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CHARACTERISTICS OF INTEGRATED
PROJECT DELIVERY AND CONTRACT
STRATEGIES

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CHARACTERISTICS OF INTEGRATED
PROJECT DELIVERY AND CONTRACT STRATEGIES

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A Report to
Construction Industry Institute
The University of Texas at Austin

Under the Guidance of
CII Project Team 165
Project Delivery and Contract Strategy

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TABLE OF CONTENTS

TABLE OF CONTENTS	iii
LIST OF FIGURES	vi
LIST OF TABLES	viii
EXECUTIVE SUMMARY	ix
CHAPTER I.....	1
INTRODUCTION.....	1
1.1 Overview.....	1
1.2 Research Problem	2
1.3 Research Questions.....	3
1.4 Research Objectives.....	3
1.5 Outline of Report	4
CHAPTER II.....	7
REVIEW OF LITERATURE AND CURRENT DECISION TOOLS.....	7
2.1 Overview.....	7
2.2 Literature Review.....	7
2.2.1 General Literature	7
2.2.2 Construction Industry Institute (CII) Studies.....	12
2.2.3 Summary Results	15
2.3 Decision Tools	17
CHAPTER III.....	23
RESEARCH METHODOLOGY	23
3.1 Overview of Research Approach.....	23
3.2 PDCS Option Development.....	24
3.2.1 Key Assumptions.....	25
3.2.2 Key Definitions	26
3.2.3 PDCS Descriptions	27
3.2.4 PDCS Options.....	30
3.3 Project Objectives	42
3.4 Selection Factors.....	42
3.5 Data Collection	45
3.6 Data Analysis	46

CHAPTER IV 49

GENERAL RESULTS AND FINDINGS 49

4.1	Overview	49
4.2	Response	49
4.3	General Results	50
4.3.1	Project Characteristics	50
4.3.2	Project Delivery Approach	53
4.3.3	Contract Strategy	54
4.3.4	Project Objectives	56
4.3.5	Selection Factors	58
4.4	Additional Findings	62
4.5	Summary	71

CHAPTER V 73

PROJECT DELIVERY AND CONTRACT STRATEGY CHARACTERISTICS 73

5.1	Overview	73
5.2	PDCS Option 1	76
5.2.1	Project Characteristics	76
5.2.2	Compensation Approach	76
5.2.3	Project Objectives and Selection Factors	76
5.2.4	Description	79
5.3	PDCS Option 2	81
5.3.1	Project Characteristics	81
5.3.2	Compensation Approach	81
5.3.3	Project Objectives and Selection Factors	81
5.3.4	Description	84
5.4	PDCS Option 3	86
5.4.1	Project Characteristics	86
5.4.2	Compensation Approach	86
5.4.3	Project Objectives and Selection Factors	86
5.4.4	Description	89
5.5	PDCS Option 4	91
5.5.1	Project Characteristics	91
5.5.2	Compensation Approach	92
5.5.3	Project Objectives and Selection Factors	92
5.5.4	Description	95
5.6	PDCS Option 5	97
5.6.1	Project Characteristics	97
5.6.2	Compensation Approach	97
5.6.3	Project Objectives and Selection Factors	97
5.6.4	Descriptions	100
5.7	PDCS Option 6	102

5.7.1	Project Characteristics	102
5.7.2	Compensation Approach.....	102
5.7.3	Project Objectives and Selection Factors.....	102
5.7.4	Descriptions	105
5.8	PDCS Option 7	106
5.8.1	Project Characteristics	106
5.8.2	Compensation Approach.....	107
5.8.3	Project Objectives and Selection Factors.....	107
5.8.4	Descriptions	110
5.9	PDCS Option 8	110
5.9.1	Project Characteristics	110
5.9.2	Compensation Approach.....	111
5.9.3	Project Objectives and Selection Factors.....	112
5.9.4	Description.....	114
5.10	PDCS Option 9	116
5.10.1	Project Characteristics	116
5.10.2	Compensation Approach.....	116
5.10.3	Project Objectives and Selection Factors.....	116
5.10.4	Description.....	119
5.11	PDCS Option 10	120
5.11.1	Project Characteristics	120
5.11.2	Compensation Approach.....	121
5.11.3	Project Objectives and Selection Factors.....	121
5.11.4	Description.....	124
5.12	PDCS Option 11	125
5.12.1	Project Characteristics	125
5.12.2	Compensation Approach.....	126
5.12.3	Project Objectives and Selection Factors.....	126
5.12.4	Description.....	129
CHAPTER VI		131
CONCLUSIONS AND RECOMMENDATIONS		131
REFERENCES		135
APPENDIX A		137
QUESTIONNAIRE		137

LIST OF FIGURES

Figure 1 PDCS Phasing Example:	27
Figure 2 PDCS Relationship Example.....	28
Figure 3 PDCS Graphical Relationship Example:.....	29
Figure 4 PDCS Compensation Example.....	29
Figure 5 PDCS Option 1	31
Figure 6 PDCS Option 2	32
Figure 7 PDCS Option 3.....	33
Figure 8 PDCS Option 4.....	34
Figure 9 PDCS Option 5	35
Figure 10 PDCS Option 6	36
Figure 11 PDCS Option 7	37
Figure 12 PDCS Option 8	38
Figure 13 PDCS Option 9	39
Figure 14 PDCS Option 10	40
Figure 15 PDCS Option 11	41
Figure 16 Overall Budget Cost	51
Figure 17 Overall Actual (Forecast) Cost.....	52
Figure 18 Overall Planned Duration	53
Figure 19 Actual (Forecast) Duration	53
Figure 20 Overall PDCS Distribution.....	54
Figure 21 Number of Project Objectives Ranked Per Respondent.....	56
Figure 22 Number of Times a Project Objective Selected	57
Figure 23 Overall Project Objective RIR.....	58
Figure 24 Number of Selection Factors Ranked Per Respondent.....	59
Figure 25 Number of Times Selection Factor Ranked	59
Figure 26 Overall Selection Factor RIR	61
Figure 27 Public Project PDCS Distribution	62
Figure 28 Private Project PDCS Distribution	63
Figure 29 Building Project PDCS Distribution	64
Figure 30 Industrial Project PDCS Distribution	64
Figure 31 Brown-Field Project PDCS Distribution.....	65
Figure 32 Green-Field Project PDCS Distribution	65
Figure 33 Domestic Project PDCS Distribution	66
Figure 34 International Project PDCS Distribution.....	67
Figure 35 Budget Cost (<\$15 Million) PDCS Distribution.....	68
Figure 36 Budget Cost (\$15 - \$50 Million) PDCS Distribution.....	68
Figure 37 Budget Cost (\$50 - \$100 Million) PDCS Distribution.....	69
Figure 38 Budget Cost (>\$100 Million) PDCS Distribution.....	69
Figure 39 Planned Duration (1 – 50 Weeks) PDCS Distribution	70
Figure 40 Planned Duration (51 – 75 Weeks) PDCS Distribution	70
Figure 41 Planned Duration (76 – 100 Weeks) PDCS Distribution	71

Figure 42 Planned Duration (101+ Weeks) PDCS Distribution	71
Figure 43 PDCS Option 1 Project Objective RIR	77
Figure 44 PDCS Option 1 Selection Factor RIR	78
Figure 45 Modified PDCS Option 1	80
Figure 46 PDCS Option 2 Project Objective RIR	82
Figure 47 PDCS Option 2 Selection Factor RIR	83
Figure 48 Modified PDCS Option 2	85
Figure 49 PDCS Option 3 Project Objective RIR	87
Figure 50 PDCS Option 3 Selection Factor RIR	88
Figure 51 Modified PDCS Option 3	91
Figure 52 PDCS Option 4 Project Objective RIR	93
Figure 53 PDCS Option 4 Selection Factor RIR	94
Figure 54 Figure 54 Modified PDCS Option 4.....	96
Figure 55 PDCS Option 5 Project Objective RIR	98
Figure 56 PDCS Option 5 Selection Factor RIR	99
Figure 57 Modified PDCS Option 5	101
Figure 58 PDCS Option 6 Project Objective RIR	103
Figure 59 PDCS Option 6 Selection Factor RIR	104
Figure 60 Modified PDCS Option 6	106
Figure 61 PDCS Option 7 Project Objective RIR	108
Figure 62 PDCS Option 7 Selection Factor RIR	109
Figure 63 Modified PDCS Option 7	111
Figure 64 PDCS Option 8 Project Objective RIR	112
Figure 65 PDCS Option 8 Selection Factor RIR	113
Figure 66 Modified PDCS Option 8	115
Figure 67 PDCS Option 9 Project Objective RIR	117
Figure 68 PDCS Option 9 Selection Factor RIR	118
Figure 69 Modified PDCS Option 9	120
Figure 70 PDCS Option 10 Project Objective RIR	122
Figure 71 PDCS Option 10 Selection Factor RIR	123
Figure 72 Modified PDCS Option 10	125
Figure 73 PDCS Option 11 Project Objective RIR	127
Figure 74 PDCS Option 11 Selection Factor RIR	128
Figure 75 Modified PDCS Option 11	130

LIST OF TABLES

Table 1 Literature Review Summary	16
Table 2 Decision Tool Summary	22
Table 3 Generic Project Objectives	42
Table 4 Selection Factors.....	43
Table 5 Example Questionnaire Results	47
Table 6 Example Score Conversion.....	48
Table 7 Owner Response	50
Table 8 Compensation Approaches	55
Table 9 PDCS Option Descriptions	75

EXECUTIVE SUMMARY

Capital facility projects are executed through numerous design, procurement and construction tasks, often performed by different service providers. The way these tasks in a particular project are packaged for execution and the types of services that the owner retains for the execution of those tasks define the delivery system for that project. Complimentary to the delivery system is the contract strategy adopted for the project. The contract strategy defines how the owner pays for the services rendered by service providers in the execution of a particular project. This implicitly defines the allocation of financial risks between the owner and the service providers. In the owner's management of capital facility projects, the project delivery system and contract strategy (PDCS) together provide the framework for organizing project execution.

In order to develop a framework to characterize PDCS options used in practice, input was sought from members of the Construction Industry Institute Research Team 165. Each research team member made a presentation that included their description of typical delivery approaches and contracting methods utilized by their organizations. These presentations were found to frequently include information on project phasing, project team relationships, and compensation approaches. These were determined to be the three defining elements of PDCS characterization, and were subsequently transformed into a framework that defines a set of PDCS options.

A list of 11 PDCS options was developed based on the three-element framework and tested for application through a mailed questionnaire. Each PDCS option was selected by at least one respondent. This list of PDCS options is more exhaustive than previous efforts because it includes many variations of some traditional and non-traditional approaches.

A list of project objectives was also tested for application through the mailed questionnaire. Using a relative index rating (RIR), the project objectives were prioritized. The results of this prioritization process produced some expected results. “Meet Cost” and “Meet Schedule” were consistently the top objectives for most every PDCS option. Individually, the PDCS options did show some variability in the prioritization of the objectives. This was expected because of the different types of projects that comprised the database.

A list of 26 selection factors was also validated. The RIR of the selection factors produced some interesting results. Similar to the project objective RIR, many PDCS options prioritized selection factors in similar fashions. The “Budget Critical” and “Schedule Critical” selection factors were shown to be important in the PDCS decision making among every PDCS option with the exception of options three and eight (one project response each). “Budget Critical” had a higher priority than “Schedule Critical” for those PDCS options that used sequential design and construction phasing. These two selection factors were frequently reversed in terms of priority when the design and construction phases overlapped, as “Schedule Critical” became the most important selection factor. Other selection factors generally fit the unique characteristics of each PDCS option.

CHAPTER I

INTRODUCTION

1.1 Overview

In the owner's management of capital facility projects, the project delivery system and contract strategy together provide the framework for organizing project execution. An efficient framework will facilitate project success and selecting such an efficient framework would be achieved when the most suitable combination of delivery system and contract strategy is selected. It had been shown that such efficiency could reduce project cost by an average of five percent (“Assessment...,” 1990). Consequently, the selection of the project delivery system and contract strategy is a fundamentally important decision made in the project development stage. It has implications for the execution of all phases of the project.

The owner plays a pivotal role in the life of a capital project, more so in the early stages of the project when it has the responsibility for performing several business-related functions. Successful performance of these functions directly impacts the owner's perception of project success. Selection of a project delivery system and contract strategy for a project is one of the functions that the owner performs during project development. This is, therefore, an owner's decision problem.

Each party that is involved in a capital project has its own project objectives. Research has shown that the level to which the owner's objectives are successfully achieved depend on the extent to which the objectives of the owner and those of the service providers are harmonized (“Innovative...,” 1997). The project delivery system and contract strategy are vehicles for achieving this harmony. At the project development stage, the owner has the opportunity to adopt the approach that is most harmonious for that project.

There are many complex issues that need to be addressed in order to ensure that capital projects are completed successfully. One of those issues is to determine what project delivery and contracting strategy (PDCS) would best facilitate project success. This, in itself, is a very

complicated endeavor. There are many options available to an owner or developer of a project. Choices of delivery approaches include but are not limited to design-bid-build, construction management, and design-build. There are also many variations of these delivery approaches. Contracting options include firm price, competitive lump sum, negotiated lump sum, cost reimbursable plus fee, and unit price. Similar to delivery approaches there are numerous variations and innovative applications of each of these contracting options. Integrating both project delivery approaches and contracting options further increases the potential list of PDCS options.

1.2 Research Problem

A critical success factor in the execution of capital projects is the development of the project execution plan. Central to this project execution plan is the project delivery system and contract strategy. A suitable project delivery system would optimally assign roles and responsibilities for the performance of project activities, including defining their sequencing. A suitable project delivery system would be one that facilitates the optimal performance of these activities, with respect to the owner's project objectives.

A major concern of owners is how to integrate both delivery approach and contracting strategy to help achieve successful project performance. There are many ways to deliver and contract for capital projects. The selection of an appropriate PDCS is a difficult task because there is no standardized approach and each project has different project objectives and factors that influence PDCS selection. Researchers have previously addressed the issue, although not comprehensively. Their efforts have been specific to particular project types and limited in the PDCS options evaluated and in the project characteristics considered. The introduction of a process and tool that would comprehensively evaluate delivery approaches and contract strategies may facilitate better project performance. The problem focus of this research is to facilitate the development of such a process and tool. Thus, a comprehensive framework for characterizing of PDCS options needs to be defined, distinguishing attributes of this framework need to be identified, and factors that influence the application of the framework in practice need to be determined.

1.3 Research Questions

Three questions have been developed for this research effort. These questions must be investigated to address the research problem. The questions identified are as follows:

- Can a framework be developed that can realistically characterize a broad set of PDCS options?
- Can this framework be used to confirm a set of PDCS options that are applied in current practice?
- Can this framework help capture what factors differentiate between selecting one PDCS option over other PDCS options?

1.4 Research Objectives

The research described in this report is part of a research project conducted by the Construction Industry Institute, Research Team 165 (CII RT 165), to develop a decision support tool to assist owners in selecting the most appropriate PDCS option for a capital project. The overall objective of the CII research project was captured in the mission statement that reads: **To produce a process to assist in selecting a contract delivery strategy to optimize owner's project objectives.** A coordinated, comprehensive and structured methodology was required for solving a problem that was largely unstructured prior to this research.

The first objective of this research is to review and evaluate current processes and tools utilized for PDCS selection. This review identified attributes and factors that influence PDCS selection. Based on the evaluation of current practice, components of a framework to characterize project delivery and contract strategy were developed. Next, specific efforts were focused on establishing a broad set of delivery approaches and contract strategies used in current practice. This research has also attempted to identify the most common project objectives used and critical selection factors encountered as well, since these attributes are believed to influence PDCS selection. Finally, the information gathered is analyzed to develop characterizations of PDCS options used in current practice. In summary, the objectives of the research are as follows:

1. Develop an adequate and verifiable framework to characterize PDCS options
2. Identify factors that drive PDCS selection
3. Develop an understanding of the typical environment in which PDCS options are used

Several means were used to accomplish these objectives. As a first step, a literature review was conducted to determine what PDCS processes and tools have been developed and are currently in use. This offered some insight as to which PDCS options, project objectives, and selection factors are being considered in the decision-making process.

In order to develop a framework to characterize PDCS options used in practice, input was sought from industry (CII RT 165). Each research team member made a presentation that included their description of typical delivery approaches and contracting methods utilized by their organizations. These presentations were found to frequently include information on project phasing, project team relationships, and compensation approaches. These three elements were determined to be the three defining elements of PDCS characterization. These three elements were then transformed into a framework that defines a set of PDCS options.

Also, as part of their presentations, research team members provided lists of typical project objectives and selection factors typically encountered. These lists were then combined with the PDCS framework and tested for their adequacy and use through a questionnaire survey designed to gather information on current use of current project delivery and contracting strategy systems.

1.5 Outline of Report

Chapter II of this report provides an overview and additional background information on the subject of project delivery and contract strategy. The review of current literature and decision support tools is presented. The result of this review is provided in summary form. Chapter III describes the research methodology. This includes an overview of the research approach and a description of the framework for characterizing a PDCS option. A set of proposed PDCS options, project objectives, and selection factors are developed using the framework. A description of the data collection process and a discussion of the data analysis are

presented. Chapter IV presents the general results and findings of the study. Chapter V provides detailed descriptions of eleven PDCS options used in current practice. Chapter VI provides conclusions and then recommendations for the continued development of the PDCS process and decision support tool.

CHAPTER II

REVIEW OF LITERATURE AND CURRENT DECISION TOOLS

2.1 Overview

To gain a better understanding of the requirements of a comprehensive PDCS selection process and tool, a review was conducted of current literature and decision support tools. As mentioned previously, this review was the first step in establishing a framework for such a process and tool. Information gathered during this step served as a guide in defining which PDCS options, project objectives, and selection factors would be evaluated as potential drivers in the decision-making process.

2.2 Literature Review

2.2.1 General Literature

Gordon (1992) examined the compatibility of various construction contracting methods used by owners and used on different project types. The catalyst for his research was stated as follows:

“Too often, an owner uses a particular contracting method because it is what they are used to, or it was suggested by the designer or contractor, when in reality some methods are more suited for certain owners and projects than others.”

Gordon addresses this issue by moving through what he has identified as the four parts of the construction contracting method. First is the scope; the portion of the project tasks – design, construction, and finance – that are assigned to the contractor. The next step is the selection of the organization, or the business entity with which the owner holds the construction contract. The owner then addresses the contract, or the agreement on how the owner will pay the contractor for the work performed. The final part is the award – the method used to select the contractor and/or price. Gordon sets up a system where the owner first chooses the most appropriate organization for the project by analyzing the drivers that control the project. Then,

the owner selects the most appropriate contract type based on a risk assessment of the project drivers.

Marsh (1995) walks through the planning process, the contract plan, and decision criteria used in formulating an overall project plan. This publication stresses the importance of setting project objectives based on specific factors. Marsh included a “decision criteria” section that “...sets out the factors which can be relevant to the employer’s decision as to which method of contracting to adopt.” The factors that the author deems relevant are governmental regulations, method of funding, project size and complexity, and time for completion. He indicates that these issues must be assessed before making a decision on the contract plan.

Smith (1995) discusses contract strategy. When determining a contract strategy he divides the main topics for consideration into:

- Project objectives
- Organization system (delivery approach)
- Risk allocation
- Conditions of contract

Smith believes that the owner must rank their objectives and seek implementation policies that optimize their achievement. The author states that the owner should consider the following when choosing the most appropriate organization, or delivery approach, for the project:

- The ability to meet project objectives
- The resources and services offered
- The resources that the owner is able to commit to the project
- The balance between management, design, and construction

Gordon, Marsh, and Smith are in basic agreement on the process necessary to select the most appropriate contracting strategy. These authors state that an understanding of the various delivery approaches and contract types is essential before attempting to make any decision. They stress that the owner must take into account the various factors or criteria that have an effect on contracting strategy.

After selecting the most appropriate project delivery approach based on the drivers impacting the project execution and performance, the owner must select the appropriate contract type. The

following literature suggests the deciding factor in selecting the contract type is project risks. The following paragraphs review articles that expand on the subject of risk in contracts.

Griffiths (1989) gives his opinion of the strategies that project managers must apply when beginning a project. He first stresses that a successful project requires not only a careful analysis and an accurate estimate, but also a successful contracting strategy and management. Griffiths states that, “the contract strategy adopted depends on many factors, not least the resources available to the owner.” Griffiths’ contract strategy is to divide the project into separate contracts and to then choose the form of the contract most likely to encourage satisfactory completion while also providing controls to rectify problems before they cause serious difficulty to the project. Griffiths believes that the contract establishes the risks to be allocated to each party. The author states the general principle that risks should be managed by the party best able to estimate and control the risk. When risk management is the contractor's responsibility, the extent of the risk carried by the contractor may be limited to risks that can be reasonably estimated and controlled. The owner should also recognize areas of risk the owner has decided to carry and include sufficient cost in the budget to cover these areas. Most importantly, the person who prepares the contract should always keep in mind the primary objective of the project, which is usually to build to specified requirements within the allowed time and budget. The contract should recognize areas of significant risk, identify who is to carry the risk and to what extent, and attempt to include adequate incentives to meet the owner’s and contractor’s objectives.

Gordon (1992) states the contract decision should revolve around risk allocation. He believes that optimizing the cost of a project depends on properly assessing project risks, allocating the risks, and ensuring that each party properly manages their allocated risks. As part of risk assessment, owners must evaluate project drivers to assess the risks involved. The owner must identify where the project risks exist. This matter is important when allocating the risk. The owner must choose a contract, or series of contracts, that most efficiently allocates the risk of the various parts of the project. The solution does not lie in transferring all risk to the contractor. Balancing the risk should be sought between the owner and contractor in order to utilize the incentive value of bearing risk while minimizing the cost contingency added for

accepting the risk. This is the risk allocation component of the process. When allocating risk, the owner must be aware that a company's efficiency in handling risk is based on the company's ability to control the risk, possible rewards for controlling risk successfully, and the financial position to assume risk. Sometimes, the owner can less expensively assume project risk and, thereby, reduce the large contingency that is often included by the contractor.

Research conducted by Kangari (1995) discusses the construction industry's attitude towards risk. His goal was to understand the current situation of risk in the construction industry from the contractor's viewpoint. While this CII research focuses on issues from primarily the owner's viewpoint, it is still helpful to review how contractors believe risks should be allocated. Kangari designed a questionnaire for contractors that included twenty-three risk descriptions. The respondent was asked to indicate how the risks should be allocated or shared by the contractor and owner. Also, the contractor respondents were asked to rate their views of the importance of each risk category. With regards to allocation of risk, a 70 percent response rate was required in order for a risk to be fully appropriated to an the owner or contractor. The survey concluded that risks allocated to the contractor generally are:

- Labor and equipment productivity
- Quality of work
- Labor, equipment, and material availability
- Safety
- Defective material
- Contractor competence
- Inflation
- Actual quantities of work
- Labor disputes

Those risks that should be allocated to the owner are:

- Differing site conditions
- Defective design
- Site access/right of way
- Permits and ordinances

- Changes in government regulations
- Delayed payment on contract
- Changes in work

The contractors surveyed rated safety, quality of work, defective design, and labor and equipment productivity as the most important risk categories. It is helpful for the owner to be aware of the contractor's major areas of risk to obtain a better understanding of the contractor's motivations when performing construction.

Chapman, Curtis, and Ward (1991) examine different ideas on allocation of risks by each party involved. The authors note previous research that indicated the contracting party bears risk in any one of the following cases:

- If the risk loss is due to the contractor's own willful misconduct or lack of reasonable efficiency;
- If the contractor can cover a risk by insurance and allow for the premium in settling charges, and it is most convenient and practicable for the risk to be dealt with in this way;
- If the preponderant economic benefit of running the risk accrues to the contractor; and
- If it is in the interest of efficiency to place the risk on the contractor.

Contractual allocation of risk is basically the responsibility of the owner. If the owner is unwilling to bear a particular risk, the owner can pass on this risk to the contractor but a price will be paid for doing so. To the extent that the contractor is unwilling to bear the given risk, a further increase in compensation will be sought. The owner may also incur a hidden cost caused by the contractor's behavior over the life of the project in the form of delays, poor quality, and/or claims. Chapman et al (1991) lists the four basic response options of the parties that bear the risk as:

- Pass the risk on to a third party;
- Continue to bear the risk and manage it for profit but accept potential liabilities;
- If a problem occurs, try to recover costs from other parties, including the client; and

- If a problem occurs, meet liabilities reluctantly, walk away from the contract, or go bankrupt.

Various factors influence the willingness of parties to take on risks. These include:

- General attitude towards risk
- Perception of project risk
- Ability to bear the consequences of a risk eventuating
- Ability to mitigate the risk
- Need to obtain work
- Perception of the risk/return tradeoffs of transferring the risk to another party

2.2.2 Construction Industry Institute (CII) Studies

To date, CII has conducted several research efforts relevant to project delivery and contract strategies. These efforts have mainly addressed how project delivery and contract strategies relate to issues such as relationships, compensation, and risk.

In general terms, several research efforts have discussed the importance of delivery approaches and contracting strategies. One such effort focused on the area of project performance (“Exceptional Projects...,” 1999). This research discussed project performance in terms of schedule. The study looked at engineer-procure-construct type projects that achieved extraordinary schedule results. The researchers found that twenty-five percent of cumulative schedule reduction was attributed to changes in the project delivery system. They found that project delivery on these exceptional projects were generally construction driven. The significance of this study is that it indicates that PDCS selection can influence at least one factor related to project performance, that is, project duration.

CII produced a special publication that provides an assessment of owner project management practices and performance (“Assessment...,” 1990). Part of the research described in this publication is based on the subjective assessment of 35 industry experts. The purpose of this assessment was to quantitatively measure the use of key principles and recommendations endorsed by CII on projects. The maximum utilization of contracting practices was found to provide a potential five-percent gross savings of total project cost. Again, this study found that

selecting the appropriate PDCS can have a positive influence on one area of project performance, that is, project cost.

CII also published a research report that developed a process to define the owner/contractor work structure (“Owner Contractor...,” 1997). The process focuses on defining project competencies and work relationships between owners and contractors. One of the steps in this process is to evaluate potential project execution strategies that fit the defined work structure. The execution strategy includes items such as project delivery approach and contractual arrangement.

The industry has also looked at developing new delivery systems that transform relationships in the engineering and construction process. In 1998, CII published a research summary that discussed a new relationship between owners, contractors, and suppliers (“Reforming...,” 1998). This new relationship included the supplier of strategic procurement items in the full Engineer–Procure–Construct process denoted as PEPc. In this method, the “big P” stands for strategic procurement items, which includes complicated engineered equipment necessary to achieve successful project performance. The “little p” stands for the balance of material and equipment items to be procured. This new method was stated to work well with competitive bidding. Either the owner or the constructor could contract with the supplier. Two ideas were taken from this study. First, the phasing of the design, procure, and construct process would have to be addressed when developing the set of PDCS options. Secondly, relationships would need to be addressed to determine which parties would be responsible for procurement. Additionally, the second revelation about relationships fostered the idea that other concepts involving relationships would have to be addressed such as overall project coordination or functional relationships between project participants.

A 1998 CII research report discussed innovative strategies for contractor compensation (“Innovative...,” 1998). This report established the existence of innovative contractor compensation strategies that led to higher levels of project performance. The findings provided some interesting concepts for consideration. For example, the study reviewed a case study that assigned subjective weightings to four performance criteria, for the purpose of designing an incentive plan. The four performance criteria were as follows:

- Schedule
- Cost
- Quality
- Safety

A key concept from this report was that the use of innovative compensation strategies was most effective when aligned with owner project objectives.

A CII research report titled, “Project Delivery Systems: CM @Risk, Design-Build, Design-Bid-Build” empirically compares three project delivery methods – construction management at risk, design-build, and design-bid-build (“Project Delivery...,” 1998). This comparison measures differences in performance between the three delivery methods in the areas of cost, schedule, and quality. The specific performance metrics compared were as follows:

- Unit Cost
- Cost Growth
- Cost Intensity
- Construction Speed
- Delivery Speed
- Schedule Growth
- Quality

Univariate and multivariate statistical analyses were conducted to determine which methods were statistically significant better performers for each of the performance metrics. The results showed that in virtually all of the performance metrics, the design-build approach provided statistically significant better results. This report was used to develop a tool that will be discussed in Section 2.3.

In 1986, CII published its findings on the impacts various contract types have on project performance (“Determining...,” 1986). This document classified contracts into two broad types – fixed price and cost reimbursable. It explored how three different elements influenced contract choice. These three elements were the amount of information available at contract award, the control effort required, and the allocation of risk. Of specific note is the conclusion that no single type of contract was best suited for all projects and that well tailored risk allocation was

the main driver for achieving cost benefits. This conclusion supports the basis of this study that no particular strategy is perfect for all projects. It also provided a starting point for determining which compensation approaches are currently used in industry.

CII also published a document in 1986 that discussed incentives in construction contracts (“Incentives...,” 1986). This document listed the main considerations for contract selection as: 1) the degree of firmness of owner’s desires; 2) degree of owner’s control of contract performance; 3) degree of owner’s assumption of risk; and 4) degree of owner’s value of project objectives relative to each other. The objectives studied were low cost, fast schedule, and high quality. Fixed cost, cost-plus, time and material, and labor/equipment hour contract types were evaluated to determine their effectiveness in achieving objectives. The significance of this document is that it relates contract strategy to achieving project objectives, which is a primary method of measuring project success.

Another document published by CII focused on the management of project risks and uncertainties (“Management...,” 1989). This report is basically an introduction to risk management, and applies primarily to construction contractors. However, several key points can be applied to owners also. The document stresses the importance of risk identification, measurement, and control as it relates to capital projects. It also provides a risk checklist that includes items important to owners when selecting a PDCS such as project execution strategy, type of contract, area factors, project size, site factors, monetary factors, and time factors.

2.2.3 Summary Results

The common proposition of each study reviewed is that there are many different elements that influence projects and these elements should be considered in PDCS selection to facilitate project success. Table 1 provides a summary of how each of the documents discussed in the literature review pertain to project delivery and contract strategy selection.

Table 1 Literature Review Summary

Document	Did the document address the following?			
	Project Delivery Approach	Contract Strategy	Project Objectives	Selection Factors
Choosing Appropriate Construction Contracting Method	Yes	Yes		Yes
Contracting for Engineering and Construction Projects		Yes	Yes	Yes
Engineering Project Management	Yes	Yes	Yes	Yes
Project Contract Strategy for 1992 and Beyond		Yes		Yes
Risk Management Perceptions and Trends of U.S. Construction				Yes
On the Allocation of Risk in Construction Projects				Yes
Exceptional Projects and Methods of Improving Project Performance	Yes			
Owner Project Management Practices and Performance	Yes	Yes		
Owner Contractor Work Structure	Yes	Yes	Yes	Yes
Reforming Owner, Contractor, Supplier Relationships	Yes	Yes		
Determining the Impact of Various Construction Contract Types on Project Performance		Yes		Yes
Incentives in Construction Contracts		Yes		Yes
Innovative Contractor Compensation		Yes	Yes	
Management of Project Risks and Uncertainties	Yes	Yes		Yes

2.3 Decision Tools

There have also been several efforts aimed at developing a framework and tools to assist in the PDCS selection process. An unpublished report by Saleh (1999) attempted to formulate a framework for a decision support tool to select the best delivery and contracting methods for construction projects. The delivery approaches considered were design-bid-build, design-build, construction management, and turnkey. The contract types considered were fixed price, cost reimbursable, and guaranteed maximum price. The basis of this decision support tool was that selecting the most appropriate method was dependent upon owner project objectives and risk allocation. The steps outlined in the document are as follows:

1. Prioritize owner project objectives
2. Prioritize list of drivers that influence selection
3. Determine project delivery approach from decision tree.
4. Determine contract type from decision tree
5. Assess the decision

It should be noted that this study did not develop a tool, but proposed a possible framework. The suggested framework is a set of decision trees with predefined branches that lead a decision-maker to select the most appropriate delivery approach and contract type. The predefined information found on the decision trees was not validated.

Other previous developments of decision tools to aid project managers and decision-makers in PDCS selection were the results of the efforts of business entities. The tools were developed as proprietary business processes for particular owners or a group of owners. In this category of tools are those developed by Flad & Associates (“Concepts...,” 1994) for clients involved with projects of the general building type, and Automotive Industry Action Group (AIAG) (“Business Methodology...,” 1998) for owners involved with facilities development in the automotive industry. A review of these tools showed that the sets of alternatives and selection factors that are presented vary from one tool to the other. None of the tools presents what could be considered a full compliment of alternatives and selection factors.

The AIAG developed a document to serve as a guide to help improve the role construction, architecture, process engineering, and equipment supplier's play in the automotive industry. The guideline that was developed is a vertically integrated package that assists buyers of these services. It does so by helping buyers to analyze and align their program requirements with an appropriate delivery system that compliments their goals and business philosophies ("Business Methodology...", 1998).

The document identifies five basic delivery systems that were considered in the implementation of this guideline. The five systems are as follows:

1. Turnkey
2. Design-Build
3. General Contract
4. Construction Management
5. Program Management

The document also contains a tool called the delivery system matrix that allows the owner to customize eight project criteria in order to determine a preferred project delivery method. The eight project criteria are as follows:

1. Program resolution
2. Complexity
3. Budget
4. Change management
5. Value engineering
6. Schedule
7. Owner's involvement/staffing
8. Performance accountability

There are four steps to using this tool:

1. Establish Owners Importance Factors (OIF). The owner must assign each of the eight factors a percentage weight. All of the weights should add to one hundred percent (100%).

2. Check Project Criteria Option. This option helps to better define the eight criteria. A selection is required for each category.
3. Establish Criteria Score. Multiply the OIF by the Project Delivery Method Ranks associated with the option selected in Step 2. Repeat for all categories.
4. Determine Project Delivery Method Scores. Vertically sum up all scores for each method. The highest score indicates the preferred method.

The document also provides a chart called the Pricing Structure Application Chart. This chart ranks three pricing options against the five delivery methods. The pricing methods are somewhat limited because it does not discuss which compensation approaches apply to the different parties involved.

A decision package created by Flad & Associates (“Concepts...,” 1994) was also developed as a tool for the selection of a project delivery system and contract compensation approach. Seventeen project factors (five physical project factors and 12 business factors) were identified along with four team structure options, and four construction-pricing options. The seventeen factors are:

1. Size/Dollars: Achieve high cost project
2. Complexity: Functional or construction complexity
3. Uniqueness: Address non-prototypical project requirements
4. Proximity: Manage project remote from owner
5. External Approvals: Help secure earliest possible approvals
6. Goals: Clarify linkage of business and project goals
7. Experience: Supplement owner’s experience or capacity
8. Decisions: Assist owner to make timely decisions
9. Construction Liability: Indemnify against construction liabilities
10. Business Risks: Reduce business/opportunity risks
11. Quality: Maximize control of aesthetic and physical quality
12. Change: Adjust to potential business/scope changes during project
13. Schedule: Achieve fastest schedule possible
14. Cost: Achieve lowest construction cost

15. Early Cost Guarantee: Achieve earliest cost approval and/or financing
16. Value: Maximize operational return on investment and/or facility life-cycle value
17. Cultural Factors: Example - bias toward bidding

The four-team structure options are:

1. Owner, Architect/Engineer (A/E), Contractor: Traditional Design-Bid-Build option. Contractor not involved in planning.
2. Owner, Construction Manager/General Contractor (CM/GC), A/E: Construction Manager is also general contractor. CM/GC and A/E participating in planning.
3. Owner, Agency CM or Project Manager (PM), A/E, Contractors: CM or PM does not assume construction or project risk. Team participates in planning.
4. Owner, Design/Builder(DB): Single entity contract, early DB selection, and team planning.

The four construction pricing options include:

1. Competitive Bid – Agreement to perform work for a fixed price. Based on complete plans.
2. Guaranteed Maximum Price – Perform work for cost plus a fee to a maximum price. Based on scope plans.
3. Cost Plus Fee – Agreement to perform work for cost plus a fee and no maximum price.
4. Negotiated Lump Sum – Agreement to perform work for a fixed price based on negotiated requirements.

A decision matrix provides pre-defined effectiveness weights for each of the team options and pricing options against the seventeen project factors. Benchmark rankings of the seventeen factors were developed from 110 survey responses. A decision-maker performs the following steps:

1. Assign an importance score from zero to five to each of the seventeen factors, where zero is not important to the project and five is highly or absolutely important to the project. The factors receiving a score of five are considered “critical success factors.”

Although the other factors are important, they are not considered to be critical to the selection of a delivery system.

2. Each factor previously determined critical is multiplied by the pre-defined effectiveness rate for each team option and pricing option.
3. The scores are totaled for each team and pricing option. The options with the highest total scores are considered the most effective for the project.

A workbook was developed based on the findings of CII Research Project 133-11, which is reviewed in the previous section. The workbook (Sanvido and Konchar 1998) is structured as a guide for a decision-maker to follow in selecting a project delivery system. The alternative delivery approaches considered are Construction Management at Risk, Design-Build, and Design-Bid-Build. The structure of the decision process is to use a selection matrix that shows how the three delivery approaches compare to each other in eight defined performance metrics. The six-step process is summarized below:

1. Classify the project type according to six prescribed categories (light industrial, multi-story dwelling, simple office, complex office, heavy industrial, or high technology). Determine the three most important performance metrics from a list of eight metrics. The eight performance metrics are unit cost, construction speed, delivery speed, cost growth, schedule growth, turnover quality, system quality, and process equipment quality. Each of the metrics has two statements to relate how the project under consideration relates to the metric. Each statement is scored from 5 (more important) to 1 (less important). The two scores are totaled to provide the metric score. The three performance metrics with the highest score are the three most important.
2. The top three metrics are used in the System Selector Matrix to identify the optimum delivery system. The matrix is structured to show, for a given facility type, how the three delivery approaches compare to each other for each of the eight performance metrics. The guide does not explain what to do in the event the suggested optimum delivery approach is different for the top three metrics.

3. Steps three through six provide guidelines when the suggested optimum delivery approach cannot be used. This information is outside the scope of this report and, therefore, not included.

Table 2 provides a summary of each of the tools previously discussed by indicating the extent to which the tools address the follow four areas: project delivery approach; contract strategy; project objectives; and selection factors. None of these tools comprehensively addressed each of the issues. As previously stated, one goal of this study is to comprehensively characterize project delivery and contract strategy options and selections factors.

Table 2 Decision Tool Summary

		Did the tool address the following?			
Author	Tool	Project Delivery Approach	Contract Strategy	Project Objectives	Selection Factors
Saleh	Selecting the Most Appropriate Contract Strategy	Limited	Limited	Yes	Limited
AIAG	Business Methodology and Delivery System Selection Process Guidelines	Limited	Limited	No	Limited
Flad	Concepts for Improved Project Delivery	Limited	Limited	No	Yes
CII	Project Delivery System Selection Workbook	Limited	No	No	Limited

CHAPTER III

RESEARCH METHODOLOGY

3.1 Overview of Research Approach

This research is based on the premise that a comprehensive PDCS selection process and tool will aid owners in completing successful projects. The classification of the research is mostly applied. A combination of both qualitative and quantitative approaches is used in this research.

A search was conducted to find literature related to project delivery approaches and contracting strategies. The literature review served as a source of background information that aided in the understanding of the issues involved in selecting project delivery and contracting strategies.

A set of PDCS options, project objectives, and selection factors were developed based on the literature review and industry input. The goal was to comprehensively capture both the PDCS options currently in use and the criteria that led to their selection. A questionnaire was developed to gather data on these existing practices regarding PDCS selection. Three methods of administering the questionnaire were investigated. The three methods were mail-only, mail with follow-up phone call, and in-person interview. A broad range of owner organizations were targeted so that many different project types would be represented.

The questionnaire provided valuable input for finalizing the PDCS options and selection factors that would eventually be used to develop a decision-making process and tool (Oyetunji and Anderson, 2001). The questionnaire-solicited information specific to individual projects such as project characteristics, project delivery approach, and compensation strategy used, prioritized project objectives, and prioritized selection factors. The objective of the questionnaire was to validate the use and comprehensiveness of the set of PDCS options, project objectives, and selection factors. Further, the questionnaire helped determine the relative importance of the project objectives and selection factors.

Analyzing the data was the most critical part of this research effort. The results determined how to proceed with the development of the selection tool. On an overall basis, an evaluation was made to describe the data collected by categories such as project type, location, cost, and schedule. More importantly the distribution of selected PDCS options, objectives, and factors was determined. The frequency of selection indicates how common the use of each PDCS option, a project objective, and a selection factor is in the construction industry, thus confirming the set of predefined PDCS options.

Analysis was also conducted on a more detailed level. Each PDCS option was evaluated in a manner similar to that conducted on the overall basis. This evaluation included partitioning the data in order to find trends in PDCS option selection. Furthermore, each PDCS option was studied to determine the relative importance of each project objective and selection factor as each relates to an individual PDCS option. The goal of this analysis was to provide direction for the development of a selection process and tool.

3.2 PDCS Option Development

Project delivery and contract strategy defines the roles and responsibilities of the parties that are involved in a project team, and how the owner pays for services. A list of 11 different PDCS options was developed. The 11 PDCS options were based on input from 13 companies with membership on CII Research Team 165. Ten of these 13 companies represented owner organizations while the remaining three represented contractor organizations. Seven of the owner organizations were private companies representing the chemical, power, pharmaceutical, steel, automotive, and manufacturing industries. The three public organizations engaged in projects related to institutions of higher education, federal buildings, and federal aerospace facilities. Two of the three contractors focused on general building projects while the third was a specialty mechanical contractor.

In May of 1999, the research team held a two-day meeting where each research team member made a formal presentation that included their descriptions of typical delivery approaches and compensation methods used by their companies. The presentations included discussions on project phasing, relationships of primary parties, and compensation approaches.

The presentations focused primarily on the project phases of engineering/design, procurement, and construction.

The information presented at the May meeting, the information obtained from the literature review, and the experience and knowledge of the academic team was combined and filtered through three distinct characteristics, which were phasing, relationships, and compensation approach. Through this filtration effort the eleven distinct PDCS options were developed. This standard format was established in order to consistently specify the characteristics of each option. In another two-day meeting in August 1999, the first draft of the PDCS options was reviewed by the research team. Based on comments from that meeting, the PDCS options were revised. A final version of the proposed PDCS options was established after incorporating concerns of the CII research team during a meeting in October 1999.

3.2.1 Key Assumptions

While establishing the 11 PDCS options, several assumptions were made. The following is a discussion of those key assumptions.

While the life cycle of a typical project includes business planning and pre-project planning (or front-end loading), the PDCS options in this study exclude these phases. For this study, PDCS options begin with detailed design of the project. An owner may choose to include the participants that would be involved in the PDCS in pre-project planning; however, such relationships are not addressed in this study.

Although commissioning and start-up are required functions of a project, the level of involvement of contracted participants in these functions will vary according to an owner's policies. Therefore, commissioning and start-up are excluded from the relationships addressed in this study with one noted exception. One PDCS option was included to capture those instances when the owner has no involvement with commissioning or startup generally known as a "turnkey" project.

Joint ventures and alliances are "umbrella" relationships that ride above a particular project and PDCS approach. These relationships do not differentiate one PDCS option from another because they can be applied with any PDCS option. Joint ventures and alliances are not

distinct characteristics of any particular PDCS option and are, therefore, excluded from the definition of the PDCS options.

Incentives, disincentives, and shared savings can be included in any compensation approach. They are not distinct characteristics of any particular PDCS option and are, therefore, not included in the definition of the options.

Build-own-operate-maintain (BOOM) strategies are not included as a PDCS option. These strategies are based on third party financing and ownership. The PDCS options included in this research are based on owner financing.

3.2.2 Key Definitions

Several definitions also had to be determined while establishing the PDCS options. The following is a list of those important terms:

- **Design:** Architectural and/or engineering services occurring after project authorization to prepare plans and specifications for construction of permanent facilities. Services provided prior to project authorization are considered part of the pre-project planning process.
- **Procure:** The processes associated with the specifying, acquiring, and transporting to the work site engineered equipment and bulk materials (concrete, steel, pipe, etc).
- **Construct:** The processes associated with physical construction, starting with construction mobilization and ending with project completion, excluding commissioning and start-up.
- **Firm Price:** Compensation contract for design or management services based on a predetermined, fixed amount or a predetermined, fixed percentage of total estimated facility cost.
- **Competitive Lump Sum:** Compensation contract based on a fixed price lump sum award to lowest bid from multiple bidders.
- **Negotiated Lump Sum:** Compensation contract based on negotiations for a fixed price lump sum amount.
- **Cost Reimbursable + Fee:** Compensation contract based on reimbursement of actual costs plus a fixed or variable fee.

- **Guaranteed Maximum Price (GMP):** Compensation contract based on cost reimbursable plus fee up to a maximum price. The fee could be fixed or variable.
- **Unit Price:** Compensation contract based on fixed price for units of work or materials placed.

3.2.3 PDCS Descriptions

As mentioned previously, the 11 PDCS options were filtered through the three distinct characteristics of phasing, relationships, and compensation approach. This standard format was developed to easily describe each PDCS option. The following sections describe the legend for interpreting the characteristics of each PDCS option.

3.2.3.1 Phasing

The three major project segments of design, procurement and construction are represented in open-ended boxes. This indicates the variability in the duration of these activities from project to project. The sequencing of these activities relative to each other is indicated by the relative positions of the boxes. Figure 1 shows an example of PDCS phasing.

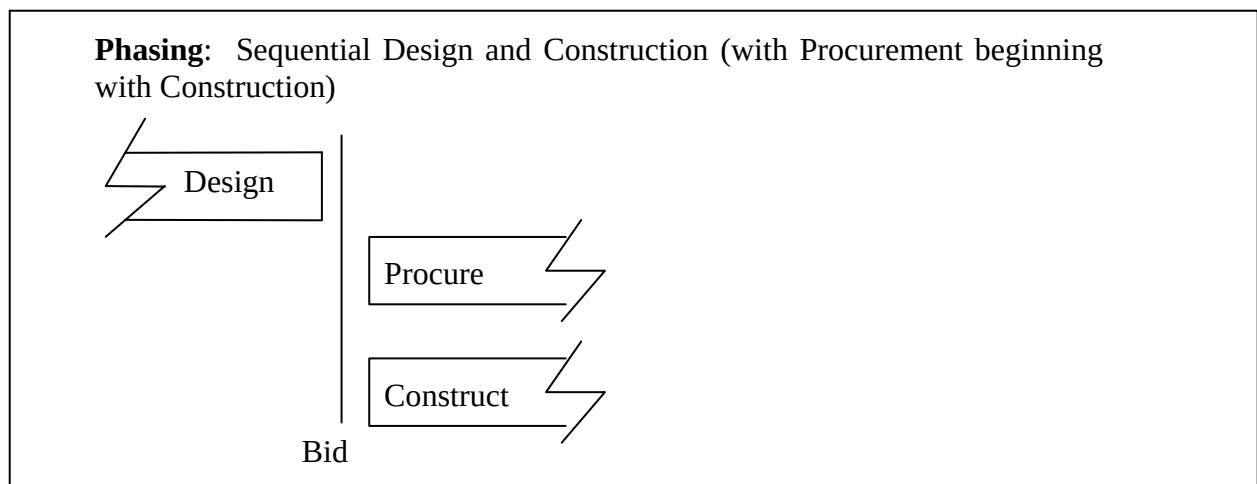


Figure 1 PDCS Phasing Example:

3.2.3.2 Relationships

Relationships are defined as contractual and functional. Contractual relationships are those relationships defined through a legal, binding contract. Functional relationships are those relationships through which coordination and/or management of the project is achieved.

The most common primary contractual relationships that are used for a given PDCS option are presented as non-boxed text. Other possible primary contractual relationships that may be encountered with a PDCS option are presented as boxed, italicized text, in a descending order of common use. Figure 2 shows an example of PDCS relationships.

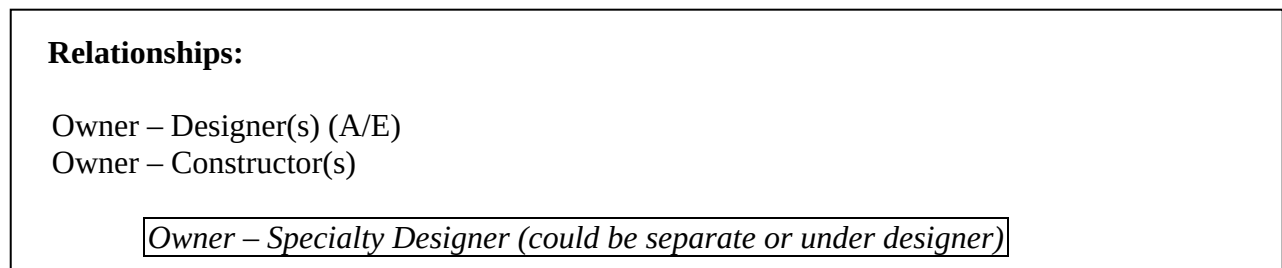


Figure 2 PDCS Relationship Example

In the graphical representation of the primary contractual and primary functional relationships, the parties that are normally involved in the relationships are shown in solid circles. Other primary contractual/functional relationships that occur less frequently, such as environmental consultants, are shown in dashed circles. Solid lines with two-way arrows are provided to indicate the functional relationships within the project team. Although secondary functional relationships may exist they are not shown. The focus is on primary functional relationships only. Figure 3 shows a graphical example of PDCS relationships.

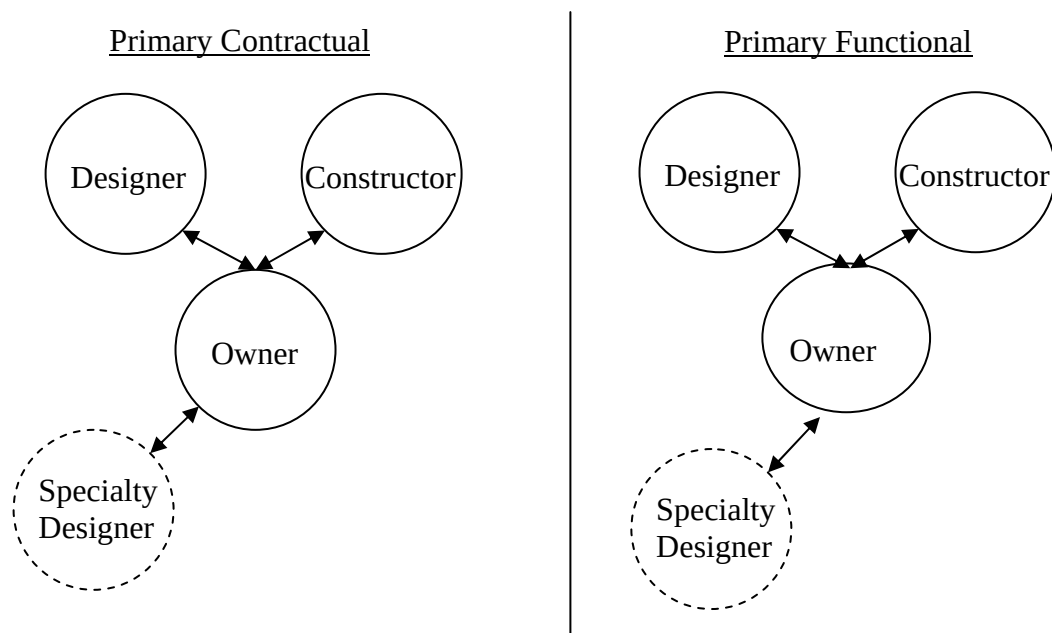


Figure 3 PDCS Graphical Relationship Example:

3.2.3.3 Compensation

For each primary contractual relationship, the most common type of compensation approach is presented as non-boxed text. Alternative compensation approaches that may be encountered are presented as boxed, italicized text, in a descending order of common use. Figure 4 shows a graphical representation of a compensation approach.

Designer(s)	– Firm Price
	<i>Cost reimbursable + fixed fee</i>
Constructor(s)	– Competitive Lump Sum
	<i>Unit Price</i>
	<i>Guaranteed Maximum Price</i>
	<i>Cost Reimbursable + Fee</i>

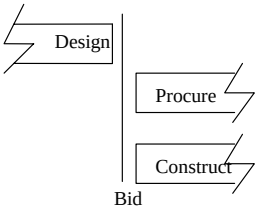
Figure 4 PDCS Compensation Example

3.2.4 PDCS Options

Figures 5 through 15 depict the eleven PDCS options proposed. Each option is shown as it was defined for purposes of assessing its general level of use in the construction industry. Each PDCS option includes the primary contractual and functional relationships between project participants including alternatives in some cases. Potential compensation approaches between the owner and other project participants are also shown. PDCS option titles were not used during data collection in order to prevent respondent bias. The goal was to have each respondent review all eleven options, before choosing the one that best fit the project for which the respondent provided data. Descriptive titles for each PDCS option were determined after data collection was completed. Detailed discussions of each PDCS option will be presented in Chapter V.

PDCS OPTION 1

Phasing: Sequential Design and Construction (with Procurement beginning with Construction)

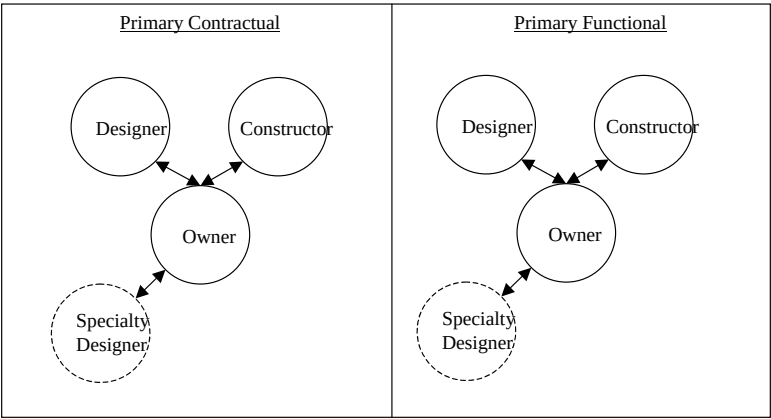


Relationships:

Owner – Designer(s) (A/E)

Owner – Constructor(s)

Owner – Specialty Designer (could be separate or under designer)



Compensation:

Designer(s) – Firm Price

Cost reimbursable + fixed fee

Constructor(s) – Competitive Lump Sum

Negotiated lump sum

Unit Price

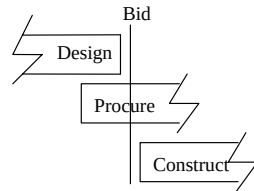
Guaranteed Maximum Price

Cost reimbursable + fee

Figure 5 PDCS Option 1

PDCS OPTION 2

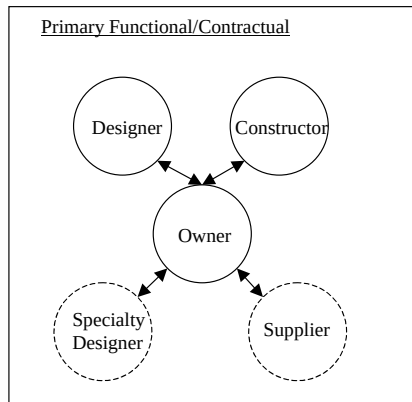
Phasing: Sequential Design and Construction (with Procurement beginning during Design)



Relationships:

Owner – Designer(s) (Designer procures special long lead equipment and/or materials)
Owner – Constructor(s)

<i>Owner – Specialty Designer</i>
<i>Owner – Supplier</i>



Compensation:

Designer(s) - Cost Reimbursable + Fee

<i>Firm Price if Owner buys equipment</i>
<i>Supplier – Firm Price</i>

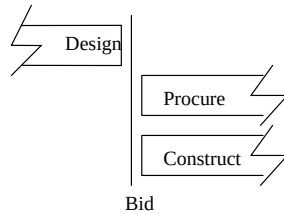
Constructor(s) – Competitive Lump Sum

<i>Negotiated Lump Sum</i>
<i>Unit Price</i>
<i>Guaranteed Maximum Price</i>
<i>Cost Reimbursable + Fee</i>

Figure 6 PDCS Option 2

PDCS OPTION 3

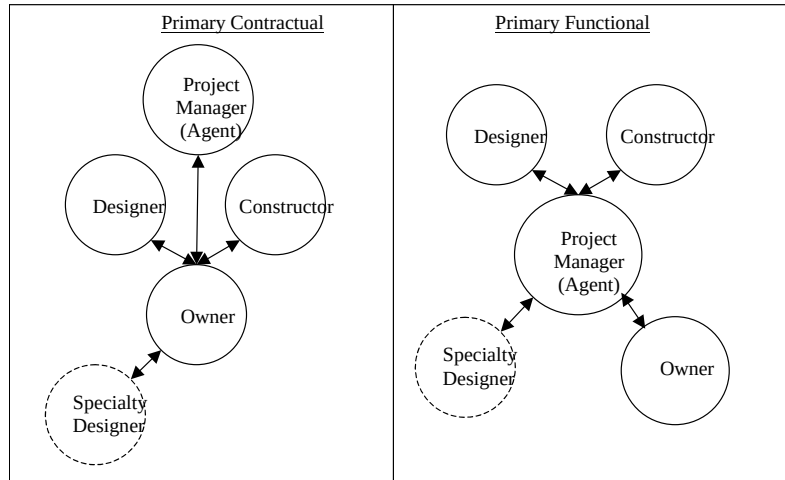
Phasing: Sequential Design and Construction (with Procurement beginning with Construction)



Relationships:

Owner – Designer(s)
 Owner – Project Manager (Agent)
 Owner – Constructor(s)

Owner – Specialty Designer



Compensation:

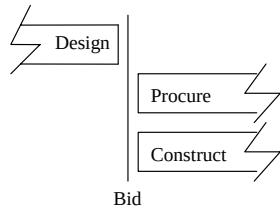
Designer(s) – Firm Price
 Project Manager – Firm Price
 Constructor(s) – Competitive Lump Sum

Unit Price
Guaranteed Maximum Price
Cost Reimbursable + Fee

Figure 7 PDCS Option 3

PDCS OPTION 4

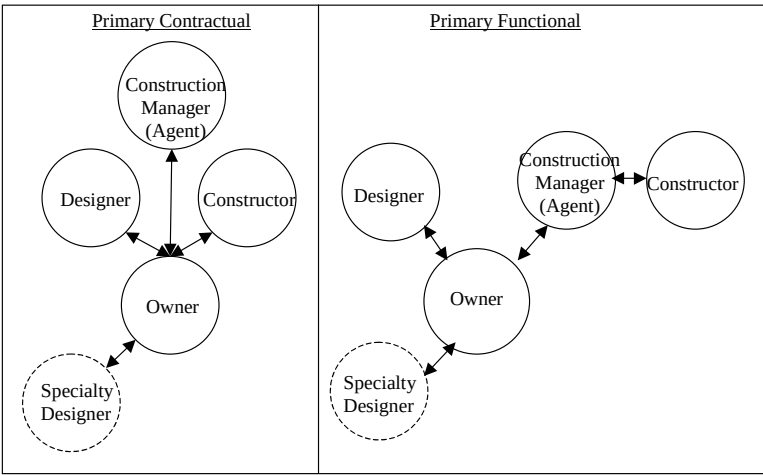
Phasing: Sequential Design and Construction (with Procurement beginning with Construction)



Relationships:

Owner – Designer(s)
Owner – Construction Manager (Agent)
Owner – Constructor(s)

Owner – Specialty Designer



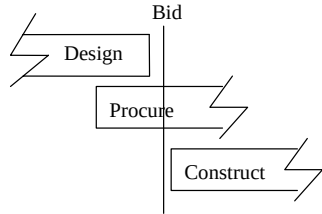
Compensation:

Designer(s)	– Firm Price
CM (Agent)	– Firm Price
Constructor	– Competitive Lump Sum
	<i>Negotiated Lump Sum</i>
	<i>Unit Price</i>
	<i>Guaranteed Maximum Price</i>
	<i>Cost Reimbursable + Fee</i>

Figure 8 PDCS Option 4

PDCS OPTION 5

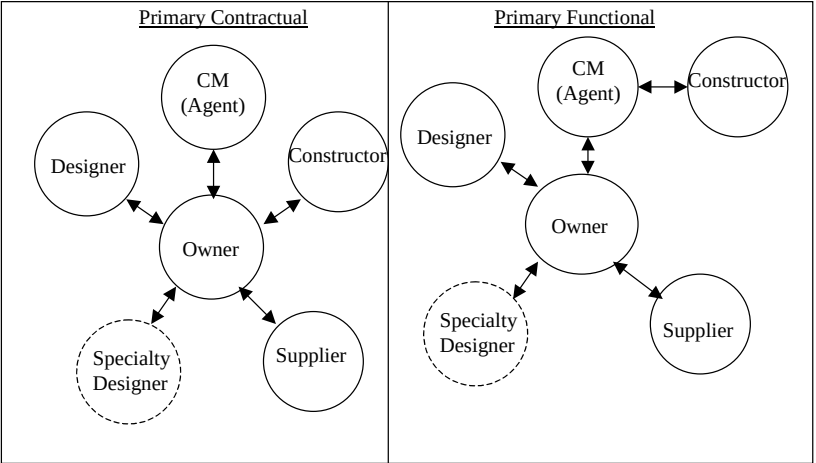
Phasing: Sequential Design and Construction (with Procurement beginning during Design)



Relationships:

- Owner – Designer(s)
- Owner – Construction Manager (Agent)
- Owner – Constructor(s)

Owner – Specialty Designer



Compensation:

- Designer(s) – Firm Price
- CM (Agent) – Firm Price
- Constructor – Competitive Lump Sum

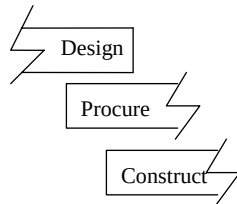
<i>Negotiated Lump Sum</i>
<i>Unit Price</i>
<i>Guaranteed Maximum Price</i>
<i>Cost Reimbursable + Fee</i>

- Supplier – Competitive Lump Sum

Figure 9 PDCS Option 5

PDCS OPTION 6

Phasing: Overlapped Design and Construction

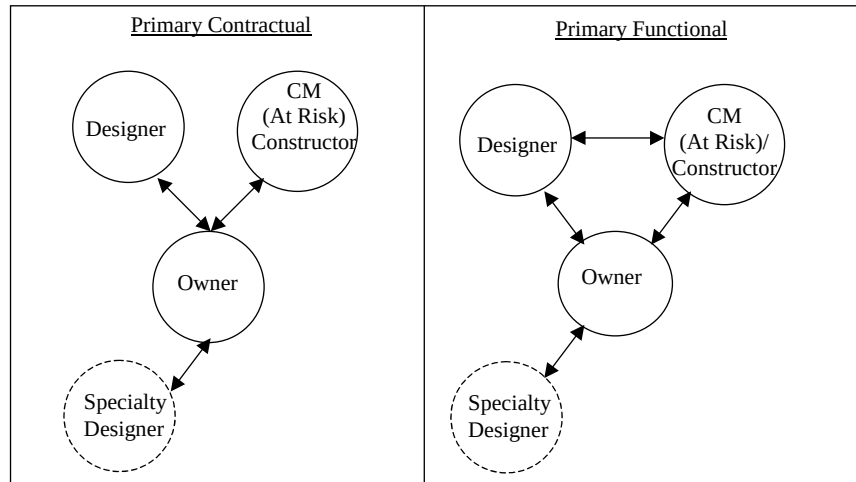


Relationships:

Owner – Designer(s)

Owner – CM (At Risk)/Constructor

Owner – Specialty Designer



Compensation:

Designer(s) – Firm Price

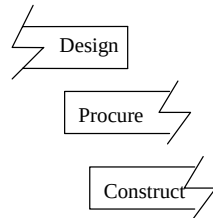
CM (At Risk)/Constructor – Cost Reimbursable + Fee during Design then convert to GMP for Construction

CM (At Risk)/Constructor – Firm Price during Design then convert to GMP for Construction

Figure 10 PDCS Option 6

PDCS OPTION 7

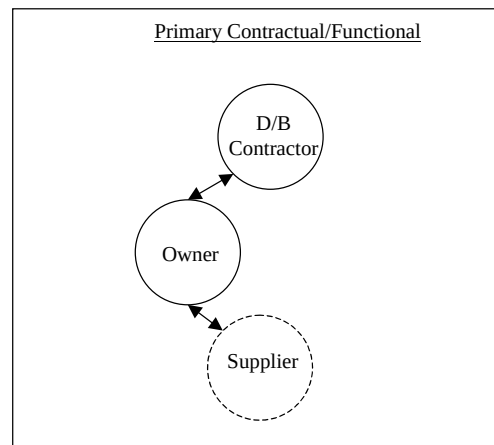
PHASING: Overlapped Design and Construction



Relationships:

Owner – Design/Build (D/B) Contractor

Owner – Supplier



Compensation:

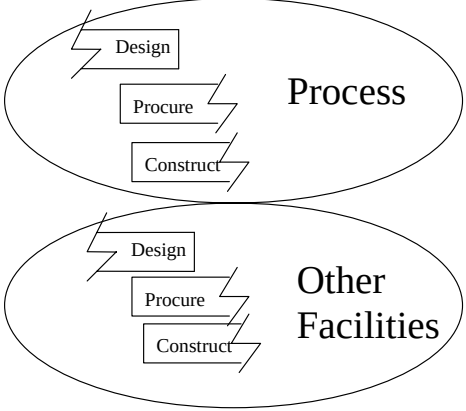
DB Contractor – Competitive Lump Sum

<i>Negotiated Lump Sum</i>
<i>Cost Reimbursable + Fee</i>
<i>Cost Reimbursable + Fee w/ Guaranteed Maximum Price</i>

Figure 11 PDCS Option 7

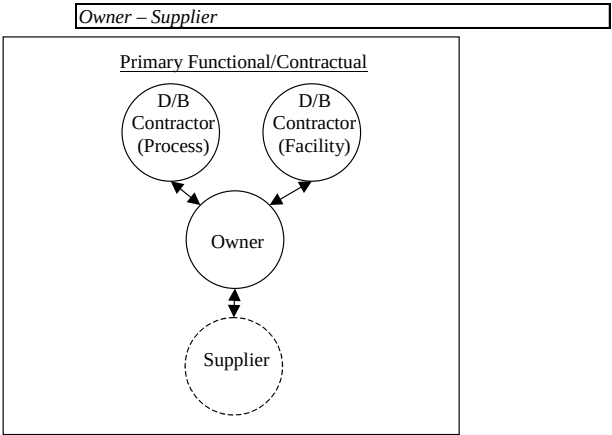
PDCS OPTION 8

Phasing: Overlapped Design and Construction



Relationships:

Owner – Design/Build Contractor (Process); includes engineering or specialty supplier
Owner – Design/Build Contractor (Other Facilities)



Compensation:

DB Contractor –	Competitive Lump Sum
	<i>Negotiated Lump Sum</i>
	<i>Cost Reimbursable + Fee</i>
	<i>Cost Reimbursable + Fee w/ Guaranteed Maximum Price</i>

Figure 12 PDCS Option 8