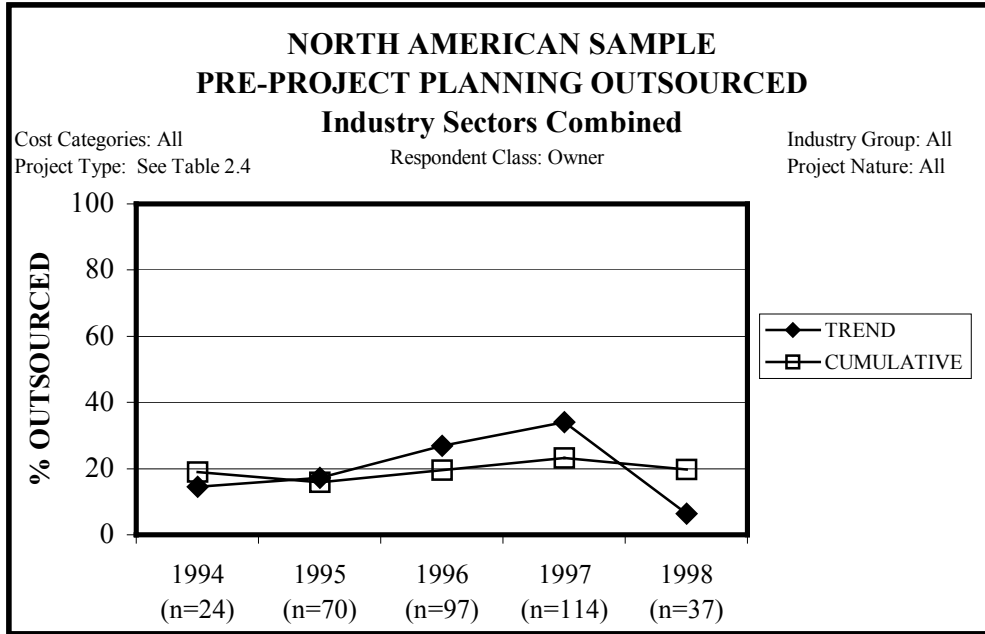


Figure 3.9 Percent of Pre-Project Planning Outsourced, North American Sample, N=342

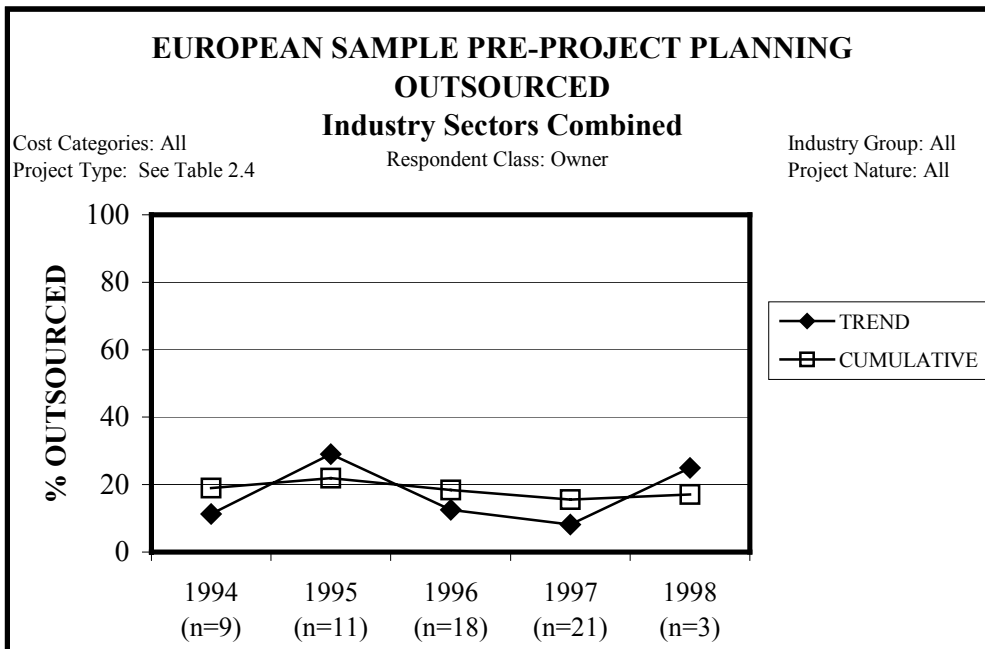


Figure 3.10 Percent of Pre-Project Planning Outsourced, European Sample, N=62

In the preceding figures, it is shown that, while the cumulative trends between continents are similar in range, the yearly trends are almost opposite in their positioning. In the North American sample, outsourcing of the pre-project planning function grew yearly until topping off in 1997 at 34 percent, before falling to a low of 6 percent in 1998. In the European sample, outsourcing or pre-project planning increases in 1995 to 29 percent from 11 percent, but falls off again in 1996 and 1997 to only 8 percent. It appears that pre-project planning outsourcing is on the rise again in 1998, where it is shown to have increased to 25 percent. Caution must be used in evaluating the European numbers, especially those for 1998, as there were many fewer projects than those used in the North American calculations. Overall, the cumulative value is almost the same for each sample.

Design outsourcing for the North American sample is shown in Figure 3.11, and European design outsourcing is shown in Figure 3.12. These two graphs are radically different. North American projects in this sample have a much greater rate of outsourced design, as can be seen in Figure 3.11. In this figure, the trend shows a steady rate of outsourcing at about 80 percent for the first four years of the study, ending with a decline to 67 percent in 1998. European project owners, on the other hand, seem to outsource much less design, starting at 65 percent in 1994, falling to 28 percent in 1996, and back up into the 50 percentile range for 1997 and 1998. On average, there is a 15-50 percent difference in the outsourcing of design services over the five-year period, with North America always outsourcing more design.

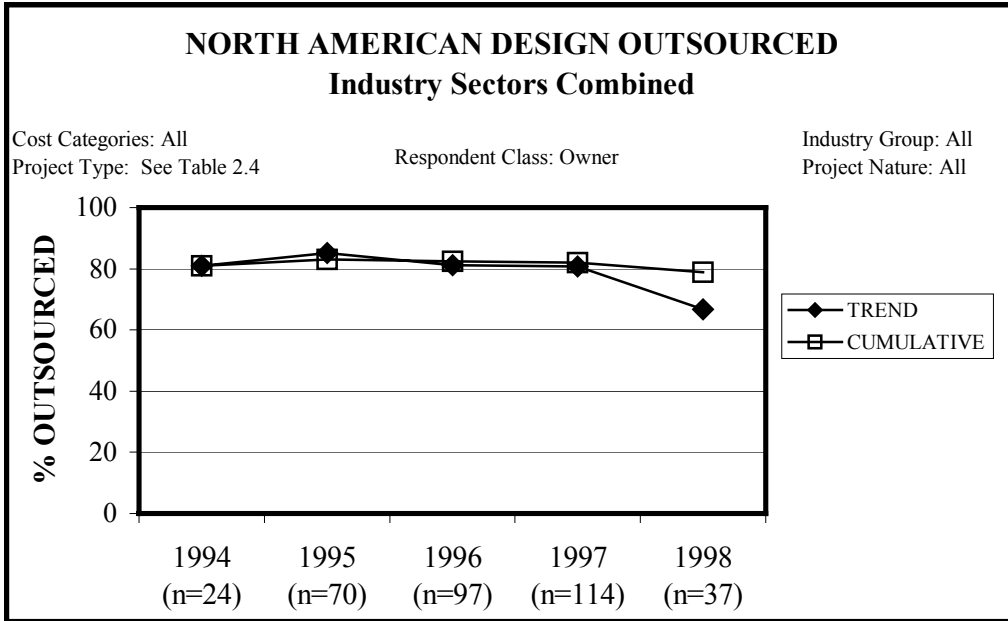


Figure 3.11 Percent of Design Outsourced, North American Sample, N=342

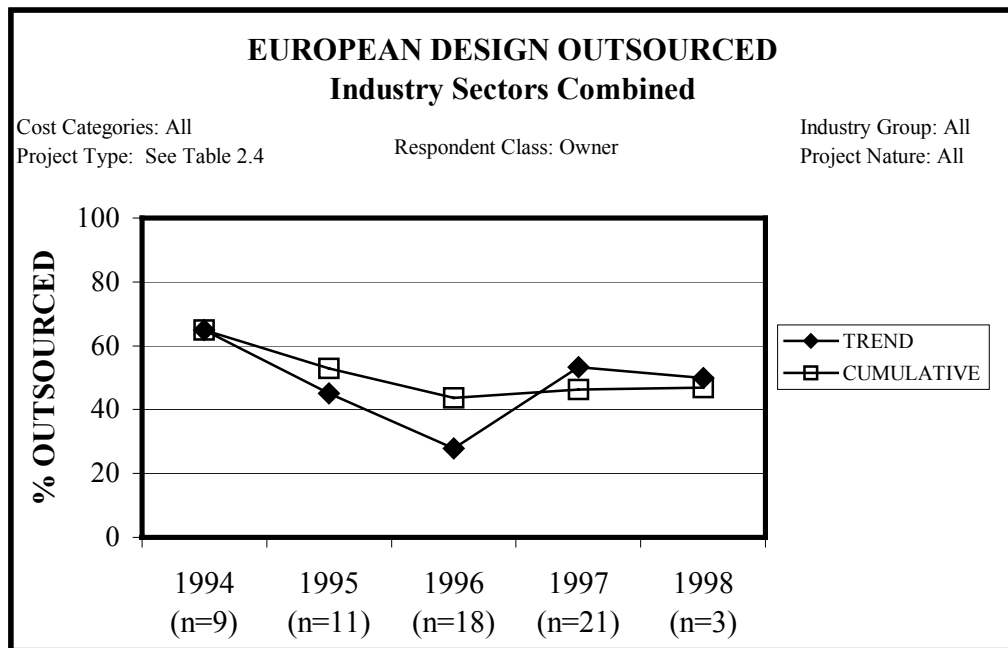


Figure 3.12 Percent of Design Outsourced, European Sample, N=62

The average procurement outsourced in North America and Europe over the five-year span is characterized in Figures 3.13 and 3.14. Both sub-samples consistently outsource a large majority of their respective procurement. In the North American sample, procurement outsourcing was at just below 80 percent in 1994, before beginning to increase in 1996, and topping out at 92 percent in 1997. Outsourcing of procurement fell to 83 percent in 1998. In the European sample, percentages were consistently higher than those of North America. The outsourcing of procurement maintained percentages in the mid-nineties for all of the five years.

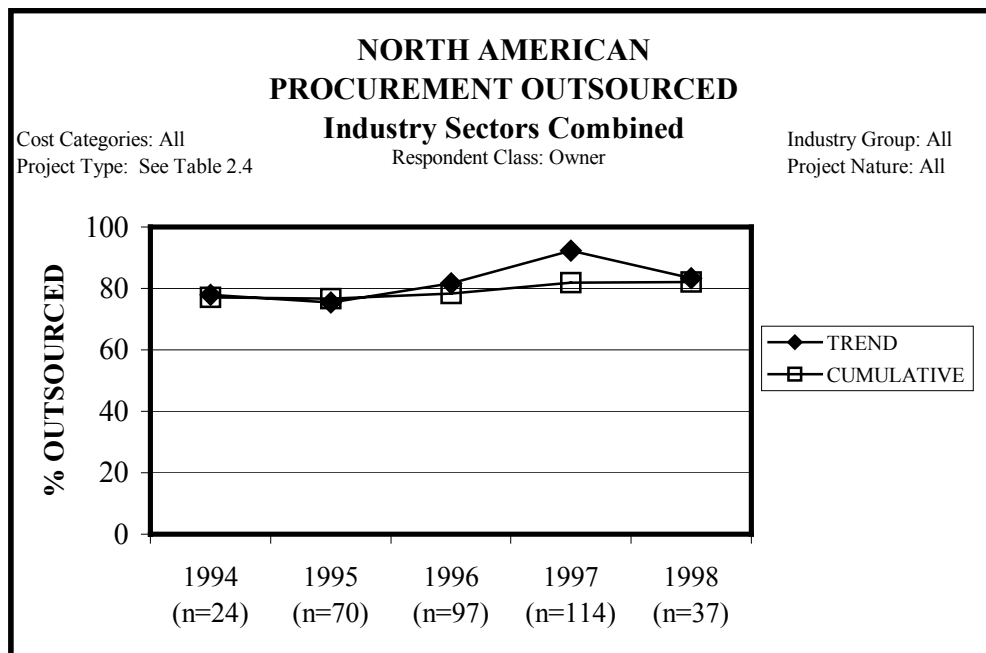


Figure 3.13 Percent of Procurement Outsourced, North American Sample, N=342

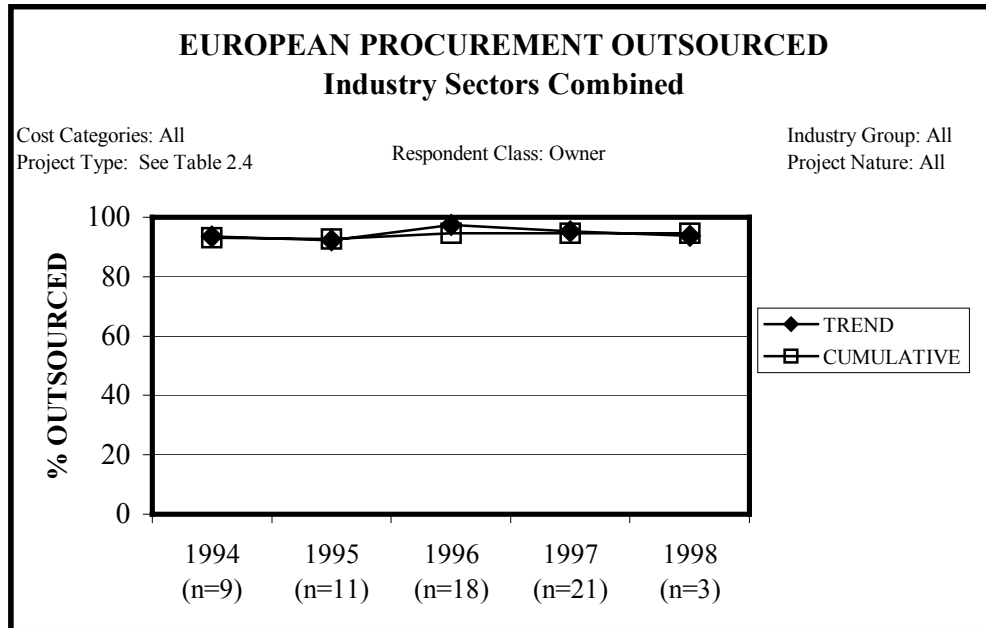


Figure 3.14 Percent of Procurement Outsourced, European Sample, N=62

The final comparisons between samples from the two continents can be seen in Figures 3.15 and 3.16. In these two graphs, it is shown that both of the sub-samples share a similar, consistent cumulative trend covering the five-year period. The North American cumulative overall trend is slightly higher than that in the European sample, but both are about 60 percent. The yearly trends show that, in the North American sample, there was a rise in 1997 to a maximum of 69 percent, before a reduction of 17 percent the following year. The European sample yearly trend remains strikingly similar to the cumulative trend, maintaining a range between 55 and 59 percent.

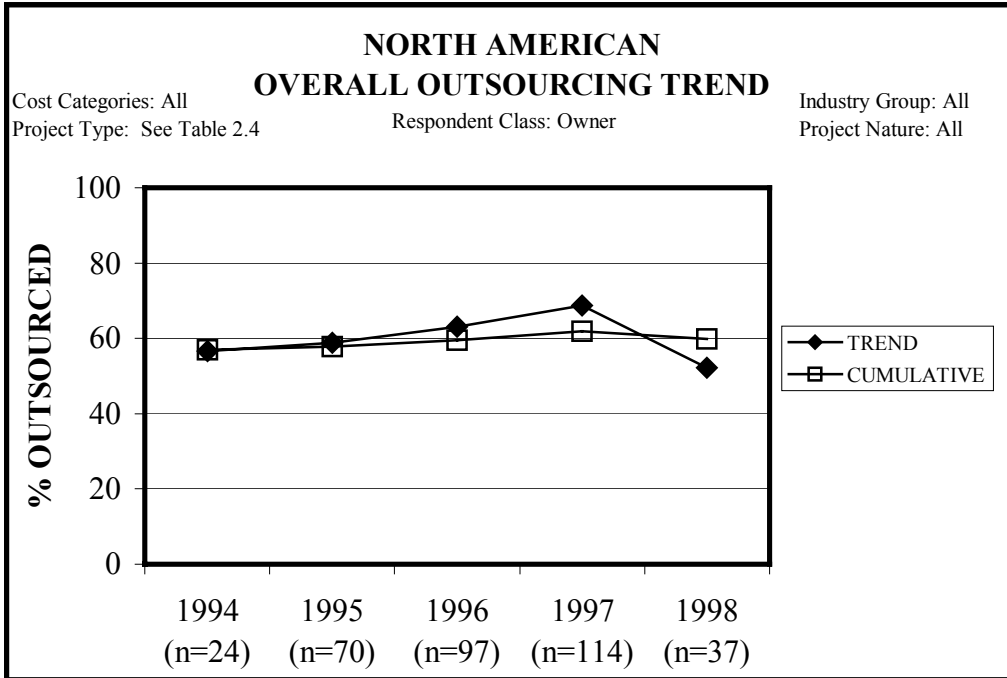


Figure 3.15 Overall Outsourcing Trend, North American Sample, N=342

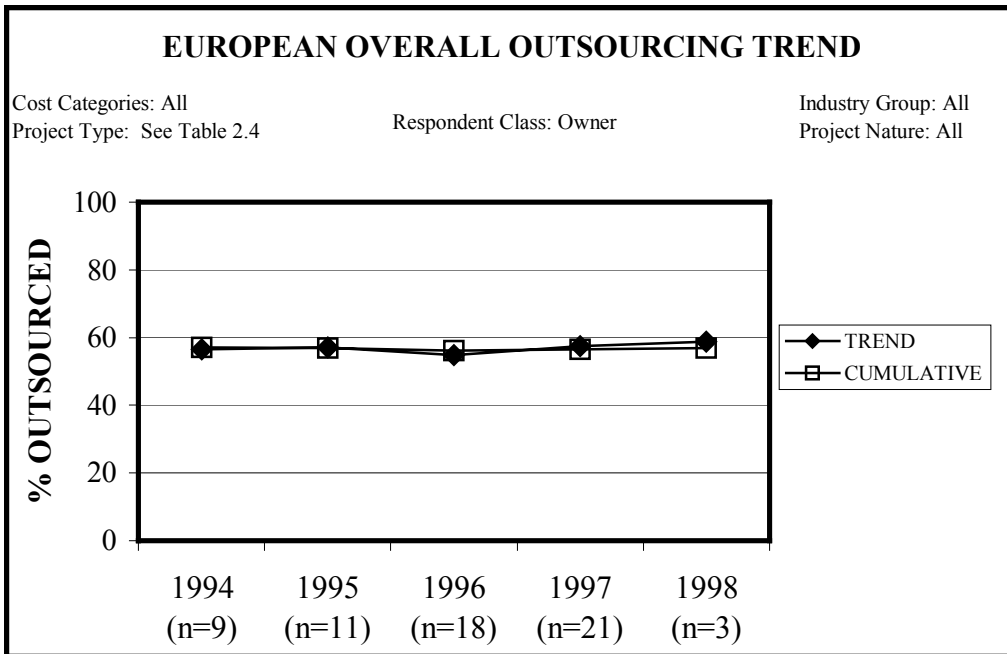


Figure 3.16 Overall Outsourcing Trend, European Sample, N=62

3.4 Conclusions from CII Owner Outsourcing Trends

Both Tables 3.1 and 3.2 serve to summarize the information shown in Sections 3.1 through 3.3. Note that sample size in some cases are small for these data.

Table 3.1 Summary of CII Owner Outsourcing Trends

Function	Combined	H.I.	L.I.	GEN BLDG	INFRA
PPP	Steady Increase from 1994-97, 28% drop in 1998	14% drop in 1995 Constant rise to 1997, 19% drop in 1998	Steep Increase from 1994-95, steady decline from 1995-98	Steady Decline from 1994-96 7% Increase '97 28% drop in 1998	Constant from 1994-95, Rise in 1996-97, 50% Decrease in 1998
Design	Fairly Constant thru 1997; 15% drop in 1998	Steady Decline from 1994-96 21% Increase '97 16% drop 1998	Increase from 1994-95, Steady Decline 1996-98	Steady Decline from 1994-97 8% Rise in 1998	High & Constant level 1995-97, 33% Drop in 1998
Procurement	Steady Increase from 1994-97, 9% drop in 1998	Overall Increase from 1994-97, 5% drop 1998	26% drop 1994-95 Steady Increase from 1995-97, 40% drop 1998	Increase from 94-95, Constant from 95-97 11% rise in 1998	Overall Increase from 1994-98
Overall	Steady Increase thru 1997; 16% drop in 1998	Steady Decline from 1994-96 30% Increase '97 15% drop 1998	Consistent from 1994-97, 30% drop 1998	Constant from 1994-1998	Steady Increase from 1994-97 (47-83%) 27% drop in 1998

From examining the above summary, it can be seen that:

1. The outsourcing of both pre-project planning and procurement of the sample owners generally increased through the first four years before peaking in 1997, followed by a drop in 1998.
2. The outsourcing of design and the overall owner outsourcing have maintained consistency over the years 1994 through 1997, before a drop in 1998.

Table 3.2 summarizes the trends of the project functions in both North America and Europe over the five-year time span.

Table 3.2 Continental Outsourcing Trend Summary

Function	North America	Europe
PPP	Consistent Growth 1994-97, 28% drop in 1998	Growth in 1994-95, Decline to 7% by 97, Up 18% in 1998
Design	Growth in 1994-95, Decline to 7% by 97, Up 18% in 1998	Decline from 1994-96, 22% Steady rise until 1998
Procurement	Steady Rise from 1994-1997, 9% drop in 1998	Constant from 1994-1998
Overall	Slight Increase from 1994-1997, 17% drop in 1998	Constant from 1994-1998

From Table 3.2, it can be seen that for this sample:

1. The main discrepancy in the outsourcing trends between the two samples exists in the outsourcing of design. North American sample projects consistently outsource more design than the European sample.
2. European sample projects outsource a slightly higher percentage of procurement than their North American counterparts.
3. Pre-project planning and overall outsourcing are both similarly outsourced in the North American and European samples.

Chapter 4: Three-Tier Analysis of Outsourcing

This chapter contains the analysis of the 43 sample owner companies in terms of their level of outsourcing, project attributes, and project performance. Analysis of these owners has been performed in order to provide a benchmark for owners in similar sectors or with similar business practices. The 43 owners, which are coded for confidentiality, have been classified into three tiers for comparison purposes, based on their respective overall outsourcing percentage over the five-year period from 1994 to 1998. The top tier includes the owners that have outsourced the most. This tier consists of 14 owner companies and 162 of the 365 sample projects. The middle tier includes owners that outsource some percentage of their work. This is made up of 14 owners and 102 projects. The bottom tier consists of the 15 owners that outsource the least percentage of their work and includes 101 sample projects. Due to a natural break that exists between tiers, they are not exactly symmetrical.

In addition to showing the outsourcing trends in each of the tiers, this analysis also evaluated different aspects of the owners, thus allowing the tiers to be characterized by different project attributes, preferred contract type, and several CII performance metrics.

4.1 Project Phase Comparison

This first three-tier table, given in Table 4.1, characterizes the 43 different sample owners into the three tiers by their overall level of outsourcing. This table includes the outsourcing breakdown between the three project phases, pre-project planning, design,

and procurement, as well as the overall outsourcing, and the industry sector in which the owner performs most of its work.

Table 4.1 Three-Tier Comparison: Owner Outsourcing for Each Project Phase

Tiers	Owner	Number Projects Per Tier	Avg. % PPP Outsourced	Avg. % Design Outsourced	Avg. % Procurement Outsourced	Avg. % Combined Outsourced	Industry Sector
Top		162	32%	93%	88%	71%	
1	O6	32	82	96	92	90	HI
2	O17	3	47	93	97	79	BLDG
3	O24	7	41	94	90	75	HI
4	O30	10	50	99	73	74	HI
5	O22	3	17	100	100	72	HI
6	O25	14	29	94	89	71	LI
7	O41	13	27	100	81	69	HI
8	O10	12	29	80	93	67	LI
9	O19	19	24	78	97	67	BLDG
10	O8	4	25	100	75	67	HI
11	O42	2	0	100	100	67	HI
12	O18	16	28	81	89	66	BLDG
13	O5	17	32	90	76	66	HI
14	O3	10	11	99	84	65	HI
Middle		102	18%	73%	88%	60%	
15	O1	3	0	100	93	64	HI
16	O28	8	33	67	93	64	HI
17	O27	5	20	80	90	63	BLDG
18	O14	2	0	100	90	63	BLDG
19	O29	15	12	96	76	62	HI
20	O36E	2	45	60	80	62	HI
21	O31	16	6	79	100	62	BLDG
22	O26	10	29	69	82	60	BLDG
23	O9	13	14	90	73	59	HI
24	O33E	4	38	58	75	57	HI
25	O13	8	10	64	94	56	LI
26	O12	8	6	63	100	56	HI
27	O35E	4	39	25	98	54	HI
28	O16	4	1	75	88	55	HI
Bottom		101	9%	33%	65%	36%	
29	O38E	6	5	50	98	51	HI
30	O15	6	13	73	56	48	HI
31	O2	17	0	62	74	46	LI
32	O23	13	23	48	68	46	HI
33	O4	4	0	60	75	45	HI
34	O21	13	18	47	60	42	HI
35	O34E	4	25	0	100	42	HI
36	O40	5	3	52	70	42	BLDG
37	O43	6	0	23	98	40	HI
38	O11	4	50	35	16	34	HI
39	O39E	1	0	0	100	33	HI
40	O20	11	0	51	33	28	HI
41	O37E	4	0	0	63	21	HI
42	O32	2	0	0	50	17	HI
43	O7	5	1	0	12	4	HI

The table shows several key calculations for each owner. The column labeled “Average % Combined Outsourced” shows the total percentage of outsourcing for the

projects that were analyzed for that owner for the three evaluated functions. This column is the primary parameter used to assign an owner to a certain tier. The column labeled “Number Projects Per Tier” shows each owner’s total number of projects that were analyzed. Thus, an owner such as O6 which has many projects present in the data sample, is better represented as a true value of the extent to which that owner truly outsources than an owner like O39E, which has only one completed project in the sample. Owner codes that end in ‘E’ are European owners from the ECI sample projects, where specific owners could be identified.

From observation, the following conclusions can be drawn from the analysis of Table 4.1.

1. Pre-project planning is the least outsourced project phases in all three tiers.
2. Design is highly outsourced in the top two tiers, but is outsourced much less in the bottom tier.
3. Procurement is outsourced more than any other phase.
4. European owners’ outsourcing percentages place them in the lower half of the data sample.
5. Most of the companies in the bottom tier are in the Heavy Industrial sector.

4.2 Project Attribute Comparison

The second of the three-tier analysis tables, Table 4.2, compares the sample owner companies with respect to five project attributes, including alliance partnering, owner/contractor relationship, project complexity, project cost, and average number of contractors per project. These attributes were taken directly from the CII surveys, and were averaged for all of the projects that are in the data sample for each owner.

The first of the five project attributes is “Percent Alliance.” This is an average of the number of projects that the owner indicated had an alliance partnership with a contractor performing one or more of the project phases on the project. Where ‘NA’ is

indicated in the table, the owner gave no response to the question, or the owner did not know the answer.

The second attribute is the Owner/Contractor Relationship (OCR) Rating. The OCR rating is an indication of whether the relationship between owner and contractor was successful or not. This rating is on a scale of 1 to 5, with a score of 5 being “very successful,” according to question 10 the CII questionnaire (Jantz 2000). Each owner’s OCR is an average of the OCRs from each of the projects for that owner in the data sample.

Next in the table is “Average Project Complexity.” This value is the average of the project complexity attribute, which indicates how complex a project is in nature. The project complexity is a 1 to 10 score, where 10 is the most complex. CII defines a complex project is one that “uses one or more new methods, technologies, processes, or configurations in its construction.”

“Average Project Cost” is simply the average of the total actual costs for the projects in the data sample for each of the owners.

The fifth of the five project attributes is “Average Number of Contractors.” This number is the average of the number of different contractors that are used on each of the owner’s projects. Included among these contractors are all construction contractors, designers, engineers, and consultants that have been outsourced by the owner.

Table 4.2 Three-Tier Comparison: Owner Outsourcing for Project Attributes

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Percent Alliance	OCR Rating	Average Project Complexity	Average Project Cost	Average Number of Contractors
Top		162	71%	42%	3.9	6.0	66.0	3.9
1	O6	32	90	91	4	6	19,740,588	4.7
2	O17	3	79	NA	NA	NA	76,833,333	2.0
3	O24	7	75	NA	NA	NA	108,704,429	6.0
4	O30	10	74	0	3.7	5	61,318,900	6.0
5	O22	3	72	NA	NA	NA	146,126,667	3.0
6	O25	14	71	100	3.6	5.8	24,224,154	5.0
7	O41	13	69	0	4	6	263,811,308	4.1
8	O10	12	67	20	4.4	7	38,785,833	4.0
9	O19	19	67	13	3.8	6	25,387,475	2.0
10	O8	4	67	100	NA	7	26,163,000	4.0
11	O42	2	67	0	4	6	87,761,700	2.0
12	O18	16	66	56	3.9	7	15,296,994	5.0
13	O5	17	66	0	4	5	14,041,480	4.2
14	O3	10	65	83	4	6	15,959,650	3.0
Middle		102	60%	36%	4.2	5.9	68.2	3.9
15	O1	3	64	33	4	6	100,410,000	2.0
16	O28	8	64	43	4.3	7	35,751,625	6.0
17	O27	5	63	NA	NA	NA	27,918,200	3.0
18	O14	2	63	NA	NA	NA	33,690,500	3.0
19	O29	15	62	80	3.8	7	67,619,867	3.0
20	O36E	2	62	50	NA	6	300,717,976	6.0
21	O31	16	62	43	3.8	7	15,135,862	2.8
22	O26	10	60	0	4.5	7	20,218,000	4.0
23	O9	13	59	100	4.3	4	12,747,873	3.0
24	O33E	4	57	25	NA	6	6,194,162	5.0
25	O13	8	56	0	4	4	48,525,622	5.2
26	O12	8	56	25	4.6	5	65,404,750	2.0
27	O35E	4	54	0	NA	6	200,559,054	3.0
28	O16	4	55	NA	NA	NA	19,738,250	6.0
Bottom		101	36%	40%	4.1	5.6	79.9	3.3
29	O38E	6	51	0	NA	5	168,264,538	3.0
30	O15	6	48	67	4.7	6	54,298,670	3.0
31	O2	17	46	38	4	7	34,267,202	6.0
32	O23	13	46	88	4	6	19,551,843	3.5
33	O4	4	45	0	NA	6	22,549,750	2.0
34	O21	13	42	50	NA	3	40,278,300	3.0
35	O34E	4	42	75	NA	3	48,177,007	3.0
36	O40	5	42	50	4.4	6	11,336,016	3.2
37	O43	6	40	50	3.7	6	31,703,000	4.3
38	O11	4	34	NA	NA	NA	9,933,250	3.0
39	O39E	1	33	0	NA	6	568,167,600	3.0
40	O20	11	28	0	4.2	6	100,530,500	4.0
41	O37E	4	21	0	NA	6	63,482,236	2.0
42	O32	2	17	100	4.0	7	13,163,500	2.0
43	O7	5	4	NA	NA	NA	13,083,000	5.0

Before conclusions could be drawn from this three-tiered table, statistical significance of the variation between the tiers was determined using a one-way analysis of variance (ANOVA).

In comparing the three tiers for the 5 project attributes, the following conclusions can be drawn.

1. Owners from the middle tier are most satisfied with their relationships with various contractors.
2. Owners in the top tier, the ones who outsource the most of their work, tend to see their work as the most complex of all of the owner tiers.
3. Although not statistically significant, the top tier has more of a tendency to have alliance partnering than the lower two tiers.

4.3 Cost/Schedule/Change Performance Comparison

CII calculates several performance metrics in their analysis of the different projects that are submitted to the CII database (CII 1998netD). The five metrics that have been analyzed in this research are project cost growth, project budget factor, project schedule growth, project schedule factor, and project change cost factor (Rodriguez 1998, Graham 1999, Jantz 2000). The CII performance metrics are presented within the three tiers system in Table 4.3.

Project cost growth was determined as the actual project cost minus the initial project estimate divided by the initial project estimate. Therefore, this metric allows one to determine whether the indicated project was on budget (growth=0), over budget (growth > 0), or below budget (growth < 0).

Project budget factor was described as the actual total project cost divided by the added value of the initial project budget and the approved change cost. The approved change cost is measured by the net increases and decreases in the initial project cost, due to approved change orders. This metric is presented as a positive value, where 1.0 is an indication that the project was on budget. A value less than one shows that the project was under budget, while a value above one shows that the project is over budget.

Project schedule growth was determined by dividing the difference of actual total project duration and initial predicted project duration by the initial predicted duration. Actual total duration represents the period from the actual start of the earliest project phases to the actual finish date of the last of the project phases. Initial predicted project duration is calculated the same way, but using the estimated start and finish dates instead of the actual dates. Once again, this factor is a positive value, where a project schedule growth equal to one indicates that the project was completed on schedule, while a value greater than one or less than one shows that the project was behind or ahead of schedule, respectively.

Project schedule factor is determined by dividing actual total project duration by the combined value of initial predicted duration and approved changes, where approved changes represents the additions or subtractions to the project schedule due to approved change orders. A value of one indicates that the project was on schedule, while values less than or greater than one indicate that the project was ahead of or behind schedule, respectively.

The last of the five metrics analyzed in this section was change cost factor. This metric is determined by dividing the approved changes by the actual project cost. Here, a value equal to zero shows that the changes had no effect on the actual final cost. A value above zero indicates that the cost of the project rose because of changes, while a value lower than zero shows a decrease in project cost due to changes.

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Average Cost Growth	Average Budget Factor	Average Schedule Growth	Average Schedule Factor	Average Change Cost Factor
Top		162	71%	-0.04	0.93	0.16	1.16	0.07
1	O6	32	90	-0.12	0.85	0.50	1.46	0.126
2	O17	3	79	-0.01	0.99	-0.04	0.96	UNK
3	O24	7	75	0.04	0.99	0.07	1.03	UNK
4	O30	10	74	-0.05	0.90	0.18	1.16	0.050
5	O22	3	72	-0.14	0.86	-0.11	0.89	UNK
6	O25	14	71	0.00	0.94	0.06	1.00	0.104
7	O41	13	69	-0.06	0.92	0.13	1.07	0.030
8	O10	12	67	-0.03	0.94	0.13	1.09	0.069
9	O19	19	67	0.02	0.93	0.25	1.24	0.111
10	O8	4	67	-0.02	0.98	-0.06	0.94	-0.005
11	O42	2	67	-0.08	0.90	0.00	1.00	0.033
12	O18	16	66	-0.03	0.91	0.24	1.22	0.112
13	O5	17	66	-0.03	0.94	0.87	1.97	0.029
14	O3	10	65	-0.03	NA	0.06	NA	UNK
Middle		102	60%	-0.01	0.95	0.03	1.07	0.08
15	O1	3	64	0.07	0.99	0.03	NA	0.075
16	O28	8	64	0.03	0.99	-0.01	0.98	0.081
17	O27	5	63	-0.05	0.95	-0.23	NA	UNK
18	O14	2	63	-0.02	0.98	-0.54	NA	UNK
19	O29	15	62	-0.01	NA	0.11	NA	UNK
20	O36E	2	62	-0.06	0.92	0.13	1.08	0.065
21	O31	16	62	0.13	0.99	0.81	1.91	0.162
22	O26	10	60	0.02	0.93	0.22	1.29	0.165
23	O9	13	59	0.04	0.99	0.11	1.04	UNK
24	O33E	4	57	-0.04	0.94	0.15	0.78	0.005
25	O13	8	56	0.03	0.99	-0.04	0.93	0.081
26	O12	8	56	-0.09	0.88	-0.11	0.90	0.031
27	O35E	4	54	-0.04	0.92	-0.11	0.87	0.052
28	O16	4	55	-0.13	0.87	-0.08	0.92	UNK
Bottom		101	36%	-0.02	0.95	0.11	1.01	0.05
29	O38E	6	51	-0.03	0.90	-0.02	0.94	0.076
30	O15	6	48	0.01	1.01	-0.30	0.81	0.032
31	O2	17	46	-0.03	0.90	-0.01	0.96	0.079
32	O23	13	46	0.06	1.01	0.73	1.73	0.094
33	O4	4	45	-0.02	0.96	-0.02	0.90	0.051
34	O21	13	42	-0.04	0.93	-0.03	0.73	0.112
35	O34E	4	42	0.14	1.02	0.54	1.19	0.106
36	O40	5	42	-0.01	0.99	0.00	0.99	0.005
37	O43	6	40	0.00	0.98	0.35	1.29	0.022
38	O11	4	34	0.00	1.00	0.13	1.13	UNK
39	O39E	1	33	-0.04	0.95	0.21	1.20	0.006
40	O20	11	28	-0.08	0.86	-0.08	1.09	0.070
41	O37E	4	21	-0.17	0.83	0.08	1.08	0.000
42	O32	2	17	-0.03	0.93	-0.02	0.00	0.055
43	O7	5	4	0.01	1.01	0.12	1.12	UNK

From this analysis, the following conclusions to be made.

1. There is not one tier that shows a much better performance than the others for all the CII metrics.
2. The top tier statistically has the least control over schedule.
3. A closer look at the companies shows a wide variation in performance, particularly in regards to schedule performance.

4.4 Affects of Contract Type Selection

The contract type generally used by the sample owners also can be analyzed using these data. Through studying which contract types specific owners use on their projects, the three tiers have been characterized by which contract types are preferred for four project phases, as construction is shown along with the three phases that have been studied earlier in greater detail. The contract types for all three tiers are shown in Table

4.4. The different contract types that have been used in the projects are as follows:

LS	Lump Sum
UP	Unit Price
CR	Cost Reimbursable
GP	Guaranteed Maximum Price
I	In-House (work performed by the owner company)
V	Various (More than one contract type is used regularly)

By analyzing the separate owner projects, one contract type was chosen for each owner for each phase, simply by taking the contract type used in a majority of that owner's projects as that owner's preferred contract type. Some owners regularly used two different types shown with both types in Table 4.4. If no preferred type could be determined, the 'V,' for various types, was given to that owner. If no contract type was available for an owner, 'NA' was specified in the table. The same procedure was used in order to choose a preferred contract type for the entire tier, and the most used contract type in that tier was chosen for each phase (Jantz 2000).

Table 4.4 Three-Tier Comparison: Contract Type

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Contract Type Used Per Phase			
				PPP	Design	Procurement	Construction
Top		162	71%	I	CR	CR	CR
1	O6	32	90	CR	CR	CR	CR
2	O17	3	79	V	CR	CR	CR
3	O24	7	75	CR	CR	CR	CR/LS
4	O30	10	74	CR	CR	LS	LS
5	O22	3	72	I	CR	CR	CR
6	O25	14	71	CR	CR	CR	CR
7	O41	13	69	I	CR/LS	LS	LS
8	O10	12	67	I	CR	GP	GP
9	O19	19	67	I	LS	LS	LS
10	O8	4	67	I	CR	CR	V
11	O42	2	67	I	CR	CR	CR
12	O18	16	66	I	LS	LS	LS
13	O5	17	66	CR/LS	CR	CR/LS	CR/LS
14	O3	10	65	I	CR	CR	CR
Middle		102	60%	I	CR	LS	LS
15	O1	3	64	I	CR	CR	CR
16	O28	8	64	CR/LS	CR/LS	LS	CR
17	O27	5	63	I	LS	LS	LS
18	O14	2	63	I	CR	CR	CR/LS
19	O29	15	62	I	CR	CR	CR
20	O36E	2	62	NA	NA	NA	NA
21	O31	16	62	I	LS	LS	LS
22	O26	10	60	I	CR	LS	LS
23	O9	13	59	I	CR	CR	CR
24	O33E	4	57	CR	CR	LS	LS
25	O13	8	56	I	LS	LS	LS
26	O12	8	56	I	CR	CR	CR
27	O35E	4	54	I	I	LS	LS
28	O16	4	55	I	CR	LS	LS
Bottom		101	36%	I	CR	LS	LS
29	O38E	6	51	I	LS	LS	LS
30	O15	6	48	I	CR	CR/UP	CR
31	O2	17	46	I	GP	LS	LS
32	O23	13	46	I	CR	CR	CR
33	O4	4	45	I	LS	V	LS
34	O21	13	42	I	CR	CR	LS
35	O34E	4	42	I	I	CR/LS	CR/LS
36	O40	5	42	I	LS	I	GP
37	O43	6	40	I	CR	NA	LS
38	O11	4	34	NA	CR	LS	LS
39	O39E	1	33	I	I	LS	LS
40	O20	11	28	I	LS	LS	LS
41	O37E	4	21	I	I	UP	UP
42	O32	2	17	I	I	LS	UP/LS
43	O7	5	4	I	I	LS	LS

Through analyzing Table 4.4, the following conclusions can be made.

1. All tiers tend to prefer to perform pre-project planning in-house.
2. All tiers prefer to use cost reimbursable contracts in the outsourcing of design.
3. The middle and lower tier prefer to outsource both procurement and construction with lump sum contracts.
4. The top tier prefers to outsource its work with cost reimbursable contracts.

This analysis gives some insight into contract type selection. The reader is cautioned in using this information because, most notably, the inclusion of a large majority of heavy industrial projects, which could skew the results, and that company tradition, rather than level of outsourcing, could dictate which contract types the company may utilize.

4.5 Affects of Project “Turbulence”

Project “turbulence” is a term that is used to describe changes in the project that can disrupt the progress for all parties. Tables 4.5 and 4.6 characterize these various changes in terms of the three-tiers by level of outsourcing.

Table 4.5 shows the 43 sample companies broken down into the three outsourcing tiers, along with project development change data and scope change data. Project development change data is that data that pertains to changes that were “required to execute the original scope or obtain original process data” (Graham 1999). Scope changes include changes to the original scope of the project. These two change categories are broken down into three columns indicating the average number of changes for each owner or that tier, the average cost of the changes for each owner or tier, and the average schedule impact in days. The cumulative change data included in Table 4.6 are simply the total of the two change categories in Table 4.5.

Table 4.5 Three-Tier Comparison: Project Turbulence

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Project Development Change Data			Scope Change Data		
				Average Number	Average Cost	Average Sch. Impact	Average Number	Average Cost	Average Sch. Impact
Top		162	71	97.0	759,945	2.4	72.5	1,024,790	4.8
1	O6	32	90	13.9	188,032	0.2	5.3	412,420	1.0
2	O17	3	79	UNK	UNK	UNK	UNK	UNK	UNK
3	O24	7	75	UNK	UNK	UNK	UNK	UNK	UNK
4	O30	10	74	4.2	596,700	0.0	11.8	1,520,400	10.1
5	O22	3	72	UNK	UNK	UNK	UNK	UNK	UNK
6	O25	14	71	153.3	979,100	2.6	42.0	824,700	3.5
7	O41	13	69	15.9	806,314	0.3	534.1	5,270,531	6.5
8	O10	12	67	62.4	3,196,250	2.6	28.8	-668,125	2.9
9	O19	19	67	15.5	470,149	6.6	7.2	426,895	11.0
10	O8	4	67	10.7	9,363	0.0	28.0	-125,525	0.0
11	O42	2	67	602.0	777,000	0.0	38.5	1,595,376	0.0
12	O18	16	66	41.1	522,554	11.4	21.5	840,667	10.8
13	O5	17	66	51.0	53,992	0.8	8.1	150,562	1.9
14	O3	10	65	UNK	UNK	UNK	UNK	UNK	UNK
Middle		102	60	55.6	1,906,276	7.5	28.5	1,356,526	8.5
15	O1	3	64	146.0	6,067,000	UNK	52.7	1,323,000	UNK
16	O28	8	64	3.2	655,067	7.3	50.4	1,522,848	3.7
17	O27	5	63	UNK	UNK	UNK	UNK	UNK	UNK
18	O14	2	63	UNK	UNK	UNK	UNK	UNK	UNK
19	O29	15	62	UNK	UNK	UNK	UNK	UNK	UNK
20	O36E	2	62	87.0	1,000,000	UNK	19.0	1,600,000	8.0
21	O31	16	62	11.6	662,654	18.8	31.9	568,845	17.6
22	O26	10	60	24.4	1,170,833	5.3	42.6	1,197,667	6.4
23	O9	13	59	UNK	UNK	UNK	UNK	UNK	UNK
24	O33E	4	57	12.3	-7,500	10.0	1.3	36,500	16.3
25	O13	8	56	80.5	1,628,000	4.0	25.0	885,667	7.3
26	O12	8	56	110.8	1,201,100	0.9	6.5	440,875	1.4
27	O35E	4	54	25.0	4,779,333	6.0	27.7	4,633,333	7.0
28	O16	4	55	UNK	UNK	UNK	UNK	UNK	UNK
Bottom		101	36	38.9	583,282	2.0	32.0	-1,177,021	1.6
29	O38E	6	51	36.8	444,820	-0.5	24.2	627,468	4.0
30	O15	6	48	9.3	111,500	0.8	5.8	366,000	0.0
31	O2	17	46	164.6	1,201,604	5.3	145.5	1,449,604	5.3
32	O23	13	46	23.0	968,992	0.0	18.4	417,985	0.0
33	O4	4	45	0.5	217,500	4.0	8.5	312,500	2.0
34	O21	13	42	0.8	525,000	2.2	0.5	121,667	1.3
35	O34E	4	42	1.0	0	0.0	55.0	5,150,000	13.0
36	O40	5	42	0.3	50,000	2.0	47.5	409	1.0
37	O43	6	40	1.6	83,333	3.0	75.8	1,192,000	0.3
38	O11	4	34	UNK	UNK	UNK	UNK	UNK	UNK
39	O39E	1	33	16.0	202,000	1.0	15.0	2,063,000	0.0
40	O20	11	28	37.3	3,495,500	6.0	8.3	-27,584,500	-8.1
41	O37E	4	21	209.0	-85	0.0	5.0	95	0.0
42	O32	2	17	6.0	282,500	2.5	6.0	582,500	2.5
43	O7	5	4	UNK	UNK	UNK	UNK	UNK	UNK

Table 4.6 Three-Tier Comparison: Project Turbulence (continued)

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Cumulative Change Data		
				Average Number	Average Cost	Average Sch. Impact
Top		162	71	276.2	2,355,101	7.5
1	O6	32	90	19.2	600,452	1.3
2	O17	3	79	1101.7	5,828,333	-16.3
3	O24	7	75	438.8	4,878,000	13.2
4	O30	10	74	16.0	2,117,100	10.1
5	O22	3	72	UNK	UNK	UNK
6	O25	14	71	185.3	1,281,071	5.8
7	O41	13	69	550.0	6,076,846	6.8
8	O10	12	67	95.7	2,335,444	10.6
9	O19	19	67	22.6	897,044	18.2
10	O8	4	67	38.7	-74,320	0.0
11	O42	2	67	617.0	1,825,000	0.0
12	O18	16	66	164.9	2,248,177	35.9
13	O5	17	66	64.2	248,070	4.1
14	O3	10	65	UNK	UNK	UNK
Middle		102	60	75.0	2,576,696	10.9
15	O1	3	64	198.7	7,390,000	UNK
16	O28	8	64	53.6	2,177,914	11.0
17	O27	5	63	71.4	2,723,353	11.2
18	O14	2	63	82.5	1,985,000	0.0
19	O29	15	62	UNK	UNK	UNK
20	O36E	2	62	106.0	2,600,000	8.0
21	O31	16	62	42.9	1,307,374	37.8
22	O26	10	60	55.8	2,030,143	10.6
23	O9	13	59	71.0	602,932	6.3
24	O33E	4	57	13.5	29,000	26.3
25	O13	8	56	101.4	3,205,857	7.6
26	O12	8	56	117.3	1,641,975	2.3
27	O35E	4	54	39.5	7,059,500	9.0
28	O16	4	55	21.3	744,000	0.3
Bottom		101	36	68.8	-18,288	3.7
29	O38E	6	51	53.6	893,573	2.8
30	O15	6	48	15.0	477,500	0.8
31	O2	17	46	229.4	3,074,160	10.7
32	O23	13	46	46.0	1,140,432	2.9
33	O4	4	45	9.0	530,000	6.0
34	O21	13	42	44.3	1,433,077	3.8
35	O34E	4	42	55.3	5,150,000	13.0
36	O40	5	42	86.0	22	0.0
37	O43	6	40	93.8	1,933,333	0.3
38	O11	4	34	17.5	255,250	0.5
39	O39E	1	33	31.0	2,265,000	1.0
40	O20	11	28	66.9	-19,006,100	-0.1
41	O37E	4	21	211.5	10	0.0
42	O32	2	17	12.0	865,000	5.0
43	O7	5	4	60.2	714,416	8.5

Through analysis of Tables 4.10 and 4.11, along with ANOVA calculations, the following conclusions can be drawn from the project “turbulence” of the three-tiers.

1. The lower tier is the least affected by project changes.
2. The most outsourced owners have the most number of changes, but are not the most affected by costs and schedule increases due to these changes.
3. The middle tier has higher change costs and more schedule additions than any other tier.

4.6 CII Practice Use Index Comparison

CII, in its analysis of benchmarking and metrics sample projects, uses responses to its survey in order to compile a set of Practice Use Indices that show how well a number of tasks were performed on a specific project. In order to calculate these indices, CII uses a summated weighting scale. Questions pertaining to the various indices are given a value and the sum of these values gives the project its practice use index. Each of the indices is based on a zero to ten scale. If none of the elements involved in the practice use index are performed on the project, then the index is scored as zero. If all of the elements are utilized, then the project is scored as a ten. The index numbers used in this thesis are taken directly from the project practice use indices which have been calculated by CII and assigned to each project (CII 2000).

Three of these practice use indices were deemed important to outsourcing since they pertain directly to the functions studied in this investigation. These three practices were the pre-project planning practice use index, the constructability practice use index, and the change management practice use index. The average practice use indices for the sample owners are shown in Table 4.7 and were obtained directly from CII (Jantz 2000).

Table 4.7 Three-Tier Comparison: CII Practice Use Indices

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	PPP Practice Use Index	Constructability Practice Use Index	Project Change Management Index
Top		162	71	6.92	4.55	7.66
1	O6	32	90	8.16	4.76	8.51
2	O17	3	79	7.00	7.41	NA
3	O24	7	75	7.80	4.77	5.71
4	O30	10	74	6.22	2.18	7.42
5	O22	3	72	5.67	7.72	NA
6	O25	14	71	7.77	5.23	8.35
7	O41	13	69	6.36	2.93	7.13
8	O10	12	67	5.85	2.46	7.07
9	O19	19	67	5.04	2.75	6.42
10	O8	4	67	9.01	5.98	9.08
11	O42	2	67	7.61	6.30	8.22
12	O18	16	66	5.68	2.29	7.42
13	O5	17	66	7.96	4.19	8.44
14	O3	10	65	6.82	4.79	8.10
Middle		102	60	7.10	4.22	7.83
15	O1	3	64	8.45	6.70	9.05
16	O28	8	64	6.84	4.19	6.52
17	O27	5	63	8.46	6.70	NA
18	O14	2	63	6.50	2.78	NA
19	O29	15	62	7.89	7.05	8.72
20	O36E	2	62	8.64	5.58	8.93
21	O31	16	62	3.29	3.69	4.49
22	O26	10	60	4.37	1.40	8.12
23	O9	13	59	7.89	4.78	8.92
24	O33E	4	57	7.28	4.28	7.32
25	O13	8	56	6.33	2.01	7.14
26	O12	8	56	8.00	5.18	9.20
27	O35E	4	54	7.56	3.84	7.68
28	O16	4	55	7.84	0.97	NA
Bottom		101	36	7.31	4.25	7.43
29	O38E	6	51	6.69	3.02	7.39
30	O15	6	48	8.20	3.77	7.47
31	O2	17	46	7.39	4.64	6.78
32	O23	13	46	7.00	5.11	7.91
33	O4	4	45	5.24	2.58	8.22
34	O21	13	42	8.33	2.39	8.02
35	O34E	4	42	7.96	6.10	9.64
36	O40	5	42	6.75	3.26	6.14
37	O43	6	40	7.39	3.29	7.02
38	O11	4	34	8.25	5.07	NA
39	O39E	1	33	8.13	5.19	7.86
40	O20	11	28	5.43	3.46	6.24
41	O37E	4	21	5.61	5.34	8.93
42	O32	2	17	7.39	2.57	5.00
43	O7	5	4	9.90	7.93	NA

Although none of the differences between the tiers were determined to be statistically significant, there are interesting observations that should be recognized. Caution should be taken when referring to these findings, because of the ANOVA results.

1. Companies that outsource the least have the highest pre-project planning practice use index.
2. Owners who outsource the most have the highest constructability practice use index.
3. Owners in the middle tier have the highest project change management index.

4.7 Industry Sector Characterization and Comparison

Table 4.8 shows the breakdown of owners by industry sector. From this table, it is once again clear that the heavy industrial sector dominates the data sample. This sector makes up of 238 of the 365 projects, or sixty-five percent, and 31 of the 43 companies. It averages 59 percent outsourcing of its work. Although the heavy industrial sub-sample has the lowest average outsourcing percentage, it has the greatest range of outsourcing percentage, from 4 percent to 90 percent. The general building sub-sample makes up a smaller percentage of the represented projects, with an average outsourcing of 63 percent. There are 76 general building projects in the sample, performed by 8 owners. The light industrial sub-sample is the smallest portion of the data sample, averaging 60 percent outsourcing. Four light industrial owners have submitted 51 projects to the CII database. None of the owners in the study perform a majority of their work in the infrastructure sector.

Table 4.8: CII Owner Outsourcing Overview

CII Owner	Number Projects Per Owner	Industry Sector	Average Percent Outsourced	Industry Sector Average
O40	5	General Building	42	63
O26	10		60	
O31	16		62	
O14	2		63	
O27	5		63	
O18	16		66	
O19	19		67	
O17	3		79	
O7	5	Heavy Industrial	4	59
O32	2		17	
O37E	4		21	
O20	11		28	
O39E	1		33	
O11	4		34	
O43	6		40	
O34E	4		42	
O21	13		42	
O4	4		45	
O23	13		46	
O15	6		48	
O38E	6		51	
O35E	4		54	
O16	4		55	
O12	8		56	
O33E	4		57	
O9	13		59	
O29	15		62	
O36E	2		62	
O28	8		64	
O1	3		64	
O3	10		65	
O5	17		66	
O8	4		67	
O42	2		67	
O41	13		69	
O22	3		72	
O30	10		74	
O24	7		75	
O6	32		90	
O2	17		Light Industrial	
O13	8	56		
O10	12	67		
O25	14	71		

4.7.1 Heavy Industrial Outsourcing

Due to the fact that heavy industrial projects make up such a large percentage of the data, it was possible to study the heavy industrial sector sub-sample much like the sample as a whole. Tables 4.9 and 4.10 show the various functions of the heavy industrial sector, as well as the CII practice use indices for the sector.

Table 4.9: Heavy Industrial Project Attributes

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	Percent Alliance	OCR Rating	Average Project Complexity	Average Project Cost	Average Number of Contractors
Top		205	68	39	4.0	5.9	80.0	4
1	O6	32	90	91	3.9	5.6	19.7	5
2	O24	7	75	NA	NA	NA	108.7	6
3	O30	10	74	0	3.7	5.0	61.3	6
4	O22	3	72	NA	NA	NA	146.1	3
5	O41	13	45	0	4.0	6.0	263.8	4
6	O42	2	67	0	4.0	5.5	87.8	2
7	O8	4	67	100	NA	7.0	26.2	4
8	O5	17	66	0	4.3	5.3	14.0	4
9	O3	10	65	83	4.0	6.0	16.0	3
10	O1	3	64	33	4.0	6.0	100.4	2
11	O28	8	64	43	4.3	7.0	35.8	6
Middle		62	56	43	4.4	5.6	99.5	4
12	O29	15	62	80	3.8	7.0	67.6	3
13	O36E	2	62	50	NA	5.5	300.7	6
14	O9	13	59	100	4.3	4.0	12.7	3
15	O33E	4	57	25	NA	6.4	6.2	5
16	O12	8	56	25	4.6	5.0	65.4	2
17	O35E	4	54	0	NA	6.3	200.6	3
18	O16	4	55	NA	NA	NA	19.7	6
19	O38E	6	51	0	NA	4.7	168.3	3
20	O15	6	48	67	4.7	6.0	54.3	3
Bottom		67	32	40	4.1	5.5	84.6	3
21	O23	13	46	88	4.3	6.3	19.6	3
22	O4	4	45	0	NA	6.0	22.5	2
23	O21	13	42	50	NA	4.0	40.3	3
24	O34E	4	42	75	NA	2.6	48.2	3
25	O43	6	40	50	3.7	5.8	31.7	4
26	O11	4	34	NA	NA	NA	9.9	3
27	O39E	1	33	0	NA	5.5	568.2	3
28	O20	11	28	0	4.2	6.0	100.5	4
29	O37E	4	21	0	NA	6.4	63.5	2
30	O32	2	17	100	4.0	7.0	13.2	2
31	O7	5	4	NA	NA	NA	13.1	5
Average		8	59	41	4.1	5.7	87.3	4
Range		1-32	4-90%	0-100%	3.7-4.7	3-7	\$9.9-264M	2-6

Table 4.10: Heavy Industrial CII Practice Use Indices

Tiers	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	PPP Practice Use Index	Constructability Practice Use Index	Project Change Management Index
Top		109	70	7.35	4.95	7.82
1	O6	32	90	8.16	4.76	8.51
2	O24	7	75	7.80	4.77	5.71
3	O30	10	74	6.22	2.18	7.42
4	O22	3	72	5.67	7.72	NA
5	O41	13	69	6.36	2.93	7.13
6	O8	4	67	9.01	5.98	9.08
7	O42	2	67	7.61	6.30	8.22
8	O5	17	66	7.96	4.19	8.44
9	O3	10	65	6.82	4.79	8.10
10	O1	3	64	8.45	6.70	9.05
11	O28	8	64	6.84	4.19	6.52
Middle		62	56	7.78	4.27	8.20
12	O29	15	62	7.89	7.05	8.72
13	O36E	2	62	8.64	5.58	8.93
14	O9	13	59	7.89	4.78	8.92
14	O33E	4	57	7.28	4.28	7.32
16	O12	8	56	8.00	5.18	9.20
17	O35E	4	54	7.56	3.84	7.68
18	O16	4	55	7.84	0.97	NA
19	O38E	6	51	6.69	3.02	7.39
20	O15	6	48	8.20	3.77	7.47
Bottom		67	32	7.33	4.46	7.65
21	O23	13	46	7.00	5.11	7.91
22	O4	4	45	5.24	2.58	8.22
23	O21	13	42	8.33	2.39	8.02
24	O34E	4	42	7.96	6.10	9.64
25	O43	6	40	7.39	3.29	7.02
26	O11	4	34	8.25	5.07	NA
27	O39E	1	33	8.13	5.19	7.86
28	O20	11	28	5.43	3.46	6.24
29	O37E	4	21	5.61	5.34	8.93
30	O32	2	17	7.39	2.57	5.00
31	O7	5	4	9.90	7.93	NA
Average		8	59	7.47	4.58	7.88
Range		2-32	4-90	5.24-9.90	0.97-7.93	5.00-9.64

The following conclusions about the heavy industrial sector can be made through the analysis of the previous tables.

1. Many of the observations made of the industry sample as a whole are applicable to the heavy industrial sector.

2. There are also differences between the heavy industrial sector sub-sample and the study of the whole industry sample.
3. Specifically, the heavy industrial sector displays higher CII practice use indices than the entire industry sample in all tiers and in all practices.

4.7.2 General Building and Light Industrial Outsourcing

The eight general building owners and the four light industrial owners that are present in the data sample are profiled in this section. Due to the smaller number of owners in these two sectors, they could not be broken down into three tiers, as in the heavy industrial sector, however, there are still meaningful conclusions that can be drawn from these smaller samples. Tables 4.11 through 4.14 profile these two sectors.

Table 4.11: General Building Project Attributes

No.	Owner	Projects Per Owner	Avg. % Combined Outsourced	Percent Alliance	OCR Rating	Average Project Complexity	Average Project Cost	Average Number of Contractors
1	O17	3	79	NA	NA	NA	76.8	2
2	O19	19	67	13	3.8	6	25.4	2
3	O18	16	66	56	3.9	7	15.3	5
4	O27	5	63	NA	NA	NA	27.9	3
5	O14	2	63	NA	NA	NA	33.7	3
6	O31	16	62	43	3.8	7	15.1	3
7	O26	10	60	0	4.5	7	20.2	4
8	O40	5	42	50	4.4	6	11.3	3
Average		10	63	32	4.1	6.6	28.2	3
Range		2-19	42-79%	0-56%	3.8-4.5	6-7	11.3-76.8M	2-5

Table 4.12: General Building Practice Use Indices

Number	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	PPP Practice Use Index	Constructability Practice Use Index	Project Change Management Index
1	O17	3	79	7.00	7.41	NA
2	O19	19	67	5.04	2.75	6.42
3	O18	16	66	5.68	2.29	7.42
4	O27	5	63	8.46	6.70	NA
5	O14	2	63	6.50	2.78	NA
6	O31	16	62	3.29	3.69	4.49
7	O26	10	60	4.37	1.40	8.12
8	O40	5	42	6.75	3.26	6.14
Average		10	63	5.89	3.78	6.52
Range		2-19	42-79%	3.29-7.00	1.40-7.41	4.49-8.12

Table 4.13: Light Industrial Project Attributes

No.	Owner	Projects Per Owner	Avg. % Combined Outsourced	Percent Alliance	OCR Rating	Average Project Complexity	Average Project Cost	Average Number of Contractors
6	O25	14	71	100	3.6	5.8	24.2	5
8	O10	12	67	20	4.4	7.0	38.8	4
25	O13	8	56	0	4.0	3.9	48.5	5
31	O2	17	46	38	3.7	7.3	34.3	6
Average		13	60	40	3.9	6.0	36.5	5
Range		8-17	46-71%	0-100%	3.6-4.4	3.9-7.3	24.2-48.5M	4-6

Table 4.14: Light Industrial Practice Use Indices

Number	Owner	Number Projects Per Tier	Avg. % Combined Outsourced	PPP Practice Use Index	Constructability Practice Use Index	Project Change Management Index
1	O25	14	71	7.77	5.23	8.35
2	O10	12	67	5.85	2.46	7.07
3	O13	8	56	6.33	2.01	7.14
4	O2	17	46	7.39	4.64	6.78
Average		13	60	6.84	3.58	7.34
Range		8-17	46-71%	5.85-7.77	2.01-5.23	6.78-8.35

From the previous tables, the following conclusions can be drawn.

1. General building owners regard their work as being more complex than in any of the tiers reflecting all industry sectors. Light Industrial owners see their jobs as very complex as well when compared to the entire industry sample, though not to the same extent.
2. General Building owners use fewer contractors than the industry sample tiers, and also have less costly projects. Light Industrial owners use more contractors than any of the industry sample tiers.
3. General building owners show very low averages in all three of the CII practice use indices. Light industrial owners average higher values, however, it seems that the heavy industrial owners skew the combined industry sample.

Tables 4.15 and 4.16 show this comparison between the three industry sectors.

Table 4.15: Industry Sector Comparison: Project Attributes

Industry Sector	Avg. Percent Outsourced	Percent Alliance	OCR Rating	Avg. Project Complexity	Avg. Project Cost	No. of Contractors
HI	52	41	4.1	5.7	87.3	4
BLDG	63	32	4.1	6.6	28.2	3
LI	60	40	3.9	6.0	36.5	5

Table 4.16: Industry Sector Comparison: Project Use Indices

Sector	Avg. % Combined Outsourced	PPP Practice Use Index	Constructability Practice Use Index	Project Change Management Index
HI	52	7.47	4.58	7.88
BLDG	63	5.89	3.78	6.52
LI	60	6.84	3.58	7.34

The following conclusions can be drawn from these comparisons.

1. The general building sector outsources more work than the other two industry sectors, and they use the fewest alliance partnerships. General buildings in the sample have the lowest project cost, and employ the fewest contractors per project. This sector has the lowest values for all of the practice use indices.
2. The light industrial sector uses the most contractors, but has the lowest OCR rating of all the sectors. This sector is in the middle on all other attributes and all three CII practice use indices.
3. The heavy industrial sector outsources the least, while it has the highest OCR relationship rating (along with the building sub-sample). The heavy industrial sector sub-sample has the highest average project cost and the fewest contractors per project. This sector leads the way in all three of the CII practice use indices.

Chapter 5: Conclusions and Recommendations

The study detailed in the previous chapters evaluated the outsourcing practices of 43 sample facility owner companies. The research was performed in order to achieve three separate objectives:

- To study the sample outsourcing trends over the five-year period, and to determine trends.
- To characterize the 43 facility owners in the sample by their level of outsourcing and determine whether or not certain project attributes and performance are related to level of outsourcing.
- To provide a basis for future guidelines for owner organizations on how they can better perform based on their level of outsourcing.

5.1 Conclusions

From the analysis in Chapter 3, the following conclusions can be made concerning trends within the sample:

1. In general, the 43 sample companies' outsourcing of pre-project planning and procurement increased in the years 1994 through 1997, and then decreased the following year. It is difficult to extend these findings to the entire industry, however, these findings are consistent with other anecdotal information showing that the level of outsourcing may be stable or declining slightly.
2. Outsourcing of the design function, along with the overall outsourcing of the companies remained constant for the first four years before a drop in 1998. Trend changes over this five year period may be indicative of the shift in project size and types submitted by participating companies to the sample.
3. North American companies in this sample continually outsource much more of their design than European counterparts, while European organizations outsource a slightly higher percentage of procurement. Both sub-samples displayed similar outsourcing practices for both pre-project planning and the overall outsourcing percentage.

The following conclusions can be made from the three-tiered owner characterizations as discussed in Chapter 4, for this sample.

Among all owners in the sample:

1. Pre-project planning is the least outsourced project phase.
2. Procurement is outsourced more than any other phase studied.

Owners in the sample that are outsourcing the most:

1. Tend to view their work as more complex than other owners.
2. Have the least control, on average, over their schedules (schedule performance is less predictable).
3. Prefer to use cost reimbursable contracts for outsourcing of all phases.
4. Have more changes, but seem to have more control over the costs and schedule additions incurred from these changes.
5. Have the best constructability practices (although not statistically significant).
6. Have a tendency to work more with contractors in alliance partnerships (although not statistically significant).

Owners in the middle tier of outsourcing these project functions:

1. Tend to have the highest change costs and schedule additions.
2. Seem to have the best relationships with their contractors.

Owners with the least outsourcing of these project functions:

1. Tend to use lump sum contracts for both procurement and construction. These owners prefer cost reimbursable contracts for procurement and tend to perform their pre-project planning in-house.
2. Are the least affected by project changes.
3. Have the best pre-project planning practices, although not statistically significant.
4. Show the worst change management practices, although not statistically significant.

In terms of the industry sectors:

1. The general building sector outsources more work than the other two sectors, heavy industrial and light industrial.
2. The heavy industrial sector outsources the least amount of work, and has the highest averages across all three CII Practice Use Indices.

5.2 Recommendations

From the conclusions listed above, several insights and recommendations can be given to owner companies.

1. Projects can be performed successfully using any outsourcing strategy.
2. Owner organizations must match their outsourcing approach with the correct project management practices, human resource capabilities, and project mix.
3. Owner organizations should take a strategy of outsourcing functions either towards a high or low level, and should build their competencies towards the needs of that level of outsourcing. The middle tier of outsourcing in this sample had the highest change costs and schedule additions, which further confirms the hypothesis set forth in a previous study that the outsourcing to a middle level tier will hurt project performance (Hui et al. 2000).
4. The level of outsourcing had certain performance implications as shown in the three-tier analysis and discussed earlier.
5. Although based on a limited sub-sample size, the light industrial and general building sectors have more opportunities for improvement in terms of practice use, such as pre-project planning, constructability, and project change management.
6. All owners need to further develop their pre-project planning practices, as owners across all sectors and outsourcing levels tend to perform these practices in-house.

Through development of a consistent business strategy in terms of human resource practices, contracting approach, and practice use, capital facilities owners will experience better project performance.

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