CCIS

Owner/Contractor Organizational Changes Phase I Report

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Center For Construction Industry Studies

Report No. 1

The University of Texas at Austin

OWNER/CONTRACTOR ORGANIZATIONAL CHANGES

PHASE I REPORT

by

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A Report to

The Sloan Program for the Construction Industry

The University of Texas at Austin

Under the Guidance of the

Owner/Contractor Organizational Changes Thrust Team

Austin, Texas

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Executive Summary

This document represents a progress report for the Owner/Contractor Organizational Changes Study research team of the Sloan Program for the Construction Industry. The primary purpose of this 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 the pilot stage of this program of study, we accomplished six tasks towards this purpose. First, the University of Texas at Austin study team was assembled. Second, we developed a list of initial objectives including the identification of specific questions and methods for further research. Third, we conducted a thorough review of the pertinent literature in the fields of engineering and management specifically related to owner/contractor relationships in the construction industry. Fourth, one site visit and 11 interviews with personnel from seven companies were conducted. The interviewees were owner and contractor managers having responsibilities related to capital facility projects. Fifth, our team analyzed 163 projects for outsourcing trends in the Construction Industry Institute Benchmarking and Metrics Database. Finally, we conducted a workshop involving 20 owner and contractor executives focusing on owner/contractor work relationships.

This document outlines the findings from these initial tasks and research questions for future work. The findings address the research that has been performed, availability and accessibility of quantitative data and interview participants, the level of owner outsourcing, and changing owner/contractor skill requirements. These findings provide a sound basis for future work that will investigate the essential nature of capital facility projects and the owner/contractor relationship. Additional future work will examine specific attributes of the owner/contractor relationship as well as critical success factors.

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Background and Literature Review

1.1 Background

The Sloan Program for the Construction Industry is a multidisciplinary research program created by a grant from the Alfred P. Sloan Foundation. Researchers from the Construction Industry Institute (CII), The University of Texas at Austin College of Engineering, and The University of Texas at Austin Graduate School of Business staff the Sloan Program. The purpose of the research we are conducting is threefold:

1. To understand the structure of the construction industry and how construction work gets accomplished particularly for capital facility projects;
2. To understand the changing nature of owner/contractor relationships for capital facility projects;
3. To understand how the structure of the industry, the organization of construction work, and the nature of owner/contractor relationships affect the tangible outcomes of capital facility projects and the human resource requirements and practices of both owner and contractor firms.

During the pilot stage of this program of study, our team accomplished the following:

- Assembled the study team;
- Developed initial objectives;
- Completed a thorough literature review;
- Conducted one corporate site visit and 11 interviews with seven companies;
- Evaluated the CII Benchmarking & Metrics Database;
- Conducted a workshop at the November CII Board of Advisors Meeting.

1.1.1 Initial Objectives

In March 1997, our study team created the following initial objectives:

1. Understand the organizational structure of large capital construction projects throughout all phases;
2. Understand how the organizational structure of large capital construction projects differs across types of business;
3. Understand how the organizational structure of large capital construction projects has been (or is) changing over the past five years;
4. Understand key challenges in the delivery of these projects with particular emphasis on owner-contractor issues;
5. Determine the availability of organizational records to study the key challenges.
6. Identify specific questions and methods for further research.

1.1.2 The Study Team

The UT study team consists of the following individuals:

Table 1.1 UT Study Team

G. Edward Gibson, Jr.	Civil Engineering Dept., Associate Professor
Alison Davis-Blake	Management Dept., Associate Professor
Joe Broschak	Management Dept., Ph.D Student
Fernando Rodriguez	Civil Engineering Dept., M.S. Student

1.2 Literature Review

An extensive review was conducted of the management and engineering academic literature on the use of contractors (see Appendix 1). Generally, there is very little literature on the effects of using contractors, much less for capital projects. Much of what we know about the use of contractors comes from the management literature. For instance, Belous (1989) identified some of the different forms that subcontracting can take: whole activities let to another firm, staff augmentation through the hiring of contractors, leasing an entire staff to operate a facility, and the use of consultants. The

different forms of contracting out can have different implications for the organization and its employees.

Some research has sought to understand why firms use contractors. Abraham and Taylor (1993) found that contracting out appears to be motivated by a desire to reduce overall labor costs. Firms that pay high wages are likely to contract out low wage work, while firms that are predominantly low wage employers are likely to contract out for high-wage services. Several researchers have commented that contracting out increases a firm's flexibility. Externalization (contracting out) and internalization are complementary arrangements that allow firms to expand and contract their workforce without great disruption (Davis-Blake and Uzzi, 1992; Pfeffer and Baron, 1988). Firms also turn to contracting out to circumvent bureaucratized employment practices when additional workers are needed (Davis-Blake and Uzzi, 1992) and because, for some transactions, the cost of contracting out is lower than the cost of having workers on the firm's permanent staff (Eccles, 1981; Williamson, 1975).

A relatively large amount of research has focused on the effects of having contractors in the same jobs as "permanent" workers. Davis-Blake, George, and Broschak (1994) found that "permanent" workers with contract co-workers had a lower intention to stay with their employing organization. The presence of contractors in the same jobs as "permanent" workers also threatens the job security of "permanent" workers (George, 1996) and reduces the level of trust workers have in their organization (Pearce, 1993). The use of contractors affects how work is distributed. One aerospace firm that brought in contract workers to work alongside their "permanent" workers reported shifting interdependent tasks to "permanent" workers because they have greater continuity of employment (Pearce, 1993). Contract workers received the simpler, less interdependent tasks.

The presence of contractors in the same jobs as "permanent" workers can have other negative consequences for individuals and organizations. Having contractors in the workplace can lead to increased monitoring responsibilities for supervisors (Pearce, 1993), increased workplace tension, conflict, and decreased communication among workers (Kochan, Smith, Wells, and Rebitzer, 1994; Smith, 1994), and increased accident and training costs (Rebitzer, 1995; Wells, Kochan, & Smith, 1991).

Industry-based studies on the use of contractors have been limited to three industries. In the home-building industry, contractors develop "quasi-firms" with their subcontractors, creating regularized relations with a small group of firms (Eccles, 1981). In essence, building contractors use a small number of subcontractors from job site to job site because there are benefits to developing long-term working relationships. In the New York garment industry (Uzzi, 1996, 1997), dress manufacturers prefer to use contractors with whom they have more of a social relationship as opposed to strictly an economic exchange relationship. Relationships between owner and contractor can become embedded in the social relationship (Granovetter, 1985). Contractors who develop embedded (also known as alliance) relationships with owners are more likely to survive than those that do not (Uzzi, 1996). Finally, Stinchcombe and Heimer (1985) studied the Norwegian offshore oil industry and concluded that the use of contracting out on large-scale projects is necessary for the performance of work. Organization for project management is fundamentally different than traditional organizations based on functional specialties or customers served.

Surprisingly, the engineering academic literature has few references to the use of contract engineers, perhaps because the use of contractors in the construction industry has a long history and has become a widely accepted method of project organization. The little relevant research in the engineering field has focused on identifying and describing project management structures (e.g., separate design and construction, design-build, design-build-finance), types of contractual arrangements, and project organizational structures.

CII has published one study that addresses owner/contractor work structures (Sullivan, Yupari, and Anderson, 1996). The goal of this study was to develop a process framework to aid owners and contractors in forming work structures; determine whether the responsibility for performing certain functions should lie with the owner, contractor, or be shared between the two. This research is based on the premise that organizational change in the form of downsizing has led to changes in how facility construction projects are developed and executed.

Sullivan et. al, (1996) develop a work process for determining the proper owner/contractor work structure for a given set of firm and project characteristics. Five

specific owner/contractor work structures are identified and a procedure for the owner and contractor jointly determining the best structure for each phase of capital projects is proposed. This study proposes an important vehicle for owner and contractor jointly determining an appropriate project work structure. However, rather than relying on objective characteristics of projects, this procedure relies extensively on the perceptions of organizational decision makers for identifying the competencies of firms, determining whether the competencies are best performed in-house or by contractors, and evaluating whether the work structure chosen was effective.

1.3 This Report

The remainder of this report is sub-divided into four chapters that address the collection and preliminary analysis of field data. Chapter 2 summarizes the corporate site visit and interview efforts of the team to date. Chapter 3 explains the analysis accomplished regarding the CII Benchmarking and Metrics Database. Chapter 4 discusses the results of the workshop conducted at the CII Board of Advisors meeting in Tucson, Arizona. The fifth and final chapter summarizes our findings and future plans.

Chapter 2

Site Visit and Interviews

2.1 Preliminary Interviews

Seven telephone interviews and four in-person interviews during a site visit were conducted with owner and contractor managers. These interviews were intended to serve two primary purposes. First, we hoped to understand some of the issues and problems concerning owner/contractor relationships for capital facility projects from the owner's perspective. The study team had adopted a working assumption that the use of contract engineers was likely to have a strong effect on owner companies. Following that assumption, an interview protocol was written from the perspective of owner firms and ten of the eleven interviews were conducted with managers or executives from owner firms. The second purpose of the interviews was to understand how owner/contractor organization varies across capital facility projects.

The small number of interviews does not allow for statistical analyses. The interview responses were used inductively to identify consistent themes across owner firms and interesting insights by managers. The interview respondents were employed by seven different organizations in six different industries: Chemical, Computer Hardware Manufacturing, Energy Production, Education/Research, Steel, and Construction. All the individuals interviewed, with the exception of one, held positions above the project management level. Thus, the responses reported herein generally represent the perspective of individuals at relatively high job levels. This level of analysis issue has important ramifications for our study. Generally, the respondents interpreted the term "contract engineer" as an individual who works for a prime contractor. However, the one project manager interviewed distinguished between three different types of contract engineers: engineers who worked for the prime contractor, specialty contract engineers who generally work off site and specialize in a piece of hardware or equipment, and "routine" engineers who augment the Owner's staff, performing the same tasks as the Owner's workers. Interviews that are targeted closer to the level at which work is

accomplished should be expected to yield a substantively different perspective on using contract engineers than a study targeting top management.

We find that the owner firms use a variety of project approaches to organize capital projects. EPC contracting, turnkey contracting, owner contracting separately for design and construction, and hiring a construction manager were all represented as project approaches used by the owner firms. The respondents indicated that the type of contract between the owner and contractor had important implications for the success of capital projects. For instance, lump sum contracting, incentive fee contracts, and cost plus contracts are all forms of contractual agreement between the owner and contractor. The use of these contractual agreements is largely independent of the project approaches and the choice of project approach and contractual agreement jointly can effect the success of the project. Some of the ramifications of contract type will be discussed in the sections below.

We find that owner firms we interviewed typically align themselves with a small number of contractors. This alignment can be a formal arrangement, such as alliance partnerships with a limited number of contractors. However, a number of firms reported informal arrangements with their engineering contractors, typically emerging from long-term working relationships between owners and contractors. These informal arrangements result in a short list of qualified or preferred contractors from which the owner firm chooses. While the majority of firms rely on a short list of contractors, one owner firm in the computer hardware manufacturing industry reported the opposite trend in the number of contractors used. This firm has evolved from a fast track, sole-source design approach to competitive bidding, where design and build responsibilities are separated, increasing the number of contractors used by the company from one to as many as 14.

2.2 Phases of the Project

Respondents were asked to approximate the percentage of work performed by their organization and the percentage of work outsourced for six phases of capital projects: Feasibility Analysis, Pre-Project Planning, Detailed Design, Construction, Start-

up, and Operation. We find considerable similarity across firms, with the exception of the computer hardware manufacturer. Owner firms generally perform the majority of Feasibility Analysis (60-100%) and a large share of Pre-Project Planning (30-80%). They generally do little Detailed Design (1-10%) and Construction (1-10%). However, owner firms perform a majority, if not all, of the facility Start-Up (70-100%) and Operations (100%).

The exception is the computer hardware manufacturer. This firm performs only a fraction of the Feasibility Analysis (10%) but the majority of Pre-Project Planning (80%). The firm also differs from the other owner firms in our sample in that it performs a higher proportion of the Detailed Design (30-50%) than other owner firms do. The percentage of facility Start-Up (100%) and Operations (100%) performed by the owner was in line with other owner firms.

So what project factors affect the extent to which outsourcing occurs? Projects with process knowledge requirements lead to more owner involvement in Pre-project Planning. In addition, off-the-shelf technology allows the outsourcing of design work.

2.3 Outsourcing of Detailed Design

Because owner firms outsource a great deal of the detailed design work for capital projects, we asked owner firm representatives to explain what factors influenced their decision to outsource. The responses fell into three categories. First, downsizing of owner firms influenced the decision to outsource. Indeed downsizing may be done purposefully to encourage outsourcing. With a smaller owner staff, there is no staff to do detailed design work. Downsizing has a separate effect on the capabilities in the industry. When downsizing is widespread among owner firms in an industry, much of the engineering expertise leaves the industry, causing owner firms to rely even more heavily on specialty engineering firms to provide engineering expertise.

A second factor underscoring the outsourcing of detailed design is cost. Owner firms stated that performing detailed design work in-house was not cost effective. In particular, diversity in the types of capital projects performed by owners requires a number of specialized skills. Maintaining these skills within owner organizations is

costly, making outsourcing a financially attractive alternative. Finally, owner firms outsourced the detailed design function because it was not a part of their core competency.

2.4 Determinants of Extent of Outsourcing

A number of factors influenced the extent to which owner firms used contract engineers. The use of contract engineers is technology driven. Owner firm engineers tended to be more involved in capital projects when new technology was involved. Owner firms tend to do more work in-house when high-risk, proprietary technology is involved in order to keep firm-specific technology within the boundaries of the firm. Capital projects that involve process knowledge also tend to lead to a higher percentage of work done by the owner firm to protect proprietary technology.

Resource constraints are a second factor influencing the use of contract engineers. Headcount restrictions may prevent owner firms from hiring staff to accommodate increased workloads. One solution used by owner firms is to hire generalist contract engineers to handle the day-to-day work. A lack of specialized skills in-house also drives the use of contract engineers. It is more cost effective to hire specialized skills as needed rather than to keep a large number of engineers on staff. Owner firms stated that even at individual plants, contract engineers are hired for maintenance projects in lieu of keeping engineers on staff. However, this practice varies by plant site.

Finally, respondents stated that owner firms tended to contract out more engineering work as the complexity of projects increased and when projects were being built in geographical locations where the owner firm was not already located.

2.5 Methods of Coordination

Given that some of the engineering work for capital projects is performed by owner firms and some by engineering contractors, an important consideration is how owner firms coordinate the work done by their contractors. One method of coordinating work is to have owner engineers on location where contractors perform work. For instance, many owner firms assign engineers or inspectors to a construction site to coordinate activities. As another example, one of our owner firms has entered into

alliance partnerships with several contractors. To coordinate work, the owner firm assigns project team leaders to a contractor's office for three to four days per week to give guidance on any of a number of projects being performed.

Many owner firms rely on purchase orders and development of project scope definitions as coordinating tools. Several firms reported that the best way to coordinate work is to have the owner and contractor jointly define the project scope and then specify the terms of work in purchase orders or contracts, including time and cost schedules. Others use informal means of coordinating work between the owner and contractor. Project managers are assigned the responsibility for deciding how often to talk or meet with contract engineers. Still others use more formal means of coordination: detailed monthly reports, regularly scheduled meetings and periodic project reviews. Finally, several firms stated that coordination of work between the owner and contractor was accomplished through careful selection of contractor and contractor personnel, relying on a select list of contractors and having contractors keep a dedicated staff of personnel assigned to the owner firm's projects helped in this regard. Firms may use more than one of these methods at a time. For example, there may be a clear project definition coupled with informal coordination of work between the owner and contractor.

2.6 Methods of Monitoring

One of the issues surrounding the contracting out of planning and design work is the inability of owner firms to monitor the progress and quality of work. Our interview respondents had some difficulty distinguishing between coordinating and monitoring work. One owner firm did state that much of its involvement in the detailed design of projects is largely validating and checking the contractor's drawing. This suggests that monitoring of contractor's work occurs at the conclusion of pieces of work (i.e. drawings). Other owner firms rely on monthly reports (including cost and schedule), on-site engineers or inspectors, or end-of-project reports to monitor and evaluate the contractor's work. Some decisions about monitoring work are left to the discretion of the project manager. Managers described to us using a holistic approach or a subjective critique to monitor work. Finally, some owner firms rely on more formalized means of

monitoring contractors work, such as annual quality and financial audits or requiring contractors to self-audit and report to the owner. Monitoring of work performed can also be accomplished through the structure of the contract. Incentive fee contracts or fee risk contracts provide incentives for contractors to adhere to the quality or schedule guidelines specified by the owner.

2.7 Problems with Owner/Contractor Relationships

We questioned owner firms about the problems they experienced in managing owner/contractor relationships. The most overwhelming problem experienced by owners was communication across firm boundaries. Because work was being performed outside the boundaries of the firm, difficulties were experienced in communicating in enough detail technical specifications, work methods, and expectations. A related problem experienced by owner firms was a lack of joint scope definition on the part of owner and contractor firms.

A second problem has to do with the lack of flexibility on the part of contractor firms. Contractors typically perform work to the letter of the contract or purchase order. At times this was in conflict with the expected quality of work, largely because many of the details that are an assumed part of high quality work are difficult to express in advance. Owners also noted that contractors find the inevitable changes in scope or design difficult to adjust to, and they adjust more slowly than owner firms would.

A third problem noted by owner firms is the inability of contractors to develop a picture of the owner's business from the owner's perspective. While this problem is understandable, it can result in competitive behavior between owner and contractor personnel, which can be detrimental to the project. Owners reported that problems could also occur keeping objectives aligned as new contractor personnel enter a project. Finally, our interview with a contractor manager revealed that the problems in owner/contractor relationships are not all one-sided. In particular, owner personnel who historically performed the work that is now being contracted out, tend to have some difficulty letting go of the work, trying too much to interfere with how the contractor is performing the work. Problems also arise when owner firms adopt a cost-driven mentality. While one of the factors leading to contracting out is cost, engineering is not a

commodity with uniform attributes. The final quality of engineering work depends on many specific decisions made over the course of the project. Incentive fee contracts initiated by owner firms often lead to disagreements and lack of innovation by contractors who must concern themselves with earning the incentive fees to make a profit.

2.8 How the Use of Contractors Has Changed Over Time

All of the respondents noted that over the past five years the use of contractors has either reached its peak and remains there, or is steadily increasing. Downsizing by owner firms has led to increased reliance on contractors, as did increases in the workload of owner firms - without a commensurate increase in staffing levels. Interestingly, two owner firms stated that they were taking certain responsibilities back from the contractor. In one case, the owner was now doing more feasibility analyses. In another case, the owner assumed general contracting responsibilities instead of using a prime contractor. Perhaps the most notable trends are the movement toward allowing contractors to perform the procurement function and the use of contract engineers by individual plants.

2.9 Speculation about the Future

We asked our respondents to speculate about future issues that would arise pertaining to owner/contractor relationships. One of the most commonly cited issues has to do with the skill sets of engineers. Engineers in these owner firms do not perform the classic engineering work of years past. Rather, their focus is much more on managing the work of contractors and managing contracts with contractors. These new tasks require an entirely new skill set for engineers, including communication, leadership, and team-related skills. Developing these skills in current and future engineers should be a priority.

A second and related issue has to do with the renewal (also called “regeneration” or “evergreening”) of engineers in owner firms. The owner firm engineers who are managing contracts and working with contractors have a large amount of experience doing many of the things they are asking contractors to do. However, as these engineers

retire, the next generation of owner engineers will not have the same wealth of experience. Career paths for engineers in owner firms have been drastically changed. Engineers no longer perform strictly engineering functions and obtain the experience that is valuable in leading others. So the question is, where do owner firms get skilled resources? This question becomes increasingly difficult to answer with the dissolution of many of the career paths for engineers in owner firms. Because the tasks of engineers and career opportunities have been drastically altered, owner firms must respond by changing compensation schemes and career-planning programs. However, these accommodations lag the changes that are occurring in the organization of work. This problem is exacerbated for international projects because there is no incentive for engineers to relocate.

A third issue in owner/contractor relationships has to do with managing across organizational boundaries. Owners now have higher expectations of contractors. Owners are striving to develop a seamless relationship with contractors, requiring them to be more innovative, use best practices, become more a part of the owner orginization, align their goals with those of the owners, and develop more flexibility. In effect, owners are striving for many of the benefits of internalizing engineering work without having to pay for the overhead. These expectations of contractors are at direct odds with the actions of owners squeezing contractors financially, as evidenced by one owner stating that an advantage of using contractors is that it is easier to hold them accountable for parts of the work. Owners and contractors do not always reach agreements, particularly on issues of technology versus cost. There are also issues to resolve over who is in charge and who should listen to whom. Part of the problem seems to be a level of analysis issue. Inter-organizational agreements and alliance partnerships are often negotiated at the top management level in hopes of achieving a high level of cooperation between firms. However, at the level where work is being performed, adversarial relationships exist, likely in part because of the criteria on which owner personnel are rewarded. Alignment must be achieved between the expectations owners have of contractors and the details and form of the contract between them.

Several owners stated that one future issue to deal with is the tendency of owner personnel to get lax toward their contractors. Outsourcing engineering work does not

mean ceasing to strive to improve designs and innovation. Rather, it is likely that owner firms must be even more diligent about insuring that both the owner and the contractor do not simply settle for the minimum terms of the contract. Owners, as well as contractors, must be motivated to constantly seek to improve the project approach.

Finally, some owners expressed concerned about the protection of proprietary technology. Heavy reliance on contractors makes the protection of proprietary technology a difficult task. This becomes a particularly pressing problem with consolidation among contractors. If two owner firms who are competitors both use the same contractor, how can one insure that there will be no technological spillover? How do owner firms preserve their technological edge as a source of competitive advantage?

Chapter 3

Benchmarking & Metrics Database Analysis

3.1 Purpose

This chapter discusses the trend analysis accomplished using the CII Benchmarking and Metrics Database. The objective of this analysis was to quantitatively determine from the CII database the trends in owner outsourcing for three project-specific functions: pre-project planning, design, and procurement. The analysis included completed-project data from 1994 to 1997 (Construction Industry Institute, 1997).

3.2 The Data Sample

The sample for this analysis consisted of 163 projects representing approximately $7.3 billion of capital facility expenditures. Project data were gathered using two questionnaires, designated as Version 1.0 and Version 2.0, completed by CII owner companies. The following table demonstrates the distribution of projects by industry sector and year:

Table 3.1 Data Sample Breakdown

INDUSTRY SECTOR	1994	1995	1996	1997	TOTAL	$BILLIONS
Heavy Industrial (HI)	14	37	37	7	95	4.69
Light Industrial (LI)	1	6	10	8	25	1.12
General Building (GEN BLDG)	3	9	13	6	31	1.28
Infrastructure (INFRA)	2	3	6	1	12	0.21
COMBINED	20	55	66	22	**163**	**7.3**

As the table indicates, heavy industrial projects comprise approximately 60% of the data sample. These 163 projects represent a total of 31 owner companies with most having projects in at least two of the four industry sectors.

3.3 Analysis Methodology

The trend analysis consisted of compiling and sorting completed project data from both Version 1.0 and Version 2.0 of 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 3.2 Completed Project Data

COMPLETED PROJECT DATA: OWNERS (VERSION 1.0 and 2.0)
CII member company name
Principal type of project by industrial sector
Project participant company names
Function performed by participant
Percent of function performed by participant
Total project actual cost
Pre-project planning phase actual cost
Design phase actual cost
Procurement phase actual cost
Construction actual finish date

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 (1994-1997)
- Percent of Design Outsourced Trend (1994-1997)
- Percent of Procurement Outsourced Trend (1994-1997)
- Percent of PPP, Design, and Procurement Outsourced Trend (1994-1997)

The first three graphs are shown below in Figures 3.1, 3.2, and 3.3 respectively.

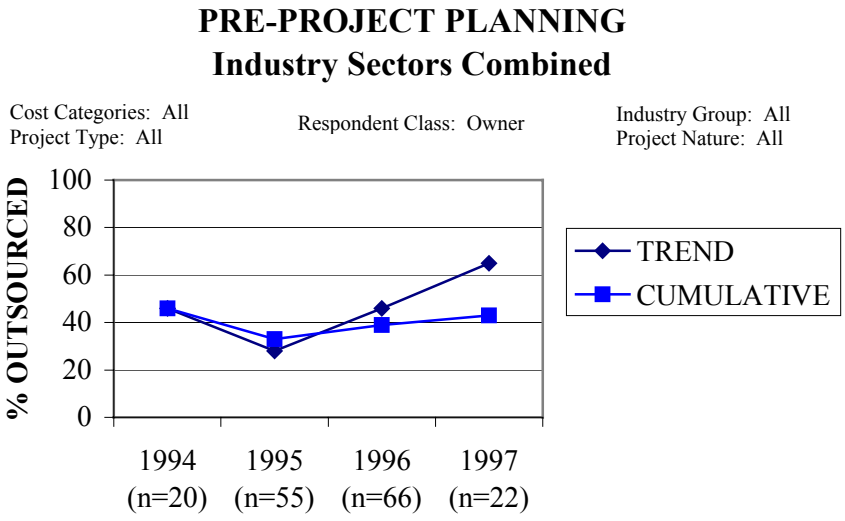

Figure 3.1 Percent of PPP Outsourced: Industry Sectors Combined

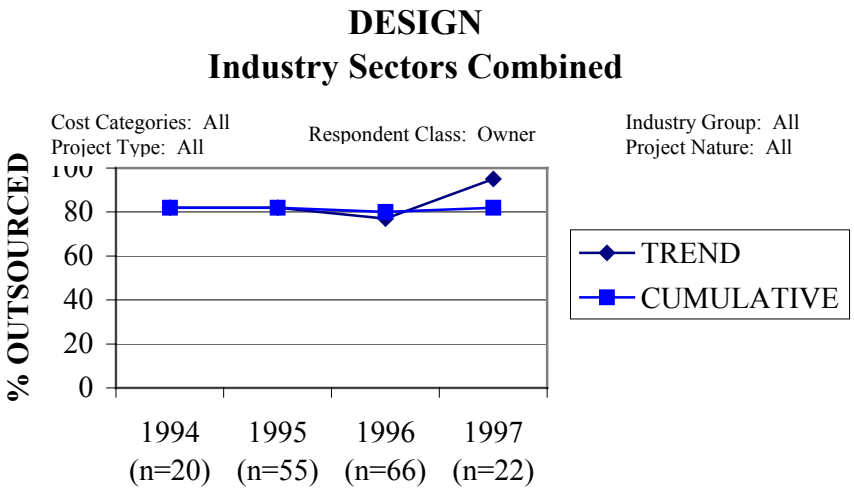

Figure 3.2 Percent of Design Outsourced: Industry Sectors Combined

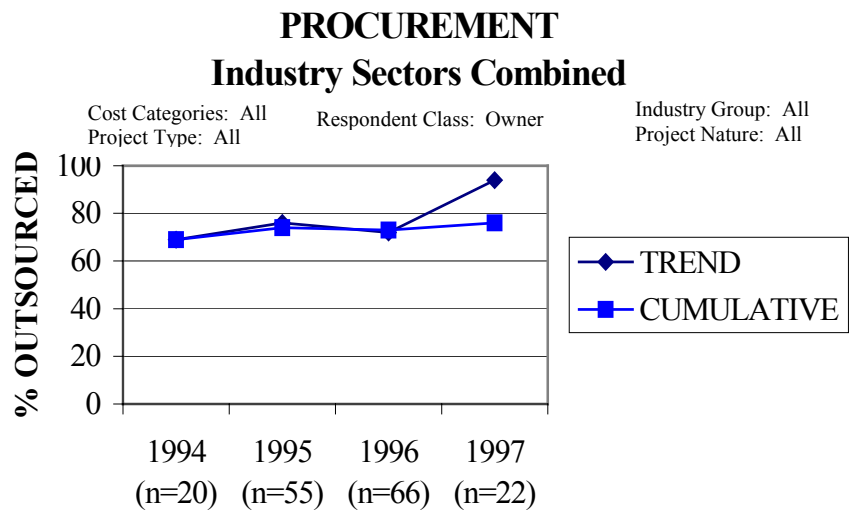

Figure 3.3 Percent of Procurement Outsourced: Industry Sectors Combined

Figure 3.4 combines the three project functions into a "roll-up" graph showing the overall percentage outsourced over time.

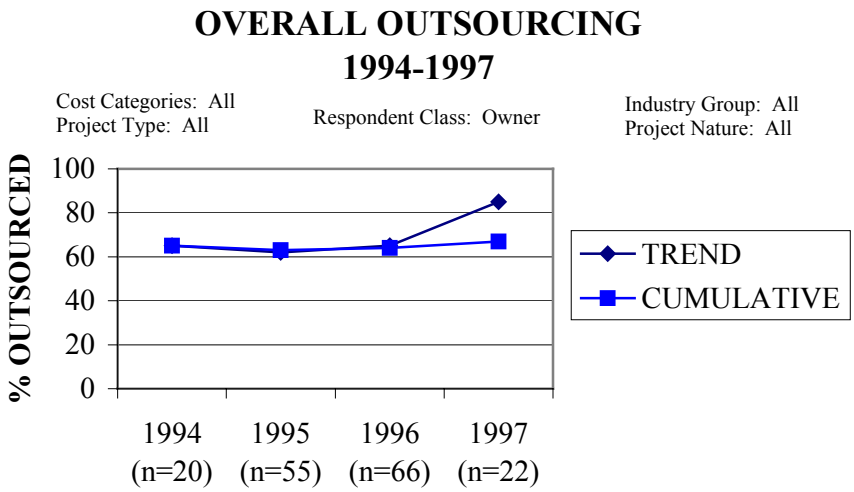

Figure 3.4 Overall Owner Outsourcing: Industry Sectors Combined

Evaluation of the trend graphs provides some initial insight into the level of owner outsourcing from 1994 through 1997. The "roll-up" graph (Figure 3.4), showing overall owner outsourcing for the industry sectors combined, indicates a fairly constant trend in the level of outsourcing at approximately 65% over the period 1994 through 1996 with a jump to 85% in 1997. This means that on the average, between 1994 and 1996, owners outsourced 65% of their planning, design, and procurement. But the level of outsourcing "jumped" by 20% in 1997. (Construction outsourcing was not considered since it is almost always outsourced.)

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. Figures 3.5 consolidates the "Percent of PPP" graphs for each industry sector into one chart below.

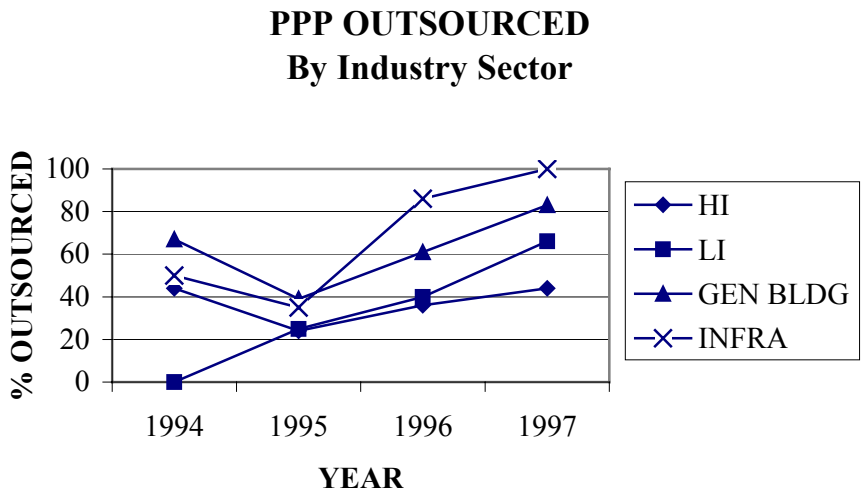

Figure 3.5 Percent of Pre-Project Planning Outsourced: By Industry Sector

Figure 3.6 groups the "Percent of Design Outsourced" graphs together in the chart below.

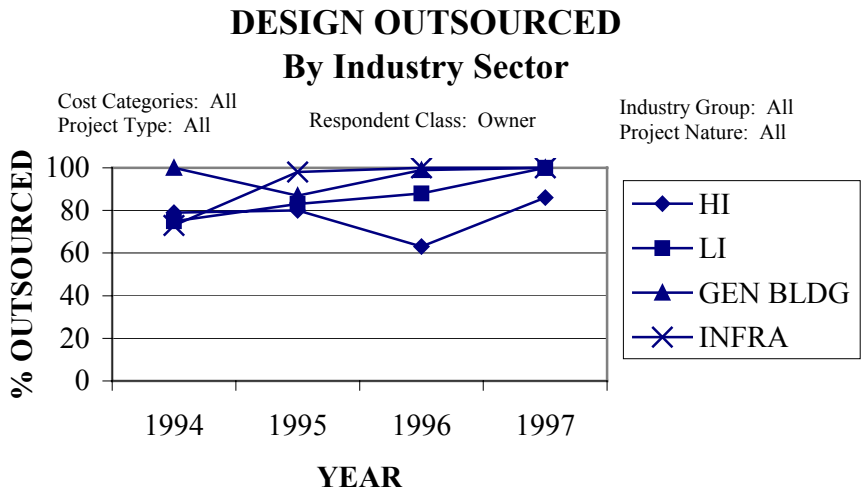

Figure 3.6 Percent of Design Outsourced: By Industry Sector

Figure 3.7 below provides a visual comparison of the percent of procurement outsourced in each of the four industry sectors.

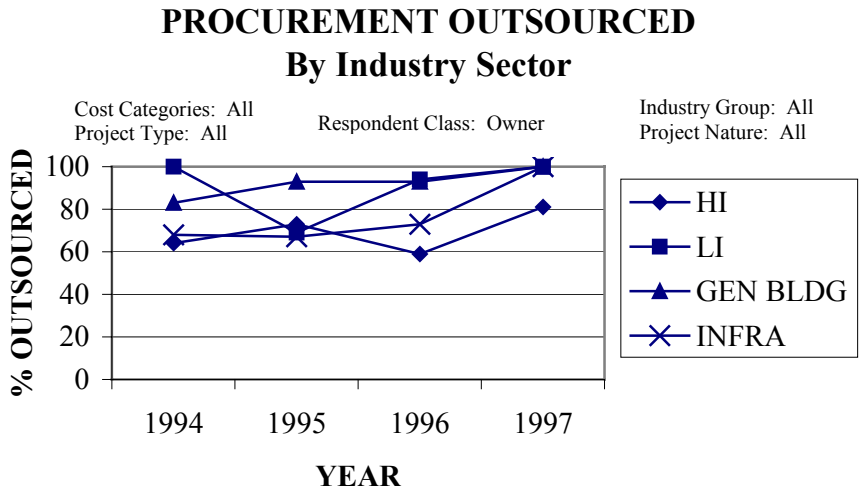

Figure 3.7 Percent of Procurement Outsourced: By Industry Sector

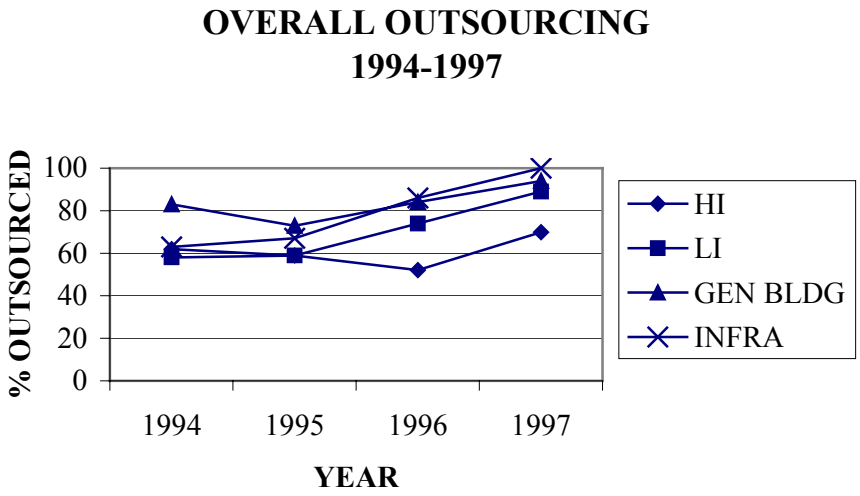

Figure 3.8 Overall Owner Outsourcing By Industry Sector

The "Heavy Industrial" line graphs (contained in Figures 3.5-3.8) provide the first breakout from the combined trend. The Heavy Industrial "overall outsourcing" trend (Figure 3.8) indicates that the level of owner outsourcing of planning, design, and procurement decreased slightly from 60% in 1994 to 52% in 1996 and then increased to 70% in 1997. This increase contributes heavily to the 1997 industry-wide "jump", but does not, in and of itself, account for the high percentage of outsourcing that occurred in 1997.

Analysis of the Light Industrial, General Building, and Infrastructure sectors showed that 15 projects are primarily responsible for the high level of owner outsourcing in 1997. Owners outsourced an average of 89% for Light Industrial projects in this group, 94% for General Building and 100% for Infrastructure. In addition, each of the "overall outsourcing" line graphs for these three industry sectors (Figure 3.8) demonstrates an increasing trend from 1994 through 1997, in contrast to the Heavy Industrial sector's slightly decreasing trend through 1996. Looking beyond the three "roll-up" graphs to their respective Pre-Project Planning (PPP) graphs (Figure 3.5) reveals that both the trend graphs for Light Industrial and Infrastructure projects show a steep increase in pre-project planning outsourced from 1995 to 1997. Also, the Design graphs (Figure 3.6) for both General Building and Infrastructure show fairly constant owner outsourcing trends of 90-100% from 1994 through 1997. Finally, the Procurement graph (Figure 3.7) for Infrastructure projects indicates a fairly constant outsourcing trend of approximately 70%, through 1996 but jumps to 100% in 1997. Each of the trends given in this paragraph should be used with caution because of the small sample size.

3.4 Preliminary Findings and Conclusions

Table 3.3 provides a summary of outsourcing trends given in this sample. It is significant to note the extent of outsourcing for these project functions and changes that have occurred in the sample over the past four years.

Table 3.3 Summary of Outsourcing Trends

Function	Combined	H.I.	L.I.	GEN BLDG	INFRA
PPP	Steady Increase from 1995-97	Steady Increase from 1995-97	Steep Increase from 1994-97	Steep Increase from 1995-97	Steep Increase from 1995-97
Design	Fairly Constant thru 1996; 18% jump in 1997	17% drop in 1996; 23% jump in 1997	Steady Increase from 1994-97	Fairly Constant from 1994-97	Fairly Constant from 1995-97
PROC	Fairly Constant thru 1996; 22% jump in 1997	Fluctuating thru 1996; 20% jump in 1997	Steady Increase from 1995-97	Slight Increase from 1994-97	Fairly Constant thru 1996; 30% jump in 1997
Roll-up	Fairly Constant thru 1996; 20% jump in 1997 (65-85%)	Slight Decrease thru 1996; 20% jump in 1997 (62-70%)	Steady Increase from 1994-97 (58-89%)	Slight Increase from 1994-97 (83-94%)	Steady Increase from 1994-97 (63-100%)

Note: The percentages in parentheses indicate the 1994 and 1997 percentages outsourced.

Although, the data sample may or may not be representative of the construction industry as a whole, it is a large sample that provides some indication of industry outsourcing practices. It should be noted that the sub-sample analysis does uses small samples and may significantly in the future as more projects are added to the sample.

Approximately 60% of the projects in the data sample are heavy industrial, but the remaining 40% from the other industry sectors have a significant impact on the "combined" outsourcing curve. All four industry sectors exhibit an increase in owner outsourcing in 1997, but it is noteworthy that the industry sectors, other than Heavy Industrial, contribute so heavily to the high 1997 level of owner outsourcing while comprising only 40% of the data sample.

These results are enlightening and show the potential for future use of the CII Benchmarking and Metrics database as more data are collected in 1998. Of particular interest is the apparent increase in certain sectors and the fact that large percentages of these functions are being outsourced by owners. Our team plans to help revise the questionnaire to leverage its usefulness for future data collection.

Chapter 4

Tucson Workshop

4.1 Purpose

This chapter summarizes the results of the Owner/ Contractor Organizational Changes Breakout at the CII Board of Advisors workshop held on November 19, 1997 in Tucson, Arizona. Our goals at the workshop were to disseminate and gather information, identify study topics, and to solicit participation in the study from CII member companies.

4.2 The Breakout Session

Twenty organizations were represented in the breakout with 12 owner and 8 contractor personnel in attendance. The session began with these individuals completing a one-page questionnaire and then breaking into four groups to brainstorm on several key topics significant to the owner-contractor organizational structure.

4.3 The Questionnaire

The questionnaire consisted of three questions regarding the owner/ contractor relationship. A sample questionnaire is provided in Appendix B. The first question asked respondents to rate the level of importance of six different issues to the successful management of the owner/ contractor relationship (see Figure 4.1). The second question had them indicate the level of suitability for contracting-out various phases of a construction project (see Figure 4.2). In the third question the respondents were asked their opinion about the best way for owners and contractors to coordinate their efforts (see Figure 4.3).

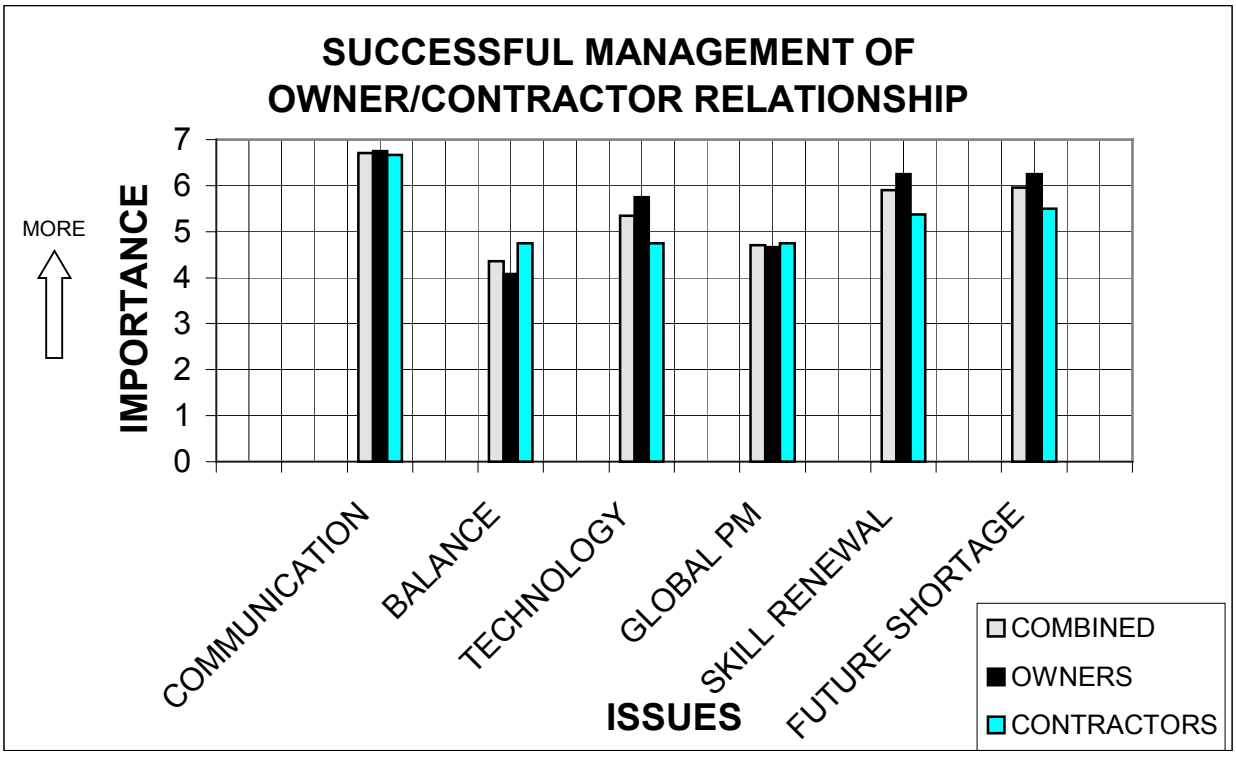

Figure 4.1 Question #1 Response Summary

As indicated in Figure 4.1, the respondents felt that communication and skill issues were important in handling the owner/ contractor relationship. Note that there was some difference between owner and contractor respondents.

The six categories in Figure 4.2 represent the following project phases:

- Feasibility Analysis (FA)
- Pre-Project Planning (PPP)
- Detailed Design (DD)
- Procurement (PROC)
- Construction (CONST)
- Start-Up (SU)

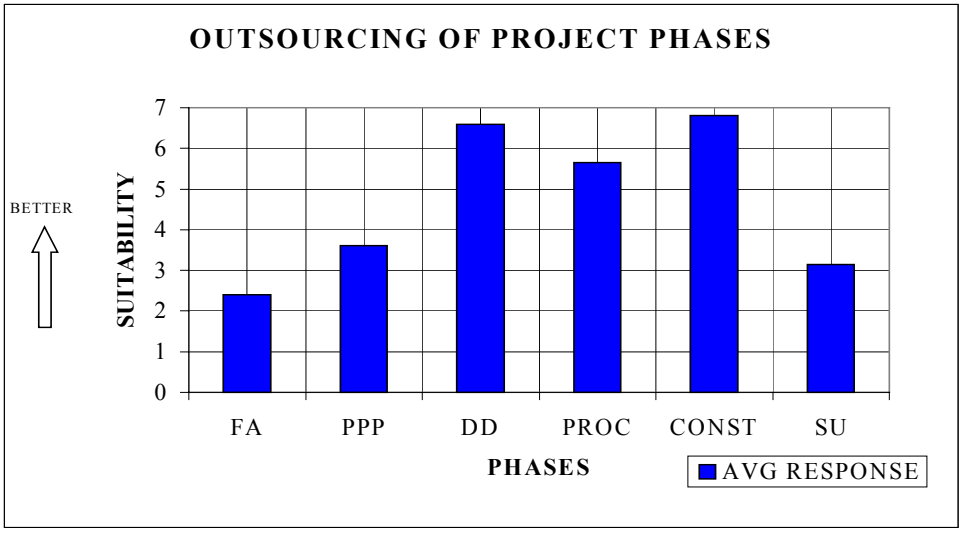

Figure 4.2 Question #2 Response Summary

The data shown in Figure 4.2 complement the data collected during the interviews. According to the respondents, the early and late phases of the project are less suitable for contracting out.

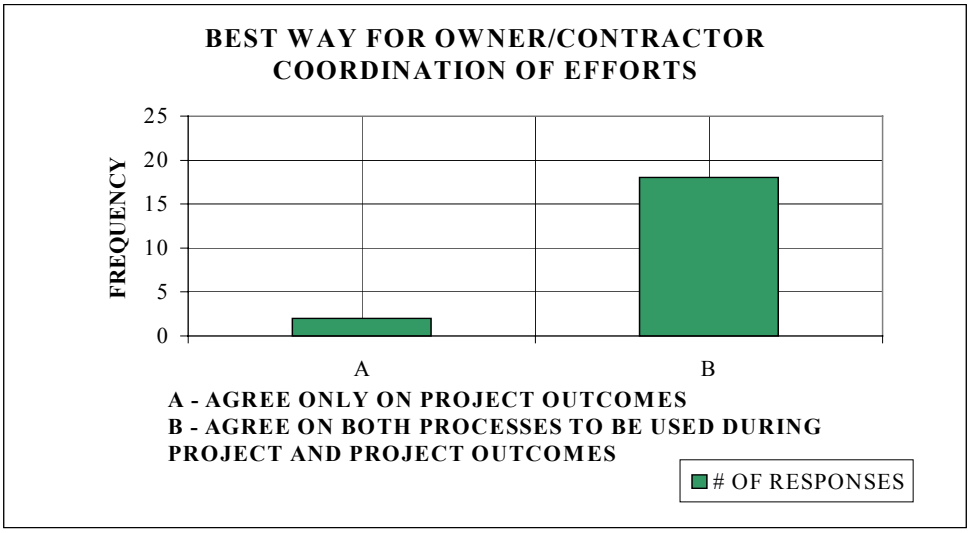

Figure 4.3 Question #3 Response Summary

Figure 4.3 shows that most respondents felt the owners and contractors should focus on both the outcomes and project processes used in order to be successful.

In addition to the first three questions, the respondents were asked two open-ended questions regarding the most important difficulties they face and the three most

effective tools or techniques for managing owner-contractor relationships. About a third of both the owner and contractor representatives stated "Alignment of Objectives" as the most important difficulty they face in managing owner-contractor relationships. The most effective tool for managing owner-contractor relationships for two-thirds of the owners and one-third of the contractors was "Team Building/Partnering/Alliances".

Generally, the responses gathered from the workshop reinforced the findings we gained during the site visit and interviews. The interactive nature of the workshop also provided a rich source of ideas and opinions from high-level personnel.

4.4 The Breakout Groups

The four groups brainstormed on the following topics for the critical issues, solutions, and potential research topics inherent to each of them:

- Regeneration of capabilities;
- Alliance impact;
- Globalization issues;
- Changing skill requirements.

4.4.1 Regeneration of Capabilities

The "Regeneration" group developed the following list of critical issues in order of importance:

- Contractor's flexibility to meet varying owner needs;
- Getting resources necessary to implement regeneration plan;
- Continuity of personnel;
- Mapping/defining what needs to be regenerated and where;
- How to utilize key techniques to supplement key skills;
- Losing in-house expertise (technical & project management);
- Continued improvement in communications/ requirements.

They then developed potential solutions to the first two issues. Getting contractors and owners to identify core competencies, developing a process for making the right matches based on core competencies, and the ability to utilize third party alliances were all seen as solutions for increasing contractor's flexibility to meet varying owner needs. Potential solutions to the second issue of obtaining the necessary

regeneration resources consisted of developing a long-term approach, realigning in-house resources to help develop new capabilities, demonstrating the value-added of specific technical resources, and cross training.

Based on their discussion, the group suggested the following research topics:

1. Impact of emerging new technologies on retaining key skills
2. Methodology for defining core competencies and key skills
3. Method to define value added for technical skills (impact on life-cycle cost)

4.4.2 Alliance Impact

The "Alliance" group developed the following list of critical issues for managing alliances:

- Showing the value of an alliance;
- Managing the critical mass (peaks/valleys of workload);
- Overcoming traditional roles both within the owner organization and for the contractor taking on the traditional owner role;
- Aligning the owner's goal (least cost) with the contractor's (profit);
- Establishing career paths – project personnel (owner);
- Looking at the global aspects of alliances;
- Balancing the tug between business side and engineering (cost vs. quality/effectiveness);
- Focusing on "bottom line cost";
- Overcoming complacency.

The group did not develop a list of solutions but did discuss several alternatives to alliance contracting including bidding every job, pre-qualifying/ selecting preferred bidders, partnering, and developing an integrated team with incentives.

This group suggested that potential research topics address the following question: Do alliances add value? If so, how and why? What are the critical factors to success? What organizational structures lead to successful alliances?

4.4.3 Globalization Issues

The "Globalization" group developed the following list of critical issues in managing the owner/contractor relationship in the global arena:

- Special contractual relationships;

- Political and business risk (including government requirements – laws, regulations, etc.);
- Managing on-site requirements;
- Project duration (cycle time);
- Procurement;
- Business Structure;
- Culture (including language and religion);
- Craftsman productivity;
- Training;
- Codes and Standards;
- Financing;
- Understanding roles and responsibilities (including accountability, risk);
- Number of available contractors;
- Startup and maintenance;
- Identification of "real" capability of local contractors and subs;
- Environmental regulations;
- Availability of construction equipment;
- Transportation accessibility;
- Personnel practices.

They then provided several overall solutions to include partnerships between owners and contractors, early planning with the right parties, education within US companies, risk sharing, and potentially greater contractor responsibilities (fewer owner resources to understand the facility process).

Potential research topics would address the requirements to effectively manage a project outside North America:

- Risk management for international projects including:
    - Design and construction standards,
    - Human resource issues,
    - Equity position issues,
    - Management approaches,
    - Front-end planning,
    - Review existing CII studies and missing topics for incorporation into an overall CII strategy.

4.4.4 Changing Skills Requirements

This group developed a list of critical skills for both the owner and contractor organizations. Critical owner skills include technical knowledge of the process, alignment with business units' goals and objectives, facility definition, stewardship of the overall project process and objectives, and project controls. The group also saw the

general manager and alternative methods/process decision maker as important roles in the owner organization. Detailed design and alignment with project goals and objectives were seen as critical contractor skills.

The group suggested the following skill development aids to support the issues discussed above:

- Consultants as an interim step (retirees);
- Integration of the team: business unit, capital project process, consultant, contractor;
- Leveraging resources on the project from the beginning;
- Succession plan within owner engineering groups – hire at the grass root (development plan);
- Cross fertilization between owners and contractors;
- Investigate within industries what owners now consider their core competencies and how are they now adding to their needs.

Chapter 5

Findings and Future Work

5.1 Findings

Over the past 10 months, we have conducted in-depth interviews with individuals from seven firms, evaluated project-specific data from 163 projects provided by over 30 owner organizations, and conducted a workshop with representatives from 20 organizations. To date, this pilot investigation has been of a scale that certainly cannot be considered indicative of the construction industry as a whole, but has allowed our research team to identify several critical findings that provide a sound basis for future work. These findings include:

- Very little substantive research has been performed in the area of owner/contractor organizational change in engineering and construction. Most of the related research has occurred in other industries or is anecdotal in nature. The only exception is the work performed previously by CII and completed in 1997. This research is seen as complementary to the work proposed for this investigation.
- The availability and accessibility of quantitative data and interview participants may be a problem as the research unfolds. Given the emphasis that CII has placed on this area in its Strategic Plan and the enthusiasm of many of the participants contacted, this problem can probably be overcome.
- A large amount of the capital facility work is now outsourced by owner organizations. The work structure between contractors and owners is and has been changing in recent years, but the rate of change is tied to industry segment.
- Certain project phases seem to be more suited to outsourcing than others. In order to manage this interface, communication, alignment, team building, and alliances were all identified as issues that are critical to the relationships between owners and contractors. The difficulty in managing the owner/contractor interface is exacerbated in the global (non-domestic) arena.

- Subcontracting requires individuals at many levels in the owner firm to work with a variety of individuals in a contractor firm. Inter-organizational agreements made at the highest level often do not adequately address the operational issues that inevitably arise when implementing these agreements.
- Effective management of subcontracting relationships requires that owner and contractor personnel possess new skill sets (e.g., conflict resolution, interpersonal communication, and leadership). Resources must be committed to develop these new skill sets in the pools of existing and potential employees.
- The extensive use of subcontracting has led to unanticipated difficulties that affect all firms in the industry (e.g., critical skill shortages). Owner firms that are increasing their reliance on subcontracting for short-term economic gains should anticipate these long-term difficulties.

5.2 Future Work

In order to pursue this investigation into the future, we must concurrently identify the essential features of the organization of capital facility projects. This includes answering such questions as:

a) What types of firms participate in capital facility projects? What are the contracting strategies in place?
b) What are the stages of capital facility projects? What are the delivery strategies employed for these stages?
c) How are the stages of capital facility projects distributed across firms?
d) How have a) through c) changed over the past decade?
e) How do we expect a) through c) to change in the decade ahead?

These questions are not the core of the research but rather are an essential backdrop for all of the other research questions. The other research questions derive from changes that have occurred in the organization of capital facility projects. Thus, the importance of our key research questions cannot be grasped without first understanding the fundamental structure of capital facility projects. For example, the skill renewal

problem faced by owner organizations has been created largely by higher levels of subcontracting accompanied by sharp reductions in engineering staffs.

The research questions identified include:

1. What constitutes a successful owner/contractor relationship? Do owners and contractors have different definitions of its 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?

We envision examining several attributes of these relationships. However, our initial results have identified staffing, communication and coordination, and maintaining an appropriate balance of power and influence as critical success factors for these relationships.

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.

Increased use of contractors has resulted in significant loss of engineering expertise in owner firms. Contractors have not replicated the deep expertise available in owner firms. Under current institutional arrangements (heavy and increasing use of contractors in all phases of capital construction), there is little incentive for EITHER owner or contractor firms to invest in employee skill development.

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?

These last two questions are daunting to organizations that rely on proprietary technology to maintain a competitive advantage in the global economy. The ability to effectively address these issues is critical to the long-term growth of the organization. The last question, in particular, will need to be addressed at some future date due to near-term resource constraints of the study, although exploratory work can be done in the initial investigation.

Appendix A

Annotated Bibliography

Abraham, K.G. & Taylor, S.K. 1993. Firms' use of outside contractors: Theory and evidence. Working Paper. National Bureau of Economic Research. Cambridge, MA.

Contracting out for janitorial services, a low-skill service activity, appears to be motivated primarily by a desire to reduce hourly labor costs. Contracting out for machine maintenance, engineering and drafting, accounting and computer services is correlated smaller establishments and location in a metropolitan area, both implying the existence of important economies of scale for these services. Firms with more volatile demand appear less likely to contract out for janitorial and machine maintenance services, suggesting that work is reallocated during slack periods. High wage firms are more likely to contract out for low-wage services. Low wage firms are more likely to contract out for high wage services.

Belous, R.S. 1989. *The contingent economy: The growth of the temporary, part-time, and sub-contracted workforce*. Washington, DC: National Planning Association.

Based on 50 case studies and Bureau of Labor Statistics data. Subcontracting can take many forms: whole activities can be let to another firm, workers for a separate can be brought in to augment the focal firm's staff, an entire staff can be leased from an outside firm to operate a facility, consultants can be hired. Identifies a number of ways that using external workers affects organizations and full-time employees.

Bettis, R.A., Bradley, S.P., & Hamel, G. 1992. Outsourcing and industrial decline. Academy of Management Executive, 6: 7-22.

Based on research in North America, Europe, and Asia, this article discusses the manner in which the improper use of outsourcing can destroy the future of a business, and how the proper use of outsourcing can help build competitive advantage.

Bresnen, M.J., Wray, K., Bryman, A., Beardsworth, A.D., Ford, J.R., & Keil, E.T. 1985. The flexibility of recruitment in the construction industry: Formalisation or re-casualisation. Sociology, 19: 108-124.

In a survey of the construction industry in Britain, this paper shows that adoption of the market mechanism as an alternative to bureaucratic control is increasing. The construction industry is an example of the simultaneous operation of the market and bureaucratic mechanisms of control. Suggests the implication of increasing reliance on subcontractors for this industry.

Business Roundtable, 1997. The business stake in effective project systems. Unpublished, confidential report by the Business Roundtable.

Using the data base of Independent Project Analysis (IPA), investigated the differences between good and bad project performance. Outsourcing and downsizing have not resulted in reduced engineering costs. Identified characteristics of the best capital project systems.

Carty, G.J. 1995. Construction. Journal of Construction Engineering and Management, 121: 319-328.

Some history on the evolution of the construction industry, types of construction companies, types of construction contracts, and the organization of engineering and construction companies.

Construction Industry Institute, 1997. Benchmarking and Metrics Report for 1996. Benchmarking and Metrics Committee.

Constitutes the first product of four years of data collection and analysis by CII of almost 400 projects. Based on two questionnaires, Version 1.0 and Version 2.0, submitted to CII owner companies and contractors for input into the Benchmarking and Metrics database. Provides a description of the database, the metrics used to analyze the data, and the 1996 results of "Best Practices" assessment.

DaParma, E.U. 1957. Views on decentralization. IRE Transactions on Engineering Management, September, 85-90.

Noted that the increasing complexity of projects was leading to increased subcontracting. Identified some disadvantages of subcontracting for project teams, including, 1) lack of identification with team effort, 2) poor decision-making due to distance of decision maker from the team, 3) lack of suitable training ground for the development of executive talent.

Davis-Blake, A., George, E., & Broschak, J.P. 1994. When temporary solutions create permanent problems: The effects of employment externalization on internal employees. Working Paper, University of Texas at Austin. Paper presented at the Academy of Management Annual Meeting, Dallas.

Using a probability sample of adult Americans, found that when contract workers were used in the same jobs as full-time workers, the full-time workers reported a weaker intention to stay with their organization. The authors speculated that full-time workers with contract co-workers may experience negative equity (due to contractors receiving higher pay) and incentives to leave the organization in order to become contractors themselves.

Davis-Blake, A. & Uzzi, B. 1993. Determinants of employment externalization: A study of temporary workers and independent contractors. Administrative Science Quarterly, 38: 195-223.

Examined what determined the use of external workers in a variety of organizations. Referring only to independent contractors, variation in employment, bureaucratization of employment practices at the establishment level, firm size, and being part of a multiple-site firm all had positive effects. Construction firms were more likely than manufacturing firms, who were more likely than services or trades, to use contractors. Concluded that externalization increases organizational flexibility, that externalization and internalization of the labor force are complementary arrangements, and that large organizations were more likely to use independent contractors and less likely to use temporary workers.

Dozzi, P., Hartman, F., Tidsbury, N., & Ashrafi, R. 1996. More stable owner-contractor relationships. Journal of Construction Engineering and Management, 122: 30-35.

From a sample of 16 major organizations in Alberta, received the answer to 11 questions. Of particular importance here, the areas identified as needing the most improvement (in order of most importance) in the contracting process were communications, dispute resolution, claims, contract interpretation, administration, bidding process, paper work, payment, insurance, safety, and bonding.

Eccles, R.G. 1981b. The quasi-firm in the construction industry. Journal of Economic Behavior and Organization, 2: 335-357.

Found evidence in the residential construction industry of the existence of quasi-firms: relations between a general contractor and his subcontractors that are stable and continuous over fairly long periods of time and only infrequently established through competitive bidding. In each trade only a few subcontractors are used. Less subcontracting was done for the basic trades, primarily to achieve better coordination and quality. General contractors are also likely to do many of the basic trades in-house because these low-skill workers can be used for many other tasks, thus obtaining scale economies.

George, E. 1996. The effects of external workers on internal workers' organizational commitment. Unpublished Ph.D. dissertation, University of Texas at Austin.

The use of contract workers in the same jobs as full-time employees had a negative effect on the commitment of the full-time employees. This effect was mediated by full-time employees' perceptions of job security and perceptions of the legitimacy of employment externalization. Thus, the presence of contract workers presents a threat to the continued employment of full-time employees.

Goodman, R.A. 1968. Organization and manpower utilization in research and development. IEEE Transactions on Engineering Management, EM-15: 198-204.

Identified project management and matrix management as two basic organizational forms for complex projects. Project management appears to be most suited for a short-run perspective.

However, matrix management appears to be better suited for long-run organizational problems. Matrix form is associated with lower rates of voluntary turnover.

Gordon, C.M. 1994. Choosing appropriate construction contracting method. Journal of Construction Engineering and Management, 120: 196-210.

Examines the compatibility of various construction contracting methods with certain types of owners and projects. Creates some guidelines to help the owner choose the organization, contract types, and award method for their project and themselves.

Kochan, T.A., Smith, M., Wells, J.C., & Rebitzer, J.B. 1994. Human resource strategies and contingent workers: The case of safety and health in the petrochemical industry. Human Resource Management, 33: 55-77.

Plant managers cited the need for specialized services and flexibility as principal reasons for their reliance on contract workers. Lower costs were significantly less important, but they were a motivating factor. Due to employment issues, plant managers are advised by their legal counsels to refrain from supervising, training, or determining the terms and conditions of employment. As a result contract employees receive less ongoing or overall safety training than direct-hire employees. Contract employees experience higher accident probabilities due in part to their being more likely to engage in higher risk work, receiving less safety training, and having less experience than direct hire employees. Finally, the authors speculated that the increasing presence of contract workers can lead to less communication between direct hire and contract workers and to increased tensions in the workplace.

Nam, C.H. & Tatum, C.B. 1991. Noncontractual methods of integration on construction projects. Journal of Construction engineering and Management, 118: 385-398.

This paper describes four noncontractual means of integration on construction projects. Gives examples of how each method overcomes disintegration.

"Owner/Contractor Work Structure: A Preview," CII Research Summary 111-1, December 1996.

"Owner/Contractor Work Structure Process Handbook," CII Implementation Resource 111-2, April 1997.

Developed a process framework to aid owners and contractors in forming work structures: determine whether the responsibility for performing certain functions should lie with the owner, contractor, or be shared between the two. This framework is valuable as a tool for facilitating a discussion as to the required project competencies and the sourcing of those competencies. However, this research lies heavily on the perceptions of organizational decision makers for identifying and locating these competencies. No discussion of the effects of the sourcing decisions.

Pearce, J.L. 1993. Toward an organizational behavior of contract laborers: Their psychological involvement and effects on employee co-workers. Academy of Management Journal, 36: 1082-1096.

Studied the use of engineer and engineering technician contract workers in the aerospace industry. Found that the company accommodated contractors by shifting interdependent tasks to their employee co-workers. Employees with contract co-workers reported less trust in their organization than did those in employee-only work units. Also suggested that the use of contractors put a higher monitoring burden on supervisors.

Pearce, J.L. 1994. What difference does it make? The psychological involvement of members of a mixed core-periphery workforce. Working Paper, University of California, Irvine.

Studied the use of engineers and engineering technicians in the Aerospace Components and Software divisions of a large aerospace firm. Found that contractors reported less satisfaction with their security in the organization, and were significantly less likely to view organizational change as beneficial.

Pfeffer, J. & Baron, J.N. 1988. Taking the workers back out: Recent trends in the structuring of employment. In B.M. Staw & L.L. Cummings (Eds.), Research in Organizational Behavior, 10: 257-303. Greenwich, CT: JAI Press.

Conceptualized contract workers (as well as temporary, part-time, and leased workers) as a form of externalizing the employment relationship: diminishing the administrative, temporal, and/or locational attachment between workers and the organization for who they do work. Developed testable hypotheses of the determinants and consequences of using external workers.

Powell, W.W. 1990. Neither market nor hierarchy: Network forms of organization. Research in Organizational Behavior, 12: 295-336. JAI Press.

Discusses how network forms of organization differ from the two most common forms: markets and hierarchies. Gives examples, discusses conditions that five rise to network forms, and sets a research agenda.

Rebitzer, J.B. 1995. Job safety and contract workers in the petrochemical industry. Industrial Relations, 34: 40-57.

Surveyed 569 direct hire and contract workers at 40 petrochemical plants. Found that safety supervision by the host employer markedly reduces the accident rates of contract employees. Additionally, the author concluded that the safety training offered to contract employees had no effect on accident rates even though safety training dramatically reduces the accident rates of direct-hire employees. This highlights the point of the danger of co-employment issues.

Ruff, C.M., Dzombak, D.A., & Hendrickson, C.T. 1996. Owner-contractor relationships on contaminated site remediation projects. Journal of Construction Engineering and Management, 122: 348-353.

Studied sixty completed remediation projects to identify and document the effects of different project management structures and contracting strategies on project outcomes. Of the five different project management structures (Separate Design & Construction, Contractor Hire Designer, Designer Hire Contractor, Turnkey, and In-House Design), flexible project structures were best suited to accommodate the uncertainty of the project. Separating design and construction was positively correlated with cost overruns.

Sherman, J.D. 1986. The relationship between factors in the work environment and turnover propensities among engineering and technical support personnel. IEEE Transactions on Engineering Management, EM-33: 72-78.

Studied turnover propensities in engineering, scientific, and technical support personnel from the electronics division of a large U.S. firm. Found that engineers and technical support personnel differed, and that for engineers factors such as autonomy and goal congruence (with one's supervisor) had a strong influence on turnover propensity.

Smith, V. 1994. Institutionalizing flexibility in a service firm: Multiple contingencies and hidden hierarchies. Work and Occupations, 21: 284-307.

Reported on a case study of a subcontractor of photocopying and other business services. Subcontracting a particular business service creates restrictions on the jobs performed by the subcontractors employees while at the same time allowing these workers to develop interactive, administrative, and organizational skills they normally would not have developed. Subcontractors also must rely on multi-tiered and heterogeneous external work arrangements: "contractors", in an effort to reduce costs, must often work alongside and supervise temporary workers. Finally, subcontracting often creates hidden hierarchies between the clients' permanent employees, the subcontractors employees, and the subcontractors' temporary workers. Employment status differences produce tension and conflict in the workplace.

Stinchcombe, A.L. & Heimer, C.A. 1985 *Organization theory and project management: Administering uncertainty in Norwegian offshore oil*. Bergen, Norway: Universitatsforlaget.

This book uses the Norwegian offshore oil industry as a backdrop to research the organization and administration of multiple organizations, that are connected together by contracts, to accomplish complex and high uncertainty projects. Argues that there are important differences between project administration and the administration of repetitive processes (e.g. manufacturing and production). Thus understanding project administration is likely to require modifications to existing theories of organization.

Three chapters in particular are applicable. Chapter two ("Contracts as Hierarchical Documents") discusses how in spite of the fact that transaction cost economics explains when markets will give way to hierarchies, there still are situations where work is arranged through contracts though transactions cost economics predicts the opposite. Stinchcombe argues that for project administration such as large scale construction, hierarchy can and should be arranged through contracts. Chapter three ("Authority and the Management of Engineering on Large Projects") discusses how the social structures in the industry are necessary in order to get the engineering decisions made on time, what the role of engineers is in the social structure, and finally some pathologies of the system. Chapter five ("Organizational and Individual Control of Career Development in Engineering Project Work") discusses how career development, especially in project work, depends on a series of factors related to organizational structure and human action, and that these factors differ for different kinds of workers.

Sullivan, G.R., Yupari, M.A., & Anderson, S.D. 1996. Owner/contractor work structure: A process approach. Report to The Construction Industry Institute, University of Texas at Austin, Research Report 111-11.

Uzzi, B. 1996. The sources and consequences of embeddedness for the economic performance of organizations: The network effect. American Sociological Review, 61: 674-698.

Studied the New York garment industry and developed the ideas of market and embedded relations between dress manufacturers and their contractors. Though manufacturers preferred embedded relations, this industry is characterized primarily by a combination of the two relations, but primarily market relations. Further, the survival chances of contractors is improved by establishing more embedded relationships with manufacturers. However, there is some optimal mix of embedded and market relations in a network of relations that maximizes the survival chances of contractors.

Uzzi, B. 1997. Social structure and competition in interfirm networks: The paradox of embeddedness. Administrative Science Quarterly, 42: 35-67.

Develops propositions on the antecedents and consequences of embedded relations in the New York garment industry. Embedded relations allow building trust, the transfer of fine-grained information, and joint problem solving arrangements. However, overembedded relations and networks can have negative effects such as feuding, the loss of new and novel information from other networks, and extinction due to overdependency.

Ward, S.C., Curtis, S., & Chapman, C.B. 1990. Advantages of management contracting: Critical analysis. Journal of Construction Engineering and Management, 117: 195-211.

Literature review of management contracting and presents findings from interviews with top-level managers of client, design, and contractor firms in the UK. Shows the advantages and disadvantages of management contracting. Tries to identify project characteristics best suited for this form of contracting.

Wells, J.C., Kochan, T.A., & Smith, M. 1991. *Managing workplace safety and health: The case of contract labor in the U.S. petrochemical industry*. The John Gray Institute, Lamar University.

Surveyed full-time workers, contract workers, and plant managers at petroleum and chemical plants. Concluded that the use of contract workers resulted in increasing labor-management tension and conflict, an increase in the number of injuries and accidents at the plant, and a reduction in the organization's investment in training and human resource development. The authors noted that contract workers were treated as a separate and distinct workforce, and that supervisory and training responsibility for contract workers was assigned to the contractor rather than the plant management. This study panned by CII researchers due primarily to the methodology and overstatements in their conclusions.

Sources for Transaction Cost Economics

Monteverdi, K. & Teece, D.J. 1982. Supplier switching costs and vertical integration in the automobile industry. Bell Journal of Economics, 13: 206-213.

Walker, G. & Poppo, L. 1991. Profit centers, single source suppliers, and transaction costs. Administrative Science Quarterly, 36: 66-87.

Walker, G. & Weber, D. 1984. A transaction cost approach to make-or-buy decisions. Administrative Science Quarterly, 29: 373-391.

Williamson, O.E. 1975. *Markets and hierarchies*. New York: Free Press.

Williamson, O.E. 1981. The economics of organization: The transaction cost approach. American Journal of Sociology, 87: 548-577.

This theoretical perspective explains the existence of specific economic organization as a result of minimizing the cost of the transaction. Under certain conditions (small numbers bargaining, asset specificity, opportunism, information asymmetry), organizations may rely on market structures for a transaction while under other conditions they may internalize the party with whom the transaction otherwise would have taken place. In its simplest form, this theoretical perspective answers the make vs. buy question.

Appendix B: Tucson Workshop Sample Questionnaire

Owner/Contractor Organization Changes Workshop

November 19, 1997

Tucson, Arizona

Name (optional):_____

I work for (please check one): _____an owner firm _____a contractor/consulting firm

I. Please indicate the importance of each of these issues to the successful management of the owner-contractor relationship (circle one number per issue):

1) Maintaining effective communication between owner and contractor personnel

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

2) Maintaining a balance between long-term (alliance) relationships and short-term relationships

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

3) Implementing new technologies (e.g., technology transfer, protection of proprietary technologies)

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

4) Managing projects across global boundaries

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

5) Renewing the skills and capabilities of engineers in your own organization

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

6) The potential future shortage of skilled engineering personnel

1----------2----------3----------4----------5----------6----------7

Not at all important *Somewhat important* *Extremely important*

II. Various phases of a capital construction project can be contracted out. In your experience, which phases of a project are best suited to contracting out (i.e., outsourcing):

1) *Feasibility analysis*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

2) *Preproject planning*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

3) *Detailed design*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

4) *Procurement*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

5) *Construction*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

6) *Start-up and Operations*

1----------2----------3----------4----------5----------6----------7

Not at all suited *Somewhat suited* *Extremely suited*

III. In your opinion, what is the best way for owners and contractors to coordinate their efforts (please check one of the options below)

_____*Agree only on the* ***project outcomes***

_____*Agree on* ***both processes to be used during the project and project outcomes***

IV. Open-Ended Questions:

1) *What is the most important difficulty you face in managing owner-contractor relationships?*

2) *In your experience, what is the most effective tool or technique for managing owner-contractor relationships?*