



Construction Industry Institute®

Starting from Scratch: A New Project Delivery Paradigm

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The University of Texas at Austin

Under the Guidance of
CII Research Team 271
Innovative Project Delivery Processes – Is There a Better Way?

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Executive Summary

RT271 was challenged to rethink the capital project delivery system. We tried to dream how the system could be different than it is, at both the industry and project levels. While developing dreams into testable hypotheses, we were struck how easy it was for a group of diverse industry practitioners and academic researchers to agree on an ideal project delivery system. That raised the question why then wasn't everyone working to create it?

We found an explanation in the theory of paradigms, which says that the way we think and behave is driven by fundamental presuppositions about the world. Thomas Kuhn (Kuhn, 1996) revealed how scientific knowledge progresses. Far from the methodical accumulation of knowledge previously understood, science moves through periods of revolutionary upheaval, in which fundamental presuppositions and conceptualizations change. An example of such a paradigm shift is the change to seeing the sun as opposed to the earth in the center of the universe. As a historian of science, Kuhn documented the process of paradigm shift, noting the difficulties opposing camps had in even talking with one another. Rational discussion requires shared presuppositions. When presuppositions are radically different, rational discussion gives way to battles—sometimes physical battles, but in the case of scientific disputes, more often battles in which experiments are the weapons of choice.

When experiments yield anomalistic results, they reveal underlying presuppositions and cause some people to question those paradigms. On the other side of the battle, those who have spent their careers believing in certain paradigms may never be able to “get their head around” new ways of thinking and acting. Kuhn tells sad stories about able, intelligent scientists who were never able to embrace the new theory of combustion.

RT271 came to think that realization of the ideal project delivery system is best understood as a clash of paradigms. What paradigms underlie and inform current thinking and practice in construction project management? Here are a few:

- Trust is for suckers.
- Win-win is an illusion. What counts is that I win.
- You can manage projects by managing contracts.
- Risk is managed when transferred to someone else.
- If you pay least price for each part of a project, you pay least price for the project.
- Management by results yields the best results.
- Variation in work flow is from external causes.
- Resource utilization trumps project flow.
- Control starts with identifying a negative variance between DID and SHOULD.
- Social factors are interesting, but don't really matter.

Such paradigms may be understood as “common sense,” or the “no-nonsense” way of viewing the world realistically and pragmatically. But in fact, they are obstacles to a much better world—a world in which the construction industry is known for challenging and developing people, in which personal relationships not only survive projects but thrive in them, in which continuous improvement is a fact of life. The ideal capital project delivery system we developed provides the following benefits:

- aligns the interests of the parties with the interests of the customer(s)
- integrates organizationally, engaging downstream players in upstream work and vice-versa
- places management attention on enabling successful performance, as opposed to enforcing compliance to overly detailed prescriptions how to achieve desired objectives.

“Capital project delivery system” can also be understood as referring to the construction industry itself; its structure, its capabilities, its ways of working. In our dreaming about the construction industry as a whole, we see a system that is self-conscious and self-directing, causing its own future—an industry which breaks free from the unproductive and wasteful oscillation between buyers’ market/sellers’ market and lives the dream of

continuous improvement. This dream would have the industry collectively shape the context in which individual project delivery systems are designed, rather than simply react to what is given.

How context can be shaped

In general, construction projects have been getting more complex, more uncertain, and pushed to go ever faster. Some of that complexity and uncertainty is a result of technology, globalization, and other factors that are difficult if not impossible to manage. However, some of that complexity and uncertainty is a result of the way projects are managed; examples of this dynamic include the following:

- Only absorbing variation through buffers of time, materials, money and capacity; as opposed to first attacking and reducing the variation that needs to be buffered
- Optimizing the part, not the whole--as if speeding each process or reducing each purchase price makes the project faster or less costly (which would only be the case if all parts and processes were independent)

Contextual factors may limit design and implementation of the ideal project delivery system. Such factors include available time, procurement regulations, and the capabilities and attitudes of potential project team members. These are at least partially within industry control, and could be affected by the following changes:

- The industry could practice “go slow to go fast,” leaving sufficient time for optimizing project delivery, as opposed to rushing to start and wasting opportunity.
- The industry could impact procurement regulations, e.g., in the public sector.
- The industry could include in project strategies and budgets the development of customer and contractor capabilities, going beyond craft and technical skills to create a shared culture and the needed soft skills.

Dreaming and Beyond

To be most effective, dreaming must not be limited by presuppositions. Yet, we are creatures of our own histories. The past inevitably shapes our thinking about the future. We may say the same about dreaming as about planning; both are inherently imperfect, but both are absolutely necessary.

You will be the judge of the quality of our dreams, but whatever their quality may be, dreaming is not enough. We call on industry leaders to challenge existing paradigms, to attack the obstacles to a better future, and to create the ideal capital project delivery system described in this report.

Chapter 1

Introduction

1.1. Background

Project delivery systems are used in the construction industry for organizing the performance of construction work and assigning the roles and responsibilities to project parties. Several types of project delivery systems have been created in the industry, mostly in the last few decades, to help owners achieve their time, cost and quality targets. Systems are usually selected and applied for a project on the basis of project characteristics, project priorities, owner preferences and sources, and market conditions.

Construction projects have been delivered through a variety of systems. In the beginning and through much of the industry's history, this delivery was conducted through an integrated approach in which the master builder was responsible for design and construction of a project. Later on, design and construction practices started to separate and professional communities emerged. Design-Bid-Build (DBB) was mandated by the US government in the twentieth century to protect the owners from corruption by separating designers of a project, who were selected based on the quality of their work, from the contractors who were selected based on the lowest responsible bid. However, this fragmented approach to delivery did not work mostly because of the time and cost overruns and the adversarial relationships it promoted.

In the late twentieth century, however, the construction industry started to move towards more integrated delivery approaches. Design-Build (DB) is a major example in which a single entity assumes the responsibility of design and construction of a project. Integrated Project Delivery, as the most recent approach, brings in all parties involved in delivery of a project, such as owners, designers, contractors, subcontractors, suppliers, etc., into an integrated team which then, they are assigned the responsibility of delivery of the project as a team not as separated entities.

1.2. Problem Statement

Extensive research and published material exists addressing owner, contractor, and supplier relationships and contracting methods. Also, there exist a variety of capital project delivery systems in construction industry which all aim at delivering projects to project owners with desired quality and within expected cost and schedule. These project delivery systems are pre-defined systems and processes each defined to address some of the many problems that keep owners of projects from achieving their desired results. According to results of researches done on the impact of these project delivery systems on project performance and success, however, the outcomes of applying these delivery processes are still disappointing to owners and not promising to a major part of the construction industry.

Research Team 271 was established and funded by Construction Industry Institute (CII) to address the problem by developing a new and innovative approach to capital project delivery. The purpose of this research is to put aside the conventional methods and iterative improvement approach and start from scratch to develop a new and innovative approach. By assuming a scenario where no convention exists, the researchers are not constrained by the inefficiencies of legacy systems. Accordingly, the primary purpose of this research is to answer the essential question: “If the capital project industry did not exist and a new need was created for it, what would it look like?”

The authors of this research believe that delivering projects that meet owner’s values and expectations cannot be achieved by merely selecting from a list of project delivery systems and contracting strategies. Instead, project delivery systems should be adapted to the contexts that create unique characteristics of owners and projects. Project delivery systems should be viewed as products of design which can achieve the best outcomes through integration of organizations and people, alignment of interests and Management-By-Means (MBM). This cannot be achieved unless the mindsets in construction industry start to change. Indeed, these mindsets perform as obstacles to ideal approaches of project delivery. Lack of trust and the assumption that achieving win-win solution is an illusion, using managing contracts to manage projects, transfer of risks to

other parties, ignoring social factors and so on are just some examples of these mindsets which should be rectified.

1.3. Research hypothesis

Based on the extensive survey of literature and contributions of CII research team 271, the research hypothesis developed and tested through quantitative and qualitative approaches is as follows:

Complex, uncertain and quick projects perform better when designed and managed in accordance with alignment of interests, organizational integration, and management-by-means (lean) methods.

The hypothesis was developed based on the following evidence and considerations:

- Anecdotal data suggest that projects have been becoming more uncertain, complex and quick for a number of years, but project management education and bodies of knowledge are still based on the model of slow, simple and certain projects.
- What percentage of projects really are slow, simple and certain? In determining whether owners and contractors view the acquisition of a project as the purchase of a product or the effort of a problem solving team, CII Task Force 84 found extensive uncertainty regarding both project ends and means well into construction.

1.4. Research Objectives

The major objectives of this research may be stated as follows:

- a. Identify an innovative approach to capital project delivery that can be applied and adapted to the context of individual projects in order to achieve the best outcomes.

- b. Challenge the industry and its customers to create the conditions in which the ideal project delivery system can be realized.

The research objectives were attempted through a combination of qualitative and quantitative research methods. A comprehensive review of existing literature in the field and creative thinking workshops were steps in the research to achieve the vision to the new ideal project delivery system, and to develop the hypothesis. The hypothesis was then tested and validated through statistical analyses and case-study research. Finally, a design guideline was provided by the research team to help the industry move toward the new project delivery approach.

1.5. Research Scope and Challenges

The scope of this research project is limited to project delivery systems as practiced in construction of facilities for the process industries. While many aspects of this research and its outcomes can be generalized to other sectors of the construction industry, those sectors fall out of the scope of this research. Also, we are seeking conceptual levels of changes in project delivery rather than structural changes. Thus, we are not aiming at introduction of a new type of project delivery systems but instead, a new paradigm of project delivery which wants to change the mindsets of the industry.

The main challenge in conducting this research has to do with the issue of data. The available CII-benchmarking database, which the research team relied on for testing the hypothesis, did not include all indicators needed to measure the hypothesis completely¹. As a result, researchers used supplementary methods to overcome this challenge.

The other challenge is the research topic itself. The paradigm shift required to radically change the way projects are delivered is by its very nature out of the comfort zone of the industry. Creative thinking workshops helped the research team overcome

¹ Refer to the Chapter 3 and 4 for further discussion.

this challenge and brought in the perspective of owners, contractors, designers, and suppliers.

1.6. Outline of the Report

This chapter deals with problem statement, research hypothesis and questions, research scope and challenges, and an overview of remaining chapters.

Chapter 2 is a review of the existing, relevant literature. The researchers searched a variety of areas within the realm of construction project delivery to examine how project delivery systems are designed and what factors influences their design. Chapter 2 starts with a review of the history of Project Delivery Systems (PDSs) and their definitions and gets to the selection criteria for choosing various PDSs. Finally, the main components of PDSs were identified and explored in the literature. These components, which include organization integration, alignment of commercial interests and management-by-means, were used in later phases of research to construct the hypothesis.

Chapter 3 attempts to explain the research methodology applied in this project. Literature review, creative thinking workshops for hypothesis development, quantitative and qualitative research for hypothesis testing and refinement, and development of a call to action were the main phases in this research project. Chapter 2 makes an in-depth explanation of how each phase in research methodology was performed, what tools were applied, how data were collected and analyzed, etc.

Chapter 4 of this report describes how the ideal project delivery system was developed and the transition from ideal project delivery system to a testable hypothesis. Finally, it explains how the hypothesis was tested through a combination of quantitative and qualitative data analyses. The data needed for this part of research was provided through an existing CII-benchmarking database and from a questionnaire survey on volunteered projects.

Chapter 5 presents conclusions and recommendations for future research. It also includes a “call to action” intended to guide industry practitioners in changing the current project delivery paradigms.

Chapter 2

Literature Review

This chapter explores the existing relevant literature on project delivery. The goal is to locate the gaps in the knowledge by a survey of the existing research in the area.

The master builder concept, in which a single entity was responsible for design and construction phase of a project, has been the dominant concept in construction since ancient times. Only in the last two centuries has the idea developed to separate design and construction professionals. In recent decades, however, assigning the responsibility of design and construction to a single integrated entity has again gained popularity and resulted in development of project delivery systems like Design-Build, CM at Risk and Integrated Project Delivery. The new era might be dubbed the “collective master builder”, as it is no longer possible for a single individual to have the knowledge and know how required to design and construct.

The research team’s literature review attempted to explore this history of Project Delivery Systems (PDSs), their definitions and characteristics as well as their selection factors. PDSs are usually selected based on different factors addressing project characteristics, owner preferences, project needs and success requirements and market environment. Also, it was discovered that project organization and commercial terms are recognized in the literature as foundational elements of project delivery systems.

Another important finding from literature review and industry input was the claim that organizational integration, alignment of commercial interests and Management-By-Means are capable of addressing the founding elements of PDSs in an optimum way. In particular, Integrated Project Delivery (IPD) was realized as a recent effort to address integration, Management-By-Means methods and alignment of commercial interests in the construction industry.

2.1 History

The history of project delivery systems is as old as the history of buildings and construction. According to Beard et al (2001), the Code of Hammurabi (1795-1750 B.C.), which was developed in the era of Babylon, the ruler of Babylon, is among the oldest documents that recognizes the builder as responsible for design and construction of a building and in this way, tries to protect the owner's interests. Centuries later again, Roman architect, Vitruvius, recognized a single individual as responsible for design and construction of buildings (Beard et al 2001). This approach continued in medieval times and resulted in delivery of most of that period's masterpieces. In this approach, master builders, as the entity responsible for project delivery, designed a project, supervised craftsmen, provided materials and controlled all aspects of the project (Cushman and Loulakis 2001). The master builders can be interpreted as equivalent to contemporary Design-Build (DB) contractors (Ghavamifar et al 2008).

The opponent of the master builder approach, however, believed that the architect's task is different from builder's one. Indeed, the approach was initially criticized in 15th century Italy by architects such as Leon Battista Alberti who believed that the architect is the one who should provide simple designs of a building and that the construction superintendent is the one who performs design and construction (Cushman and Loulakis 2001).

However, separation of design and construction practices did not happen until the nineteenth century and after the industrial revolution. New types of buildings such as factories which were relatively complex required designers with more design expertise but not contractors of the same degree of expertise (Cushman and Loulakis 2001). Subsequently, a distinction between designer and builder communities began to emerge through establishment of professional organizations. These organizations aimed at regulating their practice, advancing their knowledge, distinguishing themselves from other professions and thus, increasing their social prestige (Cushman and Loulakis 2001). Also, by doing so, designers wanted to separate themselves from corrupt builders (Beard et al 2001).

In the twentieth century, the US government played a major role in further spreading this idea. Public contract laws in the US, with the goal of protecting the public from corruption, mandated separation of design from construction and required selection of contractors for public projects solely based on the lowest responsible bid and selection of designers based on quality (Beard et al 2001; Cushman and Loulakis 2001). These laws assumed the role of the owner's representative for designers and prohibited them from having any financial relationship with builders (Beard et al 2001). The outcome was the Design-Bid-Build (DBB) approach.

The implementation of DBB in construction projects, however, led to problems such as claims, disputes and delays for owners in the following decades. Moreover, with the advent of complex building systems, the need for greater coordination between architects and engineers, on one side, and manufacturers, suppliers and builders on the other side, emerged, which paved the way to creation of Construction Management (CM) (Beard et al 2001). CM applied contractors' advice on design early in the project development phase and assured owners that the designs provided by architects and other designers were practical and cost-effective.

Meanwhile, another project delivery system gained popularity because it met owners' desire to assign design and construction responsibility to a single entity. In Design-Build (DB), which began from private practice (Beard et al, 2001), the DB contractor takes all of the risk to design and construct the project. This approach had the potential to reduce cost and duration of projects and minimize the conflicts between project parties. In 1996, the Federal Acquisition Reform Act authorized the use of Design-Build for federal projects (Ghavamifar et al, 2008).

Over the last two decades, construction professionals have started to realize that owners will be better served through close collaboration of all parties under a single unit. This has resulted in Integrated Project Delivery (IPD), which attempts to overcome time and cost overruns, quality issues, conflicts, etc. through integration of team. In IPD, unlike previous approaches, all parties take responsibility for success or failure of a

project. In other words, each primary team member takes on the full responsibility of all terms, conditions and requirements of the contract (Matthews & Howell 2005).

2.2 Definitions and Characteristics

2.2.1 Definitions and Characteristics

Although many efforts have been made to define the terms “project delivery method” and “project delivery system”, there is no generally accepted definition for them. These terms are usually used interchangeably. Some of the main definitions offered for the terms are introduced here.

Miller et al (2000) defines project delivery system as *“a system for organizing and financing design, construction, operations and maintenance activities that facilitates the delivery of a good or service”*. Construction Industry Institute (2001, b) asserts that a suitable project delivery would attribute roles and responsibilities in an “optimal” way for the project activities to perform. Oyetunji and Anderson (2006) further state that the *“project delivery system defines the sequence of project phases, [the] parties involved in the project, and [the] implicitly assigned roles and responsibilities to project parties”*.

Furthermore, the Associated General Contractors of America (AGC 2004) defines project delivery method as *“the comprehensive process of assigning the contractual responsibilities for designing and constructing a project.”* It further states that *“a delivery method identifies the primary parties taking contractual responsibility for the performance of the work”*.

Table 2.1 shows a brief summary of some of the main definitions for “project delivery system”.

All construction-related activities for comprehensive design and construction of a project are parts of a Project Delivery System (PDS). Some of these activities include project scope definition, organization of designers, constructors and consultants, sequencing of project phases, etc. (Touran et al 2009). While different PDSs have

different approaches and structures in achieving owner's objectives, fundamental elements forming them are the same.

Table 2.1. Definitions of “Project Delivery System”

	Definition of Project delivery system
Miller et al (2000)	A system for organizing and financing construction process activities
Construction Industry Institute (2001,b) Oyetunji and Anderson (2006)	System that defines the sequence of project phases, parties involved and assigned roles and responsibilities
The Associated General Contractors of America (2004)	Comprehensive process of assigning contractual responsibilities and a method for identifying the primary parties that are taking contractual responsibilities

Some of research conducted to define these elements state that all PDSs possess three components of “*project phasing*,” “*project (or team) relationships*,” and “*compensation approach*” (Anderson and Oyetunji 2003; Construction Industry Institute 2001, a, b).

In another effort to explain the elements of PDSs, Pishdad and Beliveau (2009) categorize elements of project delivery and contracting strategies into macro and micro elements. Macro elements, as they define, are organizational structure, phasing & sequencing strategy, contract type, and award strategy. Moreover, Micro elements of PDS, as they explain, include: task assignment, risk measurement/allocation/sharing/mitigation, contractual reinforcement strategy process management, and contract characteristics.

Table 2.2 Elements of PDS

	Elements of PDS
Construction Industry Institute (2001,a,b) Anderson and Oyentuji (2003)	1. Project phasing, 2. Project (or team) relationships, and 3. Compensation approach
Pishdad and Beliveau (2009)	Macro Elements 1. Organizational structure, 2. Phasing & sequencing strategy, 3. Contract type, and 4. Award strategy Micro Elements 1. Task assignment, 2. Risk allocation, 3. Contractual reinforcement strategy, 4. Process management, and 5. Contract characteristics
LCI (2009)	1. Project organization, 2. Operating systems, and 3. Commercial terms

2.2.2 Selection of Project Delivery Systems

As mentioned earlier, PDSs are used interchangeably with contracting strategies. There is a variety of PDSs that could be used for development of a construction project. Some of the main PDSs include Design-Bid-Build, Design-Build, Construction Management, and Integrated Project Delivery. Various factors are usually considered when selecting a project delivery approach for a construction project. Table 2.3 shows a summary of selection factors as defined in different studies.

Gordon (1994) presents a two-part selection method for choosing a PDCS: 1. organization selection (based on project drivers, owner drivers and market drivers) and 2. contract selection. Project, owner and market drivers, as he defines, are in fact drivers for choosing a specific PDS.

Construction Industry Institute (2001, b) lists 17 selection factors for PDSs and develops a system for prioritizing these factors to reach an optimum project delivery system.