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PLANNING FOR STRATEGIC CHANGE IN THE PROJECT DELIVERY STRATEGY

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PLANNING FOR STRATEGIC CHANGE IN THE PROJECT DELIVERY STRATEGY

by

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Dedication

To my wife, Tatiana Paola, for her love and support throughout the writing of this dissertation. To my parents, Giuseppe Migliaccio and Adriana Lanzo, to my uncle, Nino Calo, and to the loving memory of my grandparents, Giovanni Migliaccio and Nina Saracino, and Abele Lanzo and Gemma Ianniello, all for instilling in me the desire to learn and the drive to succeed.

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PLANNING FOR STRATEGIC CHANGE IN THE PROJECT DELIVERY STRATEGY

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For organizations such as state departments of transportation, other public agencies, or private companies, adopting a new approach to procure services for delivery of construction projects requires significant organizational changes; modifications to both their work processes and existing organizational structures may be needed. These adjustments, encompassing many different aspects of the organization's interests, must occur for the change initiative to be successfully put into practice. In this research, the adoption of integrated project delivery methods within the transportation project sector is investigated to better understand the dynamics of this change. In the context of this study, an Owner's project delivery strategy is defined as the set of project delivery methods that are adopted for delivering capital projects. This dissertation presents findings from a study of Public Owner organizations that have implemented the design-build method for delivering highway projects.

Using as a case study the new $1.3 billion SH-130 tolled expressway project in Central Texas, the author analyzed project documentation and conducted many interviews with individuals affiliated with owner, legal, engineering consultants, and contractors. Findings suggest that project representatives institutionalize practices and routines connected to the new approach by adapting to new challenges, rather than “overwriting” previously existing practices. Similarly, the institutionalization of innovative approaches to project delivery happens concurrently with a deinstitutionalization of the previous approaches.

Building upon these findings, a conceptual framework is presented for helping Owner organizations implement change in their project delivery strategy. The proposed conceptual framework is based upon both existing published literature and interviews with managers involved in implementing a strategic change in project delivery strategy. This framework was further refined by making a comparative study of four transportation projects in the United States. In addition, a detailed implementation framework was validated and further developed through a Delphi study with representatives from several organizations whose major responsibilities and experiences include the management of change in procurement approach. Findings from these studies, including application to the construction industry and other industries are presented.

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SECTION I: RESEARCH DESIGN

Chapter 1: Introduction

1.1. Background

1.1.1. Changing Project Delivery Strategy

The concept of a “project delivery strategy” is fundamental to this research. A project delivery strategy is defined here as the set of project delivery methods that the Owner may adopt for delivering its projects. Any changes to this strategy may involve a broadening or a lessening of delivery options. In Figure 1.1, a hypothetical Owner may decide to change his project delivery strategy based on the design-bid-build delivery (DBB) method by adding the design-build (DB) method as additional option for delivering projects.

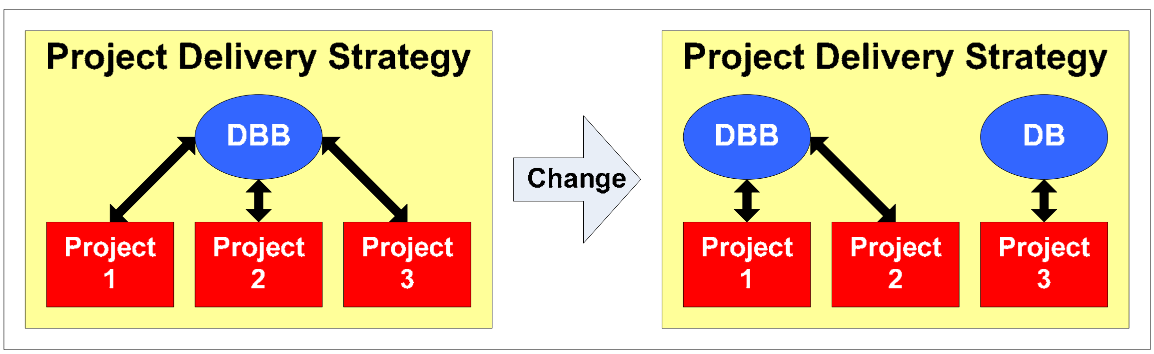

Figure 1.1: Change to Project Delivery Strategy.

For organizations such as departments of transportation, other public agencies, or private companies, adopting a new approach to procure services for delivery of construction projects requires significant organizational changes; modifications to both their work processes and existing organizational structures may be needed. These adjustments, encompassing many different aspects of the organization’s interests, must occur for the change initiative to be successfully put into practice.

1.1.2. Trends in the Delivery of U.S. Infrastructure Projects

In the United States, the infrastructure sector, which includes roads, bridges, mass transit, airports, electric power generation water supply and wastewater management facilities, has experienced a number of shifts in the preferred project delivery approach over the last century. This sector of the construction industry includes several owners that are currently changing project delivery strategy by broadening their delivery options. Therefore, opportunities to investigate implementation of a change in project delivery strategy are available.

Until the end of the 19th century, integrated delivery of design, construction, and long-term operations was mandated and facilitated largely by state statutes. As most important instances of projects using integrated delivery, Pietroforte and Miller cited the development of the transcontinental railroad and telegraph, the construction of power generation plants, and the Brooklyn Bridge delivery. Moreover, the fact that design professionals were not organized in strong professional organizations allowed for an environment in which designers were subordinate to constructors (Pietroforte & Miller, 2002). These factors, among others, led to a wide application of integrated delivery methods.

By the end of the 19th century, however, certain historical developments produced a push to segregate design and construction activities. First, design-oriented professionals organized themselves into professional societies, such as the American Society of Civil Engineers and the American Institute of Architects. These groups' interests were supported by growing public concern over the quality of construction-directed design activities. As a result, de-coupling the procurement of design and construction services was first allowed by the U.S. Congress in 1893; however, the infrastructure sector's use of this split delivery method was not fully assumed until passage of the Federal Aid Road Act in 1916 (Pietroforte & Miller, 2002; Rein *et al.*, 2004). With the passage ten years later of the Public Buildings Act, the federal government required for the first time that design and construction services be procured separately.

Subsequently, the Great Depression "eclipsed [both] the private funding of public projects and the use of the combined project delivery methods" (Pietroforte & Miller, 2002; pp.428). Thus, the government's preference for using segmented approaches to delivering projects increased through World War II. This shift was later reaffirmed in both the 1956 Federal Aid Highway Act (Rein et al., 2004) and the 1972 Brooks Act, each furthering the separation of design and construction procurement activities (Pietroforte & Miller, 2002). As a result of this sequence of events, governmental agencies developed their project delivery strategies around the low-bid procurement approach of a single delivery method, the Design-Bid-Build (DBB) method. In the transportation sector, after decades of continuous use, this method has become the institutionalized standard for delivering public infrastructure projects.

The infrastructure sector is currently reencountering the issues surrounding delivery strategy change; the sector-wide standard for delivering projects, the DBB method, is experiencing a deinstitutionalization. According to Oliver (1992), "deinstitutionalization refers to the delegitimation of an established organizational practice […] as a result of organizational challenges to or the failure of organizations to reproduce previously legitimated or taken-for-granted organizational actions" (pp.564). In response to both an increasing demand for new capacity and for minimizing the impact of construction on motorists, the transportation sector is questioning the ability of a project delivery strategy that is based solely on one delivery method. Several studies have shown the poor performance of this method in terms of schedule (i.e., overall duration and schedule certainty) when compared with other methods (Ibbs *et al.*, 2003; Sanvido & Konchar, 1997; Shrestha *et al.*, 2007a, 2007b; USDOT-FHWA, 2006). Over recent years, these concerns have generated a reduction of legal, regulatory, and practical impediments to integrated delivery methods for delivering new infrastructure projects (Kennedy *et al.*, 2006; Papernik & Davis, 2006).

As a result of this deregulation, the transportation project sector is observing an increased usage of integrated project delivery methods. Among the many emerging delivery method options, the Design-Build (DB) approach has become one of the most popular alternatives. In 1990, the Federal Highway Administration (FHWA) initiated a special experimental program (SEP-14—Innovative Contracting) to enable DOTs to test and evaluate this delivery method along with a few others. The purpose of this program was to identify alternatives to the DBB delivery method that "provided the potential to expedite highway projects in a more cost-effective manner, without jeopardizing product quality or contractor profitability" (USDOT-FHWA, 2006; pp. I-2). Recently, FHWA published a report summarizing the findings and lessons learned from the SEP-14 program. This report not only acknowledged the effectiveness of the DB method in shortening project delivery time, but it also concluded that agencies could pursue alternative financing paths as a direct result of this schedule benefit (USDOT-FHWA, 2006).

1.1.3. Problems with Changing Approach to Project Delivery

Because the decades-long use of the segmented DBB method has so fundamentally shaped employee perceptions and organizational structures and practices, implementing a combined procurement approach constitutes a major paradigm shift for the state agencies adopting it (Miller *et al.*, 2000). Studies have found that "as agencies attempt design-build for the first time, they are constrained by the low-bid culture in their organizations" (K. R. Molenaar & Gransberg, 2001; pp.221). In a report to Congress on Public Private Partnerships (PPP), the U.S. Department of Transportation acknowledged these difficulties, reporting that "states not accustomed to this method of procurement can find it difficult to oversee these types of projects" (USDOT-FHWA, 2004; pp.116). In addition, although combined procurement of services is expected to reduce transactional costs for delivering a project (Pietroforte & Miller, 2002), this new type of procurement usually results in state personnel spending considerable time experimenting and developing new organizational routines to support the procurement change (USDOT-FHWA, 2004). These time excesses are often justified by a wider concern that traditional safeguards embedded in traditional procurement and financing approaches can be lost in the change process (USDOT-FHWA, 2004).

Therefore, an effective implementation of this paradigm shift requires Owners to correctly identify the dimensions of change in the delivery cycle in order to establish new work relationships with contractors, suppliers, and consultants. These challenges to changing a project's delivery strategy are summarized below in the problem statement of this research effort.

Since the combined project delivery approach is a response to changes in the industry environment, owner organizations are compelled to seek ways to adapt their organization to the new approach. This adaptation requires the development of new work processes across the delivery cycle, and involves the implementation of these processes within new organizational structures. Challenges to a change in project delivery strategy are summarized in the following problem statement that underlies the research effort.

1.1.4. Problem Statement

Changes in the project delivery strategy as a response to change in industry environment force owner organizations to seek ways to adapt their organization to the new approach. This process of adaptation includes the development of new work processes across the delivery cycle and the implementation of these processes within new project organizational structures.

1.2. RESEARCH OBJECTIVES AND RESEARCH QUESTIONS

The primary aim of this research effort is to help organizations understand challenges involved in changing project delivery strategy. To meet this research goal, an organizational response to organizations wishing to adopt new project delivery systems was developed. The resulting implementation framework may be extensible for other similar activities.

Built on the research findings and grounded in theory, this framework can provide support to Owner organizations during change initiatives by providing guidance on how to translate organizational goals into project practices. In addition, using the framework can help establish new organizational routines that support the new project delivery strategy.

Two sets of research questions were formulated in order to achieve the research objective. A first set of questions was designed to collect field observations on phenomena associated with a change of delivery strategy. The second set of questions was crafted to develop a framework to help Owner officials as they implement a delivery change initiative. The research methodology is fully described in Chapter Three.

- Collect Field Observations and Identify Significant Constructs pertaining to change in project delivery strategy
    - What changes occur or are needed
    - How these changes affect project participants
    - What new processes are needed
    - What happens during the procurement phase?
        - What activities are performed?
        - What is the timeframe?
        - What are the duration drivers?
        - How do parties interact?
    - What happens during the execution phase?
        - How do parties organize themselves under the new relationship?
        - How do communications happen?
        - How are oversight-related processes structured?
        - How are acceptance-related processes structured?
- Develop an Implementation Framework
    - Can we develop an implementation framework for both transferring organizational goals into project practices and establishing new organizational routines supporting the new project delivery strategy?
        - What are the factors affecting success of the change initiative?
        - What are the barriers to implementing the change?
        - What are actions to be undertaken for implementing a change?

1.3. Scope Limitations

This research effort is limited to the transportation project sector. In addition, only organizations that are changing or have changed their project delivery strategy by adopting the design-build method are examined. Excluded from this investigation are analyses of change to the project financing process.

1.4. Research Propositions

The author also outlined a set of research propositions to guide the research effort toward a solution to the stated problem. These propositions are presented below.

Proposition No.1: The procurement process can be effectively mapped.

Proposition No.2: Issues pertaining to the administration of new contracts can be identified.

Proposition No.3: Lessons learned can be developed and validated.

Proposition No.4: A framework for helping Owner organizations implement change in their project delivery strategy can be developed and validated.

> *Proposition No.4a:* Certain common concepts may be defined to establish a common ground for understanding change to project delivery strategy.
>
> *Proposition No.4b:* Certain elements of the organization and project design need to be addressed to implement change.
>
> *Proposition No.4c:* It is possible to identify and define a path for implementing the change at both the organization and the project level.

1.5. Dissertation Structure

This research dissertation is organized into eleven chapters and includes a set of appendices containing supporting information and results of data collection and analysis.

Chapter Two provides a review of published work in the engineering and management literature pertaining to the delivery of construction projects. Chapter Three outlines the research methodology and investigation instruments used to collect data.

The next five chapters focus on different components of this exploratory study. Chapter Four provides background information on the motivations and objectives for the exploratory study. Chapters Five, Six, Seven, and Eight present the results of a detailed investigation on the implementation of the Design-Build (DB) method for delivering the State Highway 130 (SH-130) project by the Texas Department of Transportation. Chapter Five presents findings on procurement activities leading to the award of the SH-130 contract. Chapter Six presents findings on SH-130 contract administration activities with a focus on project organization and communications. Chapter Seven summarizes key lessons learned by TxDOT in implementing the DB method for the SH-130 project. Chapter Eight outlines a conceptual implementation framework that was developed using the lessons from the SH-130 project implementation.

Chapters Nine, Ten, and Eleven present the results of framework validation. Chapter Nine presents findings from an investigation of other DOTs that have implemented the design-build method over the last few years. Information on four of these DOTs' projects is provided. Chapter Ten discusses the validation of the conceptual framework through a Delphi Study and the analysis of the results. A summary of the research, recommendations for further research and conclusions are discussed in Chapter Eleven.

Chapter 2: Literature Review

2.1. ENGINEERING LITERATURE

This section includes three subsections. In the first subsection, the concept of delivery cycle is introduced. In the second subsection, a summary of literature review is provided. In the third section, specific topics in the engineering literature are summarized.

2.1.1. Project Delivery Cycle

A capital project's life cycle is usually represented in the literature as a succession of function-based phases along a timeline. This view, based upon the traditional DBB method for delivering construction projects often depicts the owner self-performing many project functions (except physical construction). A more generic representation of the project life cycle that shows how other functions may be outsourced through transactional relationships is shown in Figure 2.1 and Figure 2.2. According to this view, during the initial project phases, the owner (or its agent) needs to make two decisions. First, the owner needs to select which project service component (physical or functional) should be outsourced (e.g., design, construction, rail stations, etc.). Second, the owner must also decide which approach is going to be used for delivering the outsourced functions (e.g., segmented or combined). In U.S. construction industry language, this second decision item is commonly referred to as the *project delivery method*. According to one definition, "…a project delivery method […] defines the relationships, roles, and responsibilities of project team members and the sequence of activities required to complete a project" (G. E. Gibson & Walewski, 2001; pp.1). Consequently, the selection of the project delivery method establishes the approach for delivering different components of the project.

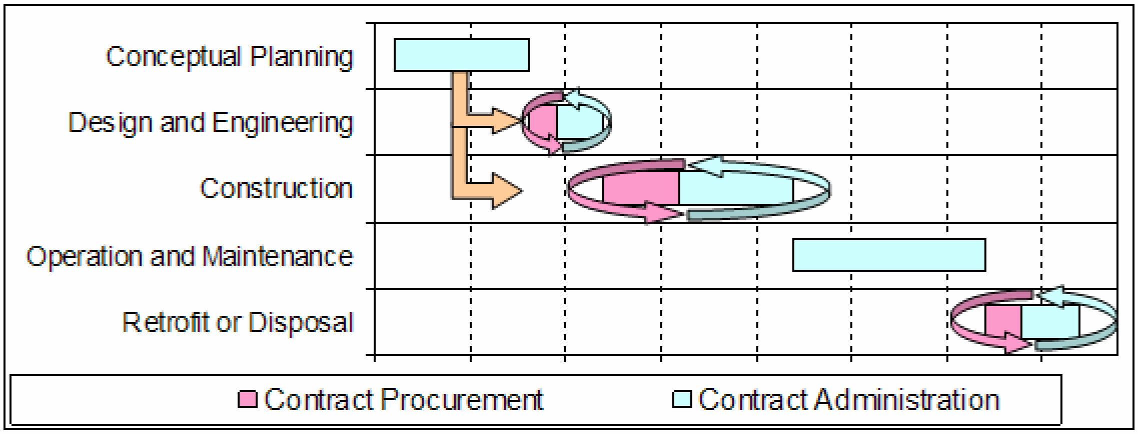

Figure 2.1: Project life-cycle with segmented project delivery.

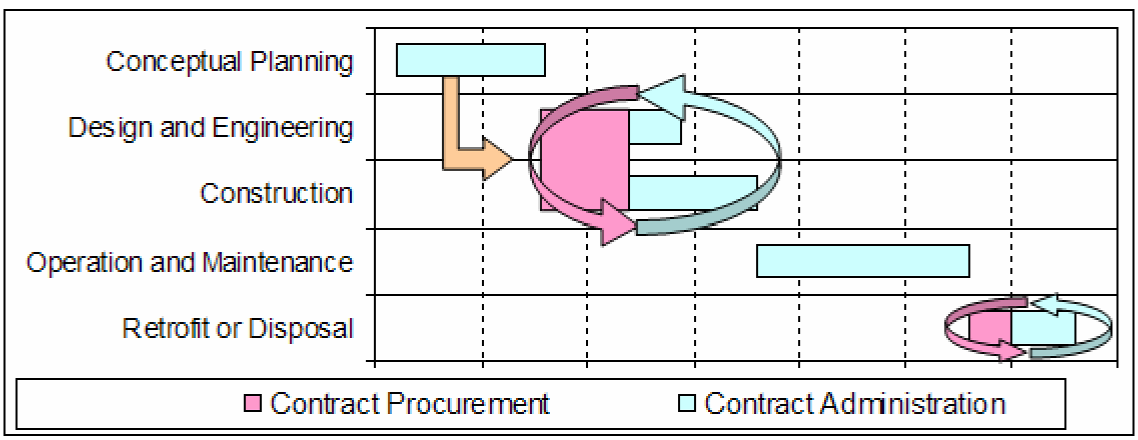

Figure 2.2: Project life-cycle with (partially) combined project delivery.

When a project component (e.g., the design role in Figure 2.1) or a set of components (e.g., the design and construction roles in Figure 2.2) is outsourced, the corresponding project life-cycle phase includes two separate sub-phases: a contract procurement (or acquisition) phase and a contract administration phase. These phases can be represented by a cycle, the *delivery cycle*. To deliver a project, an owner may need several cycles as represented in Figure 2.3. Each of these cycles may happen at different times as shown in Figures 2.1 and 2.2.

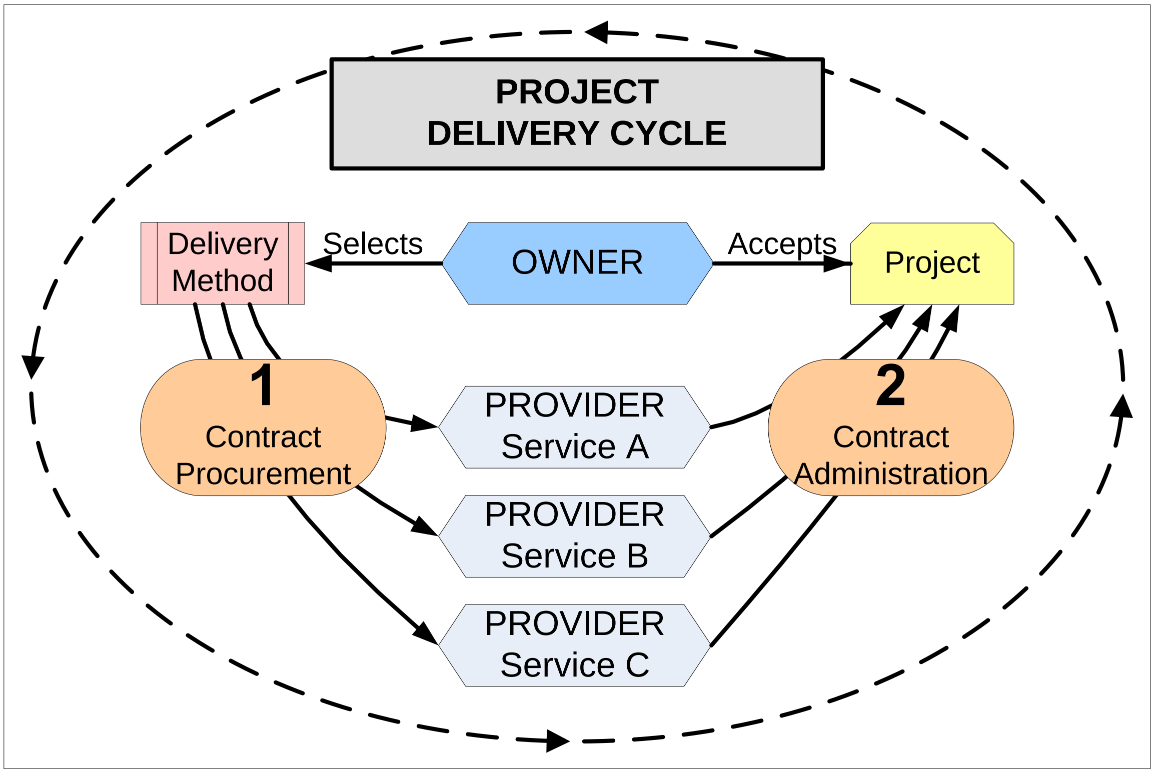

Figure 2.3: Project Delivery Cycle.

In order to develop a descriptive model for a generic delivery cycle, different definitions were analyzed. Because the literature often uses the terms "delivery" and "procurement" as interchangeable terms when talking about projects (G. E. J. Gibson *et al.*, 2006; pp.3), definitions for both terms were researched. However, for this research, the term "delivery" has a broader meaning than the term "procurement" because it covers a period of the project life-cycle from the establishment of a need until the actual delivery. On the other hand, it is assumed that the term "procurement" covers a period of the project life cycle from the establishment of a need through the selection of a provider. This concept of procurement is well expressed in a definition provided by the Federal

Transit Administration. According to this definition, procurement is the "acquisition process leading up to the purchase of goods or services" (FTA, 2006). The author also found that a leader in the finance sector had developed a good definition of the broader concept of delivery. While this definition uses the term "procurement," it was adopted in this work to describe a generic delivery cycle (MasterCard, 2006), which may include several activities as follows:

- identifying a need,
- specifying the requirements to fulfill the need,
- identifying potential suppliers,
- soliciting bids and proposals,
- evaluating bids and proposals,
- awarding contracts or purchase orders,
- tracking progress and ensuring compliance,
- taking delivery,
- inspecting and inventorying the deliverable, and
- paying the supplier.

Using these and other definitions, a descriptive model for a generic delivery cycle was developed and is presented in Figure 2.4. According to the model, an Owner organization is first required to select a *project delivery method* that allows it to identify the number of delivery cycles (and service providers) required for the complete delivery of a project. Each cycle include two phases. During the first phase, a procurement process (defined by the selected delivery method) allows the Owner organization to identify a provider and draw up a contractual agreement. During the second phase, the Provider produces the contracted project deliverable following an execution process regulated by the contractual agreement. Depending on the contractual agreement, the Owner organization retains a certain level of involvement by both overseeing the execution process and collecting information for the final acceptance of the procured project. Figure 2.5 and Figure 2.6 adopt the proposed framework to map the delivery cycles for two delivery methods, DBB and DB, respectively.

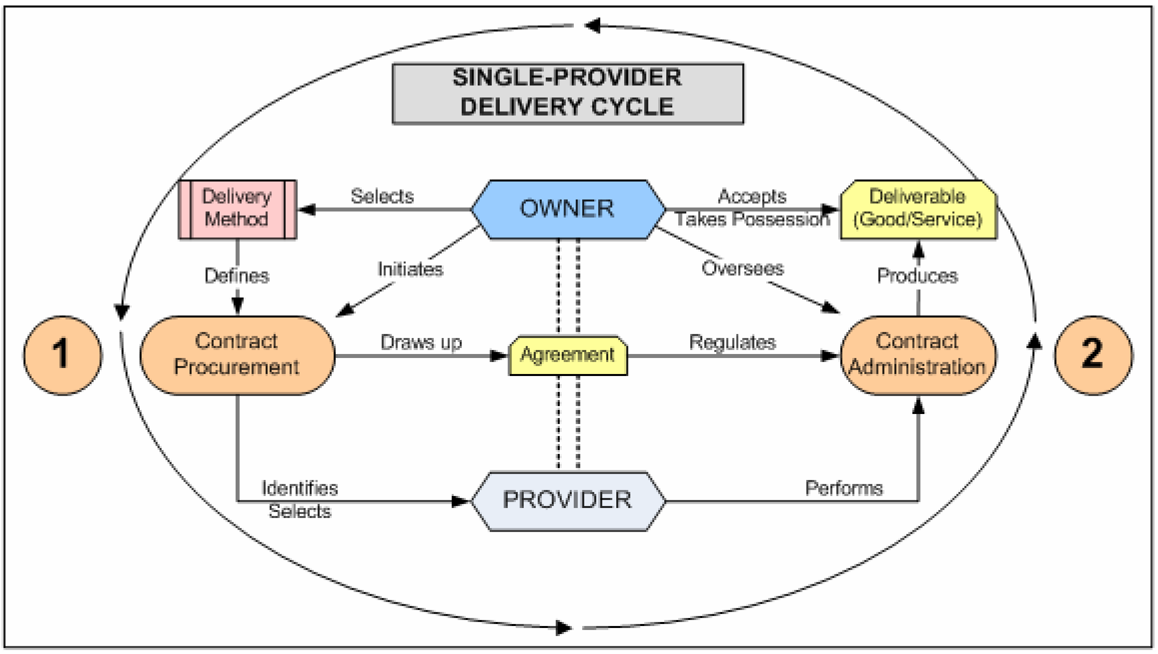

Figure 2.4: Project Component Delivery Cycle.

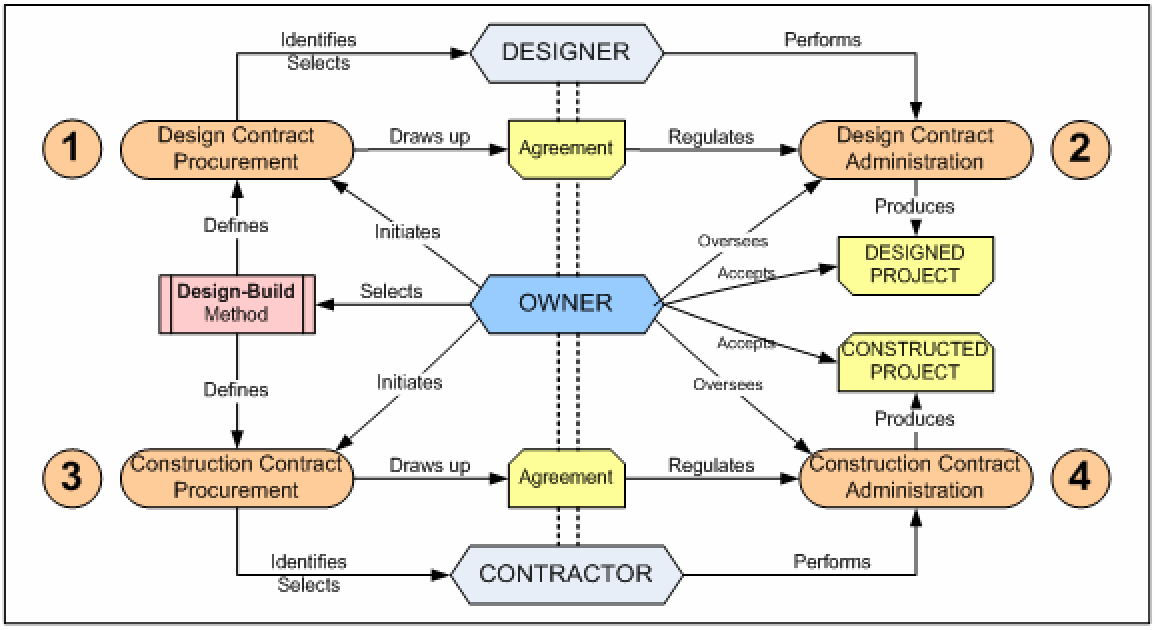

Figure 2.5: Design-Bid-Build Delivery Cycle.

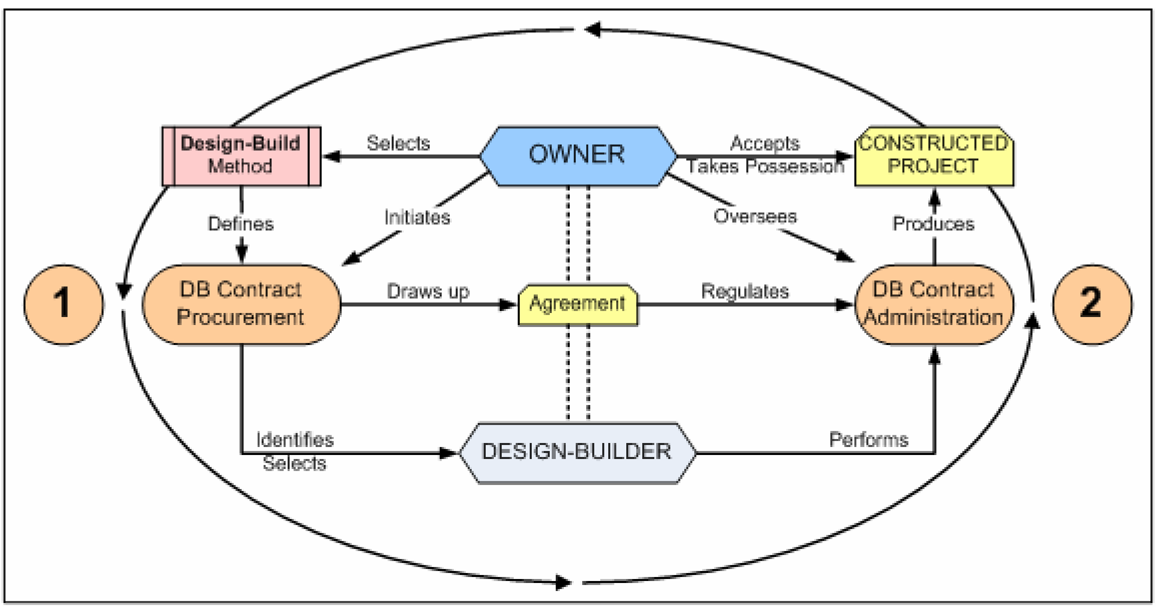

Figure 2.6: Design-Build Delivery Cycle.

2.1.2. Summary of Engineering Literature on Project Delivery

The framework represented in Figure 2.3 for a generic delivery cycle was used to map significant contributions from the literature pertaining to the delivery of construction projects. Key contributions are included in Table 2.1. Summaries of the findings of selected studies are included in the following subsections. The literature review explored several sources, including:

- ASCE journals,
- Other relevant referred journals in the construction and project management area,
- Civil engineering magazines,
- State transportation agencies websites,
- U.S. Department of Transportation website,
- Federal Highway Administration website,
- Other national and international websites on project delivery,
- ASCE Conference proceedings.

Contributions in the available literature are concentrated in studies of vertical construction projects (buildings) with a few contributions involving horizontal construction projects (infrastructure sector). In addition, most of the information related with changing procurement concerns contract procurement processes. The most investigated processes are the selection of delivery methods and the selection of service providers. Few papers focus on how the choice of delivery method affects the procurement process. As opposed to upfront processes, scarce and mainly anecdotal information are available on contract execution processes.

Other significant contributions include: (a) few longitudinal studies on the historical evolution of government procurement strategies in both the US (Miller, 1997; Pietroforte & Miller, 2002; Rein et al., 2004) and the UK (Dowd, 1996); and (b) suggestions for changing procurement approach at the organizational level for Owners (Walewski *et al.*, 2001; Yates, 1995), Design Consultants (E. M. Smith, 2005), and Contractors (Yates, 1995). Studies on historical evolutions of procurement strategies provided insight on the role of coercive effects of institutions on the dynamic of change.

Table 2.1: Summary of Construction Literature Findings.

#	Phase	Topic	Reference
1	Contract Procurement	Selection of Project Delivery Method	(Akintoye, 1994; S. Anderson & Oyetunji, 2001; Hale, 2005; Ibbs et al., 2003; Konchar & Sanvido, 1998; Miller & Evje, 1999; Keith R. Molenaar & Songer, 1998; Anthony D. Songer & Molenaar, 1996)
2	Contract Procurement	Design-Build Procurement Process	(K. R. Molenaar & Gransberg, 2001)
3	Contract Procurement	Contractual Documentation	(S. D. Anderson *et al.*, 2004; S. D. Anderson & Russell, 2001; Bing *et al.*, 2004, 2005; Grimsey & Lewis, 2002; Knight *et al.*, 2002; Schaufelberger, 2005; N. C. Smith, 2001; A.D. Songer & Ibbs, 1995; Tookey *et al.*, 2001; von Branconi & Loch, 2004)
4	Contract Procurement	Provider Selection	(Gransberg & Molenaar, 2003; K. R. Molenaar & Gransberg, 2001; Keith R. Molenaar *et al.*, 2004; Palaneeswaran & Kumaraswamy, 2000; Shane *et al.*, 2006)
5	Contract Administration	Execution Phase	(C. J. Anumba *et al.*, 1997; Chimay J. Anumba *et al.*, 2002; Chimay J. Anumba & Evbuomwan, 1997; Elvin, 2003; E. M. Smith, 2005)

2.1.3. Selecting Project Delivery Method

Representing the project life cycle with its procurement cycles helps explain the importance of the decision problem at hand. This decision problem is a choice of trading off conflicting objectives under different levels of certainty and under different points in time. An optimal choice of the delivery method has anticipated effects on the performance of the whole project. It could shorten project delivery, facilitate innovations by the private sector, reduce initial capital costs, decrease change orders, and limit the potential risk of disputes.

Several studies have been conducted to facilitate the selection of the project delivery method. Some studies have focused on specific aspects of the decision problem by identifying perceived advantages/disadvantages of each delivery method (Chimay J. Anumba & Evbuomwan, 1997; Guyer, 2005; Herbsman *et al.*, 1995; Lahdenperä, 2001; Pena-Mora & Tamaki, 2001; Schaufelberger, 2003, 2005; Yakowenko, 2004; Yates, 1995). Others have identified factors for assessing/predicting the project performance (Ling *et al.*, 2004; Pakkala, 2002; Anthony D. Songer & Molenaar, 1996). Fewer efforts have tackled the decision problem itself by developing procedures, methodologies, and/or tools to support decision-makers in their task.

Additionally, the focus of the available literature is highly variable. Some authors have developed tools to optimize budget allocation at the project portfolio level (Miller & Evje, 1999), while others have operated at the project level to suggest an optimal match between project/organizational characteristics and delivery methods (S. Anderson & Oyetunji, 2001; Khalil & Mohammed, 2002; Mahdi & Alreshaid, 2005; K. R. Molenaar & Gransberg, 2001; Keith R. Molenaar & Songer, 1998). Although many of these efforts are remarkable, they did not reveal any effort to investigate the possibility of linking the procurement of operations and maintenance with the procurement of design, pre-construction and construction services.

2.1.4. Procuring Design-Build Services

The existing literature offers several studies that have investigated procurement aspects of DB projects. Summaries of the findings of selected studies are included in this section.

In the United States, highway projects have traditionally been delivered through the Design-Bid-Build (DBB) project delivery method, which separately procures engineering and construction services. Under DBB, the procurement of engineering services is a qualification-based process, whereas the procurement of construction services is largely done by low-bid selection on sealed offers based on a completed design (K. R. Molenaar & Gransberg, 2001). Over the last decade, another delivery method, Design-Build (DB), has been increasingly adopted by state transportation agencies (STAs) (K. R. Molenaar & Gransberg, 2001; Yates, 1995). In contrast to DBB, this method combines the procurement of construction services with a variable amount of engineering services in one contract. The purpose of the DB procurement phase is both to select an entity, the design-builder, and to establish a contractual framework that allocates risks between parties.

The transportation sector first showed interest in DB and other innovative approaches in 1988, when a Transportation Research Board Task Force was formed to study such innovative contracting processes. The task force study recommended that the Federal Highway Administration (FHWA) initiate an experimental program on Innovative Contracting Practices with the objective of identifying practices that could reduce life-cycle costs for state highway agencies (Byrd & Grant, 1993). This program, the Special Experimental Project (SEP) No. 14 - Innovative Contracting Practices, was initiated in 1990.

In 1998, the Transportation Equity Act for the 21st Century (TEA-21) allowed the use of DB contracting for selected projects approved by the Secretary of Transportation. TEA-21 also required FHWA to promulgate regulations on DB procurement (TEA-21, Public Law, Title 1, Subtitle C, Sec. 1307). This legislative requirement was enacted by FHWA with the release of the "Design-Build Contracting Final Rule" in December 2002 (FHWA, 2002). The rule strongly encourages the use of two-phase selection procedures for procurement of DB services.

Likewise, many other states authorized the use of integrated delivery methods for delivering highway projects. As mentioned above, DB procurement combines the procurement of engineering and construction under one contract. Although owners have developed different customized procurement processes, most can be classified in the following few categories (K. R. Molenaar & Gransberg, 2001; Palaneeswaran & Kumaraswamy, 2000): (1) Low-bid; (2) One-step best value; (3) Two-step best value; and (4) Negotiated selection.

According to Molenaar and Gransberg (2001), owners adopt two criteria, project quality and project price, for selecting DB procurement process. Quality-driven owners select contractors by negotiation whereas price-driven owners adopt by low-bid selection. When both price and quality have to be considered, owners prefer the "best value" category of procurement. The final goal of these procurement categories is to assign a score to each project that includes price and quality considerations with price and quality evaluations usually performed separately. Best-value award algorithms are used to select the best value to the owner by combining each assigned score (Keith R. Molenaar et al., 2004). Best-value DB procurement can be performed with one-step or two-step selection procedures. One-step procedures select the design-builder in a single stage by determining the best value as a combination of price and quality considerations. This procedure is practiced mostly for simple projects where the proposal evaluation is not expensive. Two-step procedures include prequalification/short-listing and proposal evaluation phases. Because evaluating proposals becomes more expensive as project become more complex, owners prefer to short-list interested parties based on qualifications before evaluating their proposals.

2.1.5. Administering Design-Build Contracts

The existing literature offers few studies that have investigated organizational and communications aspects of DB projects. However, findings from the literature review did allow the author to identify issues that needed to be investigated. Summaries of the findings of selected studies are included in this section.

One study investigated the communications issues pertaining to the concurrent life-cycle design approach in construction (C. J. Anumba et al., 1997). DB projects are suitable for projects with a high level of concurrency between design and construction activities. This study selected some aspects of communications that need to be addressed in such projects:

- Maintaining discipline in producing, manipulating, storing, and communicating design information
- Adopting an information model that allows communication of both graphical and non-graphical information between members of the project team
- Increasing communication between stages and activities in the process
- Decreasing the amount of paper-based information.

The paper also identifies a set of managerial issues in the field of team communication:

- Access control: the need to distinguish "read access" from "right-to-modify" access among project team members (pp.213)

- Version control: the need to communicate on the most up-to-date version while maintaining the flexibility to refer to previous or alternative versions (pp. 213).
- Design change management: the need for clear protocols that allow change notification, propagation, and management. Driving principles include: (1) communication of the change to all affected parties, (2) highlighting changes from previous versions in the project model, (3) time allowance for negotiation of changes, (4) automatic propagation of changes only after proposed changes are accepted by all relevant parties, and (5) recording the rationale for all significant changes (pp.213-214).
- Data integrity and security: the need to protect information from external access (e.g., restricted access for external parties) and accidental loss (e.g., periodic back-up) (pp. 214).

The lead author of this study further pursued his studies on the application of the concurrent engineering approach to construction by evaluating different models of organization (Chimay J. Anumba et al., 2002). In this article, the researchers recommended the adoption of flat organizational structures (e.g., layered and bubbled structures) as a method to move toward concurrent engineering in construction projects. These authors believe that dispersed teams are preferable to full-time co-located teams because at various phases of the project the input from some members will be minimal. However, this study does not consider the negative effects that dispersed teams can have on teamwork.

Knight et al. (2002) investigated what they called “the architect ‘short-circuiting’ communication channels in the tender (i.e., proposal) design development process” (pp. 658) among UK-based construction and architectural firms. According to this study, architects often bypass the process of communicating with their client, the design-builder, by interacting directly with the owner. They consider this professional tendency “a major failure in design and build procurement” (pp. 655) because it “causes confusion to the contractor (i.e., design-builder) and the architect” (pp. 659). Although this study focused on organization and communication structures during the proposal phase, some of the findings can be generalized to following the execution phases of a DB project. Four major reasons for this phenomenon were identified:

- If the amount and quality of information on the owner’s requirements in the request for the proposal package is poor or inadequate, the designer “needs to communicate directly with the client (i.e., owner) to draw out his/her needs” (pp. 659).
- Designers often lack familiarity with the DB approach. This lack of knowledge is often translated into an “unwillingness to realign [the] role with DB” (pp. 661).
- There is a relationship between design-builder’s communication channels and short-circuiting. In fact, short-circuiting occurs more often when the designer believes that the design-builder’s communication channels are faulty (pp. 660).
- There is a direct relationship between short-circuiting and time requirements. Time savings offered by DB is often the main reason for its use. However, owners unfamiliar with the new process can often underestimate time requirements. Beginning a project with such faulty expectations can facilitate a communication environment in which short-circuiting is seen as a way to meet unrealistic timeframes (pp. 661).

In a work published in 2003, George Elvin emphasized the need for team building as an important factor for successful DB projects (Elvin, 2003). Here, the author related “the increased integration of project teams and project schedules in design-build” (pp. 33) to the level of communication occurring in this type of project. The same study identified some best practices that mitigate certain negative results of this increased communication. Some of these practices follow:

- “Enhancing iteration and feedback and ensuring early downstream information input” (pp. 33)
  - Designers need to get accustomed to a new role; in DB, they are downstream users of information generated from construction activities. Therefore, they need to learn “what questions to ask in order to get the information they need to continuously improve design” (pp. 34).
  - Constructors need to “provide designers with deadlines and content requirements for information production milestones” (pp. 34).
- Adopting “flexible project organization” (pp. 35)
  - Flexible project organization allows for as-needed integration of simultaneous activities.
- Co-locating team
  - “Co-location reduces the need for formal transfer of information between team members” (pp. 36) and facilitates the accomplishment of the mentioned downstream user input.
- Enabling early interdisciplinary team to create a plan that integrates different area activities (e.g., design, construction, etc.) (pp. 37).
- Adopting synchronized workflow planning for simultaneous activities (pp. 38)
  - In DB projects, workflow planning needs to integrate activities other than those associated with construction. The Critical Path Method cannot be applied successfully in such integrated scenarios because it is based on

> activity completion rather than on the integration of activities. Concisely, on DB projects there is a need to select a method based more on information flow than on activity completion.

In 2005, Elizabeth Smith reported on concerns of geotechnical firms regarding the DB delivery approach (E. M. Smith, 2005). According to Smith, DB projects offer new challenges to design professionals. She cites their need to carefully negotiate their role on the DB team in order to mitigate the uncertainties in the schedule and in the design requirements (pp. 46). The ultimate success of a team depends on the part that such professionals play during the proposal phase and on their effectiveness in communicating once the project is underway. However, design firms—and especially geotechnical firms—have a shortage of professionals with expertise in this type of delivery. Moreover, it is difficult to find experts willing to relocate to a distant project location.

2.1.6. Introducing the Design-Build Method to an Owner's Project Delivery Strategy

In 2001, researchers at the University of Texas completed a study to assist the Texas Department of Transportation (TxDOT) in the transition to achieve proficiency with the DB project delivery method (Walewski et al., 2001). The study concluded that TxDOT should develop both a comprehensive DB pilot program and assessment criteria for selecting candidate DB projects because forcing the wrong project into a DB contract may diminish or eliminate potential benefits. As a research deliverable, a guidebook with example guidelines, procedures, and process maps was developed to assist TxDOT in the transition to achieve proficiency with the DB project delivery system. The authors suggested that these same steps should be followed by any owner organization venturing into DB for the first time.

The authors of that study concluded that design-build has the potential to benefit an owner as an alternative form of delivering highway construction projects and a supplement to DBB. Nevertheless, for an owner to gain the full benefits of DB, it needs to understand, assess, and allocate the associated risks as well as determine a process to implement the methodology. This previous study summarized a set of recommendations for owners venturing into DB for the first time. These recommendations are quoted below (Walewski et al., 2001; pp.60-61).

> 1. Develop DB process guidelines and a delivery process (planning, scope, RFP, selection, management, etc.). DB is a unique, distinct project delivery method so the associated guidance documents should be developed specifically for this procurement method.
>
> 2. Assess the availability of the skills required for the use of DB in the organization. Experience with DB contracting enhances the chances for success and limits the risk to the parties involved. If the owner organization lacks the necessary skills and experience to undertake DB, consideration should be given to obtaining professional services from an experienced firm to assist with preparing the necessary documents and performing the required tasks.
>
> 3. Train selected members of the organization in the use of the DB project delivery system. DB contracting requires a different skill set than administrating traditional DBB contracts for highway construction. To perform these tasks adequately, the owner staff involved with DB project delivery should receive adequate training to gain the required knowledge needed.
>
> 4. Optimize communication among the parties involved within the owner organization. DB projects require more project coordination at the onset of the project planning phase and will require the design and construction divisions of the owner organization to integrate and coordinate on a much grander scale than currently exists.
>
> 5. Optimize the pre-project planning process. The owner organization must develop the skills to create a detailed scope package for DB and develop reasonable submission requirements. Overly detailed RFP proposals may reflect a lack of understanding of the project scope and can be financially burdensome for the bidders as well as the owner. Proposals should be

limited to the information necessary to make judgment based on the merits of the proposals.

6. Select pilot DB projects that have a relatively certain scope and contain well-known processes and technologies. Although DB can be used on all types of highway-related construction, the owner should select projects with which it has adequate experience for the initial phase of the pilot program.

7. Ensure selection of qualified DB contractors. Prequalification of contractors should limit the final competitors to those with adequate experience and financial resources. A balanced evaluation process should be administered by individuals who understand the design and construction constraints specific to the project.

8. Develop succinct criteria specifications. The project requirements listed in the RFP should be designed in performance terms rather than a more prescriptive manner that may limit creative solutions.

9. Develop a systematic way to evaluate project results to determine if existing DB procedures and approval processes are adequate, and respond to legislative requirements.

2.2. Management Literature on Organizational Change

After exploring the construction literature, the author investigated whether contributions within management literature could provide further understanding of the process of changing project delivery strategy. Several theoretical paradigms from the management literature were analyzed for significance to the research topic. Contributions on organizational change offered insight to the study.

Scholars offer contrasting interpretations of the phenomena related to organizational change, providing theoretical and empirical support that can be subdivided into two camps (Barnett & Carroll, 1995). One group of theorists views organizational change as rational adaptations for better fitness in a dynamic environment. Under this view, organization adopt changes either to improve organizational performance – to become innovative organizations – or to align existing performance to new environment conditions (Damanpour & Evan, 1984). The claim is that change promotes organizational survival by defending against environmental changes. Moreover, contingency theorists support the adaptation view by promoting that "the best way to organize depends on the nature of the environment to which the organization relates" (W. R. Scott, 1992; pp.89).

The second group of theorists, the organizational ecologists, challenges the value and effectiveness of change and propose the construct of structural inertia (Hannan & Freeman, 1984; Ruef, 1997). Inertia, the logical converse of organizational change, hinders organizations' ability to initiate change when it is needed. The claim is that inertia makes organizations unable to keep up with the speed of changes in the external environment. Consequently, it is argued, forms of organizations replace each other only at the population level in response to the changing environment. This perspective challenges the adaptive view of change, arguing that adaptation happens only at the population level. Assuming that organizations are subject to "strong inertial forces," their efforts to make radical changes in response to environmental threats rarely succeed. In addition, organizations that undergo change also suffer from the "liability of newness" because change recreates the same conditions that cause new organizations to fail (Hannan & Freeman, 1984). Therefore, organizations willing to change are first hindered by structural inertia, and then face selection pressures as they again encounter the "liability of newness." This theoretical approach is represented in its entirety in Figure 2.6 (adapted from Kelly & Amburgey, 1991; pp.593).

Most of the debate between these conflicting perspectives is based on the concept of structural inertia. Whereas organizational ecologists stress that organizational inertia inhibits organizational change, rational adaptation theorists assume that organizational inertia can be managed with thoughtful strategies. These theorists adopt the perspective that "organizational inertia is a relative rather than an absolute concept" (Larsen & Lomi, 1999; pp.407).

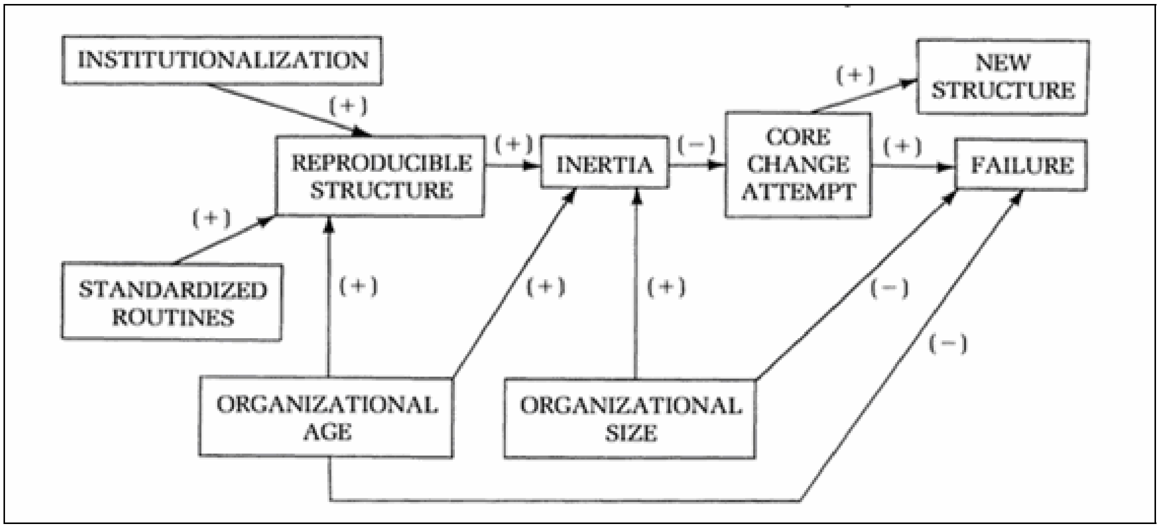

Figure 2.7: Organizational Ecology Model (Kelly & Amburgey, 1991; pp.593).

According to a commonly accepted definition, "organizational change involves a transformation of an organization between two points in time" (Barnett & Carroll, 1995; pp.219). How this transformation evolves is also an object of debate. A commonly adopted static perspective assumes instantaneous transitions between the beginning and the end states (Larsen & Lomi, 1999). Chen and MacMillan (1992) challenged this view by empirically demonstrating that managers encounter substantial delays when they attempt to modify the core elements of their organizations.

When fundamental changes occur, theorists of organizational ecology hypothesize an intermediate organizational state in which organizations spend "a period of time during which existing rules and structures are being dismantled and new ones are being created to replace them" (Hannan & Freeman, 1984; pp.158). However, a large amount of organizational change does not fit this description, and, as acknowledged by Ruef in his review of the phenomena, “organizational change is frequently incremental” (1997; pp.839).

To analyze change, the literature identifies two dimensions of change, content and process. If the analysis focuses on the content of change, it compares the organization in the two states and the significance of a change is assessed in reference to the magnitude of the shift or the number of organizational elements that are affected. Conversely, a focus on the process of a change involves the way the transmission takes place (Barnett & Carroll, 1995; pp.219).

To summarize the contrasting perspectives the author takes advantage of a visual analogy. In a perfect organizational change as depicted by rational adaptation theory, the organization works in a manner similar to the mechanism represented in Figure 2.8 where the external environment triggers any changes. Changes later spread out successfully throughout different components of the organization independently from the initial trigger. In contrast, organizational ecology theorists assume that the spreading of change across organizations is an imperfect mechanism. They typically suggest that any attempt to react to an environmental change is unsuccessful because of internal inertial forces (Barnett & Carroll, 1995). Any change will produce an imperfect mechanism with the same chance of “survival” as a new untested machine.

Within the theoretical paradigm of adaptive change, contributions on institutional theory provide great insight into the topic of changes in project delivery strategy. Traditionally, neo-institutional theorists focused their attention on active institutional pressures that were thought to be expressed in the process of isomorphism. This process of homogenization is defined by Hawley (1968) as “a constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions” (pp. 149). DiMaggio and Powell (1983) view this isomorphism as the result of active institutional pressures that act by forcing one unit in a population to resemble others.

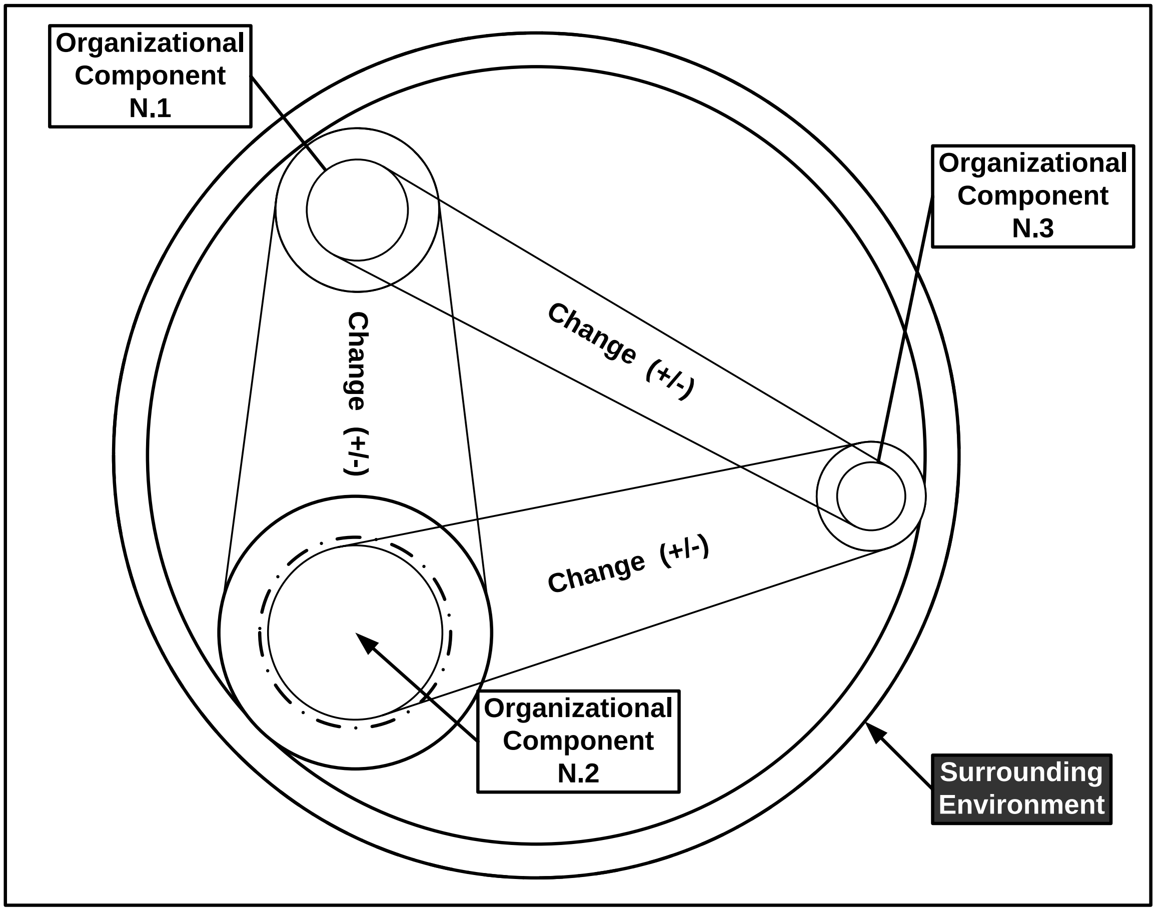

Figure 2.8: Organizational Mechanism Analogy.

Neo-institutional scholars also theorize mechanisms that produce changes to established institutions. In their view, this process of change is triggered by "precipitating jolts" that destabilize established practices (Greenwood *et al.*, 2002). These jolts activate a deinstitutionalization of established institutions (Oliver, 1992). According to Oliver, "deinstitutionalization refers to the delegitimation of an established organizational practice […] as a result of organizational challenges to or the failure of organizations to reproduce previously legitimated or taken-for-granted organizational actions" (pp.564). As a result of this delegitimation, new ideas may be introduced to an organizational practice. Referring to this phase, Greenwood et al. identified a preinstitutionalization stage as one "in which organizations innovate independently, seeking technically viable solutions to locally perceived problems" (2002; pp.60). In the same way, they define a theorization stage as one "whereby localized deviations from prevailing conventions become abstracted […] and thus made available in simplified form for wider adoption" (2002; pp.60). According to this account, this process of abstraction produces a simplification of the new practices and an explanation of the outcomes they produce. Finally, in order for the institutional change to be successful, a diffusion phase must happen. During this phase, "as innovations diffuse they become 'objectified,' gaining social consensus concerning their pragmatic value […], and thus they diffuse even further […]" (Greenwood et al., 2002; pp.61).

2.3. CHANGE IN PROJECT DELIVERY STRATEGY BY THE TRANSPORTATION SECTOR

Management literature helps explain the change in project delivery strategy that many state transportation agencies have initiated over the last decade. In this section, an explanation of current changes in project delivery in the transportation project sector is provided. Figure 2.8 provides a graphical representation of this explanation.

According to the literature summarized in Section 1.1.2, state transportation agencies established their viability by successfully delivering highway projects over the last century using a single delivery method, the design-bid-build (DBB) method. After decades of continuous use, this method has become the institutionalized organizational practice for delivering projects in the transportation sector. According to the literature, an organizational practice becomes institutionalized when it becomes "infused with value beyond the technical requirements of the task at hand" (Selznick, 1957; pp.17).

Literature on early implementation of the design-build (DB) method by state transportation agencies already suggests that these organizations "are constrained by the low-bid culture in their organizations" (K. R. Molenaar & Gransberg, 2001; pp.221). The author's findings from the study on the SH-130 contract administration (described in chapter 6) confirm the attached value of the traditional DBB low-bid approach.

While the practice of using DBB as the sole delivery method is as subject to entropy pressures toward change and disorganization as any other organizational practice (Zucker, 1988), the fact that this practice has been perpetuated over time is due to the fact "that entropy characterizes all but the most highly institutionalized social elements" (Zucker, 1988; pp.26). In addition, the institutionalized status of this practice has resulted in inertial pressures that have been manifested by "inevitable resistance to erosion or change" (Oliver, 1992; pp.580). Other practices that are the result of the sole use of the DBB method may also produce inertial pressures. For instance, a research effort was recently completed to address concerns about the adoption of DB by the State of California. This study investigated the impact of DB on the California DOT professional engineering workforce in response to concerns about staffing practices by the state professional engineering community (Gransberg & Molenaar, 2007). Additional inertial pressures may be seen in other organizational subunits.

However, over the last decade, in response to both an increasing demand for new capacity and for minimizing the impact of construction to motorists, the transportation sector is questioning the ability of a project delivery strategy that is based solely on one delivery method. As a result, pressures against the sole use of the DBB method for delivering projects have mounted in recent years. First, several studies have shown the poor performance of this method in terms of schedule (i.e., overall duration and schedule certainty) when compared with other methods (Hale, 2005; Ibbs et al., 2003; Sanvido &

Konchar, 1997; Shrestha et al., 2007a, 2007b; USDOT-FHWA, 2006). These studies originated because of pressures that are associated with concerns about level of performance. The management literature identifies these types of pressures as functional because they "arise from perceived problems in performance levels associated with institutionalized practices" (W. Richard Scott, 2001; pp.182).

Second, some organizations operating within the construction industry (including both transportation owners and industry providers) founded an industry association, the Design-Build Institute of America. As stated on their website, this association's mission is "to advocate and advance single source project delivery within the design and construction community." DBIA is also committed to promoting legislative efforts at the federal and state level. The actions of this industry association have generated a second set of pressures associated with the industry's changes in interests and power distributions. The management literature identifies these types of pressures as political because they "result from shifts in interests or underlying power distributions that provided support for existing institutional arrangements" (W. Richard Scott, 2001; pp.183).

Finally, industry sectors other than transportation have largely used integrated delivery methods over the last several years, and in some cases, decades. This widespread adoption of alternative strategies for delivering projects has prompted another set of pressures. The management literature identifies these types of pressures as social because they "are associated with differentiation of groups and the existence of heterogeneous divergent or discordant beliefs and practices" (W. Richard Scott, 2001; pp.183). As described by Oliver (1992), these pressures have acted as "precipitating jolts" (Greenwood et al., 2002) by triggering a deinstitutionalization of the sole-DBB delivery strategy. In order for the change of delivery strategy to be successful, a transportation agency needs to reach a new viable stage in which it can successfully deliver projects through the newly adopted delivery strategy. The scope of this research effort is to study the implementation of a new delivery strategy that broadens the delivery options by introducing the DB method into organizational practice.

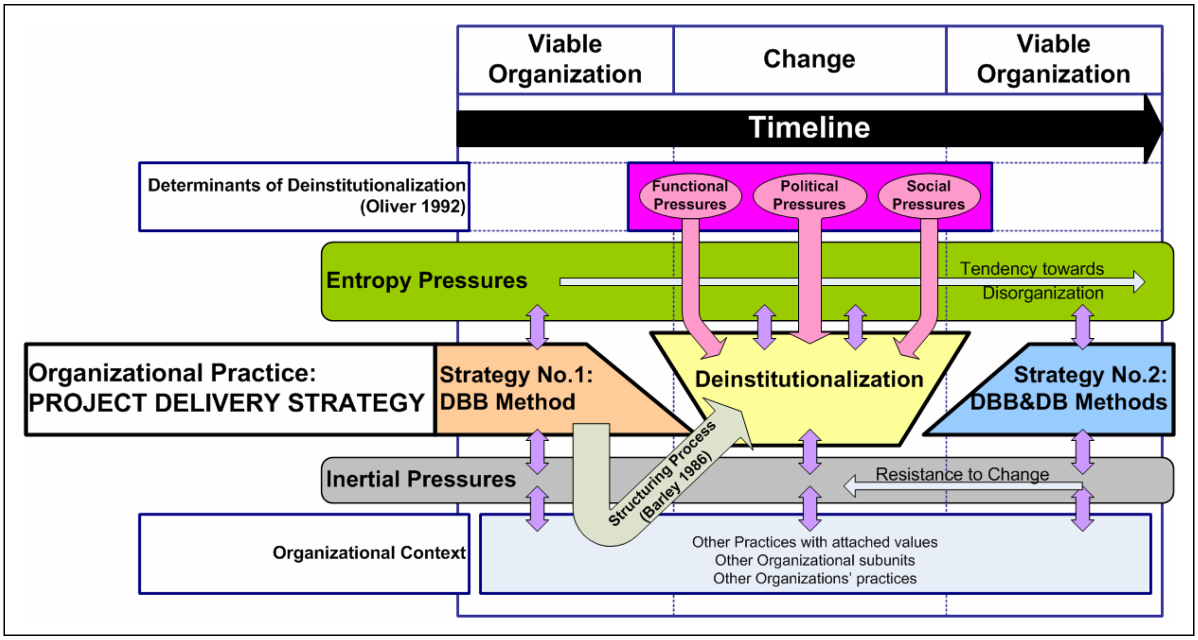

Figure 2.9: Institutional Change to Project Delivery Strategy.

Chapter 3: Research Methodology and Methods

3.1. Overview of Research Process

Figure 3.1 shows the research methodology adopted to develop and validate the proposed implementation framework. In the initial phases, research boundaries and scope were defined by performing a comprehensive review of previous studies. Subsequently a problem statement was articulated and a research methodology was outlined. This statement, presented in a previous section of this dissertation, affirms that Owner organizations adapt their work processes and organizational structures to implement a change in their project delivery strategy. The adopted research methodology follows a two-step process, with an initial phase aiming at the formulation of a conceptual framework and a later phase seeking improvement and validation of this conceptual framework. In the following subsections of this chapter, key elements of the research methodology are presented.

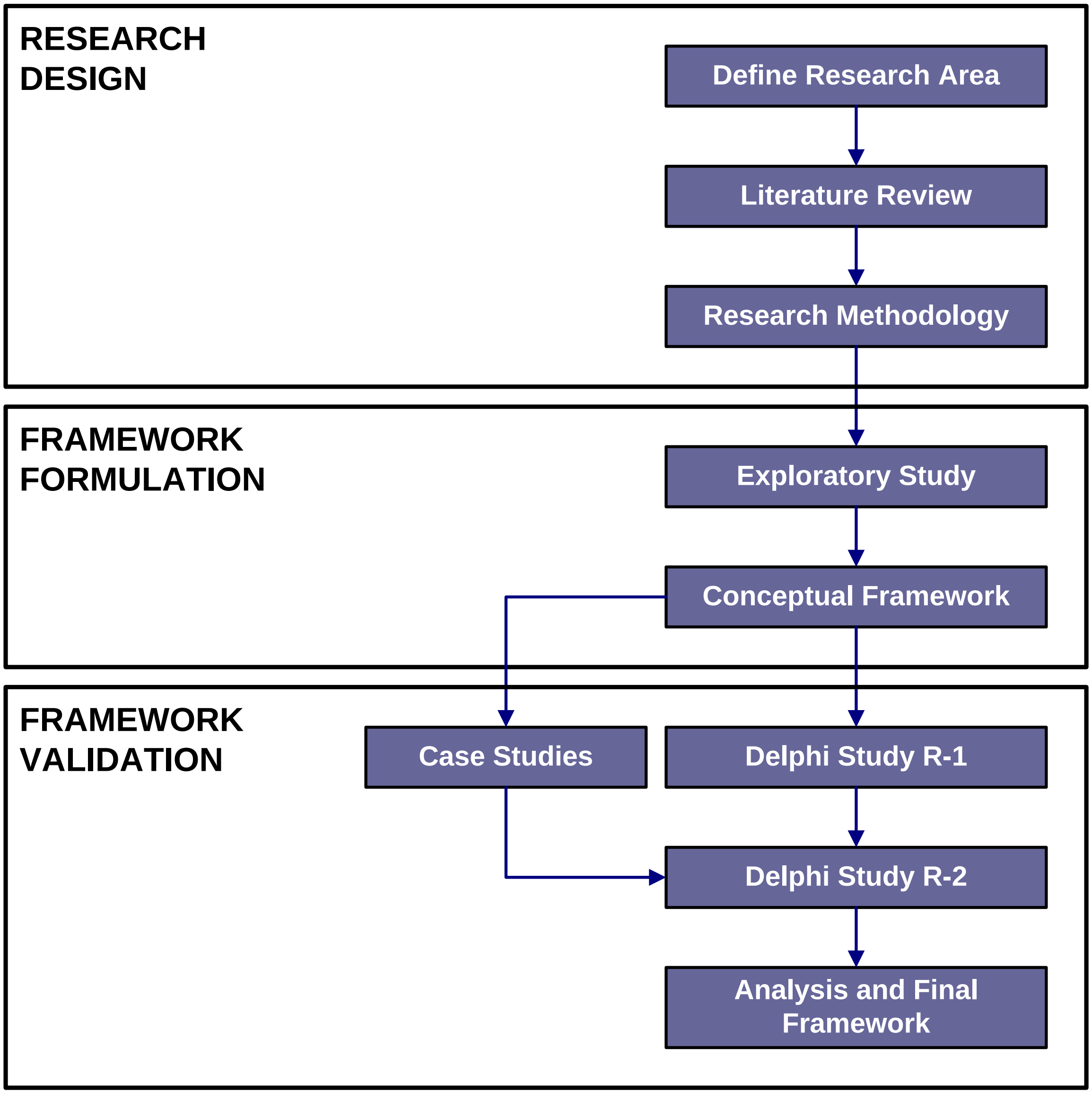

Figure 3.1: Research Methodology.

3.2. FRAMEWORK FORMULATION

3.2.1. Overview on Exploratory Study

In the literature review, little descriptive information was found on how a change in delivery strategy is implemented by Owner organizations. Subsequently, the Framework Formulation phase was designed to observe actual implementation of a change in project delivery strategy by TxDOT. The goal was to collect enough descriptive information to illuminate how this adaptation process takes place.

In 2003, TxDOT and the Center for Transportation Research (CTR) of the University of Texas at Austin initiated Research Project TxDOT-CTR No. 0-4661. The author was heavily involved in the research effort for this project, producing several reports containing lessons learned on different topics; these topics included the procurement process, the contractual documents, the project organizational structure and communication innovation. The research on the SH-130 project aimed at improving existing knowledge of DB processes as well as investigating change implementation by researching issues related to the adoption of the DB approach from an Owner's perspective. The research project includes several tasks. The author conducted research for the completion of the following tasks:

1. Task No.1: Literature Review;
2. Task No.2: Investigating SH-130 Contract Procurement;
3. Task No.3: Analyze SH-130 Contractual Documentation
4. Task No.4: Investigating SH-130 Contract Administration;
5. Task No.6: Collect Lessons Learned;
6. Task No.8: Organize a Training Workshop for TxDOT Employees.

As part of this multi-objective research project, lessons learned by TxDOT during this early implementation were collected and used to populate a database system that included more than 100 lessons (Migliaccio *et al.*, 2006; O'Connor *et al.*, 2004b, 2004c; O'Connor *et al.*, 2006b). With this rich information, the author outlined a conceptual framework that includes the needed processes and the phases of implementation. Additional information on Research Project 0-4661 is provided in Chapter 4.

3.2.2. Exploratory Study on Contract Procurement

For the contract procurement phase, the author modeled processes for procuring the SH-130 and SH-45 SE DB contracts. A model of this part of the research methodology is presented in Figure 3.2. To this end, the author analyzed project documentation and interviewed six individuals involved in the procurement of the SH-130 and SH-45 SE DB contracts. Initially, a literature review was done on the procurement of DB transportation projects in other states and on industry practices for DB procurement. Later, a set of activities needed to procure a DB project was identified by analyzing DB procurement documentation, project newsletters, and project presentations. Next, these activities were weighted against identified industry practices, and, as a result, a first draft of the procurement process at the phase/subphase level was outlined. This draft was tested and used to elicit feedback through a first round of interviews with SH-130 project personnel and legal consultants. Research activity is given in Table 3.1.

Then, a detailed draft of the DB procurement process at the activity level was developed with schedules of actions, responsibilities, and duration targets. These documents were tested through a second round of interviews. Information collected through both rounds of interviews also helped identify essential elements of SH-130 and

SH-45 SE contractual documentation. Findings from this research task were presented in two research reports (O'Connor et al., 2004b, 2004c).

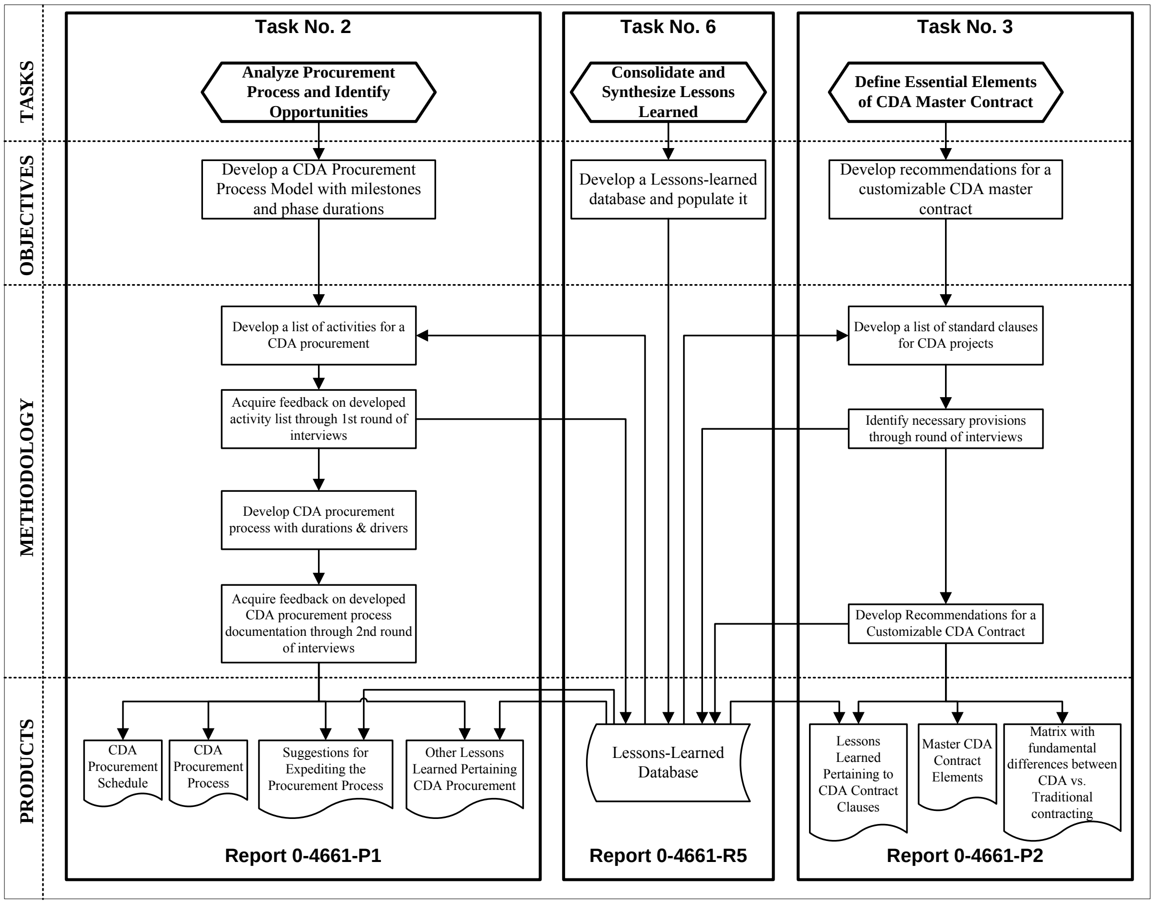

Figure 3.2: Research Tasks No. 2 and No. 3 - Methodology.

Table 3.1: List of attended meetings, events, and research interviews (first year).

Date	Type	Place	Topic
09/23/2003	Kick-off meeting	Project Office, Pflugerville	General presentation of the project; decision on what documents can be made available for research
10/15/2003	Training Conference	College Station, Texas A&M	77th Annual Transportation Short courses. Session 18: Toll Roads
11/4/2003	Interview	Project Office, Pflugerville	General discussion on project management perspective and collection of lessons learned
11/21/2003	Interview	UT, ECJ	General discussion on contractor perspective
12/15/2003	Interview	Project Office, Pflugerville	General discussion on ROW and utility adjustments and collection of lessons learned
12/17/2003	Interview	Project Office, Pflugerville	General discussion on ROW and utility adjustments and collection of lessons learned
12/18/2003	Public Hearing	High School – Del Valle	Public forum on modifications to schematic ROW – Speakers
01/12/2004	Interview	Project Office, Pflugerville	Discussion on utility adjustments and collection of lessons learned
01/14/2004	Interview	Project Office, Pflugerville	Discussion on utility adjustments and collection of lessons learned
01/22/2004	Interview	Project Office, Pflugerville	General discussion on environmental aspects and collection of lessons learned
03/25/2004	Interview	Project Office, Pflugerville	Discussion on CDA procurement process
04/27/2004	Phone Interview	UT office to Project Office, Pflugerville	Discussion on CDA procurement process
05/10/2004	Interview	Project Office, Pflugerville	Discussion on CDA contract provisions
05/21/2004	Interview	Austin district office	Discussion on CDA procurement process
07/06/2004	Interview	Project Office, Pflugerville	Discussion on CDA procurement process
07/15/2004	Interview	Austin district office	Discussion on CDA procurement process

3.2.3. Exploratory Study on Contract Administration

For the contract administration phase, the author adopted a research methodology for capturing the successes and lessons learned associated with the unique organizational, decision-making, and communications structures put in place for the SH-130 project. A model of this part of the research methodology is presented in Figure 3.3.

Initially, researchers met with the top management of the three major project parties to identify project experts within each organization. In addition, a literature review on DB project organization and communication was completed. As a result, common issues pertaining to these topics were identified. To increase data richness beyond topics from the literature, a qualitative research approach was chosen. This approach allowed interviewers to explore new topics and issues during the course of the interviews. First, a semi-structured interview guide was developed. This document is included in Appendix A.2. Then, thirteen interviews were scheduled and performed. The same member of the research team (the author) conducted all the interviews in order to ensure consistency. These interviews were recorded and transcribed. The interviewees' anonymity was guaranteed to encourage more input. Project documentation was also collected from interviewees. Research activity is given in Table 3.2.

Interview transcripts from these interviews and the project documentation served as primary data sources for the analysis that was conducted using the Template Analysis technique (King, 1994). Using this data analysis technique, initially, data were stratified according to constituent parties and were then grouped under topical categories (e.g., organization versus communication) and subcategories (e.g., organizational role versus organizational staffing). Findings from this phase of the analysis are included in Appendices A.4 and A.5 and are summarized in Section 6.3. Differing opinions on similar issues were analyzed to point out conflicts and identify issues and problems in the organizational and communications structures that need resolution. Moreover, positive aspects and communication successes were highlighted.

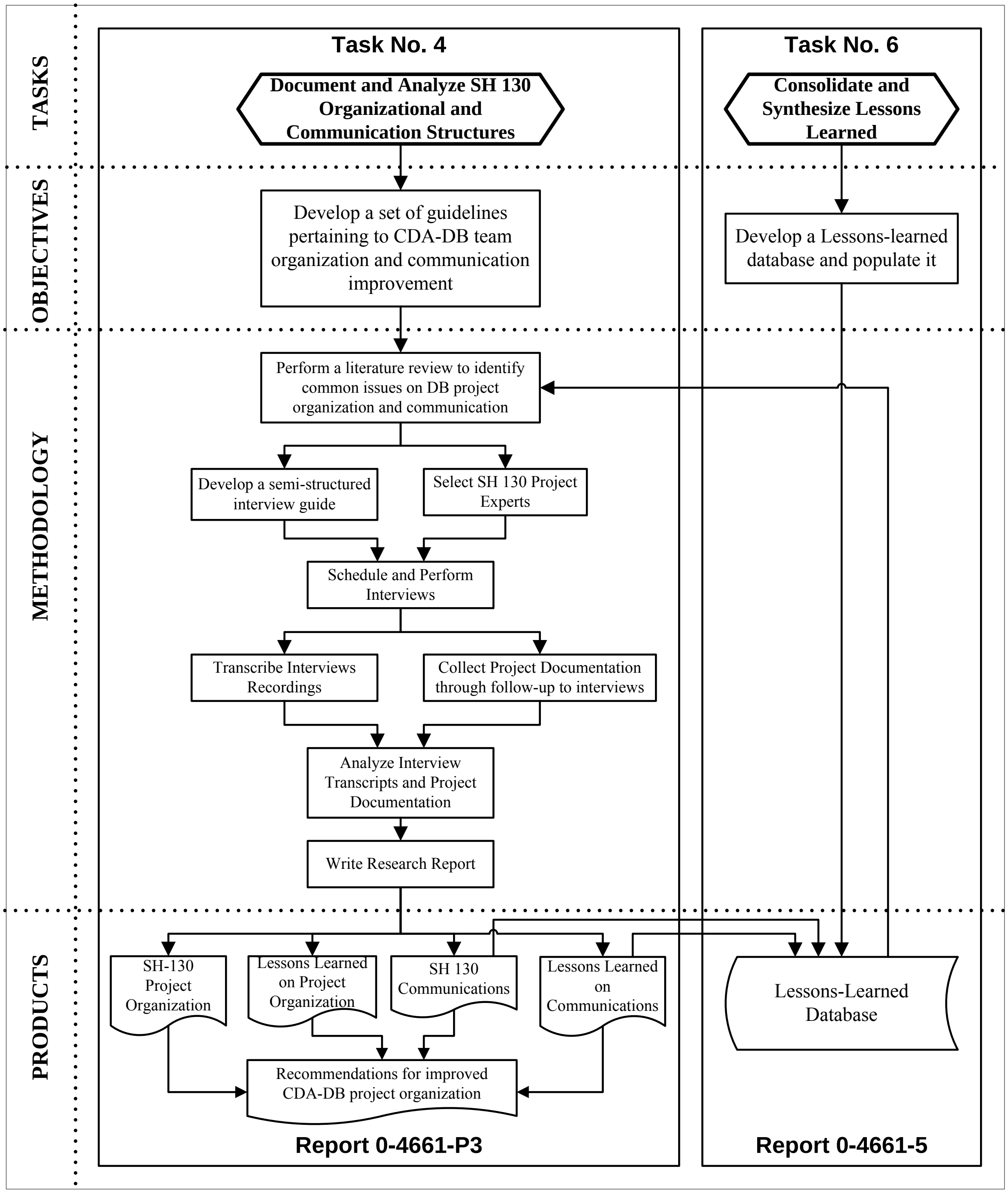

Figure 3.3: Research Task No. 4 - Methodology.

Table 3.2: List of attended meetings, events, and research interviews (second year).

Date	Type	Place	Topic
08/24/04	Meeting	Project Office, Pflugerville	Discuss study progress with Project Director and plan short-term priorities and activities. P3, P5, P6, and P7 timing adjusted to Spring 2005.
09/09/04	Meeting	Project Office, Pflugerville	Define agreement for collaboration with Developer on P3. Collect project management lessons learned.
10/13/04	Training Conference	College Station, Texas A&M	78th Annual Transportation Short Courses.
10/21/04	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on design activities.
10/22/04	Interview (*)	Project Office, Pflugerville	Collect lesson learned on organizational structures and communication flow with focus on construction activities.
11/04/04	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on ROW activities.
11/16/04	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on environmental activities.
01/26/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on construction and project control activities.
02/02/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on environmental activities.
02/28/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on design activities.
03/02/05	PMC meeting	Project Office, Pflugerville	Review study progress and finalize plans for workshop (P7).
03/15/05	Interview	Project Office, Pflugerville	Gain understanding on FHWA role for SH-130 project.
03/16/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on environmental activities.
03/17/05	Interview	Project Office, Pflugerville	Gain understanding on Information Technology implemented for SH-130 project.
03/18/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on construction activities.
03/25/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on construction activities.
04/05/05 04/07/05	CRC Conference	San Diego, CA	Attend sessions pertaining to infrastructure and delivery methods in Construction Research Congress 2005.
04/22/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on ROW activities.
04/29/05	Interview (*)	Project Office, Pflugerville	Collect lessons learned on organizational structures and communication flow with focus on preconstruction activities.
(*) Source for the analysis and grouped by observation category in Appendices A.4 and A.5.			

3.2.4. Lessons Learned

The research on the SH-130 project aimed to improve existing knowledge of DB processes. While the research scope included several research tasks, one of the key products of this research project is a lessons learned database entitled "TxDOT SH-130 Lessons Learned System." This database was developed by assembling and organizing the lessons learned that were collected throughout different tasks of this research project. The purpose of the database is to store and disseminate lessons learned from the SH-130 project so that TxDOT personnel will have a reference source when involved in future Comprehensive Development Agreement (CDA) and design-build projects. The database was also designed to incorporate additional lessons learned from the SH-130 project and future projects into the system.

3.2.5. Conceptual Framework

Using the rich information contained into the SH-130 Lessons Learned System, the author outlined a conceptual framework to help an owner organization in implementing a change in their project delivery strategy by adopting the DB method. The analysis of information was conducted to heighten specific lessons into a more abstract level of understanding. As a result, processes and phases needed for the implementation were identified and defined. The conceptual framework includes three processes: implementation, knowledge-building and assessment. Four phases regulate the execution of these processes: preparatory, planning, contract procurement and contract administration. Additional information on the process of abstracting the SH-130 lessons is provided in Section 7.3.

3.3. FRAMEWORK VALIDATION

3.3.1. Overview on Validation Effort

During the Framework Validation phase, the conceptual framework was improved and validated through two concurrent studies: (1) a comparative analysis of projects, and (2) a Delphi study involving industry experts in innovative project delivery implementation.

3.3.2. Research Methods Used for Validation

Data Collection

To improve the external validity of the framework, the author identified other DOTs that have implemented the design-build method over the last few years. Information on four of these DOTs' projects was collected through semi-structured interviews and questionnaires. This information provided suggestions for improving the initial framework.

To validate the developed conceptual framework, the author used the Delphi technique. This research method was developed by researchers at the RAND Corporation in the 1950s and the 1960s for structuring a group communication process to deal with complex problems that do not lend themselves to precise analytical techniques. In addition to being designed to minimize the time an expert devotes to responding, the Delphi exercise offers several potential research benefits, as described below. Delphi applications have evolved over the years, providing methods that involve significantly less effort by the participant than, for example, participating in an expert panel. Whereas this method serves as an effective mechanism for creating a dialogue among the participants, it also provides them an opportunity to learn from each other, and to help the researchers build consensus on the components of the implementation framework.

Data Analysis

Quantitative Data

Descriptive statistics for each of the framework components were computed. The mean was assumed as a measure of central tendency among the panelists. Therefore, the mean provided a measure of the agreement of the panel members with a given statement that asked the importance of a framework element for a successful implementation of the change. In addition, the author computed the percentage of responses within the agreement range

In addition, the author computed interrater reliability (IRR) to measure the "degree to which judges are 'interchangeable,' which is to say the extent to which judges 'agree' on a set of judgments" (James *et al.*, 1984; pp.86). To compute IRR, the author adopted a formula normally used in similar studies for estimating the agreement of judgments on a single target by one group of judges. This formula computes an index, r_{wg}, that is an estimation of the degree to which judges agree on a set of judgments. Mathematically, IRR is defined as a proportion of systematic variance (V_S) in a set of judgments in relation to the total variance in the judgments (V_T).

While the r_{wg} is the most used index for estimating panel agreement on continuous constructs, the use of this index has come under some recent criticism because of its need to assume that "a uniform distribution represents no agreement" (Brown & Hauenstein, 2005; pp.165). Moreover, James et al. (1984) provided formulas for determining r_{wg} under varying panel bias scenarios, but the choice of the distribution representing no agreement is still unclear (Brown & Hauenstein, 2005).

Because some authors (Burke & Dunlap, 2002; Burke *et al.*, 1999) recommend that values for alternative agreement indexes be found, the Average Deviation Index (AD) from the mean was computed (Burke & Dunlap, 2002). This index was developed to overcome problems with interpretation of the r_{wg} values. The AD index from the mean "is computed by finding the absolute deviation of each rating from the mean [...] of the group rating and then averaging the deviations" (Dunlap *et al.*, 2003; pp.356). According to Burke and colleagues (1999), the AD indices "may provide a pragmatic index of interrater agreement because it is a measure of variability interpretable in terms of the metric (units) of the original scale". In addition, using AD for assessing interrater agreement "does not require explicitly modeling the random or null response distribution" as compared to applications of r_{wg} (pp.53).

A last issue to be defined was interpreting the magnitude of r_{wg} and AD indices to identify whether minimum acceptable agreement is achieved. The literature offers two approaches: (a) rules-of-thumb based on cutoffs values, and (b) statistical significance tests. As pointed out by Burke and Dunlap (2002), the AD index is actually a measure of interrater disagreement. Therefore, a cutoff value to AD would be an upper limit indicative of minimum acceptable agreement. These authors identified the cutoff value for AD as "the number of response options for an item divided by six" (pp.162). For the 7-point Likert scale adopted in the Delphi study, this upper limit cutoff is equal to 1.167, and therefore, the rule-of-thumb for AD states that AD $\leq$ 1.167 for the interrater agreement to be acceptable. The AD's cutoff value was derived from the rule-of-thumb for identifying acceptable interrater reliability indexes like r_{wg}. This rule-of-thumb states that $r_{wg} \leq 0.70$

An alternative approach for interpreting whether the magnitudes of r_{wg} and AD indices are acceptable entails statistical significance tests based on Monte Carlo procedures (Dunlap et al., 2003). This approach was adopted to test statistical significance of the r_{wg} and AD indices computed for Delphi panel responses.

Qualitative Data

To analyze responses to the Delphi questionnaire's open-ended questions, a qualitative research technique known as template analysis was adopted (King, 1994). Initially, this involved defining a set of categories emerging from the preliminary research. Later, the comments of a sub-set of data were coded (i.e., responses on overall success factors and overall barriers to implementation). As a result, an initial template was created by grouping related categories in the selected comments into a smaller number of higher-order codes that describe broader categories in the data. This template analysis was applied to the three groups of comments (i.e., success factors, barriers to implementation, and implementation activities). The resulting categories were then compared and the three groups of comments were further grouped into the 25 guidance categories that are discussed in Chapter 10.

3.3.3. Delphi Study

To solicit expert judgment on the developed framework, a Delphi study was conducted (Linstone & Turoff, 2002). First, 90 potential experts in the implementation of the design-build method for transportation projects were identified and invited to participate in the Delphi study. Thirty-five experts accepted the invitation (a 39 percent invitation acceptance rate) and were asked to respond to an initial questionnaire in the first round of the study.

The first round involving steps 1 and 2 was conducted between August 27, 2006 and November 3, 2006. During this first round of the validation:

1. Panelists received a questionnaire instrument. This questionnaire contained four sections, including a section in which experts were asked to express their agreement with the importance and scope of each of the processes and phases. Their level of agreement was expressed on a 7-point scale, illustrated in the example shown in Figure 3.4. Other sections were designed to collect information on the experts' background, to assess their opinion on the need for a structured implementation approach, to assess a set of definitions on project delivery, and, finally, to provide an overall assessment on the framework usefulness. In addition to rating each item, panelists were asked to provide qualitative feedback on the definitions and on the framework components, or to provide any conditions for agreement or disagreement. They were also asked to suggest (a) success factors, (b) barriers to implementation and (c) implementation activities. Success factors were defined as factors believed to affect the success of a state transportation agency in implementing a change in the project delivery strategy.
2. Responses from all panelists were compared and analyzed. Results from the first round of the Delphi study were used jointly with information from the comparative case studies to improve and better define the initial framework. For each item, the average level of agreement with the provided definitions was computed. This score provided a measure of the overall panel agreement with how specific items were formulated. Inter-rater reliability (James et al., 1984) was also computed to measure the panel's internal agreement on each of the items. Items that the panel disagreed with were modified and resubmitted for a second round of Delphi research. In addition, qualitative comments provided in response to open-ended questions were

analyzed using Template Analysis (King, 1994) and grouped into 25 guidance categories. Each of these guidance categories addresses a single success factor. Each category also includes details on barriers to implementation to each factor as well as actions necessary to overcome these barriers.

*The **Knowledge Building Process** is the plan to manage knowledge on the new procurement strategy from the preparatory phase all the way through the contract execution phase. This process induces organizational learning by: (a) collecting, verifying, storing and disseminating lessons learned on the implementation effort, and (b) identifying sources of information on newly introduced project procurement approaches.*

D.2) Given the information provided above, this process is important to the implementation of a change in project procurement strategy.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____________________

Figure 3.4: Delphi Round 1 – Sample Question and Scale.

The second round involving steps 3 and 4 was conducted between January 23, 2007 and March 8, 2006. During the second round of the exercise:

3. Panelists received a summary of the modified framework, and a synopsis of responses from other informants. In addition, they received an additional questionnaire. This questionnaire was divided into two sections: (1) SECTION I – Rating of success factors; and (2) SECTION II – Overall assessment of a modified collection of definitions. In the first section, panelists were asked to rate for importance the previously identified 25 success factors using the scale illustrated in Figure 3.5. They also were provided these implementation guidelines so they could comment upon. A detailed description of each of these categories was provided. In the final section, panelists were asked to assess the collection of definitions recently modified to meet the panel's previous suggestions.

4. Responses from all panelists were compared and analyzed. Information submitted through this second questionnaire was analyzed to determine both the average importance rating of each of the twenty-five guidance categories and to assess the panel's internal agreement (measured by the inter-rater reliability, r_{wg}, and the average deviation index, AD).

Please score each factor using a 7 point scale, where a score of 1 = "not important at all" and 7 = "extremely important." (*Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort, and to how significant the factor's absence is in hindering the success of the implementation effort.*)

1———**2**———**3**———**4**———**5**———**6**———**7**

Not Important — Important — Extremely Important

Figure 3.5: Delphi Round 2 – Sample Scale.

SECTION II: EXPLORATORY STUDY

Chapter 4: Background on Research Project 0-4661

This chapter includes three sections. In the first section, the author summarizes legislative action that authorized the Texas Department of Transportation (TxDOT) to change their project delivery strategy. In the second section, the author describes a research project (Research Project No. 0-4661) that TxDOT awarded to the Center for Transportation Research of the University of Texas at Austin in 2003 for investigating the implementation of their change in project delivery strategy as applied to a pilot project, the State Highway 130 (SH-130) project. In the third section, an overview of the SH-130 project is outlined.

4.1. Legislative Authority for Changing TxDOT Project Delivery

A detailed review of the legal and regulatory status was performed to determine which procurement tools are legal and available for use by TxDOT at the time of the study. While other public entities are utilizing alternative project delivery methods and contracting approaches with increasing frequency, Texas state law has until recently limited the Texas Department of Transportation (TxDOT) to the design-bid-build (DBB) project delivery method along with a few innovative contracting approaches such as lane rental, partnering, and A+B contracting.

In 2001, the design-build delivery method was recently introduced in Texas with State legislation that allows TxDOT to adopt delivery methods other than the traditional design-bid-build (DBB) method for delivering highway projects. This new approach was initially called the Exclusive Development Agreement (EDA) and was later changed by the 2003 House Bill 3588 to the Comprehensive Development Agreement (CDA). The term "CDA-DB" is used throughout this dissertation to identify design-build (DB) procurement under the CDA approach.

The CDA is currently the statutory approach for adopting innovative project delivery methods in the State of Texas and the Texas Transportation Code outlines the boundaries for a CDA as:

> *An agreement with a private entity that, at a minimum, provides for the design and construction of a transportation project and may also provide for the financing, acquisition, maintenance, or operation of a transportation project (Texas Transportation Code, Title 6, Section 370.305, subsection (b)).*

Although unique to Texas in many ways, this approach agrees with the U.S. Code definition of design-build contract as:

> *an agreement that provides for design and construction of a project by a contractor, regardless of whether the agreement is in the form of a design-build contract, a franchise agreement, or any other form of contract approved by the Secretary (of Transportation) (U.S. Code Title 23, Section 112).*

4.2. RESEARCH PROJECT 0-4661

In 2002, a contract totaling $1.3 billion was awarded to Lone Star Infrastructure (LSI), a consortium of engineering and construction firms, for the State Highway 130 (SH-130) Project, a 49-mile-long toll road in Central Texas. This project constitutes the "pilot" for the CDA-DB approach to highway project delivery in the state of Texas. The SH-130 project environment is experimenting with many innovative DB delivery management processes unique to the TxDOT environment. In response, TxDOT initiated research for the purpose of leveraging the knowledge of these DB processes and comparing the performance of the CDA-DB delivery approach to traditional DBB projects. Research Project No. 0-4661 was awarded to the Center for Transportation Research of the University of Texas at Austin in 2003 and has produced several reports containing lessons learned on different topics, including the procurement process, the contractual documents, the project organizational structure and communication innovation. This rich information was assembled in a workshop format to be used to train TxDOT employees. In addition, a set of metrics for assessing the relative performance of projects delivered through different methods was identified and is being validated by another doctoral candidate (Migliaccio et al., 2006; O'Connor *et al.*, 2004a, 2004b, 2004c; O'Connor *et al.*, 2006a, 2006b; O'Connor *et al.*, 2006c).

The research effort was subdivided into several tasks that can be grouped according to two general research goals. This exploratory study contributes to the first research goal to consolidate and synthesize certain lessons learned to be organized in a database. These lessons are being collected and recorded thematically. The author has collected lessons pertaining to the procurement process and contractual documents, and to the contract administration process with focus on project organization and communications.

4.3. SH-130 PROJECT

4.3.1. Overview of State Highway 130 Project

Rapid population growth and commercial growth in and around Austin, Texas, combined with an inadequate transportation network has contributed significantly to its ranking as having the worst traffic delays among medium size cities in the Nation (Schrank & Lomax, 2004). In order to solve this problem, the Department of Transportation of Texas (TxDOT) is implementing the Central Texas Turnpike System

(CTTS) with a funding amount of about \$3.6 billion. As shown in Figure 4.1, the turnpike will be constituted by five toll ways: SH45 N, Loop 1 Extension, SH130, US183A, and SH45 SE. The delivery of the first three roads is identified as CTTS 2002 Project (CTTS-2002). The system will create a bypass to Interstate 35 with southern connector on I-35 (SH45 SE) and northern connector on I-35, Mopac-Loop 1 and US183 (SH45 N). A diagram of the entire CTTS is given in Figure 4.1.

State Highway 130 (SH-130) is one of new highways being built within the Central Texas Turnpike System (CTTS). At completion, SH-130 will include six segments for a total of 91 miles from Interstate Highway 35 (IH-35) at State Highway 195 (SH-195) north of Georgetown, Texas, to Interstate Highway 10 (IH-10), near Seguin, Texas and will be a four-lane, divided facility with eight major interchanges.

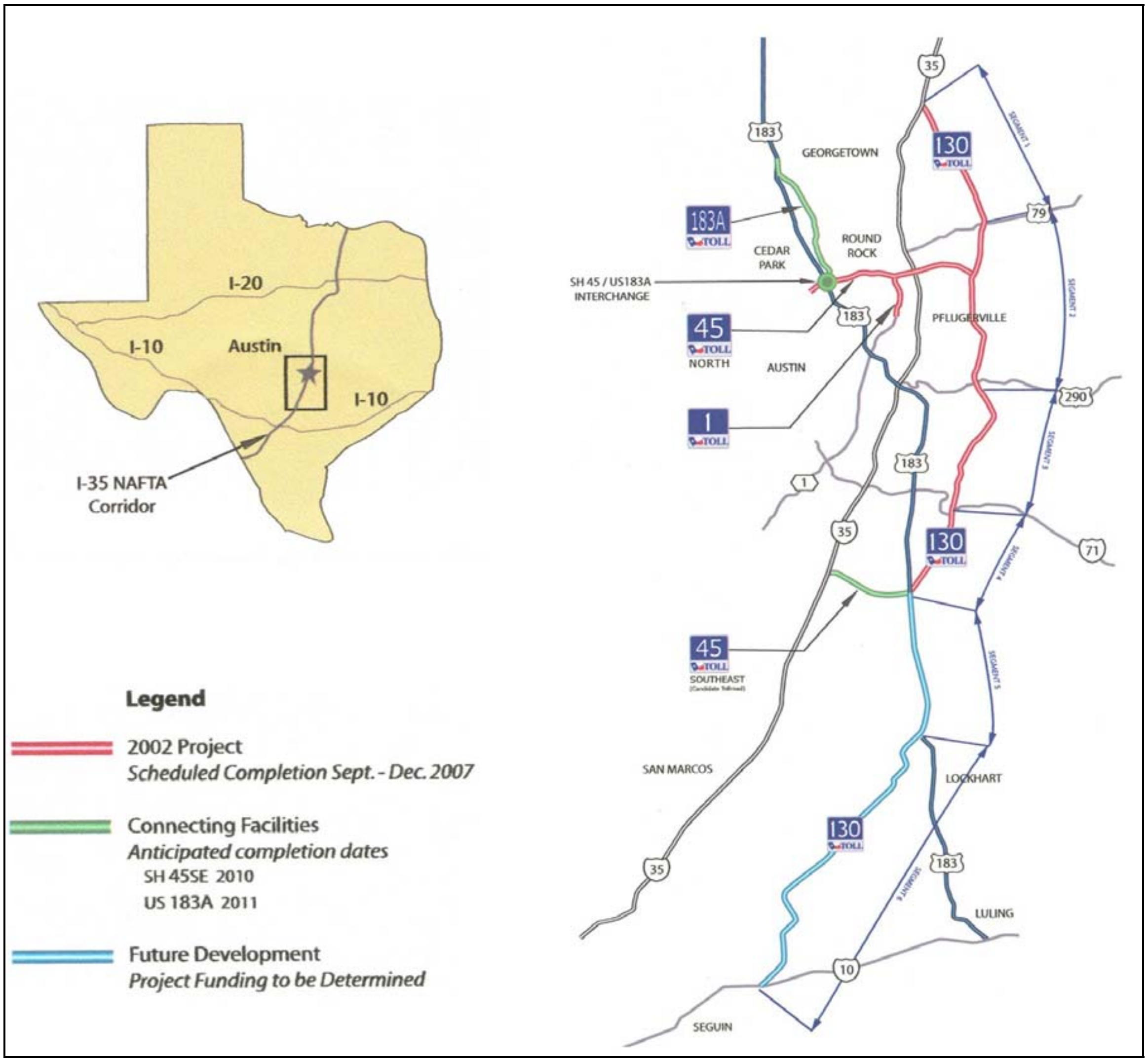

Figure 4.1: Central Texas Turnpike System (adapted from TxDOT website)

Most of the project financing relies on the issuance of revenue bonds. In order to create a favorable financing scenario, it was fundamental to decrease any schedule uncertainty by assuring guaranteed completion dates. Therefore, the Department decided to deliver the turnpike backbone, SH130, and its southern connector to I-35 (SH45SE) via the use of the CDA-DB approach. With this approach, project tasks are distributed between the Department and the design-builder. In that way, TxDOT can anticipate earlier design and construction. This approach will allow TxDOT to build these two projects in a shorter time frame. As a result, the Department is planning to use a similar approach through the State for other high-priority projects like the proposed multi-billion Trans Texas Corridor.

In 2002, TxDOT selected Lone Star Infrastructure (LSI) as design-builder for the SH-130 project. LSI is a joint venture created specifically for this project between Fluor Corporation, Balfour Beatty Construction, Inc., and T.J. Lambrecht Construction, Inc. TxDOT and LSI signed a contract totaling \$1.3 billion for the delivery of all 91 miles. However, Notice to Proceeds (NTP) for the 49 miles of Segments 1 to 4 have been issued for a total of approximately \$1 billion. The Department reserves the option to extend the highway to I-10 near Seguin by completing the remaining two segments, if future funding becomes available.

The scope of work includes several project functions that are all performed within the lump sum price (e.g., design, right-of-way [ROW], acquisition services, utility relocation, portions of environmental permitting, environmental compliance services, design quality assurance/quality control [QA/QC] services, construction, and construction QA/QC services). TxDOT retains the cost of physical properties associated with ROW acquisition for parcels within the corridor alignment. The 408 parcels within Segments 1 to 4 have an estimated acquisition cost of \$380 million. The remaining Segments 5 and 6 will involve 220 to 230 parcels. The contract has an option that LSI will provide capital maintenance of the roadway for an initial term with the opportunity for two extensions. The maximum term of the Maintenance Agreement, including both extensions, is 15 years. The detailed status of the project at March 2005 is given in Table 4.1.

Table 4.1: SH-130 Project Status as of March 2005.

Project Component		Item	Current (% of total)
ROW		Total number of parcels	408
		Parcels acquired for TxDOT through other entities (e.g. , Williamson County)	12 (3%)
		Number of parcels to be acquired by LSI	396 (97%)
		Parcels with first offer made	343 (84%)
		Parcels acquired by negotiation	144 (35%)
		Parcels acquired by condemnation	74 (18%)
		Total number of parcels acquired	230 (56%)
		Parcels not acquired with possession and use agreements	44 (11%)
		Parcels available for construction	274 (67%)
Utilities		Total number of Utilities	437
		Total to adjust	310
		Total number of required utility assemblies	130
		Assemblies in revision	28 (21%)
		Assemblies approved for construction	60 (46%)
Design	Roadway	Segment 1 (% complete)	99%
		Segment 2 (% complete)	99%
		Segment 3 (% complete)	93%
		Segment 4 (% complete)	69%
	Bridge	Total Number of Bridges	123
		100% Plans Review Complete	88 (71%)
		% Plans Certified	71 (58%)
Construction		Segment 1	Ongoing
		Segment 2	Ongoing
		Segment 3	Commenced
		Segment 4	Commence in December 2005
Contract Status		Original contract amount	$1,306,554,920
		Authorized amount	$998,955,914
		Authorized Change Orders (COs)	8
		Authorized COs Amount	$ 52,535,479
		Current authorized Contract Amount	$1,051,491,393
		Approved Payments	$380,473,148
		Amount remaining	$671,018,245
		Percent Dollars Expended	36.2%
Schedule		Authorized Time Adjustments	None
		Evaluation of Critical Path	On schedule

4.3.2. SH-130 Project Organization

The SH-130 project is managed by a detachment of TxDOT Austin district personnel in a project office based in Pflugerville. This office, the Central Texas Turnpike Office, manages the execution phases of the Central Texas Turnpike System 2002 project (CTTS-2002) and is delivering its project elements through different delivery methods. SH 45 North and the Loop 1 Extension were subdivided into sections that are being delivered through traditional DBB contracts.

Initial phases of these projects, including procurement, were managed by the Texas Turnpike Authority division of TxDOT. The authority decided to allocate a project staff to manage the turnpike execution phases. This staff, including TxDOT employees and private consultants, was co-located in the Pflugerville project office in 2001. The project and its personnel were transferred to the Austin district in September 2003.

The turnpike office is directed by the director of turnpike construction, a TxDOT employee who reports directly to the Austin district engineer. In this office, a reduced TxDOT staff is supported by two engineering firms, HDR and PBS&J. HDR provides program management services to the SH-130 project, whereas PBS&J provides construction management services on the Loop 1 and SH 45 projects. As the CTTS bond general engineering consultant (GEC), PBS&J also reports on the progress of the whole CTTS project to bond rating agencies underwriting the project. This reporting process is a requirement of the Indenture of Trust that governs the revenue bonds issued for the 2002 CTTS project.

The SH-130 DB contract awarded in 2002 to LSI required the consortium to locate its main project office in the same complex of buildings as the Central Texas

Turnpike Office. In addition, LSI set up three segment area offices where personnel working on the execution phases are based. The LSI main office hosts personnel for the following functions:

- Project management
- Design services
- Environmental permitting and compliance
- ROW services
- Utility relocation services
- Design quality assurance
- Construction quality assurance

The different entities involved in the SH-130 project are represented in Figure 4.1, which also outlines the relationships between the project parties.

In the SH-130 project, the Developer functions as the single point of contact for TxDOT for all disciplines, including design, construction, ROW, utility, and environmental permitting. Monitoring of design and construction quality assurance and environmental compliance is performed by a group of independent firms that have a contractual relationship with the Developer. The independence of these firms is strengthened by the fact that they report directly to TxDOT (as well as to the Developer), and their functions cannot be substituted by the Developer without TxDOT approval.

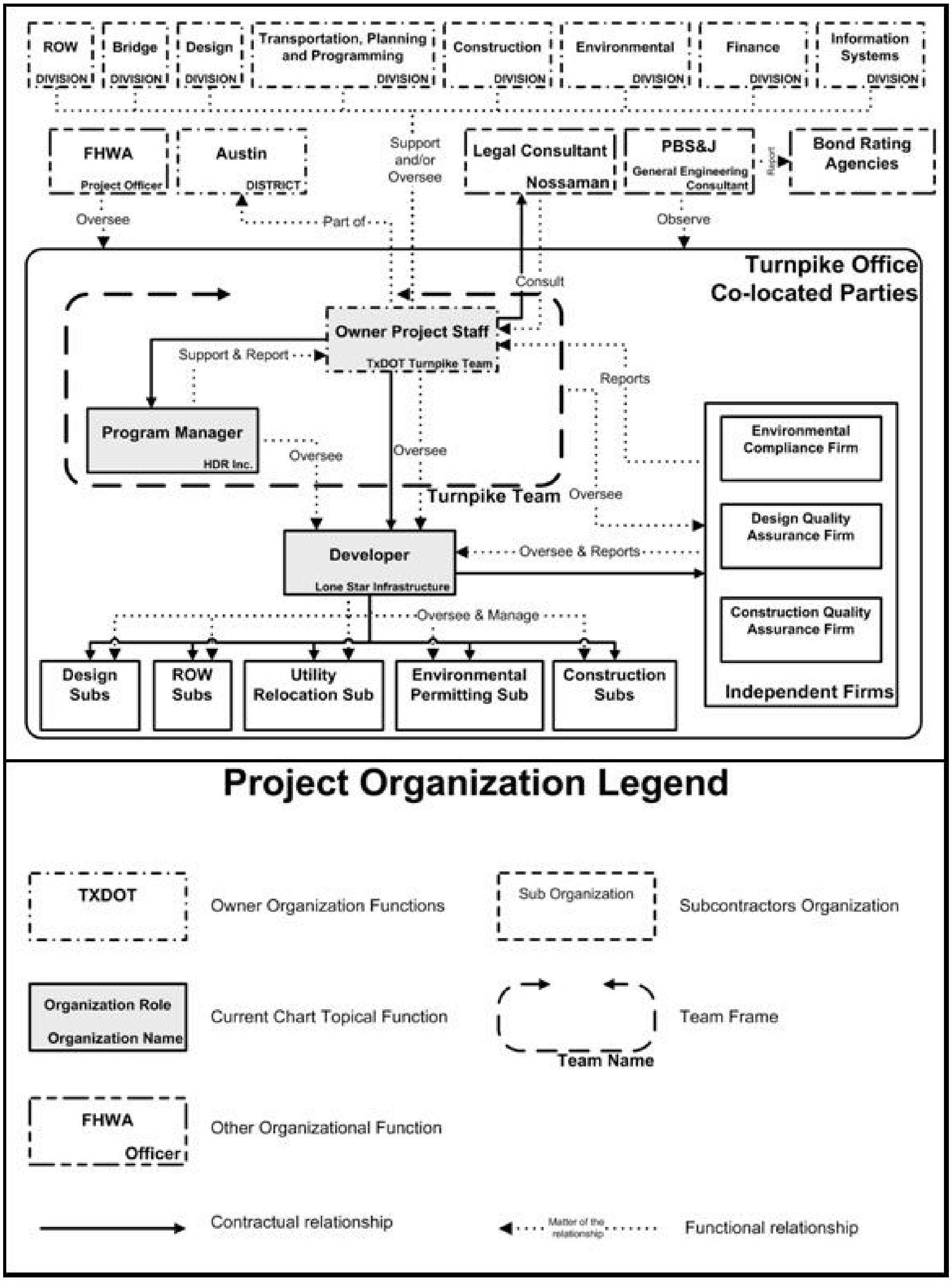

Figure 4.2: SH-130 Project Organization.

Chapter 5: Procurement of Design-Build Services

5.1. Chapter Overview

Existing literature offers few studies that have investigated how a change in delivery strategy is implemented by Owner organizations at the procurement level. Although major categories of DB procurement have been identified (K. R. Molenaar & Gransberg, 2001), the literature does not offer detailed information on activities performed during the procurement phase. Summaries of the findings of selected studies were included in Section 2.1.2.

To overcome this lack of information, a study of the process adopted by TxDOT for procuring the SH-130 contract was performed. The investigations were focused on activities needed for selecting the DB entity and for preparing the contractual document. To improve the validity of the process model, the author also studied procurement activities for the $154 million contract for delivering the SH-45 SE tolled expressway, which was procured by the same owner in 2004. Detailed information on this project is provided in Chapter 9.

The research outcome is a comprehensive procurement process, which includes activities to be performed between the delivery method decision and the contract execution. This process map was developed by the author in conjunction with the research team and project personnel. These activities are proposed along with general guidelines for preparing procurement documents; chief among these is a breakdown of the critical sequencing of document preparation activities with respect to other external processes. The model also highlights differences between the two cases attributable to the SH-45 SE adoption of the FHWA Rule. In the following section, the developed DB procurement flowchart is discussed with a focus on procurement activities related to the preparation of contractual documentation and selection of the design-builder.

5.2. DESIGN-BUILD PROCUREMENT PROCESS MODEL

To procure the SH-130 and SH-45 SE contracts, a two-phase best-value selection process was used as prescribed by the existing Texas legislation (Texas Transportation Code, Title 6, Section 223.203). Although procurement of these two contracts followed similar paths, the SH-130 procurement process included two additional phases for activities unrelated to the selection process: an initial toll viability study (absent for SH-45 SE) and additional activities during the contract finalization phase. Table 1 illustrates the breakdown of the phases and subphases. Procurement phases are identified by four intermediate objectives and are further broken down into subphases identified by milestones. A list of major procurement documents produced during procurement is also included in Table 5.1. A single person, hereafter called the procurement officer (PO), was in charge of SH-130 procurement. The PO selected a designee to oversee specific tasks and subphases.

A graphical representation of the complete process is found in Figure 5.1. This process flowchart exemplifies the overlapping of phases and identifies the range of durations at the subphase level. These measures of duration resulted from the analysis of procurement activities for the SH-130 and SH-45 SE projects with the former having longer durations. According to all the interviewees, two major factors contributed to the reduced duration of the SH-45 SE procurement: (1) increased familiarity of TxDOT employees with the process, and (2) less project complexity. First, the experience of the SH-130 project team was very beneficial to the SH-45 SE procurement staff members, who often consulted key SH-130 personnel to help them identify sequences and shortcuts in the process. Second, project complexity was critical for the preparation of the Request for Proposals (RFP) package (subphase 3.1). In fact, this subphase was shortened in the case of the SH-45 SE procurement because private financing and maintenance options were not included in the tendered contract.

Table 5.1: SH-130 Procurement Process Phases.

	Phase *Subphase*	***Duration*** (months)		***Objective*** *Milestone*	***Procurement Documentation***
		SH130	***SH45SE***		
1	**Toll Feasibility Study**	**NA**	**NA**	**Identify financing options**	
2	**RFQ Phase**	**15**	**5**	**Shortlist perspective proposers**	
2.1	Prepare RFQ	6	2	RFQ	RFQ
2.2	Develop QS	5	2	QS	RFQ Addenda
2.3	Evaluate QS	4	1	Shortlisted firms	
3	**RFP Phase**	**23**	**9**	**Select design-builder**	
3.1	Prepare RFP	15	6	RFP	ITP + Contract + TP
3.2	Develop Proposals	6	2	Proposals	RFP Addenda
3.3	Evaluate Proposals	2	1	Best-value proposal	
4	**Contract Finalization**	**3**	**2**	**Award design-build contract**	
4.1	Develop Final Price	2	1	Final Price	Contract, TP
4.2	Contract Execution	1	1	Contract signature	Signed Contract
	TOTAL	**35**	**14**		

Abbreviations:
RFQ – Request for Qualifications
QS – Qualifications Submittal
RFP – Request for Proposals
ITP – Instructions to Proposers
TP – Technical Provisions

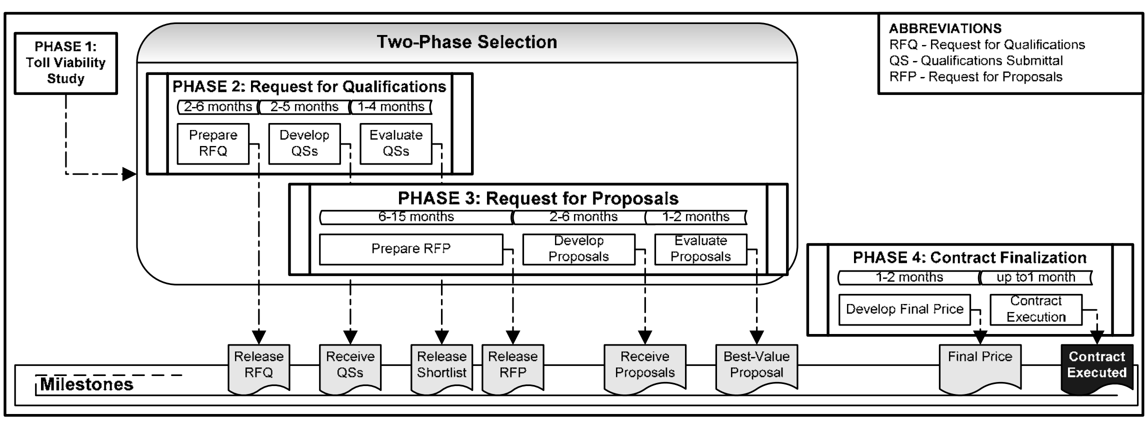

Figure 5.1: Overview of Procurement Process with Phase Durations and Milestones.

5.2.1. Phase 1: Toll Viability Study

As previously mentioned, TxDOT is allowed to adopt innovative delivery methods for toll road projects. When these projects are to be financed through issuance of toll revenue bonds, TxDOT needs to assess the feasibility of such a financing method before initiating the procurement. In this kind of situation, a toll viability study is performed during project planning before the procurement starts. This initial phase is beyond the scope of this paper. Further information can be obtained in the TxDOT online guide to conducting the toll viability study.

5.2.2. Phase 2: Request for Qualifications

Under the FHWA Final Rule for DB contracting, the Request for Qualification (RFQ) phase is denominated "Phase One Solicitation" (FHWA, 2002). During this phase, the SH-130 and SH-45 SE procurement teams performed three groups of activities with the goal of pre-qualifying firms. Tasks relating to this phase and its three subphases are shown in Figure 5.2 and described below.

Subphase 2.1 – Prepare RFQ Package

This subphase ended with the public release of the RFQ package. In order to issue this documentation package, the procurement team needed to carry out a group of iterative activities (subprocess 2.1.1) to write the document for issuance, including the forms for submittal. Concurrently, the procurement team defined all the details for evaluating submitted qualifications, including rules for evaluations, roles and responsibilities, and a tentative procurement schedule. Outputs of this subphase were the RFQ documentation and a detailed evaluation process. The SH-130 and SH-45 SE RFQ documents included the following information:

- Project description,
- Procurement process overview,
- Requirement for competing qualifications submittal (QS) with forms for submittal and required financial documents,
- Evaluation process, including information on schedule and criteria for evaluation,
- Submittal procedures with indication of the main point of contact.

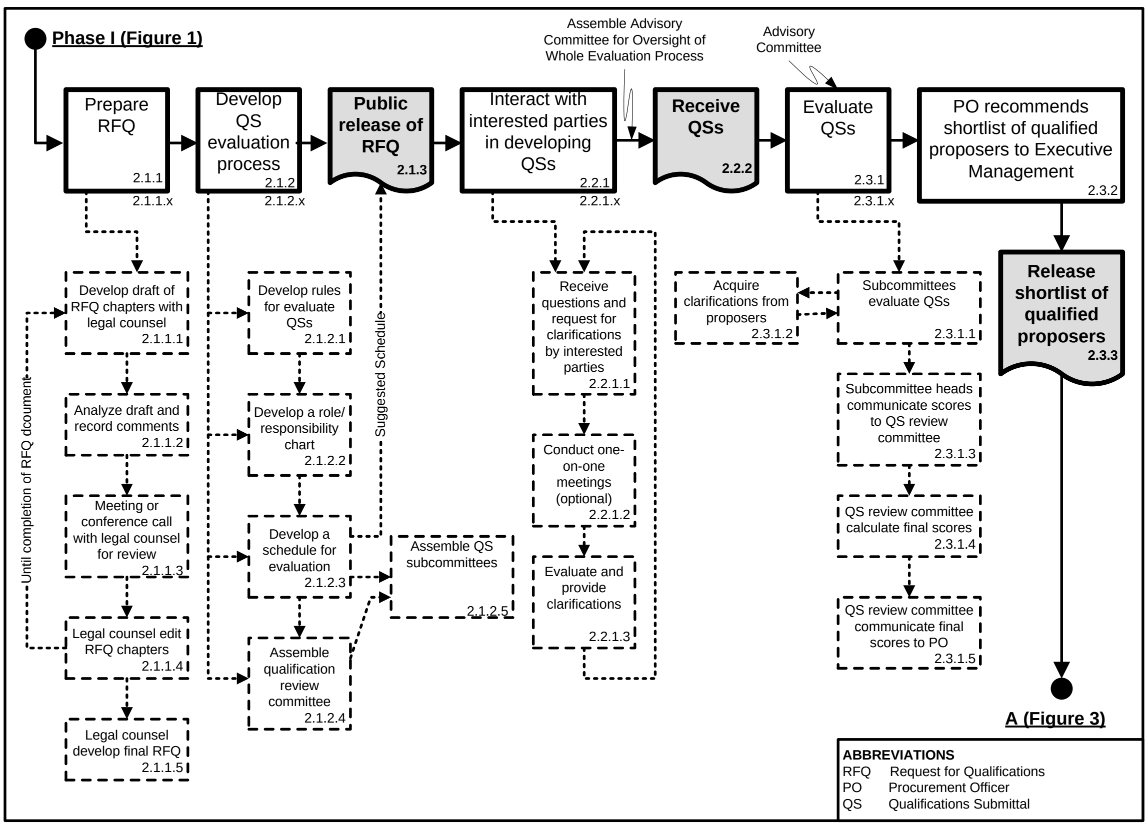

Figure 5.2: Phase 2 – RFQ Process.

Subphase 2.2 – Develop Competing Qualification Submittals (QSs)

After the RFQ release, the procurement team, including legal and engineering consultants, interacted with interested parties in order to facilitate the submittal of qualification packages. During this interactive phase, any interested party analyzed the

RFQ and submitted requests for clarifications to the procurement team. According to some interviewees, this process can be modified such that owners can investigate industry providers' availability to contribute to the financing scheme. In such a case, if the project includes bonds or design-builder financing options, the procurement also includes a few rounds of one-on-one meetings with interested firms to make any necessary corrective action (e.g. SH-130 case).

Subphase 2.3 – Evaluate Qualifications Submittals (QSs)

When Qualification Submittals (QSs) were received, the evaluation committee and subcommittees reviewed the submitted packages for responsiveness, evaluating them according to the criteria provided in the RFQ package. Finally, these scores were communicated to the PO, who recommended the shortlist of qualified proposers to TxDOT executive management.

5.2.3. Phase 3: Request for Proposals

Under the FHWA Final Rule for Design-Build contracting, the request for proposal phase is denominated "Phase Two Solicitation" (FHWA, 2002). Activities performed during this phase are broken down into three flowcharts, one for each of its subphases.

Subphase 3.1 – Prepare Request for Proposals

For this subphase, the TxDOT personnel, technical consultants (i.e. Program Manager) and legal consultants who comprised the procurement team prepared a draft of the RFP package. Committees for evaluating proposals were also assembled. The RFP draft was released to the shortlisted firms for feedback through an interactive review process denominated "industry review." When completed, the industry review produced a final RFP that was issued to the qualified proposers. Figure 5.3 illustrated this subphase and its tasks.

To prepare the final RFP draft, as much information as possible was collected to reduce uncertainties associated with project characteristics and risks. A typical RFP package for procurement of design-build services has four parts: (1) the instructions to proposers (ITP); (2) the DB contract; (3) the Technical Provisions (TP); and (4) a set of attachments. The first document describes what the proposals have to include and how they will be evaluated. The second includes the contractual agreement and its abbreviations and definitions. The technical provisions include the scope of work, project specifications, and any other technical criteria. Finally, the attachments include all the preliminary engineering work performed by the owner and available as a guide to developing a proposal (e.g. schematic design, utility survey maps, existing ROW information, etc.). To develop the RFP draft, the owner procurement team performed the following activities:

- defined the process for evaluating proposals and identifying information to be included in a proposal, and appointed the evaluation committees;
- prepared draft of the DB contract;
- identified design criteria and developed a draft of the Technical Provisions; and
- completed preliminary engineering activities as necessary to identify risks and reduce contingencies.

Two groups of interrelated activities were conducted concurrently during this phase: (a) performing preliminary engineering and developing environmental impact documentation, and (b) developing contractual documents. The preliminary engineering activities were initiated long before this phase, but they were continued concurrently to the development of the RFP documentation. The TxDOT project team could begin to develop ITP, DB contract, and TP. At the outset, these documents could be outlined, but gaps were present that could not be filled until preliminary engineering was completed. The project team had to fill these gaps before the release of the RFP. Moreover, ITP, DB contract, and TP were developed concurrently because information from any of these documents is needed for the others to maintain congruence (i.e., in terms of risk allocation). Two engineering processes substantially affected the duration of subphase 3.1 for the SH-130 project: (1) the development of the schematic design (~6 months), and (2) the environmental clearance process (~12 months). In the activity sequencing, these processes are predecessors to the issuance of the final RFP.

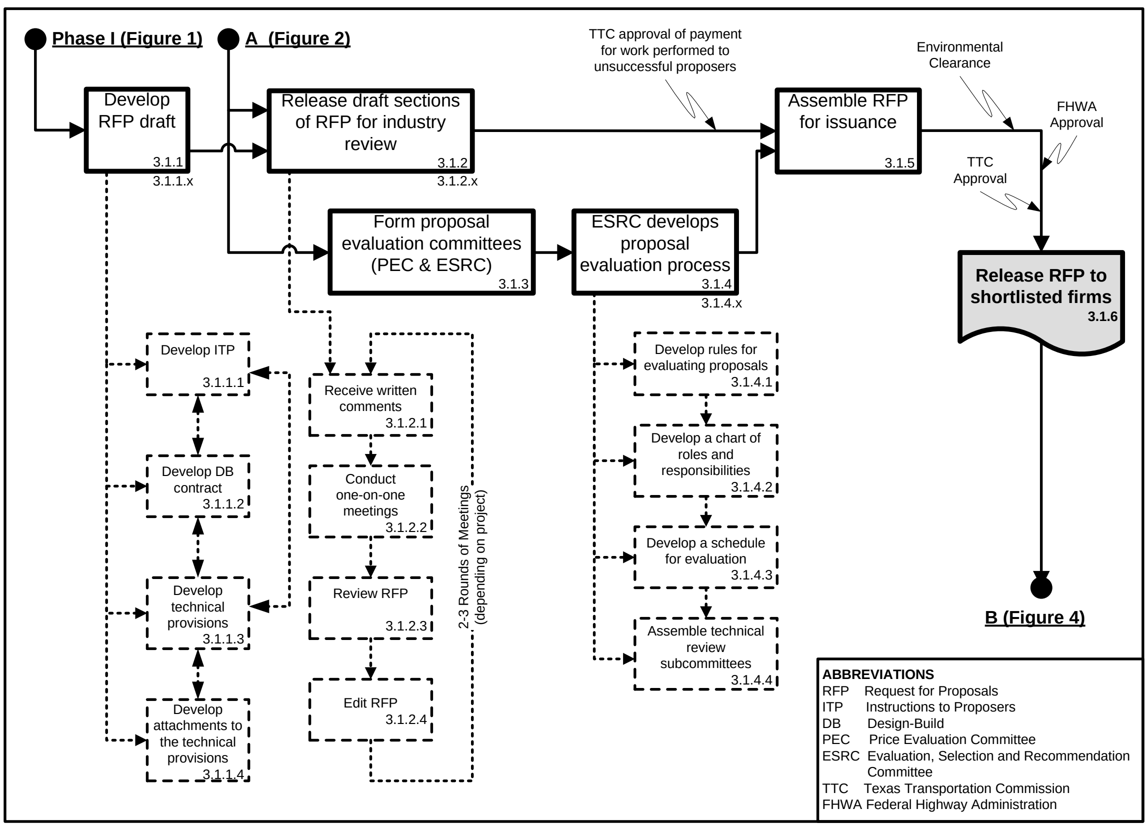

Figure 5.3: Phase 3.1 – Prepare RFP.

At this stage, the PO was also in charge of appointing members of two proposal evaluation committees: (1) the Price Evaluation Committee (PEC), and (2) the Evaluation, Selection and Recommendation Committee (ESRC), which was in charge of evaluating technical aspects. Although these committees included only TxDOT employees, they were assisted by discipline-specific subcommittees composed of outside consultants who provided advice on technical, financial, legal and maintenance aspects of the projects. In addition, TxDOT invited observers from other state and federal agencies with specific interests and responsibilities associated with the projects to form an advisory committee. All outside consultants and observers were required to endorse confidentiality statements.

Concurrent with the committee appointment process, the industry review process was critical to refining the contractual component of the RFP documentation and included a reiterative cycle of subtasks. The final goal was to achieve trade-offs with the proposers in terms of risk allocation. In the case of SH-130, the department released draft sections of the RFP to the short-listed firms and waited for their written comments. A round of one-on-one meetings was then scheduled to address these comments. The contractual documentation was reviewed, modified, and edited by the legal consultants and resubmitted to the proposers with other draft sections. How the industry review process is conducted depends on three factors. First, it is affected by the STA's previous experience with similar projects. Ultimately, risk allocation during this phase can be limited because the DB contract and the ITP document would be developed following an organization-wide model. In such circumstance, the PO can use RFP documentation from previous projects as a model or the STA can develop a master RFP package. The second factor affecting the industry review is project complexity. The industry review process usually requires between two and four rounds of meetings. For example, firms shortlisted for the SH-45 SE projects were provided a nearly complete copy of the RFP. As a result, two rounds of industry review meetings were carried out during this project's procurement. Subsequently, three rounds of meetings were conducted for the SH-130 project where industry review was conducted section-by-section. Finally, the presence of external pressures on the procurement schedule also affected the industry review process. Two external processes are predecessors to the issuance of the final RFP: (1) the development of the schematic design (~6 months for SH-130); and (2) the environmental clearance process (~12 months for SH-130). In fact, the FHWA rule for DB contracting prescribes that the federally-mandated environmental compliance review process has to be concluded, and the approval of the FHWA division administrator on the RFP document has to be obtained before the RFP is issued (FHWA 2002). For both projects, environmental clearance was obtained before the RFP was issued, but waiting for necessary authorization of environmental clearance at federal level (i.e. FHWA approval of final Record of Decision) and state level (i.e. Texas Transportation Commission approval of environmental review) delayed the SH-130 RFP issuance. According to an interviewee, waiting for these approvals afforded the team an opportunity to conduct a more thorough industry review, which improved the final RFP document.

Subphase 3.2 – Develop Proposals

In the next subphase, TxDOT personnel and external consultants interacted with short-listed firms in order to facilitate the submittal of qualification packages. Figure 5.4 represents this subphase and its tasks. First, proposers submitted questions and requests for clarification; then, a round of one-on-one meetings was conducted to discuss these comments, and finally, the documentation was reviewed and edited by the legal consultants. After each round of meetings, the TxDOT project team issued addenda of the RFP in a redline format of the original document. The duration of this activity was predetermined because the department set a deadline for getting the last clarification request from the proposers and an end date for issuing the last addendum. On the two observed projects, two or three rounds of meetings were sufficient, but on more complicated projects, such as large corridor projects including private financing options, this number is believed to increase.

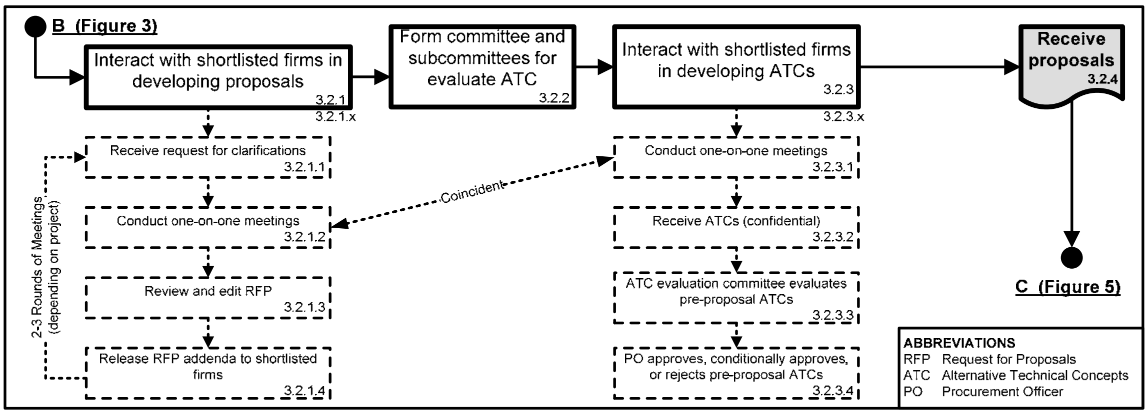

Figure 5.4: Phase 3.2 – Develop Proposals.

At this point, TxDOT personnel also interacted with the proposers to review and approve their Alternative Technical Concepts (ATC). These projects' DB procurement used the ATC concept to promote and reward innovative ideas by proposers. They are innovative solutions in exception to the provided Technical Provisions. Both case studies allowed two categories of ATCs: cost-saving and value-added. Although submittal, negotiation, and evaluation of ATCs happened during the same one-on-one meetings, performing this task needed attention because value-added ATCs needed to be managed differently from cost-saving ATCs. Proposers could decide to include approved cost-saving ATCs in the final proposal. Under such a circumstance, they would have an advantage in the price evaluation. Conversely, value-added ATCs could be included in the final price only after a firm was selected for contract finalization. In such a case, proposers received an advantage in the technical evaluation.

Subphase 3.3 – Evaluate Proposals

The purpose of this subphase, schematized in Figure 5.5, was to conduct an evaluation of proposals in order to identify the best value proposal. As a requirement of the RFP, price information was submitted in individual sealed envelopes, separate from the other portions of the proposal. At first, the PO's designee received and separated each contractor's Price Proposal from the remaining documentation and assigned an identification code to each. The record tying the generic identifiers to the actual Proposers was sealed and held by the designee. Then, the designee passed the two proposal packages to the two evaluating committees: the price proposal to the PEC and the technical proposal to the ESRC.

Thereafter, the evaluation was conducted on two parallel tracks, price and technical, and followed three steps: responsiveness, pass/fail, and score assignment. First, the committees reviewed proposals for irregularities and responsiveness to the requested format. Second, a pass/fail assessment was conducted according to pre-fixed criteria (i.e., submittal of proposal bond, use of required forms). Finally, proposals were evaluated in terms of the pre-established scoring criteria with a score being assigned for each criterion. These scores were combined using evaluation algorithms that were established in the RFP. Exchange of information during this phase was strictly regulated because price and technical committees were not allowed to communicate with each other until after the scores were assigned. The entire evaluating process was supervised by an advisory committee, which included at least one representative from each of the following entities: the state attorney general's office; the FHWA (essential for validating processes related to federally funded projects); the TxDOT internal counselor representative, and the State comptroller. A chart representing the different committees involved in the evaluation of proposals for SH-130 is included in Figure 5.6.

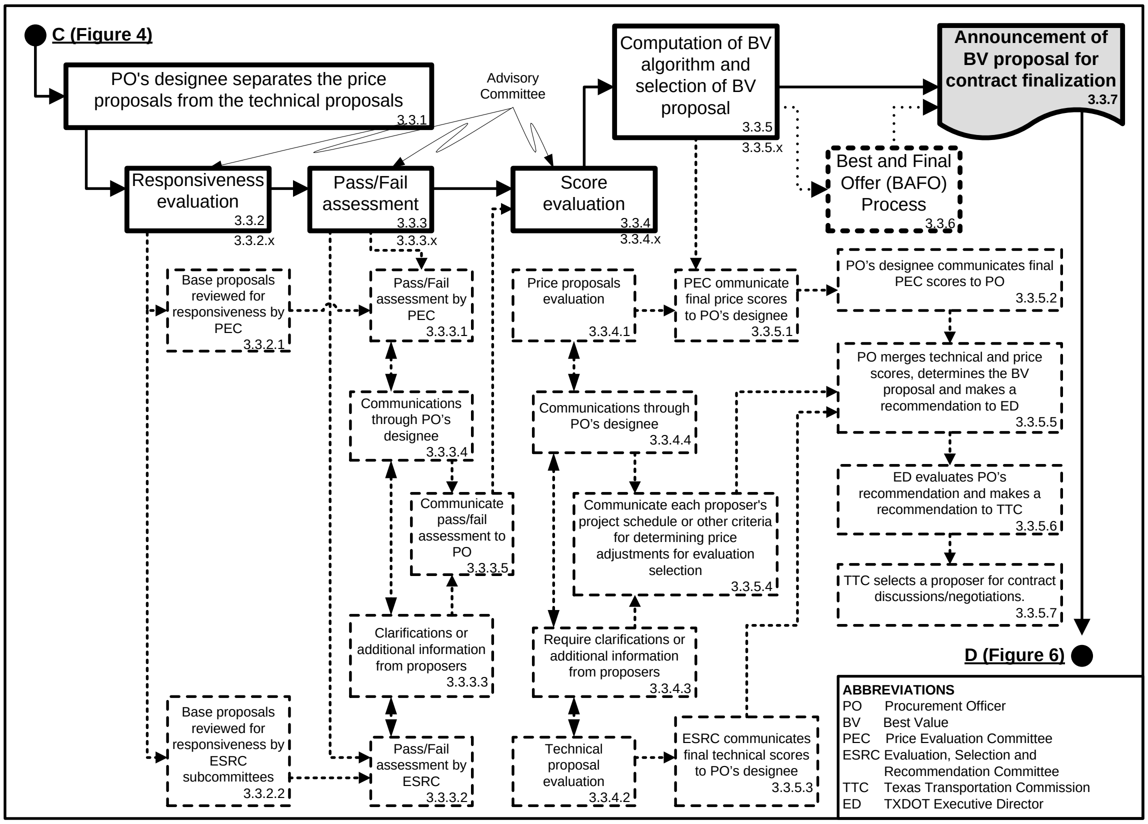

Figure 5.5: Phase 3.3 – Evaluate Proposals.

After the evaluation was concluded, the PO merged price and technical scores to determine the best value proposal and then recommended it to the executive management. Finally, the TxDOT Executive Director communicated the best value proposal to the Texas Transportation Commission (TTC) and requested authorization to proceed for contract finalization.

At this stage, both SH-130 and SH-45 SE procurement included an additional and optional step, the Best and Final Offers (BAFO) phase. Although this option was not exercised, a very detailed process for it was outlined in the two ITP documents. For both projects, the owner could initiate the BAFO process if the submitted proposals did not meet the maximum budget amount. If a BAFO process was going to be initiated, TxDOT could enter into discussion with one or more proposers, revise the RFP and request BAFO submittals. Proposers invited to participate in the BAFO process would be advised of deficiencies in their proposals and given the opportunity to correct such deficiencies and re-price their proposals. In addition, TxDOT could change the scope of work. At the end of the BAFO process, TxDOT would consider the revised information and re-evaluate and revise ratings accordingly.

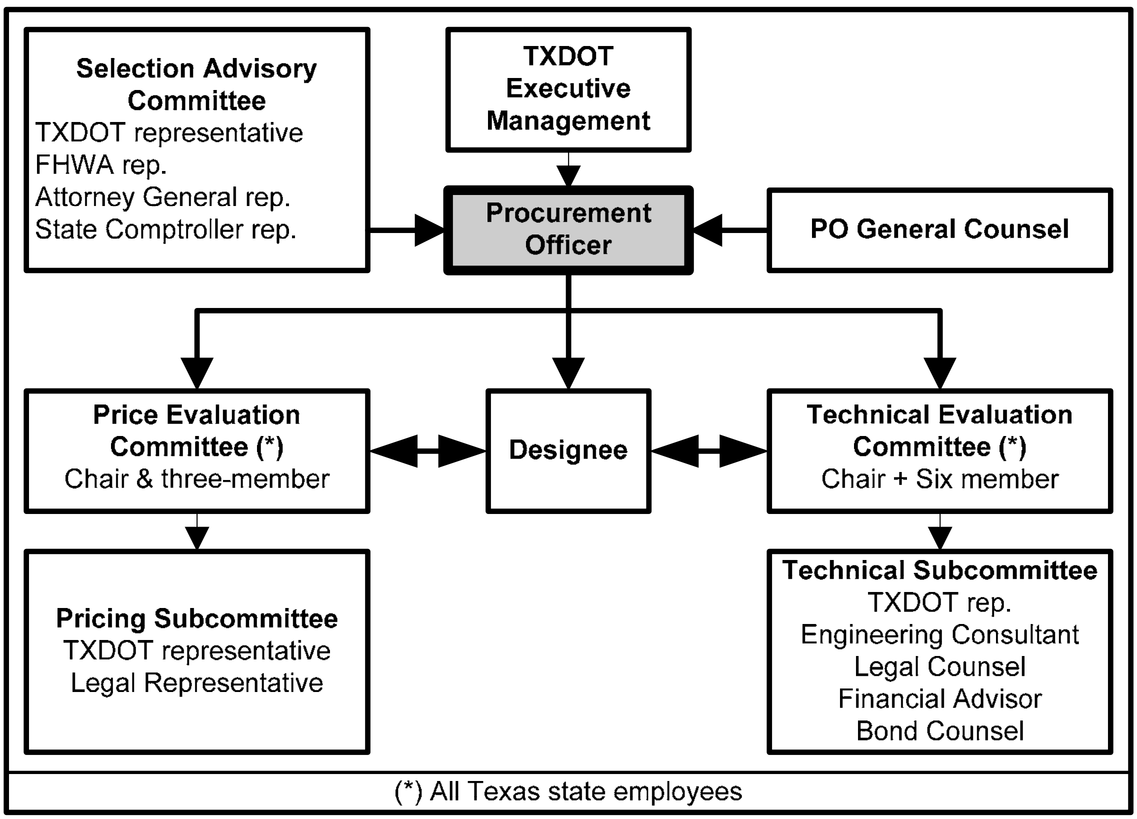

Figure 5.6: SH-130 Evaluation Committees Organization Chart.

5.2.4. Phase 4: Contract Finalization

During this phase, the procurement team performed two sets of activities. Figure 5.7 includes the tasks relating to this phase, and its two subphases.

Subphase 4.1: Develop Final Price

For the SH-130 project, the purpose of this subphase was to incorporate aspects of unsuccessful proposals into the selected proposal and to include them in the final price. Moreover, the process allowed TxDOT to enter into discussions with other proposers in case the selected proposer was not collaborative on a particular issue. On the SH-45 SE project, interactions between TxDOT and design-builder were postponed after the contract award.

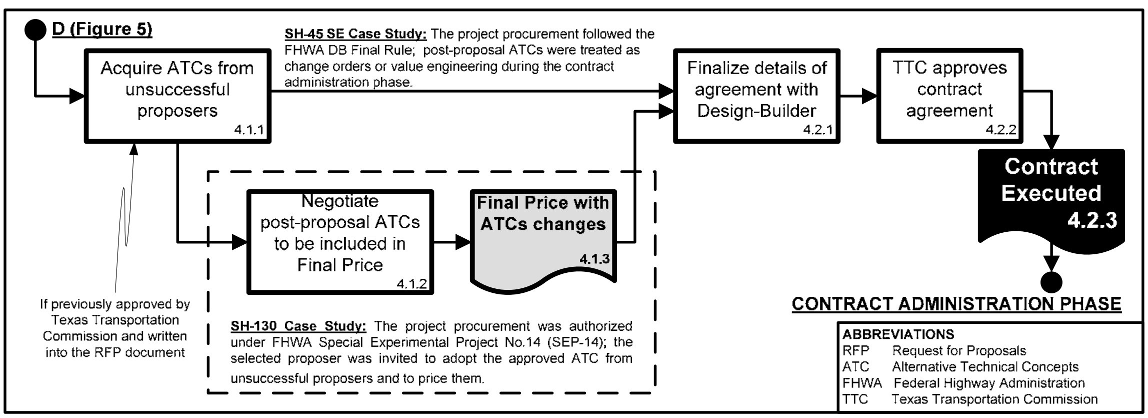

Figure 5.7: Phase 4 – Contract Finalization.

According to some interviewees, two factors affect whether and when aspects of unsuccessful proposals can be included in later design activities. First, in Texas the state transportation commission has to approve the payment of work performed (i.e. stipends) to unsuccessful proposers. In that case, TxDOT can acquire the right to use aspects of unsuccessful proposals in later design activities. While both of the observed projects received this permission, two different strategies were adopted. TxDOT acquired rights to use any proposals during SH-45 SE procurement. However, the amount of the payment was based upon the value of the Proposal that can be used by TxDOT up to a maximum amount. This maximum amount per Proposer was 0.15% of the successful proposer price as stated in the SH-45 SE ITP. Conversely, only proposals receiving a qualitative score equal to at least 70% of the maximum possible qualitative score were acquired during SH-130 procurement. The amount of the payment was 0.1% of the successful proposer Price as stated in the ITP.

The second determining factor is that the pricing of other proposal aspects can happen at different stages of the project life cycle depending upon the FHWA process adopted for the procurement. The SH-130 project was procured under the SEP-14 program, so some aspects of the acquired proposals were included in the contractual agreement with all necessary price adjustments made. In performing this activity, TxDOT began discussions with the selected proposer about the incorporation of aspects of other proposals for achieving the overall best value for the department. In the case of SH-130 procurement, this discussion phase was denominated "post-proposal ATCs." Conversely, the SH-45 SE project was procured according the FHWA rule, so the post-proposal ATCs were treated as change orders or value engineering after the contract signature.

Subphase 4.2: Contract Execution

During this subphase TxDOT executed the agreement with the selected proposer. Any details needed for contract signature were also defined at this time.

5.3. FINDINGS ON SH-130 CONTRACT PROCUREMENT

Using a case study methodological approach, a detailed study on the use of two-phase selection procedures was conducted. Investigations were focused on activities needed for selecting the DB entity and for preparing the contractual document. A process model has been developed for the procurement of design-build services through a two-phase selection procedure. This process map has been reviewed and accepted by the SH-130 project manager, the SH-45 SE procurement officer and the HDR project manager and subsequently published. Using two DB projects in Central Texas as case studies, procurement activities were identified; their sequencing was also mapped taking in consideration external processes. Two processes external to procurement were shown to particularly affect the procurement schedule: (1) preliminary investigations to identify project risks; (2) environmental clearance. Activities were grouped in phases depending on the milestone they were aimed at achieving, and phase durations were identified for the two case studies. As a result, a detailed DB procurement process was developed.

The duration of the procurement for each of the two projects show that this type of procurement can be time consuming. Procurement activities for the SH-130 project took around 35 months, whereas the contract stipulated a period of 65 months for the execution of the contracted work. As a result, procuring the contract required a period of time equal to 35% of the total delivery time. Similarly, procurement activities for the SH-45 SE project took 14 months, whereas the contract stipulated a period of 40 months for the execution of the contracted work. In this case, procuring the contract required a period of time equal to 26% of the total delivery time.

Although procurement of DB services is cumbersome, the literature does not offer detailed information on activities performed during DB procurement. With this part of his research, the author has filled this research gap for the highway project sector. The process developed here can be used by practitioners as guidance for implementing the two-phase selection procurement encouraged by the FHWA DB Final Rule. The author expects that state highway officers will be able to gain several advantages from this research. First, knowledge of information flow across procurement activities can facilitate efforts to plan efficient project procurement. Second, information on activity sequencing can reduce the amount of time that officers spend experimenting and developing new organizational routines to implement the new procurement approach. Third, an understanding of how DB procurement activities provide the same levels of safeguards as traditional DBB procurement can help agencies overcome existing cultural barriers and concerns over the new methods.

While the proposed process presented here forms the basis for understanding this new type of highway procurement, further research is required in two specific directions. First, a systematic study of specific factors affecting duration of DB procurement is needed. Such research can only be done by means of a wide collection of data on procurement schedule durations and project characteristics. It would also be advantageous to identify variations within the two-phase selection scheme and to explain under which circumstances these variations occur. This information could be beneficial for mapping decision trees. These data would provide insight into designing software for DB projects that would better reflect and assist the modified procurement processes. For instance, specifications for Project Information Management Systems (PIMS) that facilitate the procurement document exchange between owner, technical and legal consultants, FHWA officers and proposers can be built upon a general characterization of innovative procurement processes. Such systems would streamline procurement, allowing a real-time distribution of document versions and addenda.

Chapter 6: Administration of Design-Build Contract

6.1. Chapter Overview

Existing literature offers few studies that have investigated the administration of DB contracts. This lack of information was supplemented by studying the administration of the SH-130 contract. The investigations were focused on the organizational and communications aspects. The research effort identified issues related to the implementation of a new project delivery method during the contract administration phase. These issues are presented in this chapter.

While the literature lacked information on the administration of DB contracts for the transportation sector, findings from the literature review did allow the research team to identify issues that needed to be investigated. Consequently, the semi-structured interview guide adopted for this part of the investigation (Appendix A.2) includes items on these research issues. Summaries of the findings of selected studies were included in Section 2.1.3. These studies highlighted several issues to be investigated. Although the developed interview guide follows a semi-structured approach in order to increase data richness beyond topics from the literature, the research team decided to address some of these issues directly at the end of the interview to investigate their effect on SH-130 project organization. These issues include the amount of Information Technology (IT) support for the project team, the allocation of time to meetings, and the occurrence of short-circuiting of communications between the Owner's team and the Developer's designers.

The research outcome is a comprehensive identification of issues related to the implementation of a new project delivery method during the contract administration phase. These issues are proposed along with general guidelines for managing DB contracts; chief among these is a set of lessons learned for TxDOT in overseeing the execution of the SH-130 contract. In the following sections, findings from this phase of the research are presented and discussed with a focus on organizational structures to be implemented, strategies for staffing the project team, and lessons on regulating project communications.

6.2. Analysis and Synthesis of Interview Findings

6.2.1. Major Organizational Issues

This section summarizes observations made on the organizational structure of the SH-130 project. More complete documentation of these observations is included in Appendices A.4 and A.5.

Role and Responsibilities

The allocation of responsibilities for the SH-130 project differs substantially from a traditional TxDOT DBB project because the CDA-DB contracting approach shifts most of the risk to the Developer. In addition, an external consultancy entity, the Program Manager (PM) performs many of the tasks on the Owner's side. A comparison between the allocation of responsibilities for the SH-130 project and that of a generic DBB project is represented in Figure 4.1. The re-allocation of responsibilities radically modifies the roles of the parties in a DB project and puts several new entities into play. Following is an outline of the roles of the major actors for the SH-130 project:

<u>*TxDOT*</u>

The Owner team's role was defined in the CDA agreement. This contract limits its role to "oversee performance of the Development Work for the purpose of confirming that the Development Work meets the requirements of the Contract Documents.

Oversight includes design reviews, design and construction oversight, acceptance of the Development Work … and establishment of priorities for the purpose of ensuring timely receipt of revenues. [The Owner team] will also serve as a liaison with regulatory agencies in connection with Developer's application for Environmental Approvals and/or amendments or re-evaluations for which Developer is responsible" (TTA, 2002; pp.9).

Although many of these responsibilities are assumed by the PM, the Owner's representatives are responsible for communicating with regulatory agencies; however, their oversight decisions are based on legwork-by and recommendations from the PM. Some interviewees suggested that there is a need to re-allocate part of the decision-making responsibilities to the PM in order to streamline the oversight process. Moreover, other interviewees underscore that there is not a clear line drawn between the responsibilities of TxDOT and the PM. Additionally, these two entities have a duplication of roles in some disciplines (e.g., ROW and environmental). Consequently, the Developer's employees often need to communicate with counterparts from both entities when an issue occurs. According to an interviewee, there was often reluctance to embrace the DB approach within the Owner's team, and the inexperience with the new process raised caution. The same interviewee believes that this caution motivated the Owner to add additional staff for monitoring and overseeing the project. Conversely, the Owner team believes that a cautious approach was needed since this project is "piloting" the DB approach, and since it is the largest contract ever awarded in Texas.

The use of independent quality assurance firms (e.g., Design Quality Assurance Firm [DQAF], Construction Quality Assurance Firm [CQAF], and Environmental Compliance Firm [ECF], later discussed) is advantageous to TxDOT, because it relieves the Owner of part of the responsibility for the schedule. An interviewee explained this advantage by citing his experience with another DB project. On that project, the quality assurance work was done by the PM, who was forced to increase quality assurance staff in order to meet the Developer‘s production requirement. Therefore, as the Developer’s production rate rose and fell, the Owner’s quality assurance staffing requirement fluctuated with it. With this approach, the Owner was forced into accommodating the Developer’s pace. Similarly, in DBB projects, the contractor’s construction quality is usually controlled by the Owner’s staff. This arrangement makes the Owner vulnerable to litigation with the Developer for schedule issues.

Program Manager

The CDA agreement also defined the role of the PM. This entity has the responsibility “to assist [the Owner] with the administration and oversight of the Development Work” (TTA, 2002; pp.9-10). The contract also specified that the PM is not authorized to “direct the performance of the Development Work unless continued performance of the Development Work appears imminently likely to (i) result in a violation of any environmental Law or any conditions of any environmental Governmental Approval or otherwise endanger the environment; or (ii) endanger the health, welfare or safety of workers or the public” (TTA, 2002; pp.9).

Findings demonstrated that the PM’s responsibilities include overseeing the Developer’s performance, making sure that the Developer has implemented proper QA/QC systems, and reporting the project status to TxDOT. However, some participants from the Developer’s team believe that the PM’s team was overstaffed in some areas relative to its responsibilities. Some interviewees also believed that the PM’s staff was going beyond what they perceive its role to be by performing more of its own inspections than they expected. Again this may be due to the high profile of this project.

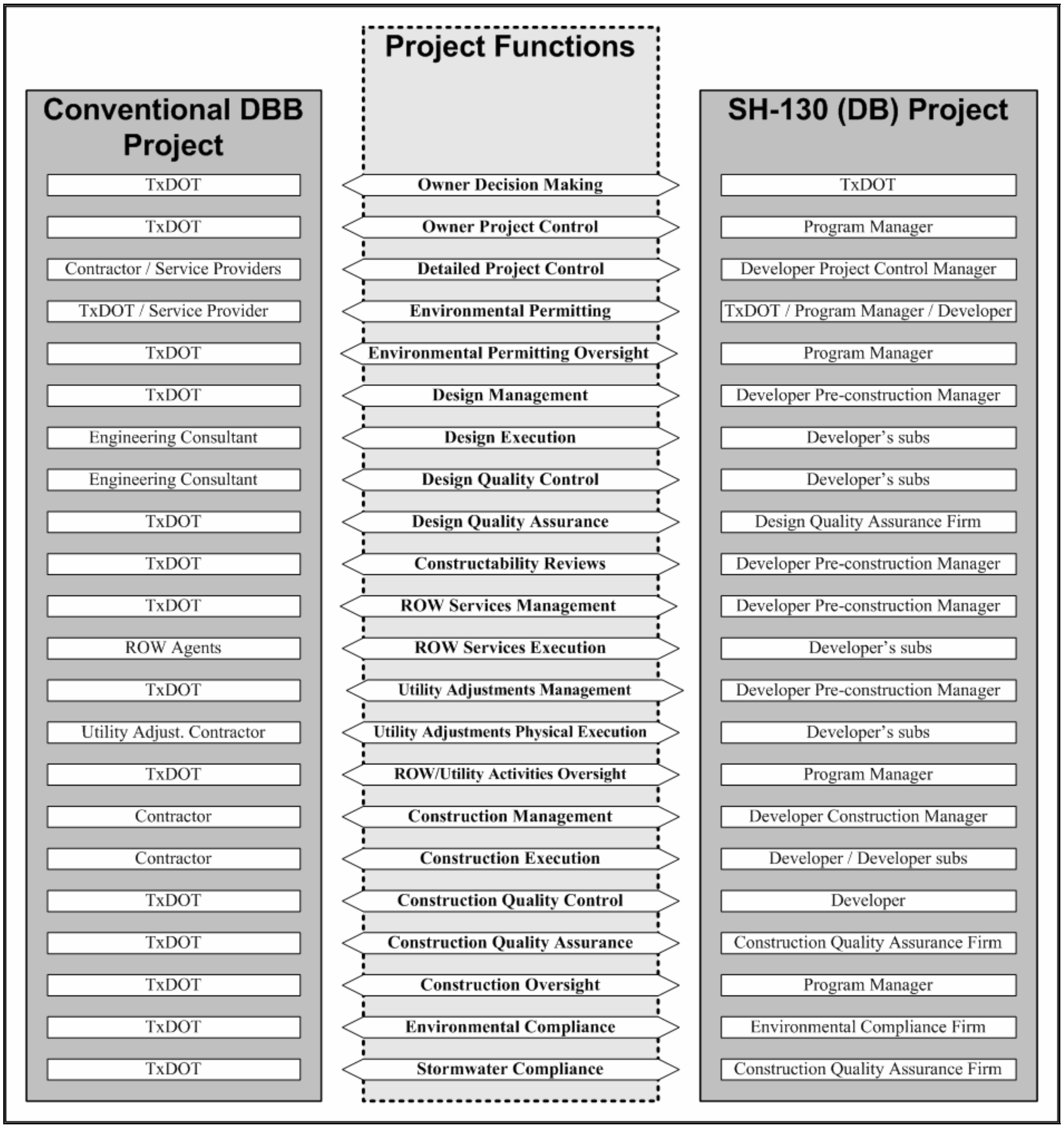

Figure 6.1: Responsibilities in the SH-130 project versus a traditional DBB project.

Developer

The Developer entity is a joint venture of three major contractors. These contractors provide personnel to build up the project team. An interviewee observed that there were some problems regarding roles and responsibilities within LSI and that the joint venture struggled to solve them during the first two years. A reason for these problems was "attributable to the joint venture itself where LSI comprises the three companies, Fluor, Balfour Beatty, and T.J. Lambrecht. So when you bring three companies together, you bring three different execution/operation approaches together."

The Developer follows a matrix structure with two levels of management directing, managing, and overseeing joint venture project personnel (based in three area offices) and several subcontractor firms (i.e., design, ROW acquisition, utility adjustments and construction firms). Additionally, the Developer's managers interact with three independent firms to implement the proper QA/QC systems and assure design and construction quality assurance and environmental compliance.

Design Consultant

An engineering firm acts as the design subcontractor for the Developer. This firm leads several other design firms. All the designers are co-located with the Developer and work as a team under a matrix organizational structure. The joint design team has a role similar to the role of a design firm on a traditional DBB project with one major exception: they are directed by the Developer rather than by the Owner.

Some interviewees pointed out that some short-circuiting of communications between the Owner and Design firm occurred early on in the project (described in Section 4.2.6). These improper communication pathways suggest that designers (and the Owner) are still often tied to the DBB approach (according to literature findings in Section 2.1). An interviewee pointed out that the design consultant does not have any person dedicated to environmental issues, an omission that makes communications with the environmental group difficult.

Design Quality Assurance Firm (DQAF)

The DQAF has the responsibility to perform reviews on design production. It reports to both TxDOT and the Developer and is subject to over-the-shoulder reviews by the PM. An interviewee suggested merging quality assurance (i.e., DQAF and CQAF) within a firm to improve both the application of constructability concepts and the coordination between design and construction groups.

Construction Quality Assurance Firm (CQAF)

The CQAF is charged with performing inspections on construction activities for both materials and stormwater compliance. It reports to both TxDOT and the Developer and is subject to the PM’s oversight, including Owner verification tests and audits of records. The presence of a CQAF is advantageous to TxDOT because it relieves the Owner of the responsibility of increasing staff for quality assurance in order to meet the Developer‘s production requirement. This modification of the responsibility allocation frees the Owner from adherence to the Developer’s schedule. As mentioned, an interviewee suggested merging CQAF and DQAF responsibilities under a single firm’s oversight.

Environmental Compliance Firm (ECF)

The CDA agreement introduced the concept of the Environmental Compliance Manager (ECM) as the person responsible for monitoring, documenting, and reporting on the environmental compliance of the Development Work. However, this concept evolved during the SH-130 project life to more of a firm-based approach. Currently, the consultancy firm managed and owned by the initially designated ECM is performing these activities (the ECF). An interviewee was concerned about this shift of responsibility because most of the activities are being performed by less experienced ECM personnel. The ECF firm is also supporting the Developer in preparing additional permitting requests and re-evaluations.

Team Staffing

The SH-130 project has adopted an innovative organizational structure and a responsibility allocation that is substantially different from a traditional DBB project. These differences affect the way project teams are staffed in terms of size, characteristics, selection, and management of personnel. The high speed of the DB process makes it challenging to keep staff aligned to the project needs in terms of size. Some problems observed with SH-130 staff size are catalogued in Table 6.1. These observations are based on comments during the interviews as of March 2005.

Table 6.1: Observations regarding team staffing.

	Understaffed	**Overstaffed**
TxDOT	Design (as of March 2005) Environmental (as of March 2005) ROW/Utility (as of March 2005) Construction (early phase)	None
Program Manager	ROW clerks (early phase)	Construction (as of March 2005)
Developer	Project Management (as of March 2005) Environmental permitting (early phase) Pre-construction management (early phase)	None

<u>*TxDOT*</u>

According to most of the interviewees, the TxDOT component of the Owner's organization has been lean from the project's inception. This small group of TxDOT employees has also been shared with other turnpike projects. Some interviewees suggested that there is a need to increase TxDOT presence on the project. They suggested that for a project of this magnitude TxDOT should allocate its resources to the project on a full-time basis until required by their respective discipline load work. The main reason is that if TxDOT retains all the decision-making responsibilities, a sufficient number of Owner representatives need to be allocated to a project of this scale to avoid bottlenecks in the process. An interviewee suggested that a more substantial TxDOT component would expedite the learning curve of the CDA process within TxDOT, as well as facilitate the learning curve of out-of-state consultants during the early stages of the project's life. Another interviewee suggested that TxDOT representatives at the project level should be very experienced in order to guarantee a quick answer to the Developer's questions.

Program Manager (PM)

According to several interviewees, the largest difference in staffing the Owner's team was having an engineering consultant, the PM, as an extension of TxDOT staff. This difference gave the project a flexibility that would not exist if the project were entirely staffed with traditional state forces. In fact, the consultant's presence allowed the Owner to respond to the extensive allocation of human resources put in place by the Developer. TxDOT project management had a large role in staffing the PM's team. In some areas (e.g., ROW), TxDOT and PM managers handpicked everyone on the team. As mentioned, some participants from the Developer's team believe that the Owner's inexperience with the DB process generated an overstaffing of some areas of the PM's component. These comments are derived from the different interpretation the Developer's personnel have of the PM's role, and from their perception of the proper level of oversight by the Owner team.

Developer

An interviewee explained that the Developer's team was staffed according to a "salt-and-pepper" strategy. Basically, the management team outlined the overall organizational structure and each of the three partners furnished people to fit into the positions according to their availability. Therefore, the staff allocation was not function-based (i.e., “We are not structured around responsibilities. For example, Fluor is in charge of project control, so all the project control is Fluor, that is [its] responsibility”), but position-based (i.e., “We organize [according to] whoever has the best people to fill those slots”). After the staff was identified, the team started planning project execution activities by defining operating procedures, reporting format, etc. At this point, the real nature of the joint venture became evident because the three different corporate philosophies needed “a long time to get molded together into one agreement.”

6.2.2. Major Communications Issues

This section summarizes observations pertaining to project communications. More detailed observations on this subject are included in Appendix A.5.

Co-location

The majority of interviews conducted for this research project underscored the advantages that co-location offered to the SH-130 project in terms of communication. First, co-location enabled an environment that enhanced the effectiveness and intensiveness of communication required for a project of SH-130’s size. In the initial phases of the project, personnel got to know each other quickly and established the foundation for teamwork. On the Owner’s team, the PM component needed to understand TxDOT’s expectations in order to perform its activities effectively. The co-location of the Owner’s teams (both TxDOT and the PM) allowed the PM to get into their role quickly since having them in the same building facilitated meetings at the project level.

Another positive aspect of co-location comes from the enhanced communications between construction, designer, and owner representatives. This aspect has been advantageous to many project disciplines because it allows project personnel to interact easily and solve problems related to a particular discipline in a shorter time than in a traditional environment. For instance, construction problems can be addressed rapidly by holding impromptu meetings between the various entities.

For the owner, co-location with the PM represents a substantial change with respect to its traditional work process. Traditionally, TxDOT delivers technical expertise to projects through its divisions. In those cases, the distance between peripheral projects and central offices tends to slow down the process significantly. In the SH-130 setting, the PM delivers the needed technical expertise to the project for any discipline in a more accessible and flexible way. Technical experts are provided as needed to the project based on the project phase. Another advantage has been the reduction of travel time for project employees.

However, some interviewees mentioned a significant disadvantage to co-location. Managing communication flows within a co-located organization is challenging because communication can easily occur at an improper level. This can be dangerous especially for the Developer because the Developer's subcontractors can be instructed by the Owner's representatives without Developer management knowledge.

Additional disadvantages offered by co-location are specific to the design area. First, the staffing phase of the design team can be challenging for the Developer because of personnel re-location issues, particularly if large numbers of personnel are required. This problem is particularly serious when the design firm does not have an established presence at the project location. Second, once the design team is staffed, the Developer needs to establish a detailed set of operating procedures for managing information flow between design components and the Owner's team.

Partnering / Issue Escalation Ladder

The partnering program put in place for the SH-130 project helps communication flows. This process established a "ladder" for managing issue resolution. A matrix identifying hierarchies in the line of authority for each project discipline was developed and distributed. A simplified version of this matrix is included in Table 6.2. In case an issue occurs at a certain level, it has to be resolved within an assigned maximum time before being escalated to the next level. This matrix-type tool allows project members to identify the right level of authority and the proper schedule for escalation of issues within different disciplines.

At lower levels (levels 1-3), each cell of this matrix represents a level of authority for a discipline and includes project representatives for each level and discipline among the project parties. At the project management level of authority (level 4), project managers for the contractual parties represented the higher level of authority at the project level. This level was the highest level involved during the SH-130 project life as of March 2005. Finally, at the highest level of authority (level 5), the executive team includes executive management from the two organizations that is not involved into project day-to-day operations. The executive team level was never involved in issue resolution as of March 2005.

Another successful tool was a bi-monthly survey for project employees, which measures the alignment of project parties with respect to project objectives. Questionnaires are distributed and results are analyzed by the firm supporting the partnering process. Disagreements are then resolved in formal partnering sessions facilitated by this independent firm.

Table 6.2: Issue Escalation Ladder.

<table>
<tr><th rowspan="2"></th><th colspan="5">Level</th></tr>
<tr><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th></tr>
<tr><td>Survey</td><td rowspan="9">Executive Team</td><td rowspan="9">Project Leadership Team</td><td></td><td></td><td></td></tr>
<tr><td>ROW</td><td></td><td></td><td></td></tr>
<tr><td>Utilities</td><td></td><td></td><td></td></tr>
<tr><td>Environmental</td><td></td><td></td><td></td></tr>
<tr><td>Public Relations</td><td></td><td></td><td></td></tr>
<tr><td>Project and Document Control</td><td></td><td></td><td></td></tr>
<tr><td>Design (broken down in disciplines)</td><td></td><td></td><td></td></tr>
<tr><td>Construction (broken down in disciplines)</td><td></td><td></td><td></td></tr>
<tr><td>Safety</td><td></td><td></td><td></td></tr>
</table>

Information Technology / Information Management

Table 6.3 summarizes the information management systems in place. Several interviewees pointed out a few problems regarding the information management systems within the SH-130 project. As is common for most projects, network security and system interoperability offered major challenges. Integration of Owner and Developer networks was accomplished by using a complex information architecture including both firewall servers and virtual private networks. To protect the project information network from the outside world, a screened subnet firewall server was adopted. This type of firewall server is also called "demilitarized zone (DMZ)" (Ibe, 1999; pp.193). Figure 6.2 describes a typical architecture for a DMZ.

The overall information architecture also used virtual private network (VPN) data tunnel between the two buildings. Using this system, the Developer's employees can upload documents that can be accessed by the Owner's representatives. On the Owner side, a file transfer protocol (FTP) program utilizes custom scripts to push and receive files and drop them into electronics folders. These files are “versioned” to determine which copies are newer. Finally, document control personnel upload them into the document management database. Figure 6.3 describes a standard VPN layout with a server in a DMZ.

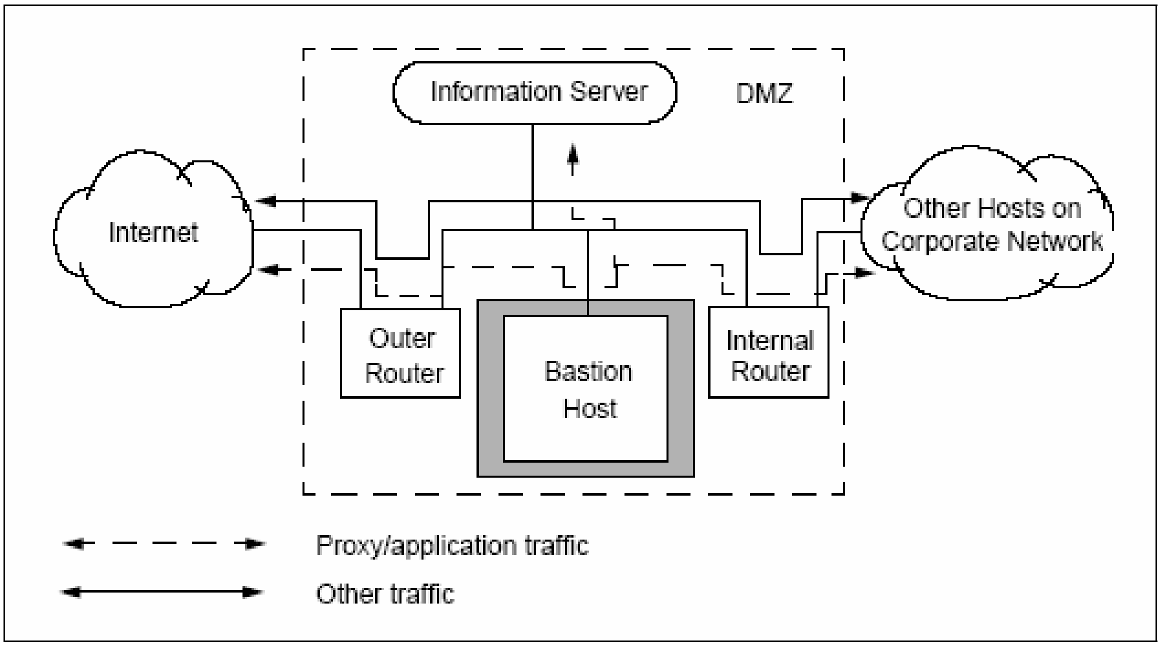

Figure 6.2: DMZ Firewall (Ibe, 1999; pp.193).

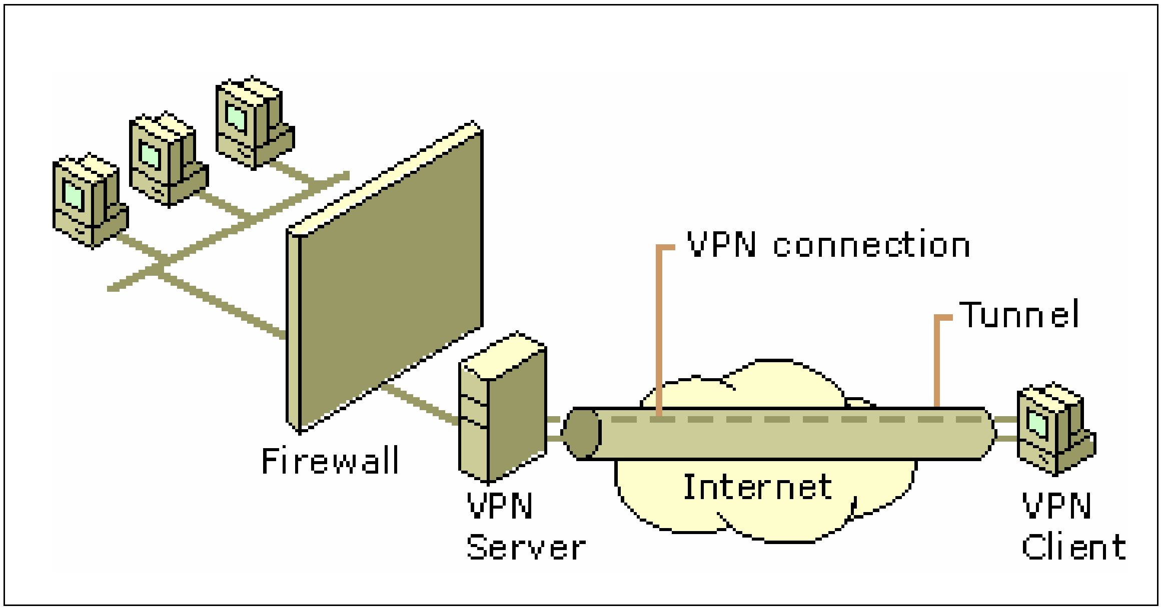

Figure 6.3: Standard VPN layout with a server in a DMZ (Microsoft, 2000; pp.462).

During the proposal phase, TxDOT outlined a contractual document that left freedom to the proposers in terms of information management systems. However, characteristics of compatibility of the needed systems were outlined. This freedom led the Developer to interpret these contract clauses with flexibility. In some cases, the Developer decided to adopt the same system as TxDOT (e.g., drawing management and project management); whereas in others, it decided to adopt a different system (e.g., ProArc).

Table 6.3: Information Management Tools.

<table>
<tr><th>Organization</th><th>Drawing Management</th><th>Schedule Management</th><th>Communication Management</th><th>Document Management</th></tr>
<tr><td>TxDOT</td><td rowspan="3">ProjectWise</td><td rowspan="2">Primavera P3</td><td rowspan="3">DocMan through data tunnel</td><td rowspan="2">eManager / FileNET</td></tr>
<tr><td>Program Manager</td></tr>
<tr><td>Developer</td><td>Primavera P3 / SureTrack</td><td>ProArc</td></tr>
</table>

Operating Procedures

The magnitude of the project required both project parties to set up detailed operating procedures. On the Owner's side, the PM developed manuals for administrative procedures, verification testing and inspections, and construction and design QC/QA. However, the CDA-DB environment allowed the Developer freedom in managing changes not affecting the project scope that would not be possible in the traditional DBB environment.

Summarized findings pertaining to different project disciplines include:

- Design:
    - After the schematic design of grading and drainage was done, a joint meeting between Developer design subcontractor, Developer design manager, TxDOT, and PM was scheduled. This meeting produced two major deliverables: first, a quality control checklist for the design team; and second, a set of comments to implement constructability concepts in the detailed design phase.
    - The Developer's design subcontractors are required to issue a design task protocol when a decision is made on enhancing a design criterion above contract requirements (e.g., a change in terms of embankment slope ratio). These protocols allow consistency along segments and also prevent owner representatives from directing design subcontractors to design above minimum requirements without Developer management awareness.
- ROW / Utility:
    - A process for ROW activities was developed by the project parties. In accordance with this process, the Owner's ROW team either approves or rejects a developer-submitted acquisition package within an assigned time.

This established procedure affects the needed level of expertise of Owner team members because personnel need to be capable of making decisions in a short time and at a lower level within the organization.

  - The SH-130 project takes advantage of an expanded signature authority that allows the SH-130 ROW team to process some of the paperwork at the project office instead of sending it to the ROW division. This approach increases the responsiveness of the Department to the needs of the SH-130 project and lessens schedule delay.

- Construction / Project Controls:
  - To overcome ambiguity of existing specifications, the Developer has the flexibility to submit revisions of the standard specifications. TxDOT can accept, reject, or ask for clarifications on these submittals.
  - The Developer provides TxDOT with bi-monthly updates on the project status that enhance communications. The first update is the monthly draw request for progress payment. The second is a monthly schedule update.

Meetings

One of the advantages of having the Developer as the only point of contact for every project discipline was revealed through the efficiency of communication through meetings. TxDOT was able to have meetings on a regular basis with the Developer's staff in every discipline. On traditional DBB projects, TxDOT conducts separate meetings with the independent service providers, so resolving problems between them is more time-consuming.

However, the size of the SH-130 project requires personnel to attend many meetings set on a fixed schedule, depending on the role and discipline of the project participant. Moreover, the fast-paced environment of the project requires employees to have the flexibility to have informal, as-needed meetings. Most of these as-needed meetings occur between project representatives at the same level of the "issue escalation" ladder. Table 6.4 gives an example of meetings attended by the TxDOT officer in charge of environmental aspects of the SH-130 project.

A major category of meetings involves technical work groups (TWGs). These are thematic meetings between representatives of the three major project parties (TxDOT, the PM, and the Developer) on specific disciplines (e.g., structures, pavement, tolls, aesthetics, utilities, drainage, roadway, etc.). Initially, project parties had meetings at higher levels with the expectation that personnel in these meetings would communicate with those on lower levels. Since that created miscommunication, the TWG category of meetings involving personnel at more levels was created. Moreover, TWG meetings are recorded and minutes distributed to all stakeholders in order to circulate the information generated. If a decision generated during a TWG pertains to an established procedure, a design task protocol is issued (see the previous section on operating procedures for more details on design task protocols). Therefore, these meetings have also been very successful in overcoming conflicting interpretations of existing specifications. Another major category of meetings includes the weekly segment update during which everyone working on a particular segment of the road can share information.

Table 6.4: Meetings on a Fixed Schedule for TxDOT Environmental Function.

Meeting Type	**Frequency**	**Participants**			
		TxDOT	***Program Manager***	***Developer***	***Other Parties***
Overall environmental project issues	Every Monday	TTO Environmental	Environmental	Design	ECF, FHWA
TWG environmental	Every other Wednesday	TTO Environmental and Environmental Affairs Division representative	Environmental	Design	ECF
Construction issues	Every other Tuesday	TTO Environmental, Environmental Affairs and Construction Divisions representatives	Environmental	Construction	ECF, CQAF
Overall project issues	Every other Wednesday	Project Team	Project team except junior staff	None	FHWA
Specific issues	Every other Wednesday	TTO director and environmental	Environmental	None	None
Overall Environmental update on procedures	Monthly	TTO Environmental and Environmental Affairs Division representative	None	None	None

Abbreviations:
CQAF – Construction Quality Assurance Firm
ECF – Environmental Compliance Firm
FHWA – Federal Highway Administration
TWG – Technical Work Group
TTO – TxDOT Turnpike Office

Improper Communication

As described by an interviewee, the main challenges for communication were: (1) "to make sure that [the] proper people communicate at the proper level," and (2) "that information was disseminated down to the lower levels" in order to keep consistency across the project. Early in the project, most communication occurred within the same levels. There were exchanges of information at higher levels that did not flow down to the lower levels, and information exchanged at lower levels was not communicated to the top.

The first issue is linked to a phenomenon that the literature names as short-circuiting of communications between the Owner's team and Developer's design consultants. According to the interviewees, this short-circuiting did occur at the preconstruction stage of the SH-130 process. Whereas Owner representatives are used to manage design, ROW and utility consultants in traditional DBB projects, this short-circuiting can make for adversarial relationships between DB project parties. Such tension arises when the project is based on a lump-sum agreement (such as in the SH-130 project), and any communication breakdown can result in a financial loss to the developer. A direct channel of communications between the Owner's team and Developer's subcontractors is needed for preconstruction decision-making purposes. During the initial phases of the SH-130 project, the Developer structured its team in a way that did not easily allow such direct communication between the Owner's team and its ROW and utility subcontractors. According to some interviewees, this slowed down the process. Therefore, the Developer's management had to re-adjust its structure as the project proceeded. However, the Owner's team must understand completely the difference between oversight and directing activities.

Other Communication Challenges

The complexity of the SH-130 project makes communications challenging. First, consultants in different technical areas need a high level of interaction to support the concurrency of the process. According to one interviewee, some people have left the project because they could not fit into the nontraditional environment of the CDA-DB approach.

Additionally, interpreting contractual obligations has been a major challenge for communications between the Owner team's and the Developer's management. Moreover, project participants sometimes feel that getting decisions made in a big project like SH-130 will be overly time-consuming. Because of the huge bureaucracy involved, they may not communicate as needed.

A few other communication challenges involve the Developer's organizational structures. First, the communication between preconstruction consultants and the Developer initially had to go through the director of that function. Later, the project gave more authority to the deputy director, who acted as substitute when needed. Second, the design quality control function of the Developer does not have any person specifically dedicated to the environmental aspect. Therefore, communications between design and environmental teams do not occur optimally.

Examples of discipline-specific communication problems:

- Utilities: Initially, the PM's staff had communication problems with the Developer's subcontractor, who was not alerting the Owner's representatives of meetings with utility companies.
- Design / Construction: Initially, the Developer's staff was unable to deliver change requests issued to the field quickly enough to allow the field inspectors to inspect the work according to the modified plans.
- Environmental: Communications between resource agencies and the Owner's team presented the following challenges:
    - Communication with resource agencies (e.g., U.S. Army Corps of Engineers [Corps], Texas Commission on Environmental Quality [TCEQ], and Texas Historical Commission [THC]) pass through TxDOT. However, some exceptions were allowed in regard to the ECF. A

deviation letter was issued to allow the ECF to contact the Corps for specific issues related to submittals.

- During the initial phases of the project, the Owner's team realized there was a need to expedite communications with all resource agencies in order to meet schedule requirements. This was achieved through meetings with these agencies and by helping maintain positive relationships with them. During these meetings, the Owner's team representatives communicated project needs directly to decision makers within these agencies.
- The SH-130 project has developed different communication procedures to manage the Environmental Permits Issue and Commitments (EPIC) sheets. Traditionally, environmental staff at the project level must submit these sheets to the design division for approval. In the SH-130 project, these sheets are "incorporated as the design progresses," and the design division does not get involved in management of the sheets, even though it can review the resulting design.

6.2.3. Recommendations from Analysis

In this section, a list of recommendations is provided to overcome some of the observed issues on future CDA-DB projects.

Role and Responsibilities

- Outline a chart comparing allocation of responsibilities between traditional projects and the selected CDA-DB project (such as Figure 6.1). Use risk allocation between contract parties to draw a first draft and update this chart with details defined after the contract signature (e.g., environmental permitting).

- Clearly define the role of the PM team in the contract by identifying its responsibilities.
- Organize a pre-project workshop between TxDOT and the PM to set up a process together and allocate responsibilities in order to establish a clear and comprehensive allocation of responsibility early on in the project:
    - o Develop guidance on legal and procedural requirements (e.g., gain understanding of activities that can be outsourced) for each discipline.
    - o Develop guidance on how to assign decision-making responsibilities to the PM.
    - o Develop a responsibility allocation framework of the Owner's team (e.g., TxDOT versus the PM). Provide this document to the Developer as a guide for appropriate interaction.
- Develop a list of frequently asked questions (FAQs) for each discipline outlining boundaries for the roles of Owner's representatives (both TxDOT and the PM).
- Assign environmental functions (e.g., environmental compliance and stormwater) to a group to allow for a more effective decision-making process.
- Assign quality assurance functions (e.g., design and construction) to a group to facilitate the implementation of constructability concepts and the coordination between the design and construction groups.

Team Staffing

- Increase presence of personnel with DB experience within the Owner's team (both in TxDOT and the PM's teams).
- Increase the size of TxDOT staff within the Owner's team, especially in regard to the construction disciplines early in the project, to expedite the learning curve of

the CDA process within TxDOT and to facilitate the learning curve of out-of-state consultants.

- Continue to select individuals for the TxDOT component who are able to work under pressure, to be flexible, and to multi-task.
- Identify level of expertise needed for TxDOT employees early on in the project in order to select personnel in time.
- Include some individuals knowledgeable in project control practices within the Owner's team.
- Staff the Owner's team (both TxDOT and the PM's teams) with individuals with high levels of expertise in their respective technical areas.
- Carefully evaluate the staff workload of some disciplines. The CDA-DB framework allocates to the Developer most of the project activities. As a result, the Owner's team experiments with a paper-free environment. This characteristic of CDA-DB projects represents an attractive aspect of managing these projects for TxDOT employees. However, some disciplines (e.g., ROW) can still require a substantial amount of paperwork to be performed on the Owner's side.
- Evaluate the amount of testing activities to be performed by Owner representatives early in the project's life to estimate the need for adjunctive personnel and to set a clear framework for the Developer and quality assurance firm.
- For each discipline, develop case studies related to decision-making activities with the purpose of surfacing differences between traditional and CDA environments. These case studies can be used to train new project members to the CDA-DB approach. A simplified version can be used during the selection of project staff to identify individuals that are more DB-oriented.

- Use independent quality assurance firms to relieve the Owner of part of the responsibility for the Developer's schedule.
- Require the Developer to provide estimates of the workload for each discipline along the project's life cycle to predict when a resource (both TxDOT and the PM) must be allocated to the project. These curves will allow TxDOT personnel to predict when a TxDOT resource must be allocated 100 percent to the project and when it can be shared with other projects.

Other Recommendations

- Allow developer-sourced innovations through a flexible acceptance process (e.g., management of design manuals' gray zones through issuance of design task protocols).
- Set design criteria to overcome adversarial interpretations of design manuals' "gray areas." Existing design manuals were written for a general engineering audience that could apply them by exercising professional judgment. In DB projects, however, the private parties conduct the bid phase according to minimum design requirements. Consequently, the private contracted party's bottom line drives the design phase toward meeting those minimum criteria.
- Allow a flexible organizational structure by expanding and shrinking the project team through consultants hired by the PM's personnel.

6.3. Findings on SH-130 Contract Administration

This part of the research effort expands on the existing knowledge of design-build (DB) processes by documenting a unique project organization and articulating some lessons learned thus far from the SH-130 project. Common issues pertaining to communications and organizational structure of this DB project include the following:

- The co-located environment makes it possible to optimize communications through face-to-face meetings. It also reduces the effects of a bureaucracy—required for any mega-project—that could become a detriment to the pace of the process.
- The flexibility to change and improve communication structures and procedures is key to improving communications on a project of this scope and complexity.
- Having the Developer serve as a single point of contact simplifies the contracting process by unifying the delivery of multiple services under one contract. It also allows a reduction of staff on the Owner's side.
- The environment in the SH-130 project makes communications between the Owner's team and service providers (the Developer and Developer's subcontractors) simpler than in a traditional DBB project of this magnitude.
- Making communications occur at the proper levels and setting up the information management systems and operating procedures needed to encourage this exchange are major challenges on a project of this magnitude.
- A formal partnering approach is beneficial to overcoming many of these challenges and in regulating communication flows.

A set of recommendations pertaining to team organization and communications improvement in future CDA-DB projects are provided in Section 6.2. Highlights of these recommendations are:

- Outline a chart comparing allocation of responsibilities between traditional projects and the selected CDA-DB project (Figure 6.1).

- Organize a pre-project workshop between TxDOT and the PM to set up the process together and allocate responsibilities.
- Consider assigning quality assurance functions (e.g., design and construction) to a group in order to facilitate implementation of constructability concepts and coordination between design and construction groups.
- Increase the size of the TxDOT component within the Owner's team to expedite the learning curve of the CDA process within TxDOT and to facilitate the learning curve of out-of-state consultants.
- Continue to select individuals for the TxDOT component who are able to work under pressure, to be flexible, and to multi-task.
- Staff the Owner's team (both TxDOT and the PM's teams) with individuals with high levels of expertise in their respective technical areas.
- Allow Developer-sourced innovations through a flexible acceptance process (e.g., management of a design manual's gray zones through issuance of design task protocols).

Chapter 7: Lessons Learned on SH-130 Project

7.1. Chapter Overview

This chapter outlines the findings of an investigation into lessons-learned during the planning, procurement and execution phases of the State Highway 130 (SH130) project currently underway in Central Texas (Migliaccio et al., 2006). As this research project proceeded, numerous interviews were conducted as well as many source documents reviewed. In addition, the author attended several industry forums and conferences to determine current practices related to project delivery methods and contracting approaches. Research activity is given in Tables 3.1 and 3.2.

As a component of the research team for project 0-4661, the author received input and guidance from TxDOT project team on a regular basis through progress meetings, phone calls and e-mail. The lessons learned, given later in this chapter, were vetted by the research sponsors. These lessons were identified and communicated to the research sponsor, who approved them as provided in this document.

7.2. Lessons Learned

Lessons learned reported in this section relate to the planning, procurement and execution phases of the SH130 project, but also incorporate lessons learned during the procurement of the SH45 SE project that followed SH130.

7.2.1. Project Planning

- In organizing the project team:
  - Consider the use of external consultants. If the Department is not familiar with DB, the use of external consultants on the owner's team is beneficial because it incorporates the experiences acquired from other DB projects and/or other states.
  - Address team leader expertise in managing complex communication environments. The extensive number of entities in DB projects, including multi-party contractors, public interest groups, and political figures, requires a team leader with outstanding communication skills.
- Other planning issues:
  - Track personal characteristics of new and existing personnel. The needed characteristics for TxDOT personnel on CDA projects are flexibility, pace, and accuracy. Recruitment of personnel with these characteristics requires time, so HR managers should investigate and track employees and perspective employees with these characteristics on a regular basis.
  - Consider co-location of highways and railroad in a timely fashion. Railroads have an acceptable slope that is different from highway projects (1% vs. 3%). Consequently, this difference will affect the footprint and the cost of the facility. Therefore, timing is important to set corridor boundaries and to activate adequate financing flow. The political and legislature support for a railway in the corridor needs to be identified early in the planning process. For SH-130, the railway requirements were identified too late (after contract award) to be included in the project.

7.2.2. Project Procurement

The SH130 and SH45 SE projects were awarded following a two-step evaluation process that included a prequalification/short-listing phase and a proposal evaluation phase. This type of selection is usually adopted for projects that are more complex in order to contain costs of proposal evaluation by short-listing interested parties based on qualification before assessing the evaluation of the proposals. Figure 5.1 (page 67) represents an overview of the procurement process at phase/sub-phase level with recommended durations at sub-phase level and milestones adopted for the breakdown (O'Connor et al., 2004b).

Initially, the Department prepared a Request for Proposals and Qualifications (RFPQ), interacted with interested parties for facilitating their submittals and finally evaluated the Proposals and Qualifications Submittal (PQS) before it released a shortlist of qualified proposers.

During the second stage, the Department prepared a Request for Detailed Proposals (RFDP). This document passed through an interactive stage with the short-listed firms and risks were allocated between project parties based in part on these discussions. These meetings were held in accordance with FHWA guidelines and any clarifications were provided through addenda sent to all short-listed firms. After the public release of the final RFDP to the short-listed firms, the Department interacted with the interested parties and facilitated their proposal submittals by scheduling recurring rounds of one-on-one meetings. Finally, an evaluation of the submitted proposals was conducted to determine the proposal offering the best-value to the State of Texas and to put forward a recommendation to the State Transportation Commission.

Because the initial planning phase (Phase I) of the project were outside the boundaries of this research study, the lessons learned concerning this part of the procurement process are not a part of this analysis.

RFQ Phase

- Before start preparing the RFQ:
    - Prepare a standardized RFQ document and make it and RFQ documentation from other CDA projects available for consultation to the project team. The DB delivery approach requires different RFQ documentation than traditional projects. Employees need to become familiar with this new documentation in order to provide quick and effective feedback to legal consultants. The availability of a standardized documentation also allows other individuals in the department to know how the RFQ will look and, ultimately improve their understanding of its preparation. Standardized RFQ documents will streamline this phase of the procurement process and will decrease the duration of the review activity.
    - Achieve a basic understanding of the project description in terms of location, characteristics, scope of work, and risk allocation. A clear identification of the needed input for the RFQ document combined with a standardization of the document itself will help shorten the preparation of the RFQ document.
- Early in the process of preparing the RFQ document, release a status report to legal counselors outlining the project's development, environmental clearance process, and amount of preliminary engineering to be included in the RFQ. Legal counselors need to be aware of the status of concurrent activities in order to

develop a good RFQ draft and to understand what is going to be included in the document.

- In preparing the PQS Evaluation process, develop a suggested evaluation schedule before appointing the evaluation subcommittee members. Understaffing a subcommittee can slow down the evaluation dramatically because the entire process has to wait as the understaffed subcommittee completes its evaluation. A defined schedule helps the process manager to understand the needed size and qualifications to achieve a streamlined evaluation process. This lesson is also applicable to the proposals evaluation process (Prepare RFP phase).
- In interacting with interested parties for developing PQSs, have one-on-one meetings with interested firms if the project includes bonds or developer financing options. Direct interaction with proposers allows the DOT team to probe the reactions of the interested parties in terms of the requirements, and to take any necessary corrective action. Again, these meetings should take place in accordance with applicable regulations in order to ensure fairness.

Phase III: RFP Phase

- In developing the RFP document:
    - Start developing technical attachments earlier in the process to decrease process duration. Development of technical attachments is a critical activity for defining details of the agreement and for releasing the RFP document. Surveying and mapping activities should begin as soon as possible.
    - Conduct interactive sessions between attorneys, engineering consultants, and DOT employees early in the development of the RFP. These meetings will improve the attorneys' understanding of what is entailed in

the technical provisions, and decrease the risk of overlapping or missing information in the contract.

- In conducting the industry review phase:
  - Identify and monitor the status of critical path activities. While a trade-off exists between project schedule and the necessity to conduct adequate industry reviews, it is common to extend this phase to allow for the completion of other mandatory activities. Environmental clearance and preliminary engineering studies are two of the activities that should be closely monitored.
  - Establish the number of one-on-one meetings with short-listed bidders depending on project complexity, and procurement schedule pressure. The number of necessary meetings depends mostly on project complexity. If the procurement schedule necessitates an early release of the RFP document, be aware that more time will be needed for interaction during proposal development and more addenda will be needed.
- In interacting with short-listed firms for developing detailed proposals:
  - Allocate sufficient time between issuing the RFP and the first round of meetings. Proposers need adequate time to thoroughly analyze the documents before interacting and making comments.
  - Schedule two different rounds of one-on-one meetings with a sufficient time between each. Usually, addenda are released after each round of meetings, so the time allotted should be adequate for the legal counsel to revise the document, distribute addenda, and have the proposers analyze it.
- In interacting with short-listed firms for selecting Alternative Technical Concepts (ATC): Limit the number of ATCs that each proposer can submit. Evaluating

ATCs is time-consuming, and can slow down the process. Therefore, there is a need for a pre-screening process to limit the effort in evaluating ATCs. For instance, defining a minimum dollar amount threshold for cost-saving ATCs can avoid time-consuming evaluations on less cost effective ATCs. These less cost effective ideas can be addressed in the design or construction phases as Value Engineering proposals.

7.2.3. Project Execution

Key lessons learned in the project execution phase, regarding project management, contract management, right-of-way and utility relocation issues, include:

- Project management
    - Co-locate project parties. Communication in DB projects is fast and furious, and co-location permits a quicker and more-efficient information flow. Co-located parties should include the DOT project team, consultants, designer, contractors, and any other necessary team member. In the case of the SH-130 project, even the FHWA officer in charge of the project and a representative of the Attorney General's office (to assist in contracts and ROW) were co-located.
    - Early in the process, allocate responsibilities between DOT employees and engineering consultants. Define all activities that have to be performed by state employees versus activities that can be performed by owner consultants to help develop an activity flowchart and define the organizational structure. This in turn gives insight into needed resources and assists in planning.
    - Address the use of Project Management Information Systems in allocating responsibilities between the owner project team and Design-Builder.

Incorporating Project Information Management Systems (PIMS) facilitates project tracking and reduces misleading information. Streamline the process by making the source of the information (Design-Builder) responsible for managing and operating the system, but make the system open to oversight by owner personnel.

- Contract management
    - Be more prescriptive in critical project specifications. More prescriptive project specifications ensure independence of the engineering group within the design-build organization. Use of prescriptive specifications should be balanced and thoroughly reviewed by the DOT. For example, if the DOT desires overpasses with no piers in the median (for safety purposes), then this requirement should be given in the specifications. Trying to negotiate this issue later (at a higher price) is not desirable.
    - Be accurate in defining repetitive pecuniary responsibilities even though of minor concern. Unclear assignment of pecuniary responsibilities can create harmful and time-consuming "question-answer" loops between contract parties.
    - Avoid complexity in contract definitions. Obscure definitions in contract clauses increase the chances for adversarial relationships. For example, the difference between "known" and "unknown" utility locations should be clear and understandable.
- Right of Way (ROW)
    - Set corridor boundaries to decrease ROW cost escalation. ROW acquisition costs typically are paid for by the DOT even if ROW procurement services are included as part of the contract (as in the case of

SH-130 and SH 45 SE). Defined corridor boundaries prevent the developer from proposing changes to the route strictly to lower construction costs at the expense of higher ROW costs to the owner.

    - Outline the desired review process of ROW documents in contract clauses. Usually, DOT employees follow specific procedures for the ROW process. Specifying the desired procedures will avoid inconsistency by the Design-Builder and will facilitate the review process.

- Utility relocation
    - Adopt a prescriptive definition of "utility" and include accurate documentation on existing utilities. An adversarial atmosphere can be generated if the contract parties begin the project without clear definitions of known versus unknown utilities and without accurate utility strip maps.
    - State clearly the Design-Builder's responsibilities for maintaining a strong relationship with the owner. Keeping the day-to-day operations on time and on budget demands careful attention to the relationship between the contract parties. Therefore, communication flows between the Design-Builder and the utility owners should be well-defined and carefully followed.
        - The Design-Builder should coordinate the communication process with the major utility owners, and must organize frequent meetings between the utility owners and the project designers. Once research on new easements is underway, utility owners need to be informed on a regular basis of ongoing ROW design developments.

    - Set design review milestones for items in conflict with Utility Adjustments early enough in the process to make new easement acquisition easier for utility owners.
    - Include a process for requesting new utility easements. Requests for easements for new utilities (those not existing at the time of the contract award) notably increased during the initial phases of the SH-130 project. Outlining a process for these situations will decrease time delays and the chance of undermining relationships.
- Keep the Quality Assurance (QA)/Quality Control (QC) process simple. Complex QA checks on utility agreement documentation may have minimal or marginal benefits when the time delays they create are factored into the equation. Start the review process early in order to achieve an optimal trade-off between time and gains.

7.3. SUMMARY OF LESSONS LEARNED STUDY

Use of DB via the CDA can be viewed as an opportunity for TxDOT to identify the use and application of DB, and to gain the required knowledge, skills, and experiences needed to implement DB in other areas. Shifting away from the existing paradigm is best achieved by an analysis of how various entities have moved toward a new model of public infrastructure and highway procurement that supports the use of multiple project delivery methods and contracting approaches, as well adopting the lessons learned from SH-130. TxDOT should anticipate that the use of DB will grow as demonstrated by the Department's procurement efforts with the Trans Texas Corridor. As a result, TxDOT should gain the knowledge needed to develop a comprehensive approach of incorporating project delivery methods and contracting approaches to improve highway acquisition and maximize public resources.

As discussed earlier, the exploratory research study outlined in this section of the dissertation lead to a series of recommendations to assist TxDOT with gaining the full benefits of DB. The following observations are an assessment of which recommendations (in italics) were implemented as part of the investigation and documentation of the lesson-learned during the planning and procurement phase of SH-130.

- *Design-build process guidelines and a delivery process (planning, scope, RFP, selection, management, etc.).* The delivery process has been drafted as part of the research project.
- *Assess the availability of the skills required for the use of DB in the organization.* These skills are being characterized as part of the research project.
- *Train selected members of the organization in the use of the DB project delivery system.* This task has not been undertaken formally as of yet and most of the learning that has taken place by TxDOT staff has been through interactions with consultants and/or the DB contractor. A seminar was conducted as part of the research project to share knowledge across TxDOT.
- *Optimize communication among the parties involved within TxDOT.* Co-location has helped facilitate communication between the parties involved with SH-130.
- *Optimize the pre-project planning process.* Developing a lessons-learned process will provide benefit, and having a two-step selection process that allows industry to review and comment on the proposal helps to address issues such as scope problems and risks.
- *Select pilot DB projects that have a relatively certain scope and contain well-known processes and technologies.* Although TxDOT has used DB on extremely large projects, these projects are new roads located in mostly rural areas where

planning, ROW acquisition, design, and construction are much more predictable than most of TxDOT's portfolio of current projects.

- *Ensure selection of qualified DB contractors.* The two-step selection process prequalifies the contractors.
- *Develop succinct criteria specifications.* Lessons-learned for this topic are being developed as part of the research project.
- *Develop a systematic way to evaluate project results to determine if existing DB procedures and approval processes are adequate, and respond to legislative requirements.* This benchmarking process is being developed as part of the research project.

The review and assessment of other state DOTs in implementing similar processes shows that success has been achieved by organizations that have been proactive in their approach to managing the transition. The lessons learned from the development of SH-130 are an additional asset to help TxDOT accommodate and effectively undertake innovative procurement and contracting practices. The following conclusions are to help TxDOT in its quest to identify the factors that can inhibit efforts to improve project quality, cost, and schedule.

- Conclusion No.1: Implementing innovative project delivery methods and contracting approaches is a paradigm shift that requires a commitment from staff and senior management to accept the challenge and provide adequate leadership to guide the change implementation.
- Conclusion No.2: TxDOT employees and others involved with innovative project delivery methods and contracting approaches need adequate training in the DB contracting process to understand and perform the duties required of public owners.

- Conclusion No.3: TxDOT and others should develop a systematic method for capturing project performance data that can be used to monitor the impacts on implemented changes and respond to legislative reporting requirements.

Chapter 8: Conceptual Framework

Using findings from the exploratory study, the author developed a conceptual implementation framework to help transportation agencies better understand and implement changes in their project delivery strategies. The framework helps agencies manage the implementation process at both the organization and the project level. Using this framework, agencies can develop their own conceptual map of decisions significant to the new scenario. Appendix B includes an initial version of the framework that was developed using input from the results of the SH-130 research investigation and information gleaned from the literature review. This initial version includes a conceptual map of decisions based on lessons learned on the SH-130 project. After several iterations, the initial version of the framework was abstracted to the version that was evaluated by the Delphi panelists. This version is presented in this chapter. A final version of the framework is provided in Appendix E.

8.1. CONCEPTUAL FRAMEWORK OVERVIEW

The conceptual framework is grounded in the strategic management literature and is based on the predominant perspective of the strategy process (Mintzberg, 1978). According to this perspective, the "dichotomy between strategy formulation and strategy implementation is a false one […] because it ignores the learning that must often follow the conception of an intended strategy" (Mintzberg, 1978; pp.947). Consequently, strategies may be formulated through a formal formation process often called strategic planning, that precedes any decision-making process. Strategies may also emerge "gradually, perhaps unintentionally, as [a decision maker] makes his decisions one by one" (Mintzberg, 1978; pp.935).

With this distinction in mind, the conceptual framework was developed to bridge formation and implementation phases by taking into account the learning that follows the conception of both kinds of strategies. As a result, some of the conceptual framework components bridge and provide a feedback loop between implementation and formation (see Figure 8.1). The conceptual framework is composed of the implementation process itself plus two supporting processes, the knowledge building process and the implementation assessment process. Descriptions of these processes are presented in Section 8.2. These descriptions are based on a set of concepts for which the author developed a set of definitions using literature findings. These definitions are presented in Section 8.3.

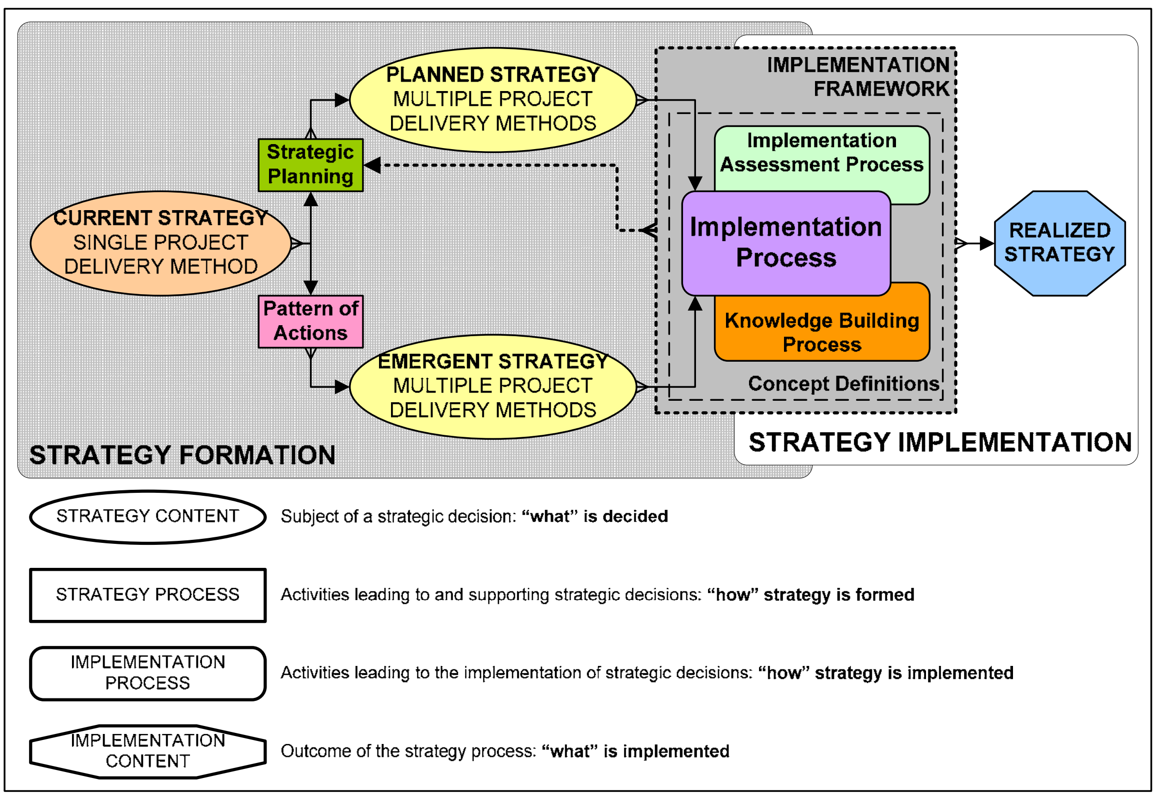

Figure 8.1: Role of Conceptual Implementation Framework.

8.2. CONCEPTUAL FRAMEWORK COMPONENTS

As illustrated in Figure 8.1, the developed conceptual framework is composed of the implementation process itself plus two supporting processes, the knowledge building process and the implementation assessment process. The activities of these processes are divided into several phases related to the life cycle of the delivery implementation (see Figure 8.2). The initial version of the conceptual framework, which is presented in Appendix B, also includes a conceptual map of decisions developed from lessons learned on the SH-130 project.

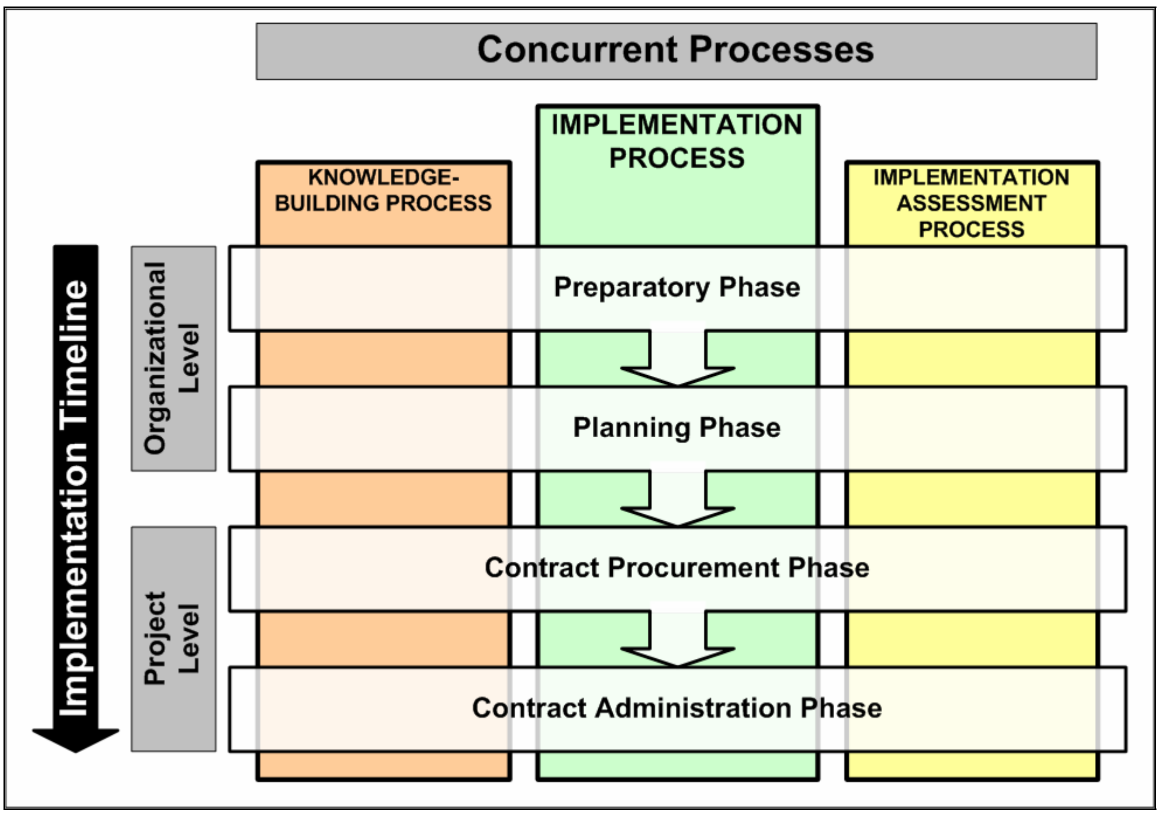

Figure 8.2: Conceptual Implementation Framework.

8.2.1. Conceptual Framework Processes

The conceptual framework includes three processes: the implementation process itself plus two supporting processes. These three processes were shaped around the three overall conclusions from the lessons learned study, which were presented in Section 7.3. These conclusions suggested that agency staff and senior management need: (1) to accept the challenges posed by the change implementation and to provide adequate leadership to guide the change implementation, (2) to undergo adequate training, and (3) to develop a systematic method for capturing project performance data that can be used to monitor the impacts on implemented changes and to respond to legislative reporting requirements. Scope descriptions for the framework implementation, knowledge building, and implementation assessment processes are given in Table 8.1. These descriptions are based on a set of concepts that are defined in Section 8.3.

Table 8.1: Implementation Framework Concurrent Processes (Delphi Q1 version).

Concurrent Processes	**Scope**
Knowledge Building	Plan to manage knowledge on the new procurement strategy from the preparatory phase all the way through the contract execution phase. This process induces organizational learning by: (a) collecting, verifying, storing and disseminating lessons learned on the implementation effort, and (b) identifying sources of information on newly introduced project procurement approaches.
Implementation	Plan to implement the new procurement strategy beginning from the preparatory phase all the way through the contract execution phase. This process facilitates implementation of the new procurement strategy by: (a) identifying decisions significant to the problem of changing procurement strategy, and (b) aligning project practices with organizational strategy.
Implementation Assessment	Plan to assess accomplishment of the new procurement strategy from the preparatory phase all the way through the contract execution phase. This process promotes continuous improvement by: (a) providing internal and external benchmarking, and (b) providing feedback on implementation progress to organizational decision-makers.

8.2.2. Conceptual Framework Phases

The implementation of a change in project delivery strategy is also divided into several phases both at the organization and at the project level. Table 8.2 gives the scope descriptions of these implementation framework phases. At the organizational level, components of the framework provide input for agency-wide change. This level comprises the first two phases: (a) preparatory phase, and (b) planning phase. During the preparatory phase, Owners need to first define the project delivery strategy and then prepare the organization for its implementation. During the planning phase, Owners need to identify projects to be developed through a specific project delivery method.

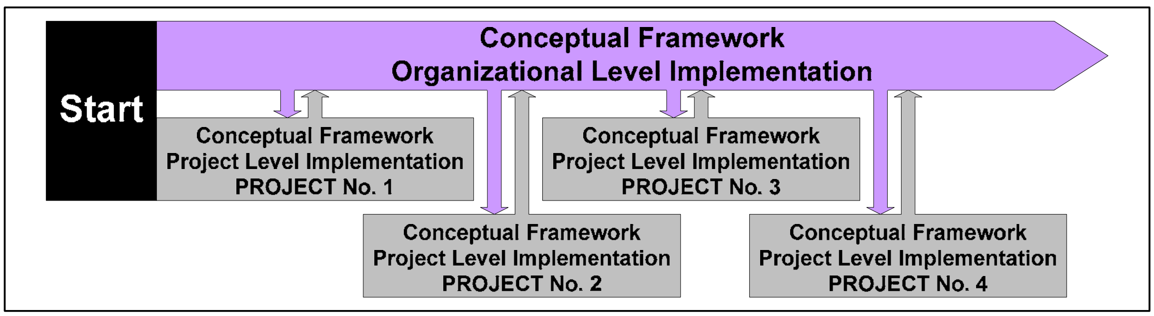

Figure 8.3: Conceptual Framework Implementation Timeline.

The next two phases comprise the implementation process at the project level and depend on the specific project delivery method for their specifications. As the implementation of delivery methods varies, the project-level implementation process can be customized according to the specific delivery cycle. Figure 8.3 shows how, conversely, the project level components of the framework affect organization-wide change because their repetitive use on every project delivered with the new approach familiarizes the agency with them. In addition, knowledge developed at the project level may be beneficial to other concurrent projects as is evidenced by the overlapping of the different projects life cycles.

Table 8.2: Implementation Framework Concurrent Phases (Delphi Q1 version).

Framework Phases	**Scope**
Preparatory	This phase focuses on identifying information available at the organizational level that can be utilized at the planning and project level for implementing new procurement approaches. The preparatory phase is driven by high-level organizational personnel and has three objectives: (1) to determine if new delivery approaches are available for use, (2) to define organizational project procurement strategy, and (3) to initiate the information loop between organization and project level.
Planning	This phase is performed by organizational-level personnel (i.e., districts and/or divisions personnel) and focuses on identifying transportation needs and constraints, selecting prioritized projects, and making early decisions on the project procurement approach. The project procurement phase led to (1) an initial project procurement approach compatible with both the organizational and the project objectives, and (2) a project management team for initiating and carrying out the procurement.
Contract Procurement	This phase is performed by project and/or organizational-level personnel and focuses on selecting the project service providers, on allocating project risks, and in establishing the project's necessary contractual relationships. The contract procurement phase led to an established contractual framework between agency and the selected project service provider.
Contract Administration	This phase is performed by project-level personnel (i.e., project management team) and focuses on monitoring provider performance, managing the contract, making payments for work performed, and accepting the final deliverables. In order to reach these phase objectives, the project management team needs to set up all the project organization-and communications structures necessary for monitoring and assisting the provider during the project delivery. The contract execution phase led to an established project execution framework between agency, the selected project service provider, and other interested parties.

8.3. FRAMEWORK CONCEPT DEFINITIONS

Some concepts are very important to formulating scope descriptions of the implementation framework components. Therefore, identifying accurate definitions of these concepts was crucial to correctly interpreting the implementation framework processes and phases. As extensively discussed in Section 2.1.1, the literature often uses the terms “delivery” and “procurement” as interchangeable terms when discussing projects. The first set of definitions presented in Table 8.3 was derived from the initial literature review and is based on an equivalency between the two terms with a preference for using the term “procurement.” The term “procurement” has been widely adopted in U.S. business language outside the construction sector to refer to the acquisition of goods and services.

After researching published sources, the author identified a set of definitions for key concepts. Among others, this set of definitions includes key terms such as *project delivery method*, *project finance method*, *project procurement strategy* (that after receiving Delphi feedback was changed to *project delivery strategy*), *procurement process*, *contract award method*, and *contracting approach*. These definitions are presented in Table 8.3. In addition, Figures 8.4 and 8.5 show the hierarchical relationships between the first three concepts.

Table 8.3: Implementation Framework Definitions of Concepts (Delphi Q1 version).

Concept	Definition
Project Delivery Method (PDM)	A system for organizing and achieving the procurement of the different services (e.g., design, construction, right-of-way, utility relocation, etc.) necessary for the delivery of a project.
	Project delivery methods can be categorized by both the degree to which a transportation agency outsources the different project services, and the degree to which different project services are combined in contractual relationships with project service providers. Combined methods integrate the delivery of more services under the umbrella of fewer service providers (e.g. design-build method) whereas segmented methods separates procurement activities of different services (e.g. design-bid-build method).
Project Finance Method (PFM)	A system for providing funds (e.g., direct appropriation, federal-aid grants, private funding, etc.) required for financing a project.
	Project finance methods can be categorized by the degree to which private funding is raised for producing the project.
Project Procurement Approach	The combination of project delivery method and project finance method adopted for a specific project, as illustrated in Figure 8.4.
Project Procurement Strategy	The set of project procurement approaches allowed by the agency's regulatory and institutional environment and pursued through specific actions. As illustrated in Figure 8.4, this set can be represented as the region of possible combinations of delivery method and financing option.
Change in Project Procurement Strategy	The broadening of options in project delivery and financing options, as illustrated in Figure 8.5.
Project Procurement Process	This process includes a combination of four systematic actions necessary to prepare for the execution of a project: (a) the allocation of project risks between owner and provider (regulated by the risk allocation process); (b) the management of interaction with providers for promoting innovation (regulated by the provider-induced innovation process); (c) the selection of project providers (regulated by the contract award method); and, (d) the establishment of contractual relationships between parties (regulated by the contractual framework definition process).
Contract Award Method	A system for selecting the provider of a tendered project service (i.e., design, construction, etc.) or component (i.e., road segment A, bridge B, etc.). Low bid, Best-value, and Qualification-Based Selection (QBS) are examples of contract award methods.
Contracting Approach	Specific legal language used under the larger umbrella of a procurement approach to target specific activities or objectives of a project. Examples of contracting approaches include clauses on unit price, lump sum, incentive/disincentive, lane rental, partnering, among many others.

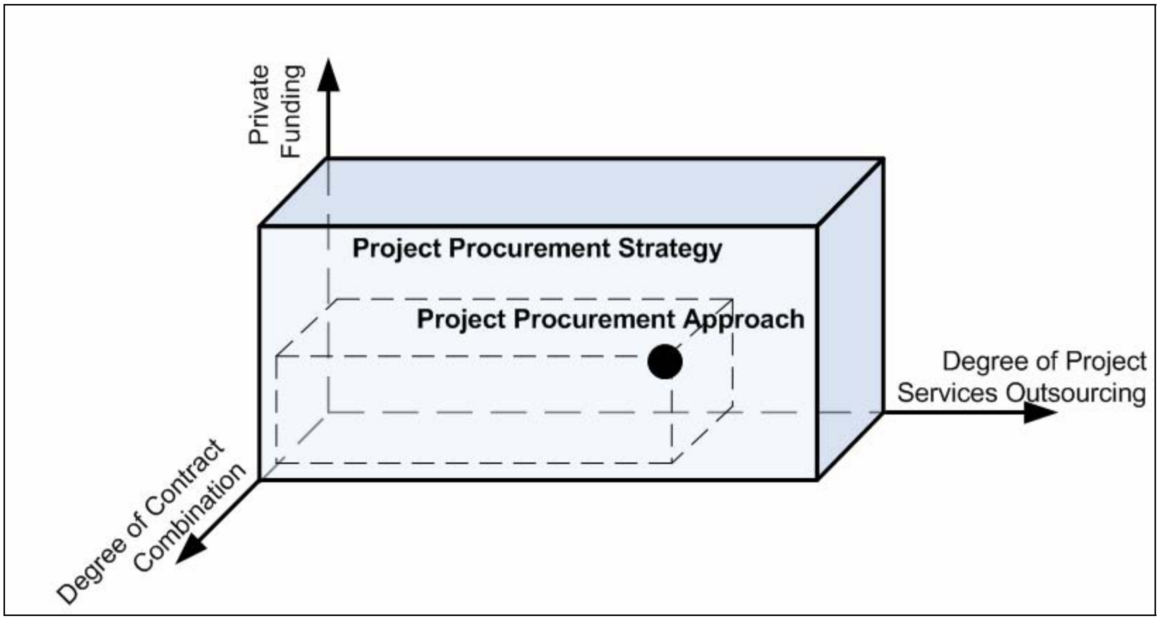

Figure 8.4: Project Procurement Approach vs. Project Procurement Strategy.

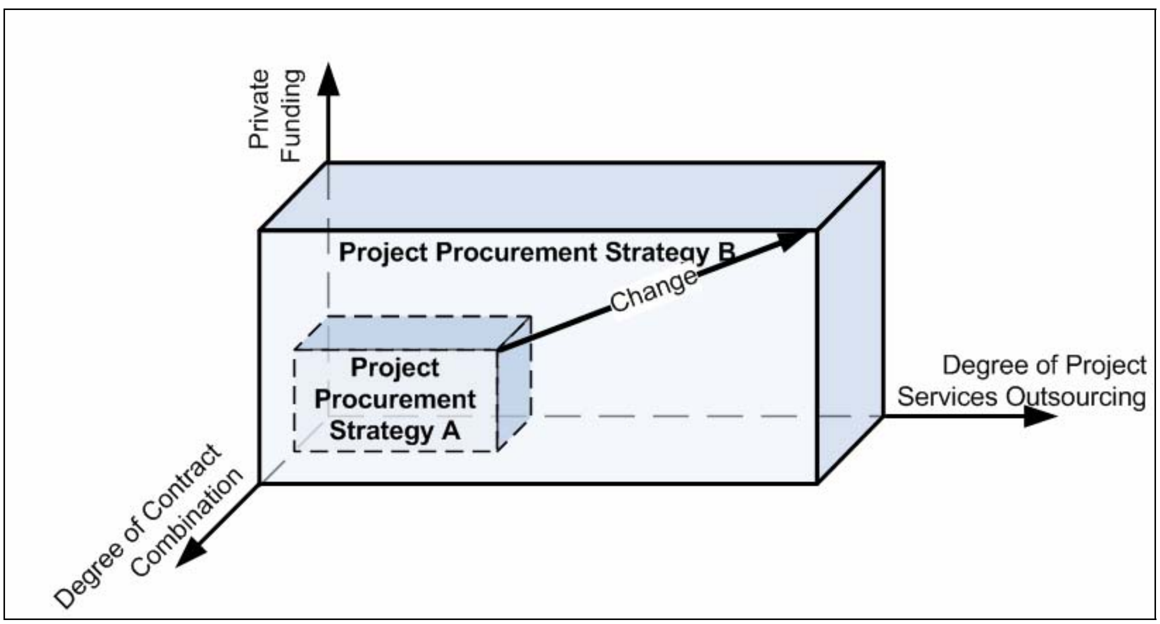

Figure 8.5: Change in Project Procurement Strategy.

SECTION III: FRAMEWORK VALIDATION

Chapter 9: Case Studies

9.1. Overview on Case Studies

The development of the conceptual implementation framework was mostly based on information from the SH-130 project. Because the Research Project 0-4661 was overseen by a research committee that included industry experts on highway project delivery, lessons from the SH-130 project were reviewed by this panel for meaningfulness. In addition, the author attended several conferences and industry events to assess industry views on the topic.

However, the author was committed to generalizing the framework beyond the SH-130 study. To further improve the external validity of the framework, the author also collected information on comparative case studies. Information on four of these DOTs' projects was collected through interviews and questionnaires. Information on these cases is provided in this chapter.

As a first case, the author investigated the procurement phase for Texas State Highway 45 Southeast (SH-45 SE). Findings from this case study were used to develop the procurement process model that is described in Chapter 5. In addition, the author attended the DBIA (Design Build Institute of America) Transportation conference in Portland, Oregon at the end of April 2006. Conference attendees included representatives from most of the DOTs that have adopted DB for delivering transportation projects. Attending this conference and establishing contacts with project representatives allowed the author to identify other DOTs that have implemented the design-build method over the last few years.

These DOTs included: the Colorado DOT (CDOT), the Washington DOT (WSDOT), the Oregon DOT, and CALTRANS (the California state transportation agency). In the months following the conference the author contacted representatives from these organizations to identify possible cases for study, but only representatives from CDOT and WSDOT agreed to provide information for some of their projects.

Three projects were identified as additional case studies. First, information on the Transportation Expansion (T-REX) Project in the Denver Metropolitan Area was collected. Secondly, the author analyzed documentation and interviewed a project representative for the I-405 Kirkland Stage 1 project in the Seattle Metropolitan Area. Finally, the author analyzed documentation and interviewed a project representative for the I-5 High Occupancy Vehicle (HOV) Project in Everett, Washington.

Project representatives were contacted and asked to provide preliminary information in the form of reports or project newsletters. In addition, the author requested and obtained copies of documentation on contractual agreements and procurement processes. After analyzing this information, the author developed an interview guide and scheduled phone interviews with a representative of each project. A sample interview guide is provided in Appendix C.1. Interviews were recorded and transcribed to allow for later analysis. Later, the author requested additional information (as needed) through a follow-up questionnaire. A sample follow-up questionnaire is also provided in Appendix C.2. Finally, the author condensed information in the write-ups of these case studies, which are provided in Appendix C.3. Table 9.1 summarizes information on the four cases.

Table 9.1: Case Studies.

	SH-45 SE	**T-REX**	**I-405 Kirkland Stage 1**	**I-5 HOV Everett**
Scope of Work: Main components	29.6 lane mile Hwy (new) 1 interchange	50 lane mile Hwy (new) 8 interchanges (reconstruct) Several bridges (widen) 13 light rail stations 19 miles double track light rail	4.4 lane mile Hwy (new) 1 interchange (improve)	16.6 lane mile Hwy (new) 1 interchange (new) 23 bridges (widen)
Scope of Work: Services performed within DB contract	Design ROW Relocate Utility Construction	Design Construction	Design Construction	Design Relocate Utility Construction
Owner	TXDOT	CDOT & Denver RTD	WSDOT	WSDOT
Design-builder	Zachry Construct. Corp.	Kiewit Construction Co.&Parsons Group	Kiewit Construct. Co.	Atkinson & CH2M Hill
DB Contract Amount (million)	$154	$1,187	$47.5	$202.6
RFQ released	September 2003	April 2000	October 2004	September 2004
RFP released	March 2004	November 2000	July 2005	December 2004
Contract Awarded	August 2004	June 2001	October 2005	May 2005
Completion Date(*)	December 2007(**)	September 2006	October 2007	June 2008
Financing Sources	State allocation (>99%)	Bonds (GARVEE), state sale taxes, federal transit grant	State allocation (>99%)	State allocation (>97%)
Amount of design provided in RFP	NA	30%	15%	10-15%
Reasons for using DB	Reduce delivery duration	Reduce delivery duration to minimize impact on public	Reduce delivery duration	Reduce delivery duration
	Obtain early price certainty	Have a single major project instead than multiple ones	Obtain early price certainty	Minimize number of WSDOT staff

(*) Expected at DB contract award
(**) DB contract was cancelled. In April 2007, a new contract for construction services was awarded to Balfour Beatty Infrastructure, Inc./T.J. Lambrecht Construction, Inc.

9.2. Key Lessons from Case Studies

Co-locate project parties

As with the SH-130 project, co-location of owner, design-builder, designers and other relevant parties is believed to be beneficial for implementing a new integrated delivery method. According to the T-REX project interviewee, co-location benefited this project in three ways. First, having parties co-located allowed for more frequent communication as compared to percentage-based submittals (e.g., 30 percent complete design submittals). Therefore, this practice comports with the need for speed that originally prompted the adoption of DB. Second, a DB contract requiring a provider delivering multiple project services and/or components necessarily involves a higher level of coordination among project teams. Co-location provided an environment that fostered this need for coordination. Finally, co-location allowed all contractual parties to establish the cooperative approach needed to achieve the pre-established common project goals. This environment facilitated the implementation of the DB approach by overcoming many cultural barriers between organizations.

Similarly, owner, owner consultant and design-builder were co-located on both the I-405 Kirkland Stage 1 and the Everett HOV projects. According to the I-405 project interviewee, co-location contributed to project success in two ways. First, it facilitated communications between project parties, and, second, it promoted partnering.

Have strong project leadership from both contractual sides

The implementation of a new delivery approach for the T-REX project was hindered by many barriers. According to the T-REX project interviewee, these barriers were mostly small, but a main barrier to overcome was the traditional style of thinking that prescribes an adversarial relationship between owner and industry provider. Without strong stance by the T-REX project leadership, that approach would have slow down the project and create claims, costs, and problems on a daily basis.

Provide local authority to project leadership within pre-established boundaries

Strong leadership is not enough to lead the project in the right direction if it does not have an adequate level of local authority to manage change at the project level. The interviewed project representative believed that the T-REX project was successful because owner top management (i.e., CDOT headquarters and RTD board members) allowed the project directors to achieve the pre-established project goals within the master budget. While top management still provided executive-level direction when a problem occurred, they delegated most of the decisions to the project leadership. One of the rare instances in which top management needed to be involved was for the approval of a $17 million change order. Because cost of this change order significantly affected the initially allocated project contingency, this decision was taken to the executive director level for final approval. This type of relationship with executive management provided both the freedom to act that is necessary for these projects and the executive-level support behind such important decisions.

Promote learning for other relevant parties

When implementing a change in delivery strategy, the owner should remember that other parties are often involved in the change at the project level. These parties may provide institutional and cultural barriers to the project implementation. For instance, counties, cities and local authorities are accustomed to interacting with transportation agencies on the basis of fully detailed plans submitted in certain pre-established formats.

However, because the design is concurrent with other activities on a DB project, this traditional submittal process is not possible. The T-REX project representative believed that a key to this project's success was the project directors' ability to educate and involve some of these parties; once they had bought in to the process they could understand the pace of project development under the new approach and were not inclined to block it. Yet in spite of this cooperation the interviewee reported that "we had some near critical path delays related to that specific problem." A successful application of this lesson was the collaboration with one of the most significant local authorities, the city and county of Denver, which recognized the need for speed. They actually provided two staff members who were colocated with the T-REX project team and given full access to the project network.

Washington DOT used a different approach to gain acceptance from local permitting agencies. In order to streamline permitting on highway projects (not only DB projects), the state of Washington recently promoted a multi-agency permitting team (MAPT); this team included representatives from several permitting agencies, including the Washington Department of Transportation, the Washington Department of Ecology, the Washington Department of Fish and Wildlife, the U.S. Army Corps of Engineers, and later King county. As a result, WSDOT only had to submit a single permit application to all these agencies. According to the I-405 project interviewee, this practice helped the communication and coordination between WSDOT and these permitting agencies.

In addition, the adoption of a "context sensitive solution" process is believed to promote acceptance of change initiatives and to build trust with the local agencies. Using this approach, WSDOT promoted the appointment of advisory committees that included representatives from all the local agencies and from the public living in the I-405 corridor. These advisory committees took part into the development of all the static elements of the project.

An additional approach was used by WSDOT to promote acceptance of the change initiative by industry providers. The agency and the local chapter of the AGC together appointed a DB policy team that was in charge of developing a master for the procurement and contractual documentation. This approach helped build consensus on the change initiative. In addition, it helped promote participation of local firms in the procurement process because the contract was based on a mutually agreed upon allocation of risks.

Promote organizational learning of the new process within the organization

When implementing a change in delivery strategy, the owner should promote organizational learning of the new approach within its own organization. CDOT promoted organizational learning in three different ways. First, they facilitated communications among different project teams that were implementing DB. For instance, T-REX project representatives reached out to CDOT officers on the COSMIX project (i.e., about $150 million highway project in Colorado Springs) to help them develop project procurement (i.e., draft the request for proposals) and to help them implement the DB method over the project's life. Second, a small group was established within CDOT to collect knowledge on innovative contracting methods and to implement it on smaller scale projects. The third way CDOT promoted organizational learning was by developing a Design-Build construction manual.

Similarly, WSDOT promoted organizational learning of the DB approach by appointing an innovative contracting office during the early implementation phase. WSDOT staff affiliated with this office collected and distributed knowledge on innovative contracting approaches, collected lessons learned on the implementation, developed internal policies on the newly adopted delivery methods, and offered training to other WSDOT units by means of publications and workshops. Therefore, the role of capturing knowledge was managed at headquarters level through this unit. A drawback to this approach is that lessons learned at the project level may be lost or may not reach other individuals on the same project.

Identify measures for success and assess change implementation

It is important to identify what the owner believes represents a successful implementation. For the T-REX project, a first aspect to assess was how different project parties were reacting to the new approach and if cultural barriers were affecting the project outcome. To this end, a survey was periodically distributed to project teams and functional groups. Responses to this survey were compiled in a partnering report that was delivered to the project director. This practice helped "understand how well the culture aspect was going." In addition, performance on different project practices (i.e., field design changes, RFI under DB) was assessed and changes were implemented when needed. This approach to performance assessment contributed to the T-REX project's winning of the Malcolm Baldridge Award by the Colorado Performance Excellence community (CPEx).

Allocate adequate resources to implementation

When implementing a new delivery strategy, owners may hinder the process by not allocating enough resources to the initiative. For instance, the I-405 project representative was concerned that not enough resources were allocated to document project quality by both contractual parties. Neither the design-builder nor the transportation agency assigned enough resources to the quality documentation process. As a result, problems in recovering costs from the federal agency (i.e., FHWA) were expected.

9.3. FINDINGS ON CASE STUDIES

Taken together, findings from the comparative case studies provided information that (1) confirmed SH-130 findings, and (2) provided additional insight and understanding. All the key lessons from these cases confirmed SH-130 findings on issues at the organization level (e.g., promote organizational learning, provide leadership support) and at the project level (e.g., usefulness of co-location, allocate adequate resources, provide adequate authority to project team). They also confirmed the importance of the supporting processes, such as assessment of implementation performance and knowledge building. In addition, information gained from these case studies provided recommendations for improving the initial framework development. For instance, these findings suggested that a transportation agency role goes beyond organizational learning to include an "active" role in promoting acceptance and understanding of the new strategy among other relevant parties. These involved groups include industry providers, local authorities, public officials and local and regional permitting agencies. This additional knowledge was helpful to the analysis of the qualitative information that was collected from the first round of the Delphi study described in Chapter 10.

Chapter 10: Delphi Validation of Implementation Framework

To solicit expert judgment on the developed framework, a Delphi study was conducted. First, 90 potential experts on the implementation of the design-build method for transportation projects were identified and invited to participate in the two-round study. Thirty-five experts accepted the invitation (representing a 39 percent invitation acceptance rate) and were asked to respond to an initial questionnaire for the first round. Figure 10.1 shows the Delphi process and explains how different components of the framework were validated. Links to sections of this dissertation are also provided for the reader. The following sections describe criteria for validation and present the results from the two rounds of the Delphi study.

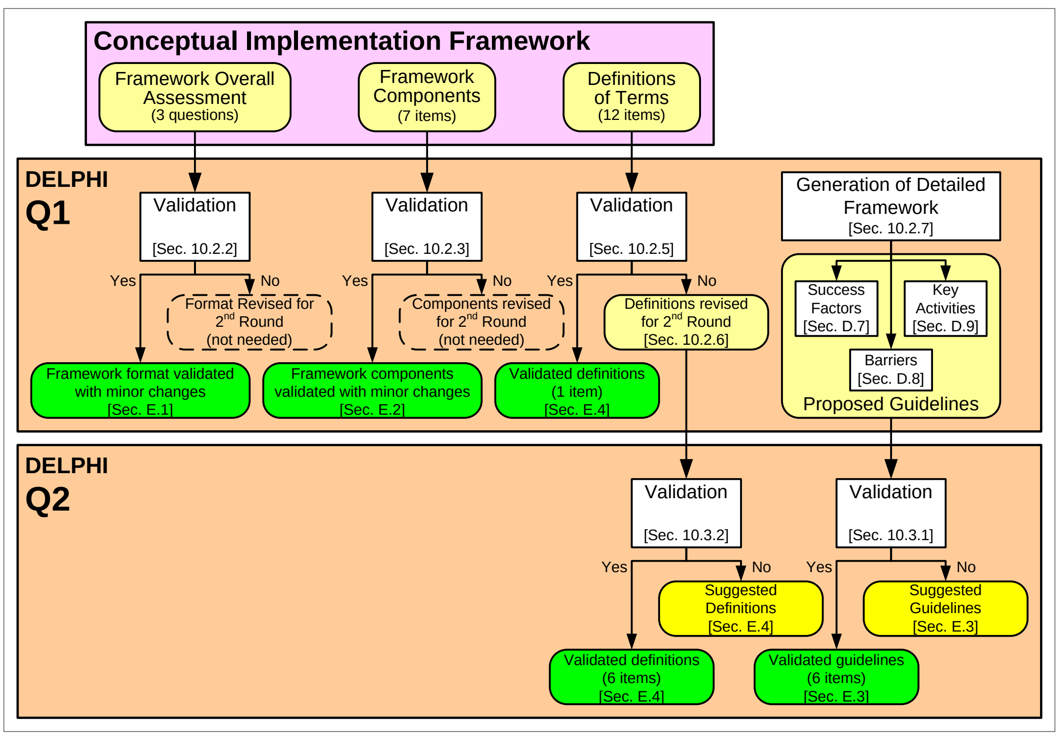

Figure 10.1: Delphi Process.

10.1. CRITERIA FOR FRAMEWORK VALIDATION

Depending on the item being validated, two different Likert-type scales are used. The components of the conceptual framework (i.e., processes and phases), the definitions of terms, and the overall framework architecture are validated using a 7-point Likert scale to assess *agreement* with a given statement (Scale A shown in Figure 3.4). Conversely, detailed guidelines addressing specific success factors are validated using a 7-point Likert scale to assess the *importance* of a given factor for the success of the implementation effort (Scale B shown in Figure 3.5). Two groups of criteria are used for the validation effort. All these criteria are shown in Table 10.1 depending on the scale of measurement. The first group of validation criteria is related to how panelists scored a given item (i.e. panel agreement with item). The second group of validation criteria is related to panel consensus (i.e. panel internal agreement). An item is not validated if it fails to meet both criteria on panel scores and panel consensus. In addition, an item is not validated if panelists suggest any major change to the item. A major change is defined as one that substantially modifies the equilibrium among items (i.e., significant change in relations among definition, revolutionized scope or objective of framework components, etc.).

To assess how panelists scored a given item, a criterion on the panel mean and a criterion on the percentage of panelists were established. An item was not validated if the scenario failed to meet both the above criteria. These criteria were defined according to the scale of assessment used. Items being validated on the agreement scale (Scale A) were considered within validation range if *75% or more of the respondents scored the item 5 (conditional/moderate agreement) or more* and *the average score was 5 or more*. Similarly, items being validated on the importance scale (Scale B) are considered within validation range if *75% or more of the respondents scored the item 4 (important) or more* and *the average score was 4 or more*.

Table 10.1: Criteria for Establishing Validation.

<table>
<tr><th rowspan="2">Scale</th><th rowspan="2">Item</th><th colspan="2">Criteria on panel scores</th><th colspan="5">Criteria on measures of panel consensus</th></tr>
<tr><th>Average score</th><th>% of panelists in range</th><th>r_{wg}[1]</th><th>$p(r_{wg})$[2]</th><th>AD[3]</th><th>p(AD)[2]</th><th>Level[4]</th></tr>
<tr><td rowspan="3">(Scale A) Agreement</td><td>Overall Assessment Questions</td><td rowspan="3">≥5.0</td><td rowspan="3">≥75%[5]</td><td>≥0.70</td><td>≤1.167</td><td><0.01</td><td><0.01</td><td>Strong</td></tr>
<tr><td>Conceptual Framework Components</td><td rowspan="2">≥0.60</td><td rowspan="2">≤1.167</td><td rowspan="2"><0.01</td><td rowspan="2"><0.01</td><td rowspan="2">Moderate</td></tr>
<tr><td>Definitions of Terms</td></tr>
<tr><td rowspan="2">(Scale B) Importance</td><td rowspan="2">Detailed Framework Components</td><td rowspan="2">≥4.0[6]</td><td rowspan="2">≥75%[7]</td><td>≥0.70</td><td>≤1.167</td><td><0.01</td><td><0.01</td><td>Strong</td></tr>
<tr><td>≥0.60</td><td>≤1.167</td><td><0.01</td><td><0.01</td><td>Moderate</td></tr>
</table>

[1] Interrater reliability (James et al., 1984).
[2] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al., 2003).
[3] Average Deviation Index (Burke & Dunlap, 2002).
[4] A lack of consensus was established if an item did not meet the previous criteria.
[5] Percentage of respondents within agreement range. Agreement range was established if the respondents scored the item 5 (conditional agreement) or more.
[6] Mean values were not used as criteria for validation but were used for ranking success factor for level of importance.
[7] Percentage of respondents within importance range. Importance range was established if the respondents scored the item 4 (important) or more.

To assess panel consensus, criteria on certain established measures of consensus were established. Two measures were used to assess panel consensus: (1) interrater reliability (r_{wg}) and (2) average deviation (AD). Depending on the values of these indexes, three levels of consensus were established: (1) strong consensus, (2) moderate consensus, and (3) lack of consensus. The panel's internal consensus on a given item was established if *(a) the average deviation (AD) was below the 1.167 cutoff*, (b) *the interrater reliability (r_{wg}) was within a certain range ($r_{wg} \geq 0.7$ for strong agreement or*

$0.6 \le r_{wg} \le 0.7$ for moderate agreement), and (c) *the null hypothesis of rectangular responding was rejected with a 99% confidence level by means of approximate randomization tests on the two measures of panel consensus*. An item lacked consensus if the scenario failed to meet the above criteria.

10.2. DELPHI ROUND 1

During the first phase of the Delphi study (Delphi Q1), the expert panel was asked to answer many questions to further develop and validate the conceptual framework. Panelists were asked to:

1. Provide an overall assessment of the conceptual framework
2. Improve and validate the framework components (i.e., processes and phases) by
    a. Expressing their agreement with given statements on a 7-point scale
    b. Providing qualitative feedback
3. Improve and validate the framework definitions by
    a. Expressing their agreement with given statements on a 7-point scale
    b. Providing qualitative feedback
4. Help generating a detailed framework by suggesting
    a. *Success Factors* – defined as factors believed to affect the success of a state transportation agency's implementation of a change in project delivery strategy
    b. *Barriers to Implementation* – defined as expected barriers to implementation of a change in project delivery strategy
    c. *Implementation Activities* – defined as key activities to be performed during the implementation of a change in project delivery strategy.

Responses from all panelists were compared and analyzed and are presented in the sections below. Results from this first round of the Delphi study were used jointly with information from the comparative case studies to revise the initial conceptual framework described in Chapter 8. Those combined results also helped the author develop a detailed framework. Descriptive statistics for each of the questions were computed, including mean, median, standard deviation, and variance. The mean was assumed as a measure of central tendency among the panelists. Values of the interrater reliability index, $r_{wg,}$ and of the agreement index, AD, were also computed and tested for both statistical and practical significance. Further details on the data analysis are provided in Section 3.3.

10.2.1. Panel Composition and Response Rate (Delphi Q1)

In September 2006, the first Delphi questionnaire (Delphi Q1) was distributed to the 35 individuals in the target sample. These experts were given 60 days to return their questionnaires to the research team. By the end of October 2006, 26 experts submitted completed questionnaires (representing a 74 percent response rate for Round One). Many of the participants had several areas of expertise (see Table 10.2 for descriptive information on participants' background).

Table 10.2: Delphi Q1 – Panel Composition Summary.

Average industry experience per respondent	22 years
Average total value of projects managed	$2.2 billion
Role of organization	14 owners, 2 design-builders, 6 consultants, 4 academics
Area of expertise of panelists	Planning, right-of-way acquisition, environmental permitting and compliance, facility operations, contract procurement, design, utility adjustment, maintenance, project management, construction, geotechnical engineering, business development, project financing, organizational management, public policy, and procurement law
Experience with different delivery methods	Design-bid-build (DBB), design-build (DB), CM at risk (CMAR), design-build-maintain (DBM), design-build-transfer-operate (DBFO), design-build-finance-operate (DBFO), design-sequencing, pre-development agreement

10.2.2. Overall Assessment of Conceptual Framework (Delphi Q1)

Table 10.3 shows the results for three questions that were designed to provide an overall assessment of the conceptual framework. First, panelists were asked to assess the importance of defining an implementation process. An average score of 6.3 with a high interrater reliability (r_{wg}= 0.88>0.70) and low average deviation index (AD=0.59<1.167) showed that the panelists widely agreed on the importance of a well-defined implementation process.

Then, panelists were asked to provide an overall assessment of the comprehensiveness and meaningfulness of the set of definitions provided. With a high interrater reliability (r_{wg}= 0.77>0.70) and a strong agreement (AD=0.70<1.167), panelists provided a conditional agreement of 5.2. Some panelists expressed a desire for resolution of the hierarchical inconsistency they perceived between the words "delivery"' and "procurement" before they could fully agree with the set of definitions.

Finally, panelists were asked to provide an overall assessment of the usefulness of the conceptual implementation framework. While Section 10.2.3 describes how panelists widely agreed on the components of the implementation framework, here, they conditionally agree with the current format and language. Eighty percent of the panelists agreed with usefulness of the tool. Following is a typical response to this item: "I agree this has potential. There are other change management tools and studies, but a framework such as this can organize and focus on the implementation of project execution strategies in the public transportation sector" (anonymous panelist). However, some panelists suggested a simplification of the overall architecture and the creation of "a format that is easily comprehended and can easily be applied by the industry" (anonymous panelist). Another anonymous panelist recommended decreasing the dissection of guidelines "you've gone to great detail to dissect each phase but I don't know that it adds value to the overall process. I would argue that an Owner/Agency would be overwhelmed with such a complex approach. It need not be complex."

Consensus on this assessment was high with a high interrater reliability (r_{wg}= 0.76>0.70) and a strong agreement (AD=0.70<1.167). Comments and simplifications to the framework components and definitions are summarized in Tables 4 and 5 in Appendix D.6.

Table 10.3: Delphi Q1 – Responses on Conceptual Framework Assessment.

Item	N	Panel Scores		Panel Consensus Measures				Validated (consensus)
		Average Score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]	
Importance of defining an implementation process for the success of a new strategy	26	6.3	100%	0.88	<0.001	0.59	<0.001	Yes (strong)
Comprehensiveness and meaningfulness of set of definitions	25	5.2	84%	0.77	<0.001	0.70	<0.001	Yes (strong)
Usefulness of implementation framework	25	5.1	80%	0.76	<0.001	0.70	<0.001	Yes (strong)

[1]Panelists provided a rating on a 7-point scale expressing their agreement with the given statement
[2] Percentage of respondents within agreement range. Agreement range was established if the respondents scored the item 5 (conditional agreement) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).

10.2.3. Assessment of Conceptual Framework Components (Delphi Q1)

In addition to providing an overall assessment of the framework components, panelists were asked to answer questions that would help the author improve and validate these components. They were asked to express their agreement with the given statements on a 7-point scale. They also were asked to provide qualitative feedback on the descriptions and scope of the framework components.

All these components were validated over the first round of Delphi with panelists requiring only minor changes on a few items. In addition, conceptual framework components also achieved a strong panel consensus. Table 10.4 shows the results of the first round of the Delphi study as related to the rating of the framework components. With average values between 5.9 and 6.2, all the framework components were validated, showing the panel's agreement with the importance assigned to each process and phase.

These results were achieved with high values of interrater reliability that ranged between 0.85 and 0.92, but well beyond the 0.70 cutoff. The panel agreement was confirmed by values for the average deviation index that were between 0.23 and 0.49, but also well below the 1.167 cutoff.

Table 10.4: Delphi Q1 – Responses on Conceptual Framework Components.

Item	N	Panel Scores		Panel Consensus Measures				Change suggested[6]	Validated (consensus)
		Average Score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]		
Implementation process	26	5.9	92%	0.85	<0.001	0.49	<0.001	None	Yes (strong)
Knowledge-building process	26	5.9	96%	0.91	<0.001	0.35	<0.001	Minor	Yes (strong)
Implementation assessment process	26	6.0	96%	0.92	<0.001	0.23	<0.001	None	Yes (strong)
Preparatory phase	26	6.0	92%	0.85	<0.001	0.45	<0.001	Minor	Yes (strong)
Planning phase	26	6.0	96%	0.92	<0.001	0.24	<0.001	Minor	Yes (strong)
Contract procurement phase	25	6.2	96%	0.88	<0.001	0.47	<0.001	Minor	Yes (strong)
Contract administration phase	25	6.1	92%	0.85	<0.001	0.49	<0.001	None	Yes (strong)

[1] Panelists rated an item description (including objectives and scope) on a 7-point scale expressing their agreement with the statement that "the item is important to the implementation of a change in project delivery strategy."
[2] Percentage of respondents within agreement range. Agreement range was established if the respondents scored the item 5 (conditional agreement) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Change suggested by panelists in the form of qualitative comments. Items with minor change or no change were validated.

10.2.4. Validated Conceptual Framework Components

While all the framework components were validated, experts also provided suggestions for improving them. These comments were used in conjunction with information from the comparative case studies to improve and better define the initial framework components presented in Chapter 8. This slightly modified version is provided in the sections below. In addition, descriptions of the Conceptual Framework components were modified to take into account the changes to the Conceptual Framework definitions.

Change to Framework Processes

The framework processes required minimal changes. The role of the knowledge building (KB) process was extended beyond the initial focus on organizational learning to include a public outreach component. Therefore, the sentence, "this process facilitates acceptance among stakeholders (e.g., the public, elected officials, industry providers, utilities, local agencies, etc.)," was added to the description of the KB process. This role was confirmed by some of the panelists' comments such as "[there is] a need to go outside of the agency to [include] other key stakeholders." This adjustment also took into account lessons from the WSDOT and T-REX projects. Revised descriptions of the framework processes are provided in Appendix E.2.

Change to Framework Phases

The framework phases required some additional changes to address specific comments from panelists. Revised descriptions of the framework phases are provided in Appendix E.2. The scope of the preparatory phase (Phase 1) was extended to include two additional objectives: (a) to state reasons for the change and (b) to initiate the information loop between the organization and the surrounding environment. This change was required to address case study findings (i.e., T-REX project) and Delphi Q1 comments (i.e., "the definition is missing the motivating component: goals/reason/vision for the change. […] 'A new process for new process sake,' that does not occur. […] In my experience, typically agencies have a need, a project need, and that drive[s] the change.").

Similarly, the scope of the planning phase (Phase 2) was extended to include two additional objectives. First, the implementation of organizational change was included in the scope of this phase because it needs to happen before the project gets underway. This change addresses comments from panelists (i.e., "The project planning phase needs to focus on getting the stakeholders and the project ready for the particular procurement strategy/approach."). It also fit better with some late lessons from the TxDOT implementation (i.e., "we have set up a steering committee […] looking at improving all the technical provisions [and] working on business terms. [It] provides global direction. [This] steering committee is probably something we should have done earlier.") Second, drafting an early risk allocation strategy was included in the Phase 2 scope. This change allowed a better fit with observations from the case studies (i.e. WSDOT performed an early risk allocation during the drafting of the master contractual documents. This risk allocation was reviewed and negotiated with the local industry providers.) It also addressed a specific comment from a panelist (i.e. "Risk allocation needs to occur here. Risks cost someone money, either the owner or the developer.") In addition, this phase's focus on identifying transportation needs and constraints was eliminated to address specific comments from Delphi panelists (i.e., "Identification of needs and constraints is part of a long-range plan. I would probably take out the transportation needs and constraints part from this definition. Probably at this phase project goals are set."). This modification was also a response to the case study findings (i.e., planning for both T-REX and WSDOT projects required a decade and was initiated long before these agencies obtained legislative authority for using DB).

The scope of the procurement phase (Phase 3) was slightly modified to address comments from some of the Delphi panelists (i.e., "allocation of project risks should be done earlier in the process.") This change also aligns the framework with observations from the case studies (i.e., the WSDOT-AGC policy team drafted risk allocation at the master contract level. Later, this risk allocation strategy was reviewed and implemented at the project level during the procurement industry review.)

10.2.5. Assessment of Conceptual Framework Definitions (Delphi Q1)

The rationale for developing definitions of project delivery concepts was to establish a common ground for understanding changes to project delivery strategy. Therefore, both consensus and agreement were required to validate definitions. Consequently, a definition was validated if agreement with the given statement was achieved with a strong or moderate consensus, and if no major changes were suggested.

Table 10.5 shows the results of the first round of the Delphi study as related to the rating of the framework definitions. The average values were between 4.0 and 5.9, and percentages of experts who agreed with a specific definition varied between 38% and 92%. As result, agreement was established for six of the framework definitions.

Consensus on these definitions was also established. Values for the average deviation index were between 0.65 and 1.23, with all but three definitions below the 1.167 cutoff for interrater agreement. However, only four definitions achieved strong consensus with values of the inter-rater reliability above the 0.70 cutoff: (1) project finance method, (2) project procurement strategy, (3) contract award method, and (4) contracting approach.

Table 10.5: Delphi Q1 – Responses on Framework Definitions.

Item	N	Panel Scores		Panel Consensus Measures				Change suggested[6]	Validated (consensus)
		Average Score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]		
Project delivery method (PDM)	25	4.9	64%	0.46	0.005	1.22	0.010	Major	No
Factors differentiating PDMs	26	5.3	85%	0.61	<0.001	0.92	<0.001	Major	No
Project finance method (PFM)	26	5.5	85%	0.74	<0.001	0.81	<0.001	Major	No
Factors differentiating PFMs	26	4.0	38%	0.38	0.014	1.23	0.010	Major	No
Project procurement approach	26	5.0	69%	0.62	<0.001	0.92	<0.001	Major	No
Project procurement strategy	26	5.5	85%	0.86	<0.001	0.65	<0.001	Major	No
Change in p.p. strategy	26	4.8	69%	0.46	0.004	1.19	0.006	Major	No
Project procurement process	26	5.2	77%	0.63	<0.001	0.95	<0.001	Major	No
Contract award method	26	5.9	92%	0.71	<0.001	0.65	<0.001	Major	No
Contracting approach	26	5.4	81%	0.74	<0.001	0.83	<0.001	Minor	Yes (strong)

[1] Panelists rated a concept definition on a 7-point scale expressing their agreement with the statement that "the given definition adequately describes the concept and is meaningful within the context of the transportation project sector"
[2] Percentage of respondents within agreement range. Agreement range was established if the respondents scored the item 5 (conditional agreement) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Change suggested by panelists in the form of qualitative comments. Items with minor change or no change were validated.

Finally, six definitions were validated with strong panel consensus and two with moderate consensus. However, five of them required substantial changes to address qualitative feedback by the panel. Therefore, only one definition (i.e. "contracting approach") was fully validated.

10.2.6. Revised Framework Definitions

Comments for improving the definitions and format were also provided by the panelists; these comments indicated problems and suggested improvements to the definitions. Using these comments, the author adjusted the initial set of definitions provided in Chapter 8. Comments and resulting changes to the terminology are proposed in Table 4 in Appendix D.6. Revised descriptions of the framework definitions are provided in Appendix E.4. This modified set was later validated in the second phase of the Delphi study.

A large number of comments criticized the use of the term "procurement" and the adopted equivalency between the terms "procurement" and "delivery." Some panelists suggested a different use of these two terms; they suggested that the term "delivery" has a broader meaning than the term "procurement" because it covers a period of the project life-cycle from the establishment of a need up to the actual delivery. Conversely, they pointed out that the term "procurement" covers a period of the project life cycle from the establishment of a need through the selection of a provider. As a result, a major change was made to implement these suggestions into the revised version of the framework definitions.

10.2.7. Formulation of Detailed Framework Components (Delphi Q1)

The first Delphi questionnaire (Delphi Q1) included a set of questions designed to elicit detailed suggestions for a successful implementation. These questions asked for three pieces of information:

a. *Success Factors* – factors believed to affect the success of a state transportation agency's implementation of a change in project delivery strategy
b. *Barriers to Implementation* – barriers expected to the implementation of a change in project delivery strategy
c. *Key Implementation Activities* – activities to be performed during the implementation of a change in project delivery strategy.

This information was collected from two groups of questions. Initially, two questions asked for identifying Success Factors and Barriers to Implementation at the overall level. Later, panelists were asked to identify these three pieces of information for each phase and process in the framework (see example in Figure 10.2). The panel's responses to these questions are provided in Appendixes D.7, D.8, and D.9.

In response to these open-ended questions for developing a detailed framework the panelists provided a large amount of qualitative information, contributing almost 1,100 comments. The analysis of this rich source of data was performed with a qualitative research technique known as template analysis (King 1994). While a detailed description of this research method was provided in Section 3.3, a short description is provided below.

Initially, this technique involved defining a set of categories emerging from the preliminary research. Later, the comments of a subset of data were coded (i.e., responses on overall success factors and overall barriers to implementation). As a result, an initial template was created by grouping related categories mentioned in the selected comments into a smaller number of higher-order codes that describe broader implementation guidelines in the data.

D.5) Please list key factors affecting the success of the implementation effort during the preparatory phase (e.g. legislative environment, etc.):

CPPS Process	Factors affecting the success of the implementation effort (separated by commas)
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

D.6) Please list main barriers expected during the preparatory phase (e.g. industry lobbying, etc.):

CPPS Process	Main barriers to the implementation (separated by commas)
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

D.7) Please list key activities to be performed during the preparatory phase (e.g. identification of procurement sourcing of knowledge on new approaches, etc.):

CPPS Process	Key activities to be performed for the implementation (separated by commas)
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

Figure 10.2: Delphi Q1 – Sample Questions on Detailed Implementation.

The author applied this template analysis to the three groups of comments (i.e., comments on success factors, barriers to implementation, and implementation activities). The resulting categories were then compared. As a result, the author was able to establish that success factors and barriers to implementation mirrored each other in such a way that an absence of success factors was categorized as a barrier to implementation. Subsequently, the three groups of comments were further grouped into the 25 implementation guidelines that are provided in Appendix D.11. Each of these guidelines addresses a single success factor; the corresponding success factors are itemized in Table 10.6. Each guideline also includes details on barriers to implementation of each factor as well as actions necessary to overcome these barriers. In the second round of the Delphi study, panelists were asked to use a 7-point scale to rate for importance the success factors relative to each guidance category. Results from this rating are provided later in this chapter.

These guidance categories were further subdivided into three groups, according to their particular influence on or affiliation with the conceptual implementation process. The first group of guidance categories is affiliated with an area of success factors and barriers to implementation that are present at the agency-environment (external level) interface. The other two groups of guidance categories are affiliated, respectively, with the organization and the project level. The first guidance category (i.e., SF-1) may affect aspects of each of the three levels.

While the complete list of guidelines is provided in Appendix E, as an example, Table 10.7 shows three sample implementation guidelines, one for each analysis group. Each implementation guideline corresponds to an area of success factors and barriers to implementation; in addition, the affiliation with a certain level of application is provided (e.g., external, organization, or project). Each category also includes (1) a short description, including details of how the success factor affects the conceptual framework and (2) a set of recommendations for implementing positive changes to overcome barriers. In the second Delphi round, panelists were provided with the corresponding success factors so they could rate them in terms of importance; they also were provided with these implementation guidelines so they could make comments on them. Their insight is included in the final framework and discussed in a subsequent section.

Table 10.6: Delphi Q1 – Detailed Framework Success Factors.

Level	ID	Success Factors
NA	SF-1	Change to the agency's delivery and finance strategy is driven by clear needs
EXTERNAL	SF-2	Elected officials are supportive of the effort
	SF-3	Industry providers accept the change and are supportive of the effort
	SF-4	The general public accept the change
	SF-5	Other relevant parties accept the change
	SF-6	Legislative authority for changing agency's delivery and finance strategy is obtained
ORGANIZATION	SF-7	Agency's management vision and support for change is behind the effort
	SF-8	A comprehensive implementation plan at the organizational level is developed and used
	SF-9	An assessment program for the change's outcome is implemented
	SF-10	Staffing procedures are redesigned to facilitate the effort
	SF-11	There is availability of agency's staff for implementing change
	SF-12	There is acceptance of change by agency staff
	SF-13	Training on newly introduced approaches is provided to agency staff
	SF-14	External parties affected by change are informed
	SF-15	A method for matching projects with delivery methods is in place
PROJECT	SF-16	A comprehensive implementation plan at the project level is developed and used
	SF-17	Owner project team is adequately staffed
	SF-18	A clear and transparent approach to managing project risks is developed
	SF-19	An efficient procurement process is in place
	SF-20	Competitive participation in procurement of qualified industry providers is encouraged
	SF-21	The project contractual documentation is ready and suitable for the new approach
	SF-22	Project's organizational structure is designed to facilitate the new approach
	SF-23	Project's communications are designed to facilitate the new approach
	SF-24	Contract administration procedures for facilitating the new approach are well defined
	SF-25	Project parties accept change

Table 10.7: Delphi Q1 – Detailed Implementation Framework Sample Categories.

Obtain legislative authority for changing delivery and finance strategy (External)
Description Legislative authority is obtained by a change in the legislative framework allowing changes to the agency's project delivery and finance strategy. A transportation agency needs legislative authority before instituting changes to its procurement and finance strategy. Changes to the regulatory framework occur at different levels (federal/state), and affect different aspects including: (a) allowed degree of project services that can be outsourced; and (b) allowed project delivery methods. An absence of legislative authority constitutes a barrier to change. *Recommendations* (1) Working with and educate industry providers and elected officials (2) Informing general public (3) Advocating for legislative authority (4) Drafting legislation
Be sure change is supported and promoted by agency's management (Organization)
Description A change to an agency's project delivery and finance strategy affects all the elements of the delivery system (i.e. procurement, contracting, financing, payment, and administration). Support by upper management is crucial for the success of the change initiative in many ways. *Recommendations* (1) Championing for necessary legislative changes (2) Seeking support by legal counsel on legislative actions (3) Setting clear objectives for the change (4) Mandating needed internal adjustments (e.g., recruitment, outsourcing, creation of additional organizational units, etc.) (5) Providing resources for implementing change (monetary and staff) (6) Proclaiming commitment to agency's community (to mitigate agency's internal resistance) (7) Manifesting commitment to knowledge-building (e.g., measures, time and money) (8) Manifesting commitment to implementation assessment (e.g., measures, time and money) (9) Monitoring change implementation
Adopt a clear and transparent approach to managing project risks (Project)
Description A clear strategy for identifying, allocating, sharing, and managing project risks exists. Some potential problems include: (a) unreasonable allocation of risk with resulting high bid prices; (b) unwillingness to manage risk; and (c) unclear contractual language. *Recommendations* (1) Eliciting input of industry associations on master contracts (2) Developing risk allocation matrices for projects (3) Having industry providers review the risk allocation during the procurement phase (4) Developing a risk management plan with selected provider

10.3. DELPHI ROUND 2

10.3.1. Panel Composition and Response Rate (Delphi Q2)

In late January 2007, the second round Delphi questionnaire (Delphi Q2) was distributed to the 26 individuals who responded to the first questionnaire. These participants were given 30 days to respond and by the end of February 2007, 21 had submitted their answers. As a result, the response rate for Round Two was above 80 percent. Because 21 of the 35 experts who accepted the invitation responded to both questionnaires, the absolute response rate of the Delphi study was equal to 60 percent.

Descriptive information on the respondents is provided in Table 10.8; it shows that the new panel composition basically mirrored the first. The main difference was that the Round Two respondent pool had managed a larger average total value of projects than the first round pool. The questionnaire included two groups of questions designed to assess and validate success factors, implementation guidelines, and revised definitions of terms.

Table 10.8: Delphi Q2 – Panel Composition Summary.

Average industry experience	22 years
Average total value of	$3.3 billion
Role of organization	13 owners, 1 design-builder, 5 consultants, 4 academics

10.3.2. Assessment of Detailed Framework Components (Delphi Q2)

First, panelists were asked to use a 7-point scale to rate for importance the success factors relative to each guideline. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important"; it also adopted a central score of 4 = "important." Importance level refers to how vital the factor's occurrence is to facilitating the success of the implementation effort, and to the significance of the factor's absence in hindering that success. Respondents could also provide qualitative feedback on the implementation guidelines.

Information submitted through this second questionnaire was analyzed to determine both the average importance rate of each of the twenty-five success factors relative to each guideline category, and to assess the panel's internal agreement (measured by the inter-rater reliability). Tables 10.13, 10.14 and 10.15 show the results of the second round of the Delphi study as related to the validation of the success factors. Descriptive statistics for each of the categories were computed and the mean was assumed as a measure of central tendency among the panelists.

External Level Factors

Table 10.9 shows the results of the validation for success factors at the external interface level (Agency-Environment). The Delphi panelists rated all the success factors with average values between 3.8 (4 = Important) and 6.5 (7= Extremely Important). Percentages of experts who rated a given factor as important or more varied between 62% and 100%. As result, four items meet the criteria related to panel scores.

Panel consensus on these items was also established. Values for the average deviation index were between 0.75 and 1.22, with all but one item below the 1.167 cutoff for interrater agreement. However, only three items achieved strong consensus with values of the inter-rater reliability above the 0.70 cutoff: (1) "change to the agency's delivery and finance strategy is driven by clear needs," (2) "industry providers accept the change and are supportive of the effort," and (3) "legislative authority for changing agency's delivery and finance strategy is obtained."

It is apparent from the panel assessments that external implementation guidelines and factors are critical to implementing a major organizational change such as described in this paper. The success factor with the highest average value among all 25 categories is, not surprisingly, legislative authority for changing an agency's delivery and finance strategy. This factor is closely followed by support/acceptance by industry providers. Also support from elected officials (SF-2) was rated highly, but without consensus. Legislative authority is often a direct result of these two constituencies.

Table 10.9: Delphi Q2 – Responses on External Success Factors.

Item	**N**	**Panel Scores**		**Panel Consensus Measures**				**Validated (consensus)**
		Average Score[1]	**% of panelists within range[2]**	**r_{wg}[3]**	**$p(r_{wg})$[4]**	**AD[5]**	**p(AD)[4]**	
Change to the agency's delivery and finance strategy is driven by clear needs	19	6.1	100%	0.71	<0.001	0.80	0.001	Yes (strong)
Elected officials are supportive of the effort	21	5.5	90%	0.51	0.005	1.22	0.019	No
Industry providers accept the change and are supportive of the effort	21	5.4	100%	0.76	<0.001	0.82	<0.001	Yes (strong)
The general public accept the change	21	3.8	62%	0.68	<0.001	0.90	<0.001	No
Other relevant parties accept the change	21	4.1	67%	0.60	0.001	0.98	0.001	No
Legislative authority for changing agency's delivery and finance strategy is obtained	21	6.5	95%	0.71	<0.001	0.75	<0.001	Yes (strong)

[1] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[2] Percentage of respondents within importance range. Importance range was established if the respondents scored the item 4 (important) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Items were ranked using the average score. Validated items were assigned a numerical rank whereas items failing the validation where considered "suggested" and assigned an alphabetical ranking.

Critical to implementing a major change to project delivery are the political ramifications of such changes and the amount of authority the agency is given. It should be noted that support by elected officials was the factor at the external level with the most variation among the panelists. A comment provided by one of the panelists may provide a possible explanation for the lack of agreement. Referring to the recommendation to assess opposition from elected officials to a change in delivery strategy, this panelist commented:

> I think it needs to go beyond assessing the opposition, I think that you need to actually attempt to address their concerns as much as possible. In doing so you may not convince them to support your cause, but they may understand a little more about what you are doing, and hopefully not oppose you as vigorously.

This comment strongly confirms the "educative" role that agency management needs to play in regard to certain external groups.

As a final point, it is important to the entire implementation process that the change to the agency's delivery and finance strategy be driven by a clear need (SF-1). This success factor transcends all the issues discussed in this research. The recent emergence of infrastructure deficits, aging and failing infrastructure, and the loss of agency expertise for effectively managing large capital programs have all led to a movement toward alternative delivery methods.

Organizational Level Factors

Table 10.10 shows the results of the validation for success factors at the organization level. The Delphi panelists rated all the factors with average values between 4.8 (4 = Important) and 6.4 (7= Extremely Important). Percentages of experts who rated a given factor as important or more varied between 86% and 100%. As result, all nine factors meet the criteria related to panel scores.

Panel consensus on these items is also established. Values for the average deviation index are between 0.76 and 1.08, with all items below the 1.167 cutoff for interrater agreement. Four factors achieve strong consensus with values of the interrater reliability above the 0.70 cutoff. In addition other four factors achieve moderate consensus with values of the interrater reliability between 0.60 and 0.70.

Management vision and support is clearly the most important organizational-level factor as identified by the panelists. While it may seem to be a cliché that top management support is needed, the reality of such a radical change makes clear the need for upper-level leadership. Whereas the availability of a method for matching projects with delivery methods obtained only a moderate consensus, it is the second most important organizational-level factor. This factor is not an easy proposition, given the myriad factors influencing each project and the large number of variations to available delivery methods. As expected acceptance of change by agency staff is also highly ranked with a strong consensus. Whereas organizational implementation planning did not meet the criterion for interrater reliability, it received the second most significant average score for importance. This factor is related to the leadership that top management must exhibit in order to make the change a reality.

Table 10.10: Delphi Q2 – Responses on Organizational Success Factors.

Item	N	Panel Scores		Panel Consensus Measures				Validated (consensus)
		Average Score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]	
Agency's management vision and support for change is behind the effort	21	6.4	95%	0.74	<0.001	0.77	<0.001	Yes (strong)
A comprehensive implementation plan at the organizational level is developed and used	21	5.6	90%	0.59	0.003	1.07	0.001	No
An assessment program for the change's outcome is implemented	21	4.8	90%	0.73	<0.001	0.84	<0.001	Yes (strong)
Staffing procedures are redesigned to facilitate the effort	21	4.9	86%	0.45	0.002	1.08	0.008	No
There is availability of agency's staff for implementing change	21	5.3	95%	0.64	0.001	1.02	<0.001	Yes (moderate)
There is acceptance of change by agency staff	21	5.3	95%	0.74	<0.001	0.83	<0.001	Yes (strong)
Training on newly introduced approaches is provided to agency staff	21	5.1	95%	0.67	<0.001	0.94	<0.001	Yes (moderate)
External parties affected by change are informed	21	5.0	90%	0.70	<0.001	0.76	<0.001	Yes (strong)
A method for matching projects with delivery methods is in place	21	5.4	100%	0.69	0.001	0.97	<0.001	Yes (moderate)

[1] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[2] Percentage of respondents within importance range. Importance range was established if the respondents scored the item 4 (important) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Items were ranked using the average score. Validated items were assigned a numerical rank whereas items failing the validation where considered "suggested" and assigned an alphabetical ranking.

Project Level Factors

Table 10.11 shows the results of the validation of success factors at the project level. Some factors include recommendations for both the contract procurement and contract administration phases.

All 10 of the project-level factors scored at five or above, indicating that the panelists considered them important to extremely important. Average scores were between 5.1 (4 = Important) and 6.0 (7= Extremely Important). Percentages of experts who rated a given factor as important or higher ranged between 86% and 100%. As a result, all ten factors met the criteria related to panel scores.

Panel consensus on these items was also established. Values for the average deviation index were between 0.67 and 1.07, with all items below the 1.167 cutoff for interrater agreement. Seven factors achieved strong consensus, with values of the interrater reliability above the 0.70 cutoff. In addition other two factors achieved moderate consensus, with values of the interrater reliability between 0.60 and 0.70. Only the factor pertaining to project implementation planning was not validated.

Adopting a clear and transparent approach to managing project risks was clearly the most important project-level factor identified by the panelists. This finding confirmed the importance of developing an approach for managing risks under a new delivery strategy. While the readiness of the project contractual documentation obtained only a moderate consensus, it was found to be the second most important organizational-level factor. As expected, acceptance of change by project staff is also highly ranked with a strong consensus. Two additional factors are highly ranked with a strong consensus. First, implementing an efficient procurement process, and second, encouraging competitive participation in procurement of qualified industry providers.

Table 10.11: Delphi Q2 – Responses on Project Success Factors.

Item	N	Panel Scores		Panel Consensus Measures				Validated (consensus)
		Average score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]	
A comprehensive implementation plan at the project level is developed and used	21	5.2	86%	0.56	0.002	1.07	0.003	No
Owner project team is adequately staffed	21	5.3	100%	0.74	<0.001	0.86	<0.001	Yes (strong)
A clear and transparent approach to managing project risks is developed	21	6.0	100%	0.78	<0.001	0.67	<0.001	Yes (strong)
An efficient procurement process is in place	21	5.5	100%	0.73	<0.001	0.88	<0.001	Yes (strong)
Competitive participation in procurement of qualified industry providers is encouraged	21	5.6	95%	0.74	<0.001	0.83	<0.001	Yes (strong)
The project contractual documentation is ready and suitable for the new approach	21	6.0	95%	0.65	0.001	0.86	<0.001	Yes (moderate)
Project's organizational structure is designed to facilitate the new approach	21	5.1	95%	0.72	<0.001	0.91	<0.001	Yes (strong)
Project's communications are designed to facilitate the new approach	21	5.1	95%	0.78	<0.001	0.78	<0.001	Yes (strong)
Contract administration procedures for facilitating the new approach are well defined	21	5.5	100%	0.68	<0.001	0.98	0.001	Yes (moderate)
Project parties accept change	21	5.8	100%	0.76	<0.001	0.75	<0.001	Yes (strong)

[1] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[2] Percentage of respondents within importance range. Importance range was established if the respondents scored the item 4 (important) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Items were ranked using the average score. Validated items were assigned a numerical rank whereas items failing the validation where considered "suggested" and assigned an alphabetical ranking.

Overall Ranking of Factors

Validated factors were ranked at the overall level and at the phase level as shown in Figure 10.12. Ranking was developed using the following order of precedence among criteria: (1) Average score, (2) Percentage of panelists within importance range, (3) r_{wg}, and (4) AD.

10.3.3. Assessment of Framework Definitions (Delphi Q2)

Later, panelists were asked to assess the revised set of definitions using a 7-point scale to agree or disagree that each definition adequately described the concept and was meaningful within the context of the transportation project sector. Table 10.13 shows the results of the validation for the revised framework definitions. The average values were between 4.6 and 6.1, and percentages of experts who agreed with a specific definition ranged between 62% and 100%. As result, agreement was established for seven of the framework definitions.

Consensus on these definitions was also established. Values for the average deviation index were between 0.43 and 0.99, with all the definitions below the 1.167 cutoff for interrater agreement. However, only three definitions achieved strong consensus with values of the inter-rater reliability above the 0.70 cutoff: (1) project delivery method, (2) project finance method, and (3) industry review process. In addition three other definitions achieved moderate consensus with values of the interrater reliability between 0.60 and 0.70: (1) Strategy for Financing and Delivering Projects, (2) Alternative Technical Concept Process, and (3) Contract Award Method.

Table 10.12: Prioritization of Validated Success Factors (overall and by phase).

Rank	Item	Panel Scores		Panel Consensus Measures		Ranking by phase			
		Average score	% in range	r_{wg}	AD	1	2	3	4
1	Legislative authority for changing agency's delivery and finance strategy is obtained	6.5	95%	0.71	0.75	1			
2	Agency's management vision and support for change is behind the effort	6.4	95%	0.74	0.77		1		
3	Change to the agency's delivery and finance strategy is driven by clear needs	6.1	100%	0.71	0.80	2	2	1	
4	A clear and transparent approach to managing project risks is developed	6.0	100%	0.78	0.67			2	
5	The project contractual documentation is ready and suitable for the new approach	6.0	95%	0.65	0.86			3	
6	Project parties accept change	5.8	100%	0.76	0.75			4	1
7	Competitive participation in procurement of qualified industry providers is encouraged	5.6	95%	0.74	0.83			5	
8	An efficient procurement process is in place	5.5	100%	0.73	0.88			6	
9	Contract administration procedures for facilitating the new approach are well defined	5.5	100%	0.68	0.98				2
10	Industry providers accept the change and are supportive of the effort	5.4	100%	0.76	0.82	3			
11	A method for matching projects with delivery methods is in place	5.4	100%	0.69	0.97		3		
12	Owner project team is adequately staffed	5.3	100%	0.74	0.86			7	3
13	There is acceptance of change by agency staff	5.3	95%	0.74	0.83		4		
14	There is availability of agency's staff for implementing change	5.3	95%	0.64	1.02		5		
15	Project's communications are designed to facilitate the new approach	5.1	95%	0.78	0.78				4
16	Project's organizational structure is designed to facilitate the new approach	5.1	95%	0.72	0.91				5
17	Training on newly introduced approaches is provided to agency staff	5.1	95%	0.67	0.94		6		
18	External parties affected by change are informed	5.0	90%	0.70	0.76		7		
19	An assessment program for the change's outcome is implemented	4.8	90%	0.73	0.84		8		

Table 10.13: Delphi Q2 – Responses on Framework Definitions.

Item	N	Panel Scores		Panel Consensus Measures				Change suggested[6]	Validated (consensus)
		Average Score[1]	% of panelists within range[2]	r_{wg}[3]	$p(r_{wg})$[4]	AD[5]	p(AD)[4]		
Project Delivery Method	21	5.7	90%	0.82	<0.001	0.60	<0.001	None	Yes (strong)
Risk Allocation Method	21	5.4	81%	0.59	0.001	0.99	0.001	None	No
Contract Packaging Method	21	5.0	67%	0.79	<0.001	0.73	<0.001	None	No
Project Finance Method	21	6.1	100%	0.90	<0.001	0.43	<0.001	None	Yes (strong)
Strategy for Financing and Delivering Projects	21	5.5	76%	0.66	<0.001	0.98	<0.001	None	Yes (moderate)
Project Procurement Process	21	4.6	62%	0.66	<0.001	0.91	<0.001	None	No
Alternative Technical Concept Process	20	5.7	80%	0.68	<0.001	0.89	<0.001	None	Yes (moderate)
Industry Review Process	20	5.7	90%	0.76	<0.001	0.76	<0.001	None	Yes (strong)
Contract Award Method	21	5.6	86%	0.64	<0.001	0.91	<0.001	None	Yes (moderate)

[1] Panelists rated a concept definition on a 7-point scale expressing their agreement with the statement that "the given definition adequately describes the concept and is meaningful within the context of the transportation project sector"
[2] Percentage of respondents within agreement range. Agreement range was established if the respondents scored the item 5 (conditional agreement) or more.
[3] Interrater reliability (James et al., 1984)
[4] Approximate randomization test of the null hypothesis of rectangular responding (Dunlap et al. 2003).
[5] Average Deviation Index (Burke & Dunlap, 2002).
[6] Change suggested by panelists in the form of qualitative comments. Items with minor change or no change were validated.

10.4. Framework Overall Architecture

Figure 10.3 shows the overall architecture of the implementation framework for Changing Delivery Strategy (CDS Framework). The final version of the framework is provided in Appendix E. The framework is composed of three elements: (1) the set of definitions, (2) the conceptual framework, and (3) the prioritized guidelines.

The set of definitions is the first element and includes both validated definitions and suggested definitions. These definitions are provided in Appendix E.4. Definitions for seven terms were fully validated and can be considered as shared concepts within the transportation project sectors. Three additional definitions are suggested though they were not fully validated.

The second element of the framework is the conceptual framework that acts as a strategic map for the detailed framework. The conceptual framework is composed of three concurrent processes that are implemented along four phases. These components are provided in Appendix E.2. The objective and scope of each process and phase is provided as a result of the validation effort. All these elements were fully validated with strong consensus. Detailed guidelines are linked to the conceptual framework phases in order to provide guidance to transportation agencies when they implement a change in project delivery strategy.

The last element of the framework is a set of detailed guidelines that include both validated guidelines and suggested guidelines. These guidelines are provided in Appendix E.3. These guidelines are ordered for importance level and linked to the implementation phases.

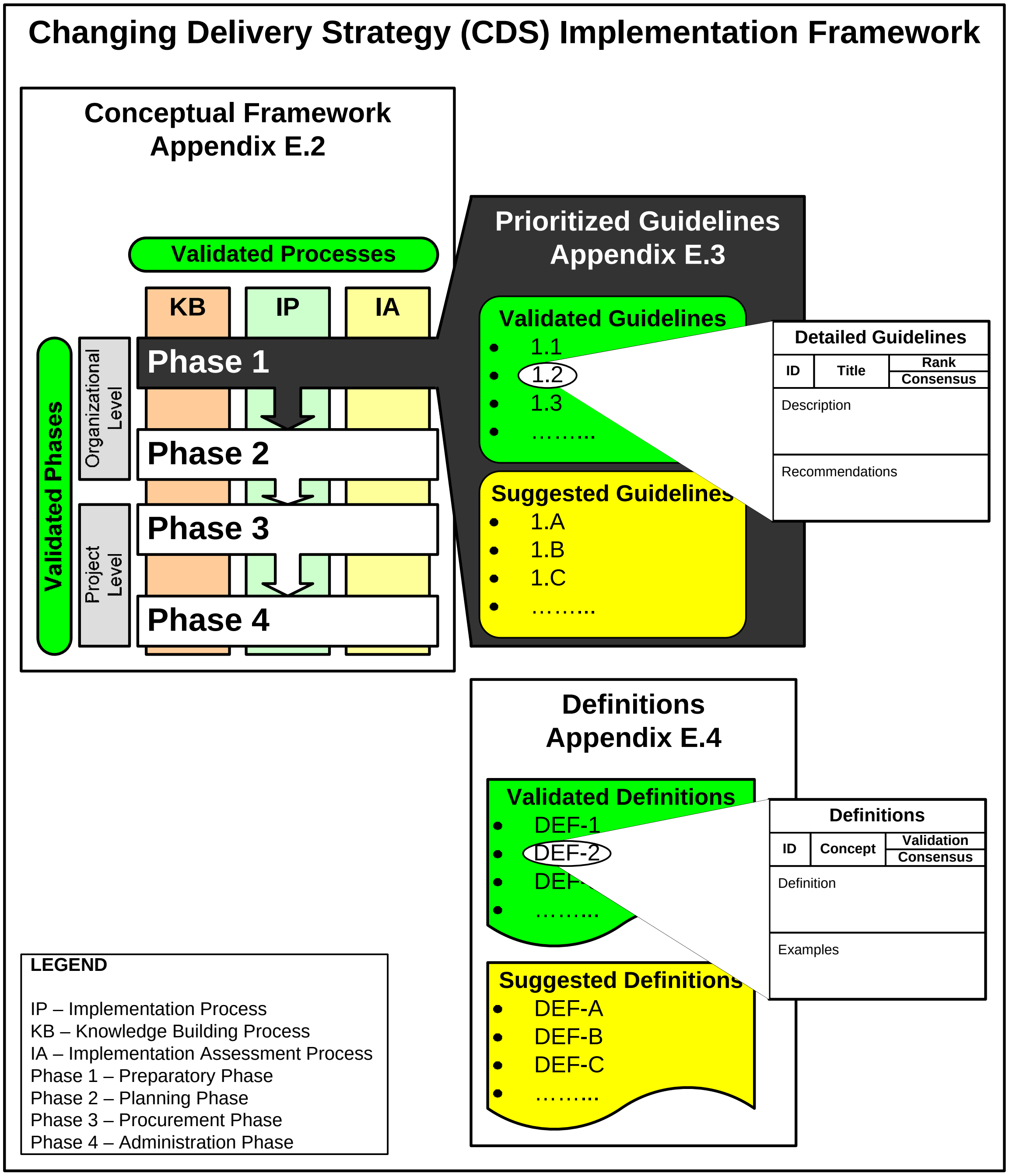

Figure 10.3: CDS Framework Overall Architecture.

Chapter 11: Conclusions and Recommendations

11.1. Conclusions

Many public owner organizations such as state departments of transportation and federal agencies such as the General Services Administration are fundamentally changing the way they procure contracts for delivering construction projects. The recent emergence of wide-scale infrastructure deficits, aging and failing infrastructure, and the loss of expertise to effectively manage large capital programs have all led to a movement toward alternative project delivery methods such as design-build.

Changing from a low-bid, design-bid-build process to a best value, competitive design-build process for delivery of a facility is not easy. Information about how this change should be implemented is limited, especially at the organizational level.

In conjunction with an ongoing research investigation of the SH-130 project in Texas (a $1.3 billion design-build toll road), four comparison case studies, and a two-round Delphi study, the author developed a framework to address the organizational change involved in using alternative project delivery methods. This dissertation has outlined the development and validation of this Changing Delivery System (CDS) implementation framework, and discussed its three major processes:

- the implementation process,
- the knowledge-building process, and
- the implementation assessment process.

These three concurrent CDS processes must be addressed through four phases:

- Preparatory,
- Planning,
- Contract procurement, and

- Contract administration.

This study's overall finding is that the CDS framework provides valid and valuable guidance to organizations changing their project delivery strategy. Its detail, including definitions, processes, level of effort, and implementation guidelines is useful to industry practitioners and can provide an excellent starting point for facilitating a wide-scale change of this type.

Of particular note are the guidance categories that emerged from the investigation related as they are to both the facilitation of and barriers to implementation of alternative project delivery systems. Among these:

- the agency's delivery and finance strategy must be driven by a clear need to change;
- management vision and support within the agency must be behind the effort;
- elected officials need to be supportive of the effort;
- support and acceptance by industry providers should be in place;
- comprehensive legislative authority for changing the delivery and finance strategy must be gained;
- organizational implementation plans to facilitate the change should be developed and used;
- a method for matching projects with delivery methods should be in place;
- a clear and transparent approach to managing project risks should be developed;
- the quality of the contractual documentation should match the delivery method and project risks;
- acceptance by project parties, both internally and externally, should be developed;

- contract administration procedures for facilitating the approach should be well defined; and
- competitive participation of qualified providers should be encouraged.

Finally, this research effort developed a solution to the initially stated problem. Research propositions outlined in Chapter One were met by (a) mapping a DB procurement process, (b) identifying issues pertaining to the administration of new contract, (c) developing and validating lessons learned, and (d) developing and validating a framework for helping transportation agencies implement change in their project delivery strategy. This framework, presented in Appendix E, is based on common concepts that were defined to establish a common ground for understanding change to project delivery strategy. In addition, the framework includes a set of guidelines that help identify elements of the organization and project design that need to be addressed to implement change and, also, suggest a path for implementing the change at both the organization and the project level.

11.2. RECOMMENDATIONS

Based on the results from the analysis, the author recommends that both practitioners and researchers build on the CDS framework for organizational change, with some modifications. The author feels that the concurrent processes and phases of the framework are applicable to any organizational change. The guidance categories, although specific to the procurement and delivery of capital facilities (in this case highway projects), are certainly extensible for use in other types of industries and/or organizational changes. Given the difficulties in affecting these types of changes, this framework provides a good first view of the steps needed to make it a reality.

11.3. CONTRIBUTIONS

This research achieved the objectives set forth in Section 1.2 and has made several contributions. These contributions include:

1) *The first detailed case study documentation of the use of two-phase selection procedures for procuring design-build contracts*. Using a case study methodological approach, the author focused the investigation on activities needed for selecting the DB entity and for preparing the contractual document. A process model has been developed for the procurement of design-build services through a two-phase selection procedure. This model provides guidance to practitioners for implementing the two-phase selection procurement encouraged by the FHWA DB Final Rule. Section 5.3 reports an extensive description of contributions and implications of this component of the research.
2) *The first detailed case study documentation of the administration of a design-build contract*. This part of the research effort expands on the existing knowledge of design-build (DB) processes by documenting the method's unique project organization. By highlighting the challenges posed by the implementation of a change in project delivery strategy, it also contributes practical knowledge to the field. Finally, a set of recommendations for improving team organization and communications improvement on DB projects was developed to give guidance to practitioners. Section 6.3 provides an extensive description of the contributions and implications of this component of the research.
3) *A detailed documented collection of lessons learned during the implementation of the design-build method for delivering a large highway project.* The author collected more than 100 lessons learned on the SH-130 project. These lessons were structured to reflect the delivery cycle of a design-build project. In addition, this was the first

time a collection of lessons learned for a design-build project was conducted longitudinally; so designed, it includes aspects of project planning, contract procurement, and contract administration.

4) *A comprehensive framework to address organizational change needed for successfully implementing a change in project delivery strategy.* The developed CDS framework provides valuable guidance to organizations changing their project delivery strategy. Its detail, including definitions, processes, and level of effort, is useful to industry practitioners and can provide an excellent starting point for facilitating a wide-scale change of this type. The framework was verified against comparative case studies and validated through a Delphi study involving a panel of industry experts.

5) *A comprehensive set of definitions of concepts necessary for understanding change to project delivery strategy.* Certain common concepts were defined to establish a common ground for understanding change to project delivery strategy among practitioners.

6) *A comprehensive set of guidelines that must be addressed for the successful implementation of a change in project delivery strategy.* While developing the framework was the main objective of this research effort, the guidelines that emerged from the investigation are of particular note because they address both the facilitation of and barriers to implementation of alternative project delivery systems. They identify prioritized learning for practitioners.

SECTION IV: APPENDICES

Appendix A: Exploratory Study

A.1. INTERVIEW GUIDE ON CONTRACT PROCUREMENT PHASE

Background

1. Interview purpose: gather information about the CDA procurement process
2. Information use: outline a streamlined CDA procurement process, and track associated lessons learned
3. Interview outline:
    a. Review of Phases Constituting the Procurement Process:
        i. Sequence of phases
        ii. Phase approximated duration for SH45 SE
        iii. Suggested optimal target duration (fixed or duration range)
        iv. Key duration drivers at phase-level
        v. Lessons learned to streamline the process
    b. Activity Constituting Each Phase
        i. Additional Activities
        ii. Review at Activity-level
        iii. Sequence of activities (precedence matrix at activity-level)
        iv. Activity approximated duration for SH45 SE
        v. Suggested Optimal Target Duration (fixed or duration range)
        vi. Key duration drivers at activity-level
        vii. Lessons Learned to streamline the process / reduce duration
4. We want to be sure that our report is as accurate as possible. With your permission, we'd like to audiotape this interview; this allows us more time for dialogue and minimizes the time required for written notes

5. We respect the confidentiality of the recording and it will be used solely for information and will not be distributed or communicated to other individuals

Face sheet

Topic: Interview on Procurement of SH-130 and SH-45SE Contracts	Research Project: TxDOT Project 0-4661 Monitoring and evaluation of SH130 Project
Type: Interview appointment	Expected Duration: 1 Hour
Date: 05/21/2004	Place: Austin District
Location: Austin, TX	Participants: Interviewee: XXXXX Interviewer: Giovanni Migliaccio

Phase-level Review

Item	Phase/Activity or Milestone	Actual Duration	Optimal Target Duration	Comments / Key Duration Drivers	Lessons Learned
1	Toll viability study				
2	Prepare request for qualifications (RFQ)				
3	Develop and evaluate qualifications				
4	Prepare request for proposals (RFP)				
5	Develop proposals				
6	Evaluate proposals				
7	Negotiation for agreement details				
8	Contract execution				

Activity-level Review

Item	Phase/Activity or Milestone	Actual Duration/ Milestone	Optimal Target Duration	Comments / Key Duration Drivers	Lessons Learned
1	Toll viability study				
1.1	Traffic studies				
1.2	Corridor Analysis				
1.2.1	Preliminary Environmental Analysis				
1.2.2	Preliminary ROW				
1.2.3	Preliminary Utility				
1.3	Preliminary project scope				
1.4	Preliminary Cost Estimate				
1.5	Economic Viability				
2	Prepare request for qualifications (RFQ)				
2.1	Formation of Review Committee				
2.2	Develop RFQ Draft with legal counselor				
2.3	RFQ Draft review and comments				
2.4	Public release of RFQ	(M)			
3	Develop and evaluate qualifications				
3.1	Receive questions and requests for clarification by interested parties; evaluate and provide clarifications by e-mail or telephone				
3.2	Receive RFQ Packages	(M)			
3.3	Evaluate packages				
3.4	Acquire written clarifications from proposers				
3.5	Release shortlist of qualified proposers	(M)			
5	Develop proposals				
5.1	Form ATC evaluation committee				
5.2	Multiple individual meetings with proposers for clarifications and ATC discussion (carried out concurrently to other activities)				
5.3	Receive Alternative Technical Concepts (ATCs), additive or deductive				
5.4	Receive final request for clarifications from proposers;				
5.5	Receive Value-added ATC Prices (confidential)				
5.6	Evaluate and approve pre-proposal ATCs				
5.7	Reissue RFP in corrective format				

5.8	Final one-on-one meetings with Proposers as deadline for comments and changes	(M)			
5.9	Issue late addenda (if applicable)				
5.10	Receive proposals	(M)			
6	Evaluate proposals				
6.1	TxDOT separates the Proposals into a Price Proposal and a Development and Maintenance Proposal				
6.2	Pass/Fail Assessment				
6.3	Require clarification or additional information from or disqualify Proposers				
6.4	(1) Price Subcommittee assesses Price Responsiveness and Configuration Evaluation; (2) Review and Recommendation to Price Evaluation Committee (PEC); (3) PEC review Base Proposals for Responsiveness and submits results to Director				
6.5	(1) Technical Subcommittee assesses Development and Maintenance Responsiveness Evaluation; (2) Review and Recommendation to Evaluation and Selection Recommendation Committee (ESRC); (3) ESRC review Base Proposals for Responsiveness.				
6.6	Final request for Proposals Clarifications	(M)			
6.7	District Engineer merges technical and price scores, determines the Best Value Proposal and makes recommendation to Administration;				
6.8	Administration selects a proposal for negotiation	(M)			
7	Negotiation for agreement details				
7.1	Share ATCs from unsuccessful proposers				
7.2	Negotiate post-proposals ATCs to be included in Final Price				
7.3	Negotiating Final Price with ATCs changes				
8	Contract execution				
8.1	CDA signatures from both parties	(M)			
8.2	Triggering financing flow				

	(applicable only if bond financed)				
8.3	Finalize details of agreement with Developer				
8.4	Start-up the partnering process				

A.2. INTERVIEW GUIDE ON CONTRACT ADMINISTRATION PHASE

Research Background: This interview is related to an ongoing research project that the Center for Transportation Research / University of Texas at Austin is conducting on behalf of TxDOT.

Interview Purpose: Gather information about the CDA process with focus on organizational structures and communication flows.

Information Use:

- Document and analyze SH-130 organizational and communication structures,
- Track associated lessons learned.

Interview Outline:

- First, focus on significant differences in how key organizations have structured their organizations for this CDA contract in contrast to traditional DB-B projects.
- Second, examine the unique relationship between owner (TxDOT) and program manager (HDR).
- Finally, look at communication flows between elements of the project team.

Interviewee Anonymity:

The following conditions will be maintained:

- The text and/or recording of this interview will not be placed in any permanent record, and will be destroyed when no longer needed by the researchers.
- The identity of the interviewee will remain anonymous, and any and all information obtained in the course of this interview will not be linked in any way to participant names.

Permission to Audiotape Interview: We want to be sure that our report is as accurate as possible. With your permission, we would like to audiotape this interview; this allows us more time for dialogue and minimizes the time required for written notes. Therefore, I would like to ask your permission to tape-record this interview. You can choose to discontinue the tape-recording at any time during this interview, and/or to request that portions of it not be used in any way. The tape will be completely erased once it serves the interviewer's purposes. Your identity will remain anonymous.

Interview Information:

Topic: Interview on Procurement of SH-130 and SH-45SE Contracts	Research Project: TxDOT Project 0-4661 Monitoring and evaluation of SH130 Project
Type: Interview appointment	Expected Duration: 1 Hour
Date: 05/21/2004	Place: Austin District
Location: Austin, Tx	Participants: Interviewee: XXXXX Interviewer: Giovanni Migliaccio

Interview Questions:

- Significant Organizational Differences
  - TxDOT: Owner
    - What are some very significant differences from traditional DBB projects in how the TxDOT is organized for this CDA contract (compared to other traditional turnpike projects)?
    - How/why has each difference been significant?
    - Regarding TxDOT's organizational structure, what specifically would you do differently on the next CDA?
      - Any area where overstaffing was a problem?
      - Any area where understaffing was a problem?
      - Any critical role/responsibility not well defined or understood?
  - HDR: Program Manager (PM)
    - What are some very significant differences from traditional DBB projects in how the PM is organized for this CDA contract (compared to other traditional turnpike projects)?

        - How/why has each difference been significant?
        - Regarding HDR's organizational structure, what specifically would you do differently on the next CDA?
            - Any area where overstaffing was a problem?
            - Any area where understaffing was a problem?
            - Any critical role/responsibility not well defined or understood?
    - LSI: Developer
        - What are some very significant differences from traditional DBB projects in how the Developer is organized for this CDA contract (compared to other traditional turnpike projects)?
        - How/why has each difference been significant?
        - Regarding LSI's organizational structure, what specifically would you do differently for the next CDA?
            - Any area where overstaffing was a problem?
            - Any area where understaffing was a problem?
            - Any critical role/responsibility not well defined or understood?
- Program Manager (HDR) – TxDOT Relationship
    - Any lesson learned thus far in setting up/operating under this relationship?
        - Misallocation of duties?
        - Compatibility of operating procedures/systems?
        - Sufficiency of staff?
    - What would you do differently on the next CDA?
- Communication Flows
    - Where/in what way have project team communications been most challenged?

- How significant has colocation between TxDOT, HDR, and LSI been in achieving effective communication? If possible, please describe some specific examples.
- Has short-circuiting of communications between TxDOT/HDR and LSI subcontractors been problematic?
- Have there been any unique aspects of communications notably successful for this CDA?
  - Any notable communication successes or lessons learned in the design area?
  - Any notable communication successes or lessons learned in the ROW area?
  - Any notable communication successes or lessons learned in the utility relocation area?
  - Any notable communication successes or lessons learned in other project processes?

A.3. ORGANIZATIONAL CHARTS FOR SH-130 TEAM

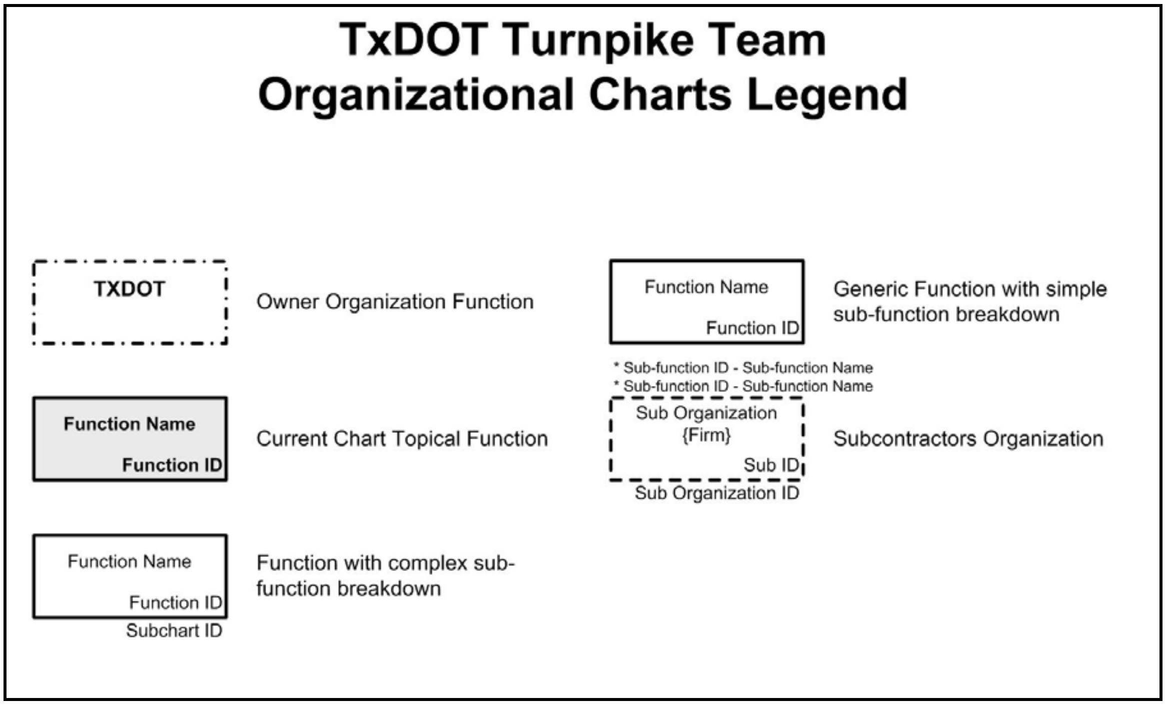

Figure A.3.1. TxDOT Turnpike Team Legend.

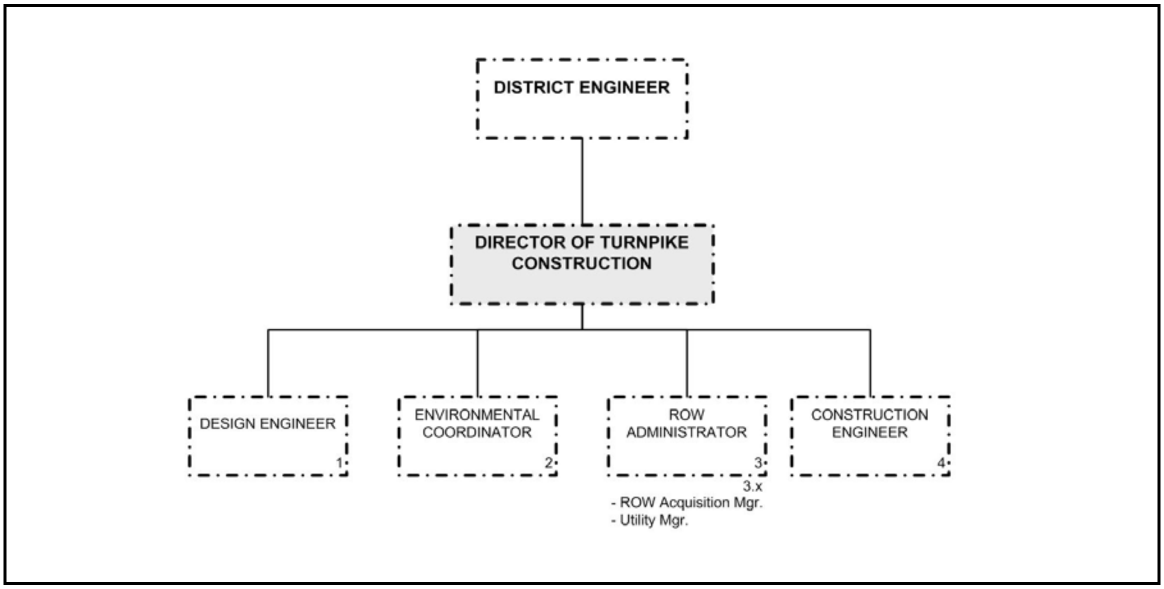

Figure A.3.2. TxDOT Turnpike Team Organizational Chart.

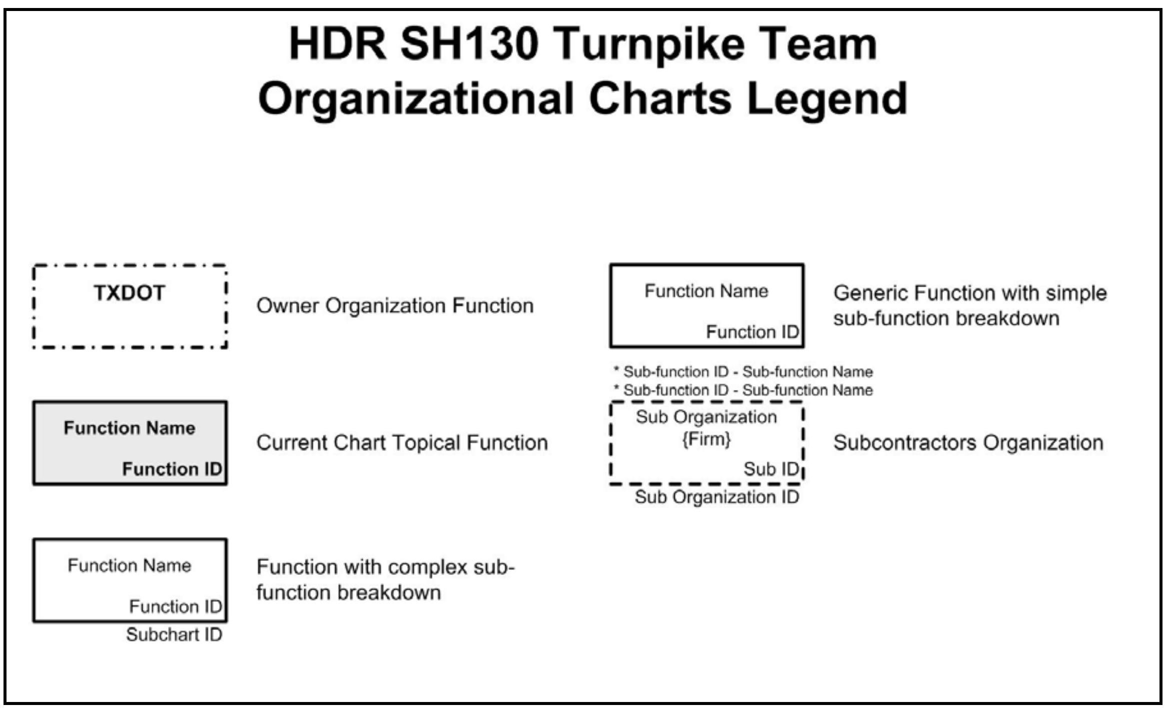

Figure A.3.3 HDR SH-130 Team Organizational Chart Legend.

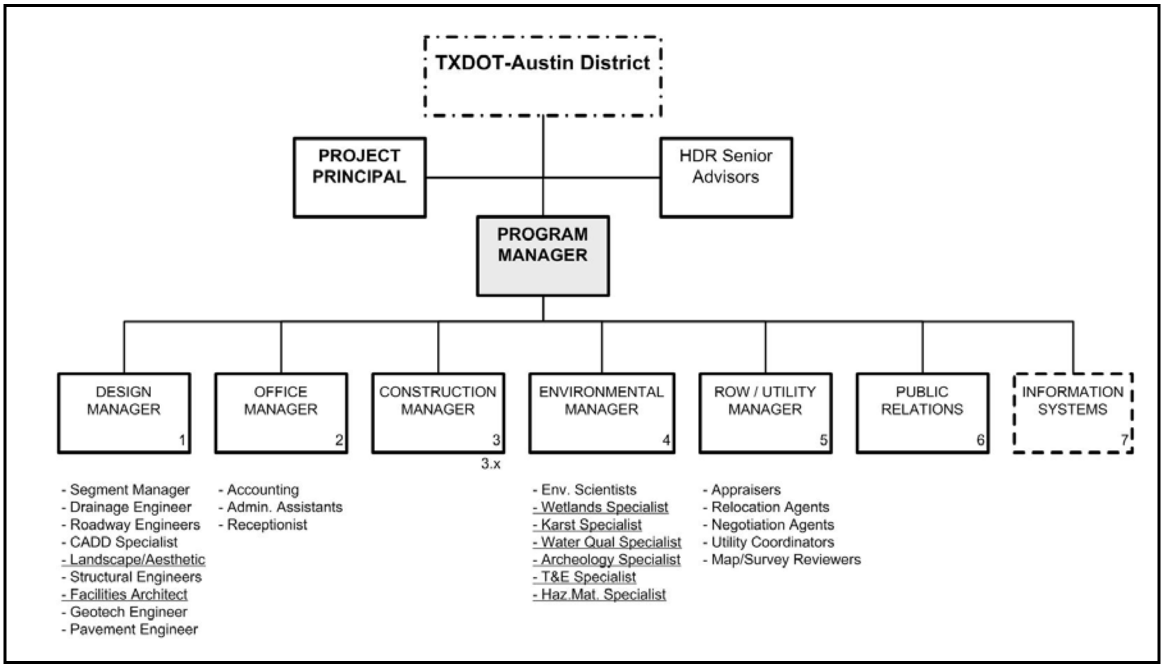

Figure A.3.4 HDR SH-130 Team Organizational Chart.

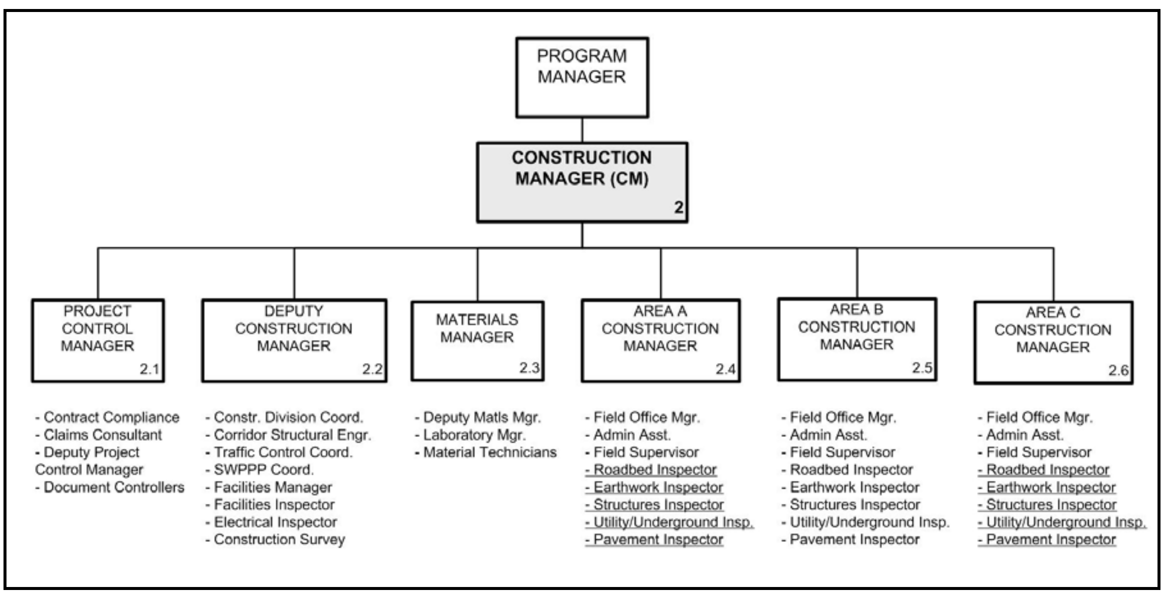

Figure A.3.5 HDR SH-130 Construction Team Organizational Chart.

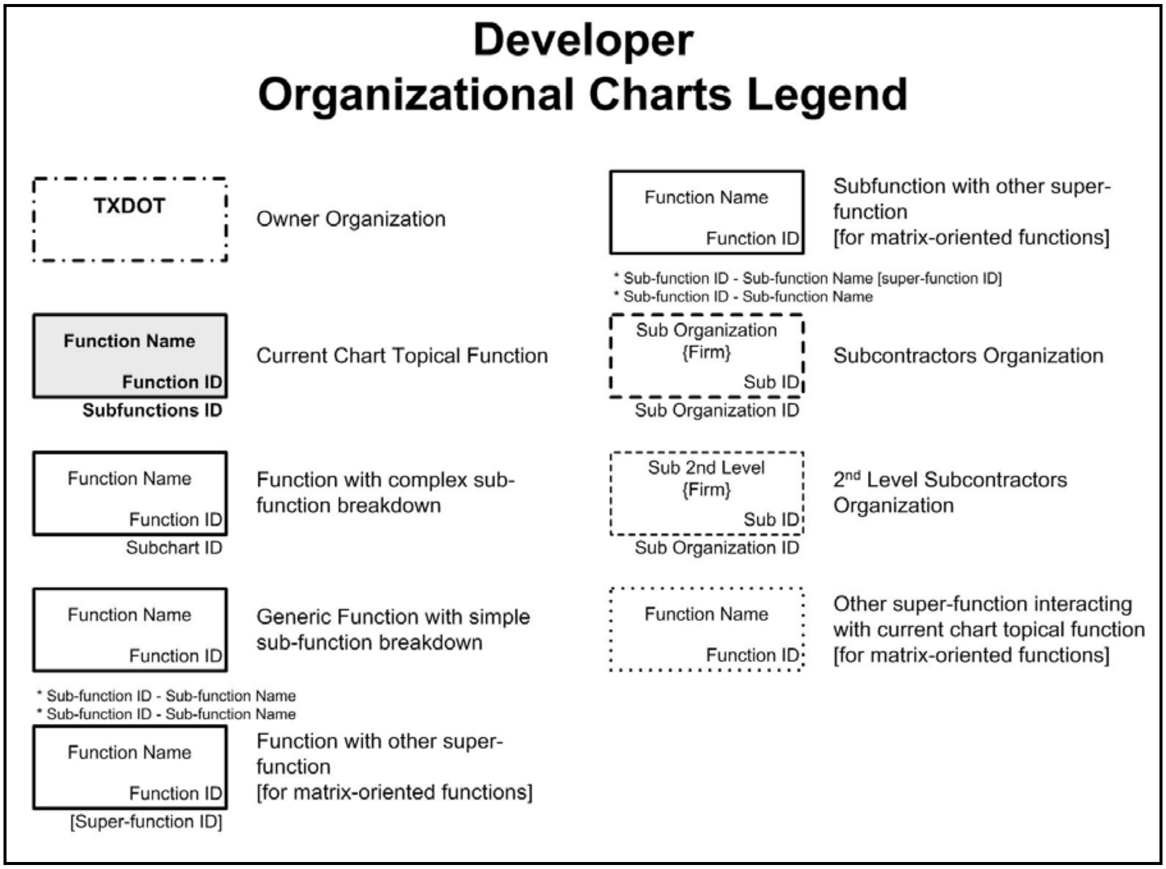

Figure A.3.6 LSI Team Organizational Chart Legend.

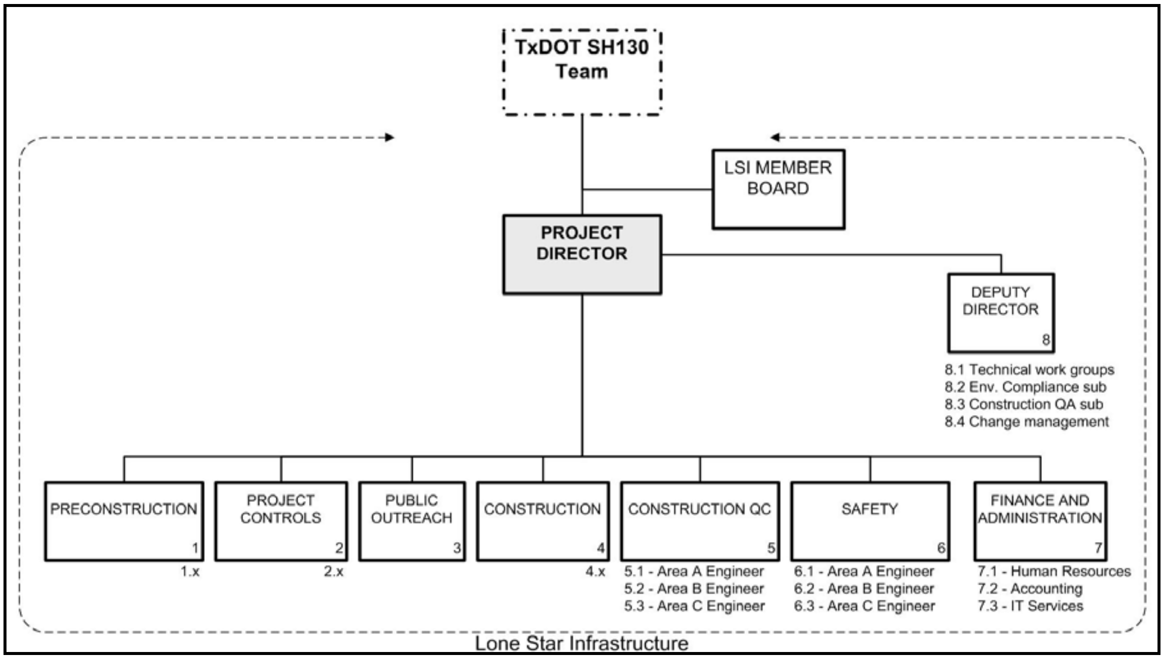

Figure A.3.7. LSI Team Organizational Chart.

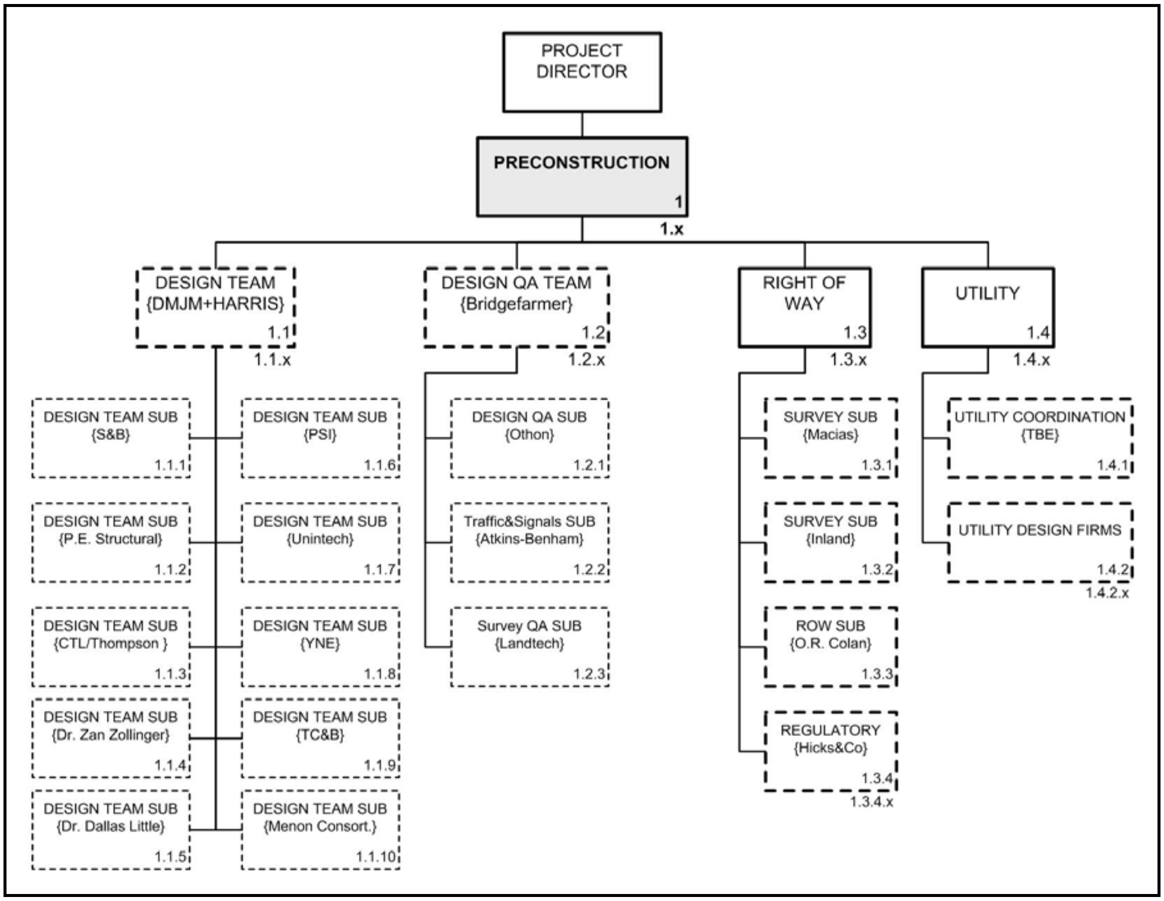

Figure A.3.8. LSI Preconstruction Team Organizational Chart.

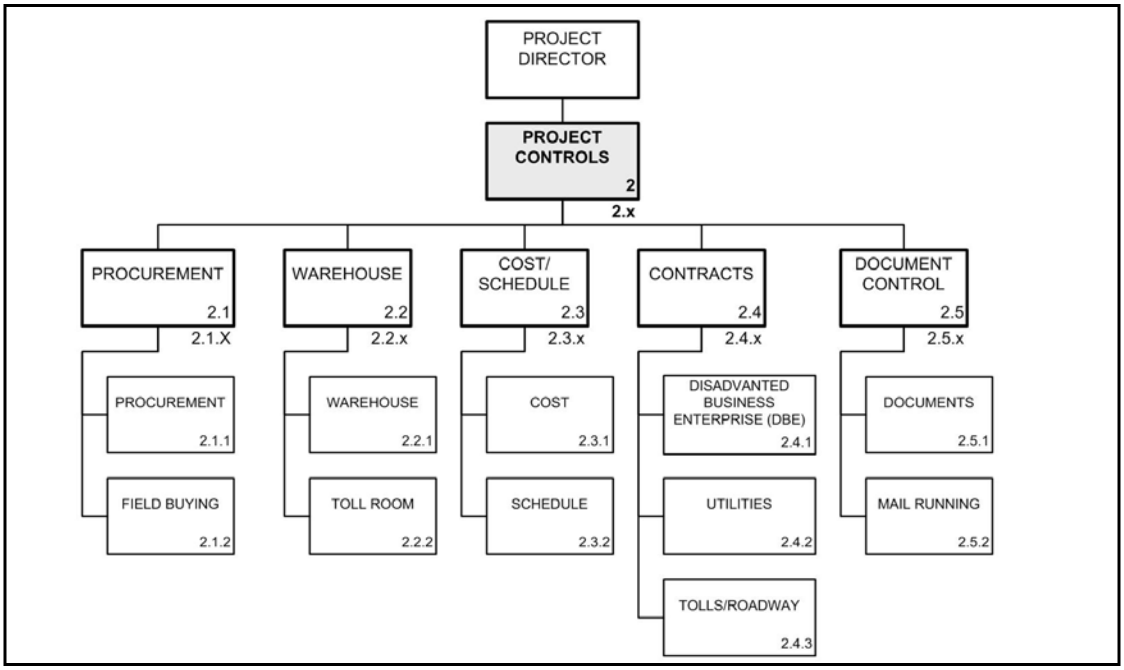

Figure A.3.9. LSI Project Controls Team Organizational Chart.

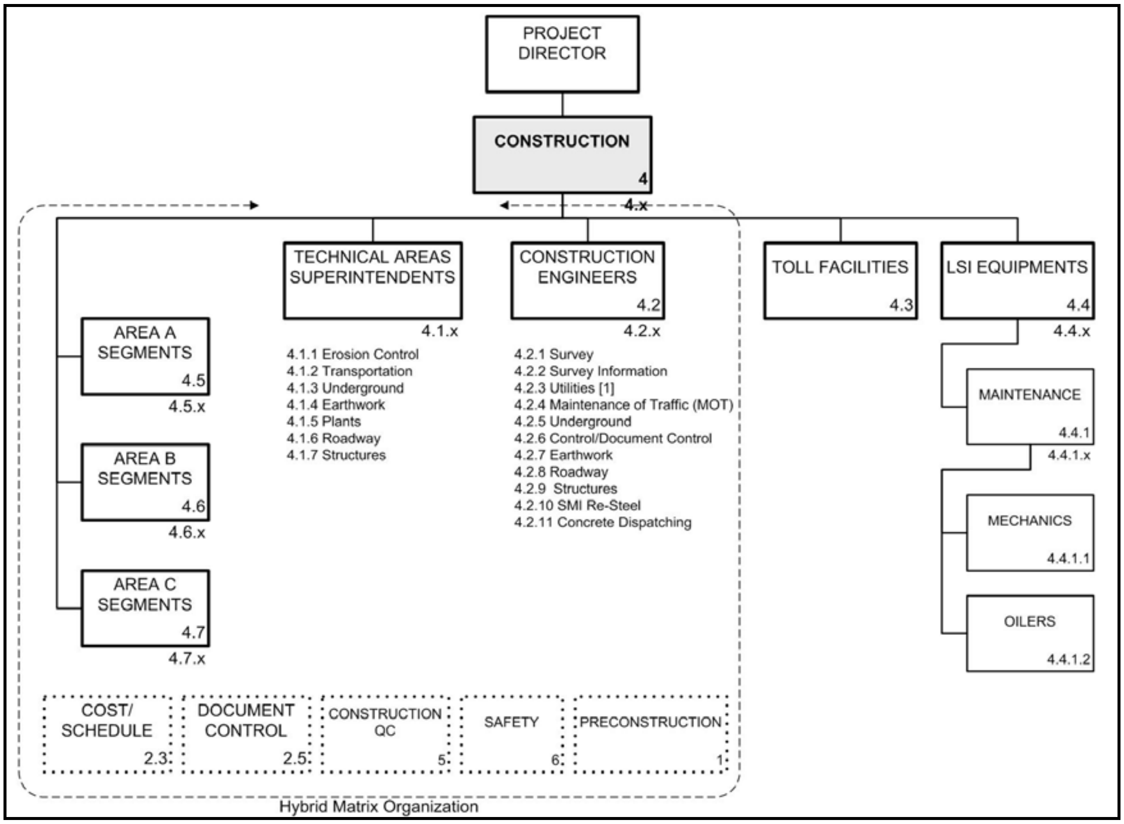

Figure A.3.10. LSI Construction Team Organizational Chart.

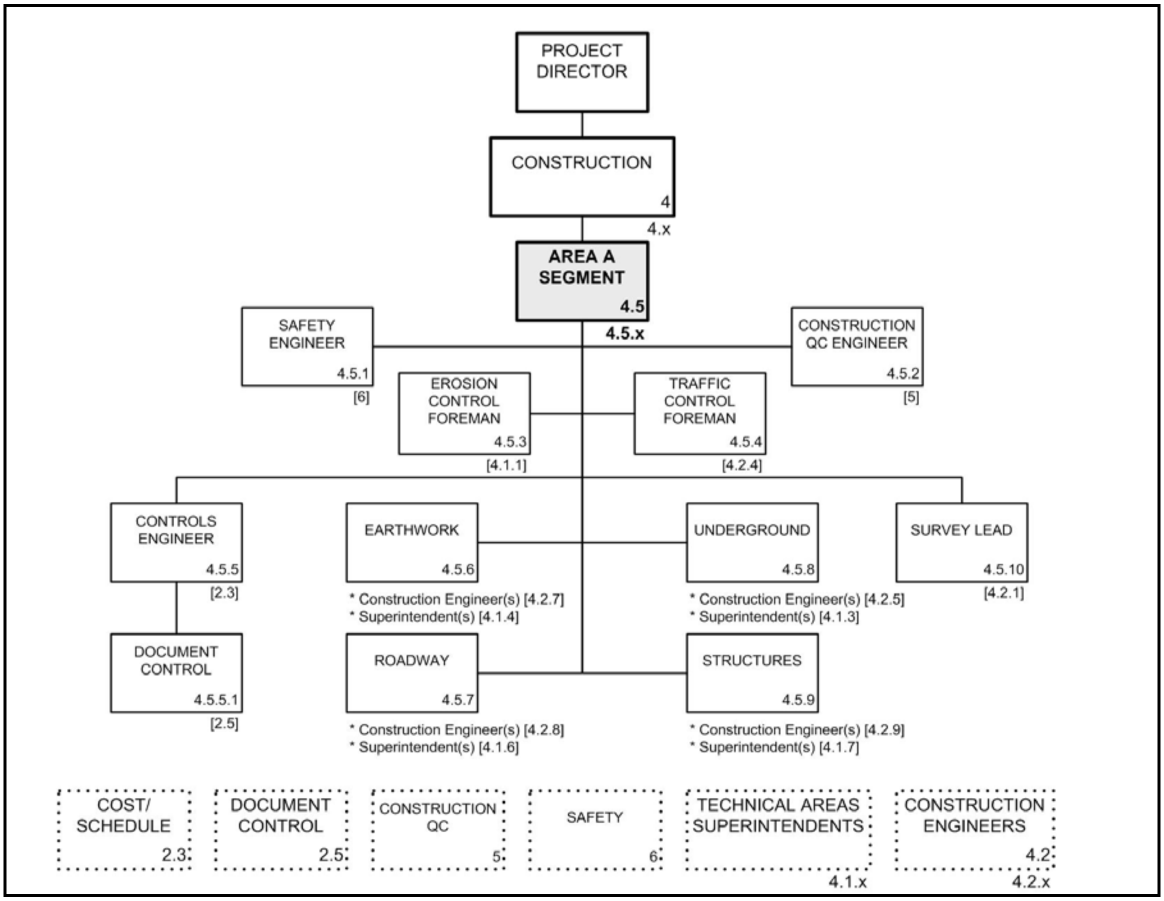

Figure A.3.11. LSI Area Segment Construction Team Organizational Chart.

A.4. COMMENTS ON PROJECT ORGANIZATION

This appendix includes comments pertaining to one of the three primary organizations participating in the project: (a) TxDOT, (b) the PM (HDR), and (c) the Developer (LSI). In the discussion, the terms "Owner('s) team" and "turnpike team('s)" are used to mean the joint TxDOT-HDR staff on the SH-130 project. Findings are grouped in Sections a, b, and c by project organization rather than necessarily by source of the comment. These findings, resulting from interviews with project representatives, are categorized and grouped in five sections as follows:

- Section (a, b or c).1 – General Comments
- Section (a, b or c).2 – Comments Pertaining to the Design Function
- Section (a, b or c).3 – Comments Pertaining to the Environmental Function
- Section (a, b or c).4 – Comments Pertaining to ROW/Utilities Function
- Section (a, b or c).5 – Comments Pertaining to Construction/Project Control Function

Each of these sections is further subdivided according to two subheadings:

- ❖ Role and responsibilities
- ❖ Team staffing (size, characteristics, selection, and management)

For convenience, these observations are tagged by a two-number identifier [x.x] that allows one to locate the observation in the interview transcripts. The first number identifies the interviewee and the second the position within the transcript.

a. Comments Pertaining to TxDOT Turnpike Team Organization

As mentioned before, the TxDOT staff on the CTTS project includes the director of turnpike construction and a small number of additional TxDOT employees. This team includes personnel from various areas of expertise as required for oversight of highway-execution operations, including ROW, utility relocation, design, environmental, and construction activities, as well as TxDOT employees supporting the project in accountability and managerial activities. A basic organizational chart representing the TxDOT turnpike team is included in this Appendix. Comments presented in this section pertain to the TxDOT team organization and were derived from a wide variety of sources.

a.1 General Comments

Role and Responsibilities

[5.1] CDA-DB projects need a joint collaborative effort between both Owner and Developer. TxDOT is approaching DB for the first time, and they are still tied to the old-fashioned DBB approach. The role of the PM is to bring additional expertise from all fields (design, ROW, etc.) into the management of DB projects.

[1.1] TxDOT had a significant role in shaping the PM's organizational structure by making clear its needs and expectations in this regard. The goal of HDR in staffing its team was to select and propose individuals that meet TxDOT declared expectations.

[12.1] Based on his own experience with DB, an interviewee believes that in order to benefit most from the new environment, the Owner's team should have a very small organization. It should pass most responsibilities down to the contractor, who has to get things done and is liable for the final product. The Owner's team role should be restricted to oversight activities that are sufficient to ensure that the contractor is meeting all requirements. Yet, while the Owner's team, HDR, and TxDOT are "embracing the contractor, they are still trying to perform their traditional [role as] inspectors."

[1.4] Design manuals create a challenge in the management of DB projects as compared with traditional DBB projects. Traditionally, the existing design manuals were written for a general engineering audience that could apply them anywhere in the U.S. by exercising professional judgment. Moreover, these manuals have many gray areas where engineering judgment comes into play. Conversely, because in DB projects the private party's bottom line comes into play in the design phase, the presence of these gray areas can make the relationship between Owner and Developer adversarial. To address this challenge, the Owner's team decided to partner with the Developer by giving the Developer guidelines on how TxDOT has interpreted these gray areas in the past.

[4.1] One significant difference between this CDA and traditional DBB is the construction work pace. Because the SH-130 is a rapidly paced job, there is no time for TxDOT to review Developer-executed work, so TxDOT and the PM must act quickly on their own.

[8.1] In CDA projects, TxDOT personnel should be available to the project for decision-making purposes. TxDOT personnel should make decisions on time with the benefit of information gathered by the PM. Although TxDOT should give some decision-making authority to the PM, "TxDOT should not let the consultant make decisions that could cost TxDOT money. TxDOT should [also] not let the consultant make decisions that have implications for the contract."

[9.2] The most critical responsibility of TxDOT staff is to make the final decision pertaining to any issue and "stand with it." Because of the complexity of this project, TxDOT personnel have to make frequent decisions in this CDA. Therefore, they need very qualified and experienced individuals.

[12.7] Developer staff has trouble understanding the different roles of TxDOT and PM project staff. Initially, they expected to deal with the PM as owner representative on the project. However, the significant presence of TxDOT staff on the project made the source of authority unclear. This ambiguity of roles is heightened on the ROW/utility and environmental side of the Owner's team: "More on the ROW and utility side and environmental side, we basically saw two different organizations that were nearly [mirror] images of [each other]. You have a Program Manager and you have TxDOT, and instead of dealing with one, the Program Manager, we ended [up dealing] with

TxDOT. [Essentially] we had to deal with both of them. So now we are talking with more people, there are more people we have to satisfy going into the process, there are more people feeding information back to me, contradicting each other, that we have to resolve. I would [prefer that] the Program Manager be our primary point of communication in order to communicate [about] what the client needs or to perform reviews and to advise the client, TxDOT, if we are doing satisfactory [work] or not. But, we do not have that; we have two fronts coming in."

[12.2] TxDOT and HDR have an overlap in their organizations. For example, HDR has assigned an area segment manager to oversee the segments, but TxDOT has also a corresponding manager at that level. Therefore, LSI personnel have to communicate with both TxDOT and HDR counterparts when there is an issue at segment level.

Team Staffing

[1.2] The turnpike team, also known as the Owner's team, includes TxDOT and the PM's staff. The TxDOT component on the turnpike team is composed of about fourteen people. Six or seven staff members work on the SH-130 project.

[5.2] An interviewee pointed out that TxDOT personnel are used to the DBB approach, and they need to be more open-minded and flexible in their approach to DB projects. Thus, TxDOT management must consider personal attitudes toward flexible work environments during team personnel selection.

[12.4] Another interviewee suggested that the Owner should select personnel with DB experience because the transition to DB procurement is not easy for traditional TxDOT employees who feel they are losing control of the process to which they are accustomed. This lack of control makes Owner representatives uncomfortable about the new process.

[3.2] One interviewee believes that the TxDOT component of the Owner's team on the SH-130 project is understaffed. The entire Owner team, including consultants, is not overstaffed and is well balanced. He thinks that more TxDOT people in every discipline, such as on the SH 45 SE project, are required to expedite the learning curve of the CDA process within TxDOT. Factors affecting the size of needed TxDOT staff are project size (e.g., cost and road length) and project complexity.

[8.3] Again, another interviewee suggested that a difference between CDA-DB and DBB project management is that TxDOT is lean on staff. He described this situation as follows: "In this CDA, the TxDOT structure has been lean from the start, and they are forced [into] that because they have limitations, FTE limitations. They can put only so many folks on a project and everybody (else) has to come from the consultants." On this project, TxDOT has a staff of six or seven people assigned to design, environmental, ROW/utility, and construction disciplines. Because these people are shared with other traditional projects, they cannot devote all their time to the SH-130 project. Although TxDOT does not necessarily need to assign a person in each discipline on a full time basis, it should have enough people to make decisions that affect financial and public issues. TxDOT needs to assign the staff to full-time or part-time work depending upon the phase of the project. "It is probably more critical to have TxDOT personnel be available early in the project. As the project process and procedures are set up and things become more routine, TxDOT does not need … full time staff in each discipline. So stages of the project are critical." For instance, TxDOT may need less staff on design discipline as the design gets closer to completion. Another characteristic affecting the number of TxDOT staff members is project size.

[3.1] The financial approach adopted for these projects has also changed the process significantly. TxDOT employees on the project feel more responsibility for their work, a sentiment consistent with the amount of interest that is being accrued on the revenue bonds. One interviewee assessed this cost: “Three dollars per second is what we are paying in interest on all our bonds." This reality places greater pressure on TxDOT staff and requires that they be flexible and able to multi-task in response to the needs of the Developer. The same interviewee explained that staff members need to “learn how to pick [their] battles,” meaning that they need to maximize their flexibility toward the Developer. He added that early on, “a lot of people were just hardliners: ‘That is the way it has always been, and that is way it always is going to be,’” implying that these staff members had to change that approach in order to meet schedule requirements.

a.2 Comments Pertaining to Design Function

Role and Responsibilities

[4.3] An interviewee described the shift of responsibilities from the Owner to the Developer as follows: “The biggest difference I have seen between traditional design-bid-build projects and this CDA is [the] fact [that] the Developer has liability for the design.” In traditional projects, the Owner has more liability with respect to design errors. In fact, in case of design mistakes, TxDOT is responsible for the cost and time associated with rework activities. TxDOT is also involved in disputes with the contractor on design issues on DBB projects. Conversely, in this CDA, the liability for design is shifted to the Developer, who has to revise the design without cost to or schedule impact on the Owner. However, TxDOT personnel have only 24 hours to approve or reject the Developer’s design.

[12.5] Traditionally, designers are accustomed to “honoring” the Owner by accommodating the Owner’s desires, and that work is done on a time-reimbursable basis. At the same time, TxDOT is accustomed to directing designers. The DB environment makes it challenging to these project parties (owner and designers) to realign their behaviors. The Developer needs to establish its role by understanding the ground rules under which TxDOT and designers can communicate directly, but TxDOT cannot direct design activities. Because the project is now based on a lump sum amount, the Developer must adhere to the minimum requirements used during the bid phase and that are included in the contract. If the Owner wants to increase these minimum requirements, a change order must be issued. LSI's approach to this issue was to educate its designers on the minimum requirements on which the bid relied. Designers were allowed to coordinate directly with TxDOT to ensure that there was no conflict on the designed facility. "We have to educate our designers that [their] responsibility is to design to the minimum criteria … to coordinate with TxDOT and ensure that there [are] not conflicts, that [they] are providing what [TxDOT] wants. However, if [TxDOT] desires something beyond the minimum, identify it so we can inform TxDOT that we can provide that … but that it is an extra to the contract, and [that they will] have to pay more to resolve it."

Team Staffing

[1.5] The function of SH-130 design manager within the TxDOT team was filled by four different individuals along the project's life.

[5.3] The interviewee suggested that for a project on the scale of SH-130, TxDOT would need a design manager totally dedicated to the project until about 80 percent of design is completed. After that, the design manager can be shared with other projects.

[9.4] According an interviewee, at the time of the interview (Spring 2005), the TxDOT team is definitely understaffed. In projects such as SH-130, TxDOT needs to have some experienced employees who are available all the time for decision making regarding design. There are a few reasons for this need. First, TxDOT is accountable for delays to the developer's schedule, so its staff should guarantee a quick turnaround. Second, because there are several ways of interpreting the roadway design manual, TxDOT staff needs to be experienced enough to stand on the decisions it makes, otherwise problems will arise for any Developer who moves very quickly in the field on this type of project.

a.3 Comments Pertaining to Environmental Function

Role and Responsibilities

[10.1] According to the CDA contract, the Developer is responsible for the environmental work from permitting to compliance, and TxDOT is supposed to perform only the oversight role. However, TxDOT later realized that its name would be on the 404 permit that the Developer was seeking from the U.S. Corps of Engineers. Therefore, TxDOT changed the original plan and took back the 404 permit responsibility in spite of the contract's clear specification that the 404 permit was the Developer's responsibility. However, TxDOT left the management of that permit to the Developer.

Team Staffing

[3.4] An interviewee stated that a project the size of SH-130 would require a TxDOT employee totally dedicated to environmental requirements and procedures. This statement was echoed by other interviewees.

[10.2] The TxDOT environmental project coordinator is also responsible for all Austin district turnpike projects. TxDOT relies on the PM for additional environmental tasks, a reliance not possible on traditional DBB projects. However, considering the size of SH-130, TxDOT needs a person totally dedicated to the SH-130 project.

[7.3] For the SH-130 project, TxDOT has dedicated little staff to the environmental function. TxDOT has one person who interacts with the Developer through the PM's staff, whereas this same person must interact directly with the contractor and make visits to the field in other traditional turnpike projects. However, given that the PM acts as an extension of TxDOT, the total environmental function is sufficiently staffed.

a.4 Comments Pertaining to ROW/Utilities Function

Role and Responsibilities

[2.1] An interviewee illustrated the innovative way work allocation is structured between the two components of the ROW Owner team: "One of the ways [that] is significantly different … is how those two components (HDR and TxDOT) work together to provide for the paperwork flow, the approval processes, [and] maintain the checks and balances that are necessary to assure compliance." The way the ROW and construction schedules interact with each other is another fundamental difference between CDA and traditional projects. The construction work is broken down into parcel-related units. Therefore, it is common that construction teams wait for every ROW property to be acquired, and sometimes bulldozers start moving dirt the day after a parcel is delivered to construction. The ROW Owner team has 10 days to review an acquisition package for a parcel and either approves it, rejects it, or asks for corrections. In case of delays to this agreed schedule, the Developer can potentially hold that delay against TxDOT later in the situation of liquidated damages. Consequently, the people on the ROW team must work very closely with one another, differently from any "other projects [TxDOT] ever has to deal with." Another issue associated with the process pace is that ROW staff demonstrates more sensitivity to costs associated with the duration of the review activities relative to traditional projects. As a result, the turnaround of ROW documentation is faster in turnpike (CDA and DBB) projects than in other DBB projects.

[2.4] The ROW staff must be very responsive to the CDA Developer in order to allow for the above-mentioned turnaround of documents, even though it is still important to follow both federal and state rules and regulations. However, no matter how much pressure the ROW component is under, it is always better to perform the task correctly the first time because there is not enough time for rework. Therefore, good quality contributes to staying on schedule by ensuring that the process operates efficiently. This balancing act between quality and schedule is especially required in performing ROW activities, where most of the documents are built upon other documents. One interviewee describes the ROW process as an overlapping stream of activities: "We take a design, and on the design we build our ROW map; on the ROW map we build the parcel sketch; on the parcel sketch we get a title report, we get an appraisal report on that." If some of the initial documents present irregularities, the documents generated from them would need to be fixed. Therefore, ROW management put much effort in the front end to make sure that these ROW documents—parcel plats, sketches, and ROW maps—are done and done well the first time.

[2.5] The ROW process schedule was built according to the principle of allocating durations to work units in order to define a schedule at the task level. The compatibility of this schedule to the larger project schedule was also verified. That means that the duration for the ROW work units was calculated according to the duration needed for the completion of every task.

[6.1] One problem regarding ROW activities is the amount of control exercised by TxDOT. An interviewee said that they should delegate to the Program Manager more authority for ROW activities and avoid being too detailed. For many activities, TxDOT wants to have the last word on the PM's decisions. Organizing a pre-project workshop between TxDOT and the PM would help them to set the process up together. It would also help in deciding which activity must be done by TxDOT and which can be delegated to the PM's staff. This allocation of duties must take into consideration legal requirements, as well as availability of staff. As a result, tasks that do not need detailed oversight by TxDOT would be identified.

[12.8] A situation of having an unclear point of contact happens in ROW, where the Developer performs the process and is in charge of making the offer on behalf of the state. However, Developer representatives cannot get to that stage (the offer) before TxDOT performs a very detailed review of their package and eventually requests a re-submittal. Even taking into consideration the interest TxDOT has in controlling ROW acquisition expenses, the interviewee believes that they have infringed on the Developer's contractually-stipulated independence.

[12.9] On the issue of utility acquisition, the interviewee noted the inability to meet with the utility owners "without TxDOT being invited to the meetings and being present in the meetings." The Developer "gets chastised if TxDOT is not invited, if it is not seated at the meeting," even meetings scheduled to coordinate small issues.

[12.11]From the TxDOT side, the interviewee believes that there is a need to "embrace the EDA process [and] embrace the DB process." However, there is a reluctance to embrace it within TxDOT whose personnel is very concerned, and is not used to it, "so in order to offset that nervousness they added additional staff, additional oversight … to make sure that they are watching the contractor. They are doing it more closely than they should do for this type of contract." In identifying areas of major concern, the interviewee stated, "ROW, they probably have the hardest [time]. Construction is pretty close, but ROW had the hardest time with the concept that it is the contractor's responsibility to perform a task that TxDOT has historically performed. They have done it through consultants to help supplement them, they have hired appraisers, they have hired other consultants to supplement their staff, but they were always in charge of the strategy, of the approaches to ROW acquisition, and under the EDA they are not."

Team Staffing

[6.3] Initially, the TxDOT ROW manager was the only individual with authority for signing documents, but later another TxDOT ROW employee was authorized to sign some documentation acting as deputy manager. After the ROW manager became ROW manager of the Austin district, he trained his acting deputy and another employee for ROW management functions. In the future, the acting deputy will take care of SH 45 SE ROW, and it is likely that the other TxDOT employee will take ROW duties on SH-130. The interviewee did not know yet if the ROW manager would keep the authority of signing documents and checks for payment. He thinks that they need a person dedicated to this function for a project of this size.

[2.10] On the SH-130 project, TxDOT staffed the ROW department differently than on traditional projects. The CDA process pace requires a very well trained, highly responsive staff who can be involved in the process activities as soon as he or she gets onboard. This necessity of having a highly trained and responsive staff is motivated by the fact that TxDOT has a fixed duration of 10 days for its review activities on Developer-produced ROW documentation. This documentation package, also known as the acquisition package, contains descriptions of real estate parcels that must be acquired for the project. This package of about 300 pages includes survey documents, appraisal documents, an offer letter, environmental documents, title instruments, ownership research, a ROW map, a parcel plat, and a field note description. One of the only ways to meet this schedule requirement is on a consultant basis, which allows the best people to be brought in. For instance, in the SH-130 project, ROW management (TxDOT and HDR) brought in a handpicked team that had the expertise, training, and background needed for the SH-130 project characteristics. Turnpike team staffing presented a few innovations in the hiring process. First, the way management was able to select and mobilize that group ensured confidence that the characteristics of each member of the team would be compatible. Second, ROW management was also able to achieve a high level of flexibility in terms of resources allocated to the project. This type of flexibility was evident in two cases. In the first case, during the earlier phases of the project, there was a need for extra survey technicians who were brought in by the PM then released as soon as their work was completed. In the second case, later in the project life, when the project was obligated to get right of entry on the properties, a group of ROW agents was selected and trained according to TxDOT procedures. Each agent then received a number of properties with the prospect of getting more assignments as soon as the initial assignment was completed.

a.5 Comments Pertaining to Construction / Project Controls Function

Role and Responsibilities

[4.4] In traditional projects, TxDOT inspectors may stop the construction work and withhold payment on completed work if it is not meeting specifications. In this CDA, the liability lies with the Developer, so TxDOT staff cannot stop the construction work instantaneously or withhold payment if the Developer does not meet the specifications. However, TxDOT can “flag” it by issuing a nonconformance report (NCR). Subsequently, the Developer’s engineer can re-evaluate the design under the actual conditions and submit a justification, if any, explaining how the actual product still meets design parameters. If not, the Developer has the opportunity to come up with alternate solutions before further work is carried out. If the justification or alternative satisfies TxDOT, it can be approved. Otherwise, TxDOT will reject it, and the Developer must replace the work performed. “We have actually removed a couple of beams and columns out here [that were made] with inferior quality of work.”

[4.7] However, to maintain the process pace, the Owner’s construction inspectors have to decide very quickly on project problems. Otherwise, the Developer can shift the risk of delaying the project to TxDOT. This is very critical issue in this CDA.

[4.8] In a traditional DBB job, if TxDOT wants a contractor to produce an alternative, the contractor must submit a signed and sealed engineered submittal. TxDOT then reviews it, and it will take three to four weeks to reach a decision. However, in this CDA, TxDOT cannot affect the schedule of the Developer because the Developer bears the risk of the schedule. Consequently, TxDOT should act efficiently and quickly.

[4.9] “I agree basically with this CDA [because] the way it is set up [allows TxDOT staff not to be] paper pushers.” There is not too much paperwork involved in this CDA for TxDOT personnel because TxDOT does not have to track work by quantity. In traditional projects, there is a lot of paperwork involved because construction inspectors are required to keep track of all work done by the Developer. One interviewee said that this approach makes the CDA a much easier system to manage.

[4.5] This project’s incorporation of an independent quality assurance firm is another way a CDA project differs from a traditional DBB project. In traditional projects, TxDOT staff is used to verify the quality of all construction work, as well as track the quantity of the Developer’s work. In this CDA, the quality is verified by the CQAF. TxDOT staff from the construction division maintains the records. These records are regularly audited to ensure that testing frequency is performed according to TxDOT requirements.

[11.1] An interviewee noted that TxDOT staff responsibility should be reduced because TxDOT already bears too much for this type of project. TxDOT staff should be limited to auditing the project and spot checking some of the construction work on the site. TxDOT staff should transfer all the risk and authority to the Developer to build the road and should only dictate what the end product will be.

[11.2] For this project, TxDOT has fewer staff members than it would for a traditional project, but it should have even fewer than are on the existing staff. Under a CDA, TxDOT should not be involved in day-to-day activities. TxDOT staff should act in a similar capacity as a Federal Highway Administration (FHWA) representative on traditional projects because in this project the Developer bears all the risks and has the responsibility of delivering the project. TxDOT should only make sure that the Developer is performing the work according to the contract. In this project, there is lot of involvement from the TxDOT side.

[12.13] Hypothetically, the role of HDR as PM is to support TxDOT staff. However, TxDOT has not embraced the concept of having a PM. As a result, TxDOT staff within the project has grown, especially on "the construction oversight side. TxDOT has brought in more of their people to oversee the work, which has basically doubled some responsibilities out there." This situation has become problematic for the Developer segment managers who need to make a coordination effort with both TxDOT and HDR staff at segment levels to resolve issues. Moreover, these two Owner representatives (TxDOT and HDR) often have different opinions on the same issue.

[12.14] The interviewee compared his experience on the SH-130 project with another DB project out-of-state where the Owner delegated oversight activities to a PM. In that project, the PM had misunderstood the allocation of quality assurance (QA) to the contractor and was self-performing an excessive part of QA activities. In the SH-130 project, the impact of the Owner's team on contractor operations is more considerable because of the double interface that the Developer's field personnel have in the TxDOT and HDR staffs. He believes that Owner team organization presents too many layers and has an unclear allocation of responsibilities.

Team Staffing

[12.17] A problem for construction team staffing is that for a CDA-DB contract a totally different management approach is required from the one used by TxDOT for decades. Consequently, it is difficult to shift a traditional TxDOT employee to the new approach when he or she is not the frontline manager but the oversight manager of a consultant.

[3.5] In the earlier phases of the project, there was a need to have more TxDOT construction personnel involved in order to support the learning curve of out-of-state consultants within the PM's group. "There is definitely a need to have more TxDOT construction people involved because [from] early on that has been a problem. A lot of HDR were coming down from Nevada, California, or somewhere else, and they did not know TxDOT specifications as far [as] construction was concerned. And so when they came down here, there was a learning curve for them, and [it] would definitely have helped to have had more TxDOT construction people."

[4.10] In traditional projects, TxDOT staffs enough people to perform the testing verification of the contractor in the construction field, but in this CDA, testing verification is not TxDOT's responsibility. The Developer is required to provide enough testing personnel to test the material properly. TxDOT has less staff in this project compared to traditional projects because the PM's staff is filling traditional TxDOT roles. Given the presence of the PM's staff, understaffing for testing verification is not an issue for TxDOT.

[12.18] An interviewee believes that TxDOT is "loose" with respect to project control schedule reporting practices. "Some resident engineers are very familiar with that, require it, and review it, but most will not." Therefore, the interviewee believes that TxDOT requires the support of a PM in order to bring some experience related to the project controls function to the project. This experience is often missing in traditional TxDOT personnel.

b. Comments Pertaining to Program Manager Team Organization

TxDOT hired a program manager (PM), HDR Inc., to support the TxDOT team in overseeing SH-130 project execution. The PM staff consists of a team of consultants that cover oversight activities in each area of project execution. The organization follows a functional repartition by areas of expertise that include design, construction, environmental, ROW/utility, and public relations, as well as two other supporting departments.

Figure B.1 in Appendix B includes a simplified organizational chart for the SH-130 PM. Figure B.2 represents in detail the construction department within the program management staff.

Comments presented in this section pertain to the PM team organization and come from a wide variety of sources.

b.1 General Comments

Role and Responsibilities

[8.2] PM staff works as an extension of TxDOT staff, providing the resources necessary to support TxDOT work. Early in the project, there were some misunderstandings and misallocation of duties. These were eliminated as the project progressed. In this project, "the Owner has full authority and the PM has zero authority." In order to increase the efficiency of the project, TxDOT should give some decision-making authority to PM staff, which will help to speed project progress.

[4.12] The relationship between TxDOT and the PM is good in this project. Every week, TxDOT sits with the PM in meetings to address the problems of the project. In these meetings, TxDOT makes sure that the PM is doing a good job of disseminating and executing TxDOT's desires. "I have nothing bad to say about the Program Manager. I think they have done a very good job."

[4.11] However, the PM had some problem with the Developer in the initial phase of the project. The SH-130 project is different from a traditional project because of the way the PM functions. The Developer (or contractor) always works with the Owner directly on traditional projects. On such projects, the Developer always has a traditional mindset. In this project, the Developer was not initially ready to take direction from the PM. TxDOT had to convince the Developer to accept the PM's authority. After this initial resistance, the Developer started taking direction from the PM.

[1.7] An interviewee recognized that he was initially skeptical about how HDR could benefit TxDOT. "I came here not wanting or not understanding the role that the consultant can do for TxDOT, a little skeptical. HDR changed my mind on that." He was also pleased by the engineering consultant's ethic. He defined the firm as a "project-first" firm because it did not jeopardize the project by adapting project needs to corporate needs. To illustrate his point, he compared the behavior of the current consultant with another firm he had dealt with in the past. During the demobilization of that project team, the firm picked and chose people based on "trying to keep their people in billable positions." HDR has acted differently because "if somebody is right for the position, [he or she] is right for the position, and it does not matter if [he or she] is HDR or one of their subs. They got some of their folks that are subs and some that are HDR employees that are working for them and answering for them. That's [what] I … like to see, a [project-first] partnership like that."

[3.6] An interviewee was concerned that the role of the PM was not well defined regarding its ability to interact with TxDOT divisions or resource agencies. Although this communication is not usually a problem, there is the risk that the PM "may say things [such as] 'We are doing this, we are doing that,' [when what they are doing] is not consistent with TxDOT policies." Although the contract allows HDR to represent TxDOT, HDR cannot act as a TxDOT employee. According to the interviewee, this is not clarified in the contract.

[8.7] In this project, the contractor is spending between $1.5 to $2 million per day. The PM and TxDOT should be more responsive to the Developer. The pace of construction of this project requires a more experienced and responsive staff on the PM and TxDOT teams.

[9.1] TxDOT and the PM have experienced staff in each discipline. Early on in the project, the PM's staff was not empowered to make decisions. This caused much frustration to both PM and Developer staff. Consequently, the interviewee advised that for future CDA-DB projects, a meeting should be organized between project parties. The goal of this meeting would be to decide when the Owner's staff needs to be involved in a decision. However, later in the project, these two entities seem very well integrated.

Team Staffing

[1.3] The largest difference in staffing the Owner's team is having an engineering consultant as a part of the staff. This organization's expertise gives the project a flexibility that would not exist if the project were entirely staffed with traditional state forces. During the initial phases, the Developer assembled a design staff of approximately 200 people to meet requirements dictated by the project's pace and size. The use of an engineering consultant to provide team members on an as-needed basis allowed the Owner to respond to the extensive allocation of human resources put in place by the Developer.

[1.10] The HDR team was staffed with approximately 100 people at peak, including the construction staff. HDR was able to bring in personnel with enough experience to oversee the Developer's highly experienced personnel.

[4.13] An interviewee said that the PM had enough staff. The PM hired experienced and qualified people in this project. They have very good management staff.

[1.9] The PM's team is organized according to a streamlined matrix organization model with at least one segment lead and consultants shared across segments. This organization allows a high level of expertise in every area. Areas of expertise included in every segment are structures, hydraulics, and CAD. This built-in dual capacity of the segment leads has the effect of streamlining the organizational matrix. Since segment leads have strong backgrounds in certain disciplines, they function also as discipline leads.

[1.12] Having an engineering consultant at the project level helps in delivering the expertise needed to the project with a higher flexibility than on traditional projects. In fact, on traditional projects, TxDOT delivers expertise to the projects through divisions that include specialized groups. This expertise is delivered to projects on a case by case basis. However, divisions are Austin-based, so projects based in other areas such as El Paso or Lubbock can usually only access these resources by phone. Conversely, the SH-130 project—and to a lesser extent the whole turnpike environment—has the advantage of having such resources co-located. Moreover, these resources can be managed with more flexibility, making "the organizational structure ... an ever-changing [project environment]." An interviewee summarized the benefits of this approach as follows: "I can see it being very advantageous organizationally to have …your expertise with you rather than [assigned at a distance].”

[5.5] PM consultants require a high level of expertise in order to quickly respond to the Developer’s questions and concerns. Therefore, experience is the overwhelming factor in selecting team members. In traditional projects, HDR functions as engineering consultant in preparing the plans. That means HDR has numerous levels of expertise in the project team (entry, medium, and senior levels). However, in a DB program management role, the team includes only senior engineers able to quickly answer any questions posed by the Developer.

[3.7] An interviewee suggested including the ability to deliver local technical expertise to the projects as a criteria for selecting PMs. For instance, “Say we have a project with a lot of endangered species or karsts species… I would want to see that expertise locally…some wise [expert] that has been doing it for 20 years versus some guy in Oregon …that has to fly down here. That really has not been a big problem, but it has happened in some instances.”

[5.6] The interviewee believes that more people are needed at the segment level within the PM’s staff. The interviewee suggested that the PM’s organizational structure be modified by creating multidisciplinary positions at segment level. As repositories of a wide range of knowledge at the segment level, these people would facilitate communication.

[12.20] An interviewee was disappointed by the lack of experience in DB contracting within the PM’s staff. As a result, the PM’s staff also needed time to get used to the new approach.

b.2 Comments Pertaining to Design Function

Role and Responsibilities

[9.5] In this project, the PM should play the same role that TxDOT plays in traditional projects. The PM should make decisions on day-to-day activities and should be delegated full authority by TxDOT. However, TxDOT is more involved in day-to-day activity.

[8.6] In CDA-DB projects, the Developer owns the plan and is responsible for any error in the design. In DBB projects, plans are owned by the Owner and in case of errors in the plans, the Owner must pay for mitigating those errors. In this project, the PM reviews plans for correctness but what they "are really looking for is contract compliance, not necessarily correctness…therefore, the amount of design review that is incumbent upon the Owner is reduced in design-build projects."

[1.13] Understanding the appropriate level of communication between project parties is difficult because of the project size. Every project party had its own problems with that since the shift to the DB environment makes it difficult to understand new roles. Understanding the role of the PM's staff was challenging for some Developer subcontractors. Initially, the firm providing design quality assurance services to the Developer did not want to communicate to the Owner through the program management team. This resistance was strong enough to necessitate a meeting with a TxDOT manager to address the communication barrier it was creating. On the other hand, TxDOT personnel had to remind PM staff that they did not have full authority on all tasks. The need to make clear the PM's role is understood by TxDOT employees; in fact a TxDOT interviewee identified his counterpart in the program management staff as one of his subordinates. However, he demonstrated a wish to empower him at his same level of responsibility: "[He] is the head of design for HDR, he works for me, but I don't want to disempower him, so I usually bring him in on almost everything."

Team Staffing

[1.15] At its peak, the HDR design department was staffed with approximately twenty-five people but is now [at the time of the interview] comprised of eighteen to twenty employees. The level of experience of the HDR design staff is high, including some team members with more than 30 years of experience with TxDOT. The team is organized by segments, each with a segment manager and a couple of supporting engineers in the tier beneath the segment manager.

[9.7] In a traditional project, the management of design, ROW, and utility discipline staffs is performed by TxDOT whereas in this CDA, the PM has experienced discipline leads in each of these preconstruction disciplines. In the project life of the SH-130 project, the PM has always managed its own staff with flexibility in order to meet the project requirements at different phases. The interviewee believes that the PM's team should not be overstaffed. Otherwise, it will be difficult to make decisions in meetings during which people are trying to create issues to keep themselves busy.

b.3 Comments Pertaining to Environmental Function

Role and Responsibilities

[7.1] In this project, the relationship between the PM and TxDOT depends upon the characteristics of the counterparts of these two organizations. Both organizations must match up people with high levels of experience. For the relationships to work, both sides should be flexible. The difference between this project and a traditional project is that in a CDA both TxDOT and the PM should be ready for sudden shifts. Work allocation between TxDOT and HDR staff is sometimes done according to the individuals' preferences. If someone on the TxDOT staff has a background in archeology or historical cultural resources, he or she will review these issues in more detail than his or her HDR coworkers, leaving them to handle other areas. The PM's environmental staff needs to be flexible in order to allow for any realignment necessary during the different phases of the project. During preconstruction, the team should include expertise pertaining to wetlands, endangered species, archeological surveys, and similar issues. Later, when construction activities start, the PM should include people with experience in construction-related activities such as hazardous materials or stormwater controls. This shift in focus is difficult for people specialized in other areas. Therefore, environmental staff should try to hire people experienced in more general backgrounds. However, in the project life of SH-130, with all its shifts in road alignment, people's expertise has been applied to many different topics that are usually approached and resolved in the initial phases of traditional projects.

[7.4] The role and responsibility of the PM is to help and work with TxDOT staff as a team. The PM should monitor the Developer's environmental compliance team and how it is doing its work. "We also do routine program management tasks, some of which TxDOT staff never does." Program management staff undertakes all the interim process pertaining to the environmental discipline, whereas TxDOT staff reviews the end product of this process. The PM should tailor his or her support to the specific needs of the client and provide feedback to the TxDOT discipline head in meetings when critical issues are discussed. However, the PM cannot issue directives to the Developer without accepting financial liability for such direction. Contractually, the Developer accepts liability in a CDA. If the PM directs the Developer, there will be shift of risk from the Developer to TxDOT.

[10.3] According to an interviewee, the role of the PM is not defined in this project. As a result, the environmental compliance firm staff initially had to make assumptions about that role. “We’ve never seen their scope, we don’t know what their responsibilities specifically are, other than that they represent TxDOT.” The interviewee’s understanding is that the environmental PM’s staff is supposed to replace TxDOT staff and report issues. “They listen and take notes in the meetings. Sometime they are sent with the right information, and sometimes they are not. I think that is problematic for the project.” He also notes that the PM does not have the authority to make some decisions. These decisions are only made by TxDOT environmental staff members who would need in same cases to contact someone in a higher position within TxDOT. “They (HDR) are still an outside entity and that presents [a] problem for decision making a lot of the time, and I think that [TxDOT] need a person dedicated to the project.”

Team Staffing

[7.7] The PM’s staff includes three people in the environmental discipline. This staff supports TxDOT’s staff and monitors the Developer’s compliance with project requirements. In this project, the relationship between TxDOT and HDR environmental staff is team based, so the HDR-TxDOT work allocation “sometimes is not as clear cut as in a traditional hierarchy. Sometimes we have to function like a team and sometimes we just do our tasks [individually].” The size of the PM’s staff increases as the quantity of work increases. In this case, the PM’s environmental group is also in charge of the SH 45 SE project, so staffing is increased. If TxDOT will issue the new notice to proceed (NTP) No.4 for Segments 5 and 6, the staff will increase in order to allow the PM to be available along all 91 miles.

[10.6] According to an interviewee, the PM has a large enough organization for the environmental discipline. This group includes a discipline head and two other staff members who support TxDOT not only on the SH-130 project but also on the entire turnpike.

b.4 Comments Pertaining to ROW/Utilities Function

Team Staffing

[6.5] An interviewee believes that the only understaffing problem pertaining to the PM's ROW team was in the clerical area. Initially, the amount of paperwork needed was not accurately assessed. Regarding the selection of project management people, it is important to hire people with knowledge of all aspects of ROW (acquisition, relocation, imminent domain-condemning and jury trial) so that they can be reassigned as the project progresses.

[2.15] The turnpike ROW team includes two engineering consultant components: HDR for CDA/EDA contracts and PBS&J for traditional DBB contracts. The role of these firms is very similar, but the formation of their staff was different. TxDOT ROW management did not contribute to the selection of PBS&J personnel (with exception of the team leader) because PBS&J brought in a pre-assembled team. TxDOT had only to make clear what the project priorities. Conversely, TxDOT and HDR ROW managers handpicked everyone on HDR's team.

[2.6] To shorten the task duration in the ROW process, management carefully considered the possibility of breaking down work traditionally was performed by a single individual into smaller units that could be executed concurrently from more individuals. For instance, if a specific document were normally to take four working days to be reviewed according to TxDOT procedures, there were some attempts to identify ways to break down the same document into two parts that could be reviewed by two individuals concurrently on a two-day schedule with the same quality result. The resulting ROW process was a trade off between the schedule pressure, the additive cost requirement for additional staff, and the level of quality needed.

b.5 Comments Pertaining to Construction / Project Controls Function

Role and Responsibilities

[8.15] A difference between this project and other DB projects is the use of independent quality assurance firms. This concept relieves the Owner of part of the responsibility for the schedule (e.g., pertaining the Developer's pace) and is working very well on this project. On another DB project with a PM on board, the quality assurance work was done by the PM's staff. In that case, the PM was forced to increase the staff for quality assurance people in order to match up the Developer's production requirement. Therefore, as the Developer's production rate goes up and down, the staffing of the Owner fluctuates. With this approach, the Owner is forced to accommodate the Developer's schedule. Similarly, in DBB projects, the contractor's construction quality is controlled by the Owner's staff, which may lead the Owner to litigation with the Developer regarding schedule issues.

[11.3] On the SH-130 project, there is an overlap of roles and responsibilities of the PM and CQAF. The role of the PM is similar to TxDOT's in traditional projects, but the independent quality assurance firm also performs the same tasks as TxDOT on traditional projects. According to the interviewee, the PM should limit his or her role to oversight and cross checking of construction work whereas in this project, the PM is performing testing activities for an amount equal to about 10 percent of the testing the CQAF is also performing.

[12.27] An interviewee believes that the PM's staff is overstaffed in regard to its responsibilities. The PM's responsibilities should include overseeing contractor system performance and making sure that the Developer has implemented proper QA/QC systems. However, the PM is going beyond the role of controlling Developer inspections and inspection personnel by performing its own inspections.

[8.16] The responsibility of the PM is to have an adequate number of human resources to gather information quickly and make recommendations to TxDOT personnel. The PM should make sure there is no duplication of services from the Developer's side. For instance, if the Developer is required to provide construction inspections through the independent quality assurance firm, the PM should not hire a large number of inspectors. The independent quality assurance firm hired by the Developer should do this job, and the PM should strictly act in an oversight capacity.

Team Staffing

[8.12] The SH-130 project differs from traditional projects in that program management staff includes only experienced and qualified individuals. In fact, because of the pace of the construction, the PM cannot take the risk of hiring unqualified staff. Otherwise, it will be difficult for the PM to train the staff and bring them along in the project.

[8.13] The PM provides the project with staff required to gather the information from the Developer that allows TxDOT to make decisions. Its staff includes design, environment, ROW, utility, and construction discipline groups. The size of the PM staff is enough for an oversight role. "Understaffing is not usually a problem, but we are always [right on the line of being] under staffed …I would say that for the most part we have been understaffed. We have tried to stay lean." PM management needs to propose additional staff to TxDOT and justify its need through analyses and evaluations of the workload. Usually, the PM staffing strategy includes identifying the need and waiting until the proposed position can be "fully loaded" before proposing it to TxDOT. Consequently, existing staff is required to provide overtime work between the time the need arises and the time a person is hired for that position. The same selection process requires additional time during which the PM staff would be understaffed. PM management has tried to balance this staffing problem. “The goal is to try to find the place where you are always lean.” The big difference between the DB and DBB delivery methods is, “In traditional DBB projects, there is a design program manager and construction program manager; they are providing front line work. But in this CDA, we require a Developer to provide that staff.” This helps the Developer to come in lean and also allows the Developer to have control of their own schedule.

[11.6] An interviewee believes that in this project, the PM has a large staff. The PM is doing what TxDOT normally does on traditional projects. The PM should reduce staff and give most of the authority to the Developer in order to expedite the project. In this project, the PM’s over involvement is slowing the project down.

[12.12] Another interviewee also believes that the PM’s team is overstaffed and that they are also performing a lot of additional inspections and testing activities, whereas the Developer is paid to perform QC/QA activities. This underscores how the Owner/PM team did not embrace the new contracting approach fully. In fact, at the time of the interview, the Owner’s team was still self-performing “a significant number of tests over and beyond what a typical oversight engineer would do on a project of this type.”

c. Comments Pertaining to Developer Organization

Comments presented in this section pertain to the Developer’s team organization and come from a wide variety of sources.

c.1 General Comments

Role and Responsibilities

[8.19] On this project, the Developer bears the entire risk and can therefore go to work before the plans are complete. The Developer can perform grade and drainage work and start moving dirt before the design of every bridge is complete. "One of the biggest lessons [we] learned … [is that] in design-build, we want to let the Developer have his risk. We give it to him contractually, let him manage it. If we give [it to] him contractually and we manage it, then it is not fair. It is not a good business decision. It is not good for the project."

[8.20] The maintenance option is very effective because if the Developer builds something knowing it might require maintenance for 15 years, the Developer will build a quality product. "There is no doubt that [the] incentive is always there and always in the back of their mind." The interviewee believes that "checks and balances weigh heavier when somebody has a maintenance agreement on a lump sum bid."

[9.9] Traditionally, preconstruction activities (e.g., demolitions on ROW acquired and utility relocations) are completed before construction personnel get to the site. Because in a CDA agreement there is an overlap between these two functions, there are different ways to perform the overlapping activities. However, the Developer separated the preconstruction process from construction functions. This separation reveals some unclear or at least inefficient assignment of responsibilities between the two groups. On the construction side, "lots of time construction people get frustrated because they don't expect to have to deal with something that they consider to be preconstruction elements." On the other hand, "there tends to be some confusion because [the] preconstruction group wants to be able to use the fact that we got the construction group team there, to get some of these things done efficiently instead of having to do [it in] their own compartmentalized area."

[9.10] In this project, the entire project team works in one building. This makes it easier for communication to happen at the wrong level. This is not intentional but is rather a disadvantage of all personnel working in the same location. Owner representatives can come over and direct design or ROW staff at lower levels. The new environment is confusing to these lower level staff because they struggle to understand who they must please. In response to this confusion, the Developer educated the staff on the protocols of the new environment after which the number of these short-circuited communications decreased.

[11.7] The inclusion of maintenance in the contract has not been mandatory. The interviewee feels that maintenance work should be mandatory within the project scope and not optional because this will make the Developer more responsive to the delivery of a quality project. The interviewee believes that the Developer will build a more durable road if it must be maintained for 15 years. He also believes that the project will benefit if the Developer acquires a sense of ownership for the end product.

[12.28] Internally at LSI, there were problems in embracing the DB approach. Traditionally, project management staff for a contractor analyzes plans and specifications, makes plans for construction execution, and then builds the facility. The contractor now has new challenges because of the timing and additional tasks associated with the DB process. "Here are your design criteria; go and design it, then buy the land and utilities, then start to build it two years from now. It is different; it is a different mentality." This new mentality was difficult to absorb for project personnel with traditional backgrounds. The size of the project also made some personnel feel uneasy about the project. "We had a hard time with some of the traditional construction folks coming onboard to the DB … having a hard time grasping what [a] DB project is. You know, it is a very complex … it is a very large project, there is a very big organization, so when you come in and you used to be in charge of the whole execution side of the contract, suddenly you realize that you are over on this side [and] that you are not part of the procurement. You are not part of … some of the other aspects. It is a little bit foreign. It is like you lost control of that, so there was a learning curve for LSI internal too, on what a DB contract is, and we still struggle with that." LSI management addressed these issues by creating very detailed operating procedures. Procurement was an especially new concept on the contractor side and needed particular attention. "In order to resolve these issues, what we tried to do is to come up with a very detailed project procedure manual, and what we ended up [with] on this project in certain areas … we came up with detailed written procedures that were more specific than I ever imagined you would need. But in order to disseminate it to everybody, here is how LSI is going to operate on this particular timetable. Procurement was a very big issue; we got the joint venture … to implement the procurement process. It is very foreign to a lot of people on this project, so in order to have the proper control on it … how we got through it is, we defined it, we enforced it, and we educated people on what it is."

[12.29] As far as roles and responsibilities within the LSI organization are concerned, the interviewee observed that there were some problems and that the joint venture struggled to solve them during the first two years. A reason for these problems was "attributable to the joint venture itself where LSI comprises the three companies, Fluor, Balfour Beatty, and T.J. Lambrecht. So when you bring three companies together, you bring three different execution/operation approaches together." He explained that LSI was staffed following a "salt-and-pepper" strategy. Basically, the management team outlined the overall organizational structure, and each of the three partners furnished people to fit the positions according to their availability. Therefore, staff allocation was not function based (i.e., "We are not structured around responsibilities. For example, Fluor is in charge of project control, so all the project control is Fluor; that is [its] responsibility") but position based (i.e., "We organize [according to] whoever has the best people to fill those slots"). After the staff was identified, the team started planning such project execution activities as defining operating procedures and reporting format. At this point, the real nature of the joint venture became evident because the three different corporate philosophies needed “a long time to get molded together into one agreement.”

Team Staffing

[8.21] The Developer won the contract with an estimate based on a lean overhead staff. “They may not be understaffed necessarily on the production side, but they will be certainly understaffed on their overhead side. That’s our opinion. They work hard, they work long hours, and they work many weekends … They are always hustling, always running. There is potential for mistakes.” Moreover, the interviewee believes that in every CDA, the Developer will be understaffed in order to be lean on the price component of the bid.

[9.11] Traditionally, there will not be any preconstruction or design manager group on the contractor’s team because the job is awarded to the contractor after design and other preconstruction activities are completed. On this project, the Developer must perform all of these jobs simultaneously. Consequently, the Developer should have experienced staff for each discipline, and there should be good coordination between all disciplines to carry out the project successfully. The CDA Developer starts construction on the same parcel before all ROW is acquired and before all utilities are relocated. Therefore, there is a considerable amount of coordination between the Developer’s construction and preconstruction staffs.

[10.7] The way consultants are providing services work on a CDA project is quite different from their work on traditional DBB projects. In traditional DBB projects, a consultant’s work focuses on one area of expertise and is directed by TxDOT with low flexibility. On this project, most of the responsibilities are shifted to the Developer, who can then come up with necessary changes.

[10.8] Another difference between the two approaches (CDA-DB and DBB) is that in traditional projects, TxDOT develops the ROW plan, design plan, schematic, and environmental design plan before the construction contract procurement, with every discipline provider having a separate contract with TxDOT. These documents are later included in the general scope of work for the contractor. However, in a CDA, these are all assigned to the joint venture (the Developer) that has the contract with TxDOT to deliver the whole project. All the other companies are subcontractors of the joint venture.

[11.8] In this project, the Developer is contracted to do ROW acquisition, utility relocation, design, construction, and environmental compliance. In traditional projects, only construction work will be done by the contractor, and the preconstruction activities are done by TxDOT. To perform these additional functions, the Developer hires staff in each of these disciplines. Additionally, the Developer's staff should be well experienced in their respective fields. Areas of major concerns for the Developer's organization are ROW and utility. These areas include too many variables that are out of the control of the Developer and TxDOT to make their performance predictable. For instance, when a ROW must be purchased through condemnation, the amount of time and the result of a court cannot be predicted. And on the utility side, if a large entity such as SBC Communications, Inc. must be approached, the Developer might have problems obtaining their cooperation even when the Developer pays the cost of relocation, as large corporations are often uninterested in relocating. Because such an effort is not financially beneficial, relocation work is generally a low priority job.

[12.30] A CDA contract allots more responsibility to contractors than a traditional job. Consequently, the Developer has a larger staff than for a traditional DBB project.

The Developer staff now includes functions such as QA /QC that traditionally were performed by TxDOT. The Developer has added an additional design oversight staff member who is performing the constructability reviews on the outsourced design in order to ensure that the design produced is the cheapest to build. This is a divergent approach from traditional contracting where a contractor would price an owner-provided drawing and then provide the state with a product according to the drawing without taking efficiency into consideration. Additional functions include design, design oversight, design QC/QA, environmental permitting, environmental compliance inspections, ROW acquisition, utility adjustments, and construction QA/QC. All of these functions require more staff and managers than would a traditional execution contractor.

[12.31] LSI's organization follows a matrix structure. The interviewee underscored that the only way to manage a project of this magnitude was by breaking down the whole road alignment into three segment areas. However, another layer of management was added to guarantee consistency throughout the segments. "In order to make the project consistent, we added another layer of management above that. [It added] some matrix-type responsibilities to ensure that the field construction engineer that is working on the underground drainage on Segment 1 is performing his responsibilities consistently with the same representative on Segment 2. … We have our lead construction engineers for the underground overseeing all that, but then you have the area manager that is directing them on a day-to-day operation, so that's where the matrix organization comes from."

c.2 Comments Pertaining to Design Function

Role and Responsibilities

[1.17] On traditional projects, design firms are less involved in project risk allocation. They usually work on an hourly basis regardless of the contracting approach (e.g., lump sum or cost plus), and their impact on cost is usually about 10 percent of the total project cost. During the execution phase, contractors may attack owner-provided design plans to obtain the approval of change orders. The DB environment changes this relation. First, the Developer is responsible for both design and construction, so most of its cost savings depend on design. As a result, "there is an enhanced merging" between design and construction functions that results in a more cooperative environment. However, if the design firm does not participate in the risk allocation as a joint venture member (such as in the SH-130 project), it enters into the project with less involvement and with a sole focus on generating billable hours. This approach creates friction between the joint venture and the design firm.

[3.11] The role of the design quality assurance firm is not well defined in a CDA contract, according to one interviewee. This problem was more evident in the SH 45 SE project in an instance when the Developer disagreed with the Owner on what needed to be reviewed by this firm. In that contract, this firm is named the Professional Services Quality Review Firm (PSQRF).

[9.3] In traditional projects, the Program Manager or TxDOT performs design management work. On the SH-130 project, that is the Developer's responsibility. In a DBB model, all design is completed first, then ROW is acquired, then utility is relocated, and finally construction starts. Conversely, in this CDA, the Developer completes the work parcel by parcel. Therefore, all technical disciplines must interact to concurrently perform these activities. Because of the interaction between design and construction, the project team can address constructability issues. Moreover, because the work process is more complicated, there is a need for establishing effective communication flows to facilitate work progress.

[9.12] The design consultant firm adopted a matrix organization with segments managers, discipline leads with a discipline manager overseeing them, and a design director overseeing the segment managers. In this organization, the segment managers are responsible for delivering the design deliverables (i.e., schematic, grading, and drainage packages). Initially, the "engineers on the floor" reported to discipline leads, so there were problems with the way the discipline leads interfaced with the segment managers. Consequently, segment managers did not have a clear idea of the status of each deliverable and whether more personnel were needed to meet deadlines. They later changed the organization and assigned the "engineers on the floor" to the segments. In this way, they report directly to the segment managers. Since then, discipline leads have been in charge of maintaining technical consistency across the project. That situation improved communication. However, when the project scaled down, the design consultant started to streamline the structure by grouping disciplines under the same leads.

[12.6] In DB contracts, the Developer becomes responsible for the design. This change substantially affects the interpretation of design criteria where engineering judgment is required. Engineers traditionally work under the Owner's direction and thus tend to take a conservative approach. Engineers now work under the direction of the DB Developer whose interest is to make the project profitable. Therefore, the driving principle is to design at the minimum performance criteria. The interviewee characterized the Developer as believing, "as long as our design meets that minimum performance criteria, then that is a suitable design, and that is what we'll build." As a consequence, there is a conflict with the Owner's imperative for "desirable" performance criteria. An interviewee reported a typical comment on this issue from the Owner's side:

"LSI [is] not conservative enough with … estimates on hydrology. [If TxDOT thinks] there is more water flow than what LSI is estimated, increase the size of [the] drainage."

[12.22] Another area where interpretation issues are common is in the estimation of future traffic volumes. This phase of the design affects most of the following design activities and the cost of the constructed facility. In a CDA contract, the Owner provided to the Developer a preliminary study in terms of traffic projection data, but the contract clarified that these data were "provided for informational purposes only and shall not be used in the design of the Project." The contract also provided another set of traffic projection data that "shall be used for designing and constructing all components of the Project including the mainline of SH-130, direct connectors, ramps, frontage roads and cross roads." However, the contract shifts the risk on this issue to the Developer, who "shall prepare traffic analyses as required to complete the design and construction of the Development Work." Moreover, these Developer-prepared traffic analyses "shall be conducted so that an acceptable level-of-service (LOS) is provided. An acceptable LOS shall be defined as LOS 'C' or better for all traffic analyses." These contract clauses clearly shifted the risk to the Developer in terms of traffic capacity design. However, the interpretation of the minimum criteria made the relationship more adversarial.

Team Staffing

[1.18] On the design side, the co-location of project parties presents advantages and disadvantages. Co-locating project parties offers advantages in terms of communication. Being co-located with the PM function allows TxDOT to have necessary expertise at the local level, while in traditional projects this expertise is delivered to the project through TxDOT divisions. This advantage would be most evident in projects based in more peripheral areas such as Lubbock and El Paso. On the other hand, co-location presents a few disadvantages that can be critical to the design team setup. First, delivering personnel to the project can be problematic, especially if the design firm does not have an established local presence. Second, once the design team is established, a set of operating procedures must be defined in order to allow consistency throughout the design process. The interviewee underscored that the last problem would not exist if the design team was not co-located. In fact, design teams would normally operate in their own environment using established operating procedures.

[4.15] The Developer's design staff must have experience in Texas. A design team without local experience can negatively affect the quality of the final product because many design practices adopted in other states are often not applicable to the Texas environment.

[5.8] The interviewee considered the design team (the design subcontractor, DMJM) to be "inappropriately staffed." He explained that they even have people with good expertise inappropriately placed.

[10.9] A problem for project communication involves environmental issues and the design team. The design quality control function of the Developer does not have any person dedicated for environmental issues. The reason is that all the environmental work was initially the responsibility of the Environmental Compliance Manager (ECM) function. "The quality control of design was a design function, so there was nobody assigned on the design team for environmental QC." This was one of the most challenging communication issues between ECM and the design group, DMJM.

c.3 Comments Pertaining to Environmental Function

Role and Responsibilities

[3.12] The ECM staff "has an independent role;" they report concurrently to TxDOT and to the Developer.

[3.13] An interviewee suggested an organizational change pertaining to environmental functions. He suggested that they be organized under one group, whereas now, Raba-Kistner Infrastructure, Inc. is in charge of the stormwater, and Hicks & Company, the ECM, handles the remaining environmental activities. He also mentioned that on the SH 45 SE project, this approach was taken, and the process worked better. An advantage resulting from this change is that the same firm that inspects the stormwater for the project would have the ability to "shut it down" if needed. Currently, "Raba-Kistner does not have the power to shut down the project. So if there is an imminent threat, the R-K inspector out there … he cannot shut it down; only Hicks can shut it down, or TxDOT."

[10.11] A reason for the faster pace of the CDA-DB process compared with the traditional approach is the amount of flexibility given to the Developer. In a CDA, if the Developer wants to make a change that does not affect the project scope, the change can be managed internally and the work performed. The Developer can later submit the change to TxDOT along with a justification. Generally, TxDOT with add technical comments to the change. On the other hand, in DBB, the contractor must receive TxDOT approval before making changes. This flexibility makes CDA projects go faster.

[10.12] The role of the ECM staff is in reality wider than in the contract definition. The Developer decided to put the ECM in charge of all environmental work to be performed on this project (outlined in Chapter 4 of the contract agreement). Therefore, the ECM's job includes field monitoring compliance, preparing permitting and federal approval documents, and reviewing and approving them prior to being able to construct. The ECM is an independent entity that develops the approvals that will allow for construction to proceed and also monitors the construction for compliance with the approved drafted documents. "ECM is responsible for all the work, because the

Developer thought that it [would] be easier to have all the environmental work under one umbrella." Some aspects of the environmental discipline, such as hazardous waste management, are carried out by the CQAF. One problem for the ECM is the increased workload due to changes to initial ROW schematics. Initially, TxDOT assumed the design would not affect the environmental permits significantly. "It turned out that wasn't the case." Basically, the ECM was supposed to rewrite small parts of the initial permits but ultimately had to rewrite them completely. The CDA is unclear in this regard because it stipulates that such rework activities on the environmental side must be performed by the Developer.

Team Staffing

[3.14] With respect to environmental issues, the CDA style of delivery differs from traditional project management in that there are "full time environmental inspectors in the field," a practice never before implemented by TxDOT. This is significant because it ensures the enforcement of the commitment made to resource agencies.

[3.15] During the initial phases, "understaffing [of the Developer] seemed a problem, at least for the permitting side where production was slow." The interviewee noted that this problem was solved later. In fact, the Developer's environmental team was able to meet expectations for permitting activities required to re-evaluate changes on the initial alignment.

[7.10] The environmental group within the Developer's organization should be staffed with highly qualified personnel. The position of ECM should be filled by an experienced person who can lead environmental activities and select his or her own staff. The involvement of this person must be continuative along the project's life. A problem in the current organization is that the person initially designated as ECM turned most of his responsibilities over to his deputy. The Developer should understand the complexity of the project and keep highly experienced people in lead roles. Additionally, in a CDA, there should be a succession plan for every leading staff member. The Developer should come up with a plan for the evolution of duties and responsibilities on the project.

C.4 Comments Pertaining to ROW/Utilities Function

Role and Responsibilities

[6.6] In the beginning of the project, TxDOT did not allow LSI to anticipate ROW payment and request reimbursement. This slowed down the process by introducing a one-month bottleneck in the process. However, this was modified, and now LSI can anticipate ROW payments and ask for reimbursement.

[6.7] An interviewee suggested that the Developer "should allow us (TxDOT-HDR) to communicate with their subs on the ground to get the job done fast." The interviewee believes that a higher level of communication would speed up the ROW process.

Team Staffing

[6.8] The LSI team had difficulty regarding how it was structured. Initially, the team had a director of preconstruction who oversaw ROW, utility, environmental, and surveying issues. The director did not have experience in ROW and utility and was also overloaded. His desk became a bottleneck in the process because he (and LSI) initially wanted oversight directly over their subcontractors without allowing the PM's staff to communicate directly with these subcontractors. This barrier to communication was later eliminated and the organization modified by grouping it under the design and preconstruction purview. The interviewee believed that a project the size of SH-130 requires a person dedicated only to ROW and utility issues with expertise in these fields, especially if the Developer wants to maintain control over subcontractors.

[12.37] An interviewee believed that LSI understaffed the preconstruction division, where initially there was not a LSI direct manager to oversee performance of consultant firms.

c.5 Comments Pertaining to Construction / Project Controls Function

Role and Responsibilities

[11.10] The CQAF concept is one of the main differences between the organization of CDA and traditional DBB projects. The role of the CQAF is independent from the Developer. Even though it is hired and paid by the Developer, the CQAF cannot be fired without the agreement of TxDOT. It has dual reporting functions to both TxDOT and the Developer. The CQAF works according to the procedures written in the construction quality assurance plan. CQAF does all the testing and inspection of the Developer's work to ensure that the road is built according to specifications. The CQAF is also involved in some issues pertaining to environmental enforcement during the construction at the site level. To address these issues, the CQAF jointly works with the ECM.

[4.17] In traditional projects, the construction risk is with TxDOT, which must make sure that contractors are producing quality results. If they are not, TxDOT must stop the work. In this project, that risk lies with the Developer. Therefore, TxDOT is very flexible in the way it oversees project construction. The Developer is in charge of managing its own construction risk. If the end product is not of good quality, TxDOT will compel the Developer to replace the inferior quality product with a product meeting requirements.

[8.8] Another interviewee also said that if the product does not meet plan and specification, the Developer must remove and replace it with conforming materials at no extra cost. "Sometimes in traditional projects that conformance with plan and specification is [a] gray [area], and [the] Owner ends up … participating in litigation. In design-build projects, if the plans and specifications are unclear, the Owner does not participate in repair."

[8.9] Having an independent firm performing construction quality assurance services illustrates another difference between CDA and traditional DBB method delivery because TxDOT personnel will not be injected into the Developer's schedule. If the Developer wants to build $2 million a day, he or she is required to provide personnel to support that endeavor. The Developer should make sure that enough construction onsite inspectors and testers are available to carry out the work. In DBB projects, TxDOT is required to provide this personnel, so the process will inject TxDOT into the contractor's schedule. In a CDA project, the Developer is responsible for the construction quality assurance work, so if the Developer wants to increase the construction pace, personnel to carry out that work according to the specification must be provided. The roles of TxDOT and the PM are strictly those of oversight.

[12.39] A main challenge for the joint venture was the process of subcontracting. TxDOT required that any major subcontract in excess of $3 million had to be awarded through low bid procurement. The process of bidding subcontracts is foreign to a traditional contractor, and some of the joint venture partners had difficulty implementing this phase of the project. In order to go through that process, the project control department had to develop a set of specifications—a scope of work—and a bid package for interested subcontractors. This bidding process was an innovation in respect to traditional DB contracts.

[12.40] Another difference in organization is the need for DB projects to have a group working on subcontract procurement that manages the low bid competitive selection process for subcontractors.

[12.41] The interviewee believes that LSI brought construction supervision staff on board too early in the process before being ready to start the execution. This comment relates to another in which the interviewee noted that contractors are typically ready to go right after the bid.

A.5: COMMENTS ON PROJECT COMMUNICATIONS

This appendix includes comments pertaining to communications between primary organizations participating in the project. In the discussion, the terms “Owner team” and “turnpike team” are used to mean the joint TxDOT-HDR staff on the SH-130 project. Findings resulting from interviews with project representatives are categorized and grouped in five sections as follows:

Section a.x – General Comments

Section b.x – Comments Pertaining to Design Activities

Section c.x – Comments Pertaining to Environmental Activities

Section d.x – Comments Pertaining to ROW/Utilities Activities

Section e.x – Comments Pertaining to Construction/Project Control Activities

Each of these sections is further subdivided according to two subheadings:

x. [1] Co-location

x. [2] Partnering/Issue Escalation Ladder

x. [3] Information Technology/Information Management

x. [4] Operating Procedures

x. [5] Meetings

x. [6] Improper Communication

x. [7] Other Communication Challenges

For convenience, these observations are tagged by a two-number identifier [x.x] that allows one to locate the observation in the interview transcripts. The first number identifies the interviewee and the second the position within the transcript.

a. General Comments

a.1. Co-location

[3.16] An interviewee was satisfied by the effects of the co-location on communication across project parties: "The co-location was fully critical ... to have effective communication. For example, they are across the parking lot; it is very easy, if you [have] an issue, just to walk across the parking lot."

[4.19] In this CDA, the Developer, PM, and TxDOT personnel are co-located. Because the SH-130 project is large and complex, constant communication between these organizations is necessary to keep up on daily developments and overcome obstacles. This co-location helped a lot to achieve effective communication. It helps TxDOT to address their concerns with the Developer immediately and vice versa.

[5.9] On this project, the speed of communication is crucial, and project co-location is crucial to making communication fast and clear. Co-location allows TxDOT to organize meetings in much less time than otherwise. To illustrate the process, the interviewee related a recent event pertaining to the resolution of a design issue. The day before the interview, LSI field construction personnel reported a concern to HDR construction personnel. The latter requested a meeting that evening. After the meeting, a joint meeting with TxDOT, DMJM, and LSI construction subcontractors was held to solve the problem (scheduled for 1:30 p.m. the same day of the interview). This issue was resolved in less than 24 hours, whereas in a traditional environment it would take a few days.

[6.9] According to the interviewee, co-location has been very effective because it allows for huge savings in travel time. For instance, the day of the interview, he was having six meetings that would have been impossible without co-location. Conversely, because TxDOT and PM employees will be shared between the SH-130 and SH 45 SE projects, they must travel each time from Pflugerville to South Austin, thereby losing time in transit.

[7.11] A CDA project's success depends upon teamwork. It is crucial that the PM understand TxDOT's expectations. Co-location allows the PM to get into this role faster by making it easier to meet with TxDOT staff. Additionally, the size of the project makes it challenging to communicate without co-location. In fact, without it, there might be many communication errors. CDA projects are very detail-intensive; therefore, they require many meetings with key players of the project. Co-location helps to have special meetings (e.g., Technical Work Groups) with all people within a discipline with the goal of making on-the-spot decisions.

[8.27] In this project, the concept of the co-location of TxDOT, the PM, and the Developer works successfully. This helps the different disciplines to interact quickly. If these three entities are located far away from one another, the amount of coordination associated with setting up meetings and solving the problem quickly will be costly and time-consuming. Therefore, considering the pace of the construction and the complexity of this project, co-location is a significant factor in completing the project on time and within budget.

[9.10] The whole project team is working in one building. This makes it easier for communication to occur at the wrong level. This is not intentional; rather, it is simply a disadvantage of numerous personnel working in the same location. Owner representatives can come over and direct design or ROW staff at lower levels. The new environment is confusing to these lower level staff because they struggle to understand who they have to please. In response to this confusion, the Developer educated the staff on the protocols of the new environment, after which the number of short-circuited communications decreased.

[9.14] Co-location is a new idea used in this project. It has positive impacts, as well as negative impacts. Positive aspects of co-location include improved communication between the Owner, Developer, and PM, who can quickly reach a consensus on hot issues. The negative aspect is that anybody can go to another person and ask for information. This might have negative effects on the project. Sometimes the management level will not know what the lower level is doing if it has been directed by another of the parties to the contract.

[10.14] The co-location of project parties has helped in scheduling regular meetings. In fact, it makes it easier to get personnel together in less time than on traditional projects. If project parties were spread out over several miles, it would be difficult to meet frequently and make decisions quickly. Therefore, co-location is very important to achieve effective communication. It also helps project personnel to establish relationships quickly and set up the foundation for teamwork. However, managing communication flows between co-located parties can be challenging. In fact, communication occurs at improper levels, so it is very necessary for every staff member to know what information should be shared.

[11.12] The SH-130 project is sizeable, and there are lot of personnel representing the Developer, PM, and TxDOT working together in the same location. This co-location helps to foster good working relationships between these entities. For instance, if there is a problem on the construction site, field personnel can come directly to the PM or to TxDOT and solve the problem. Similarly, if there is a problem concerning design, construction personnel can come directly to the designer. Therefore, co-location helps the builder complete the project on time and at a faster construction pace.

[12.42] Co-location offers advantages and disadvantages. The main advantage is that it facilitates meetings with all project parties. However, the risk is to make communication too easy. Consequently, communication can occur at inappropriate levels.

a.2. Partnering/Issue Escalation Ladder

[4.20] In this project, partnering is working better than in traditional projects. Because different entities of the project are housed in the same building, it is easy to sit together in one room and make decisions.

[4.21] Another innovation is the use of an escalation matrix. If the problem cannot be solved at a lower level, it will immediately be "escalated" or taken to the next level. If the problem is still not resolved, it will be immediately escalated to next highest level. In this way, the problem can reach upper management almost immediately and a decision can be made quickly. According to an interviewee, this approach was never used by TxDOT on traditional projects.

[7.12] Using the escalation matrix is an efficient way to solve problems at the lowest levels possible. If the problem is not solved on the lowest level, then it is escalated to the second level. Personnel at the second level have 24 to 48 hours to address the problem. If it is not solved at the second level, it is escalated to the third level and so on, up to the highest level of management. In this way, the escalation matrix sets up a time frame to solve problems. As a result, problem resolution in a CDA is more expedient than in the traditional partnering process because many problems are solved at lower levels.

[11.13] One of the major steps toward reducing communication problems in this CDA is the escalation ladder. This approach is distinctly different from that taken on traditional projects. The escalation ladder works as follows: At a certain level, a group of people has been assigned to a job and must solve problems in a prescribed time. If these people cannot solve the problem within the time frame, the problem is escalated to the next highest level. Again, if that level cannot solve the problem within a given time frame, it is escalated to next level. This helps the team get the decision they need on time and at the proper level. Another advantage is that management is apprised of problems occurring at lower levels.

[12.43] The Developer implemented a partnering program that uses an escalation matrix that determines the level of authority needed for issue resolution. This tool clearly identifies at which level an issue must be resolved and if it is not, at which level it needs to go. Basically, the matrix defines a path to the resolution of an issue. This approach proved to be a way to quickly resolve project issues.

a.3. Information Technology / Information Management

[1.21] The project implemented two systems to facilitate communication and improve consistency in the design. First, a drawing management system, Project Wise, was implemented. Secondly, an information management system, DocMan, was established between the Owner and Developer team offices. This application allows for management of electronics transmissions between the two buildings and to meet the objective of a "paper-free" project. Upper management can access summaries of the transmitted documentation and thereby maintain a clear overview of the project status. DocMan also allows project employees to access documents from outside the office, making it easier to work from home if critical issues emerge.

[5.10] There is a need to find a way to make HDR and TxDOT software systems interoperable. For instance, TxDOT uses Primavera, and HDR use MS Project. HDR would use the TxDOT system if access were made available. As an alternative, the interviewee suggested that the two systems be made interoperable. Regarding the interoperability with the Developer's systems, he gave the example of the document management system (FILENET and its graphical interface, E-MANAGER), which needs to be integrated between the two contract parties. There is a need to have a more flexible IT environment in order to make this integration possible.

[8.28] "This project is a 21st-century project" because a vast majority of the communications and submittals are in electronic format with documents that "go back and forth through electronic pipelines, cell phones, [and] emails." Most of the submittals are electronic, tracked very tightly, and instantaneous. One of the advantages of this project is that personnel have all types of high tech communications devices, including telephones, cell phones, and computers. There are also two electronic data management systems, and they are working perfectly "in … that there are not lots of lost documents." These systems allow for monitoring of when something is sent and when it is actually received. Therefore, nobody can receive a package and leave it on the desk over the weekend.

[9.15] The Developer uses a customized version of ProArc Document Management. Among other features, this software ensures that personnel within the organization can access design files if they are permitted. From this system, design files can be pulled by the ROW engineering surveying group, who can then create the documents for ROW acquisition. The Developer tried to implement this software in order to streamline the process and to make sure that there was communication within the team.

[10.15] TxDOT and the Developer have different data management systems and software. Early in the project, TxDOT wanted to develop a software system to convert their data to the Developer's data management system, but this was not implemented, and the issue was subsequently resolved.

[10.16] For onsite communicating, the Developer team uses the Nextel network, a system with a walkie-talkie feature. This is a feature added to every staff member's cell phone and allows for communication between all team members. It also allows for conference calls.

[11.14] The Nextel network is one of the tools for good communication that was introduced in this project. Every member working in the project has a Nextel phone, so everybody on the project can use the walkie-talkie capability offered by Nextel. This increases effective communication.

[12.44] The CDA contract states that the Owner's team was "designing and implementing an enterprise-wide electronic document management system (EDMS) in order to manage all records, regardless of format, into a centralized management system," and that this system was based on the FileNet software platform. The Developer was required to "establish and maintain an electronic document control system" and was advised to "consider the current document control technology infrastructure being designed and implemented" by the Owner's team. Otherwise, the Developer could adopt, upon the Owner's approval, an EDMS if compatible with the FileNet software. Initially, LSI decided to adopt a Fluor system that met such a requirement. However, an interviewee stated that "when we started to coordinate the implementation of our system, it became very clear that [for the Owner's team] 'compatible' does not mean we can exchange data; 'compatible' is … they are identical systems. And so we have a lot of errors to overcome to get the two systems to actually talk." The same interviewee suggested that to simplify the contract language, "They would have said, 'Contractor, we have an electronic data management system, and you shall use it.'" He thought this type of language would have eliminated the compatibility issues from the beginning.

a.4. Operating Procedures

[8.29] Due to the magnitude of the SH-130 project, operating procedures and systems needed to be set up. The PM has an administrative procedures manual, an

Owner verification testing and inspection manual, a construction QC/QA manual, and a design QC/QA manual. There are thousands of personnel working on the project, so it is necessary to set procedures so that people will know what to deliver and how to deliver it. These procedures will be useful for future CDA projects after modified to specific projects needs.

[10.11]A reason for the faster pace of the CDA-DB process compared to the traditional approach is the amount of flexibility given to the Developer. In a CDA, if the Developer wants to make a change that does not affect the project scope, the change is managed internally and the work performed. The change is later submitted to TxDOT, along with a justification. Generally, TxDOT will simply add technical comments. On the other hand, in a DBB delivery method, the contractor must obtain TxDOT approval before making any change. This flexibility makes CDA projects go faster.

a.5. Meetings

[1.20] The relation between TxDOT and the Developer was always based on a reciprocal partnering approach. For instance, TxDOT personnel can meet with their counterparts in LSI by just walking over to their offices without needing to schedule a meeting.

[1.22] The size of the project requires management to attend a large number of meetings. There are standing meetings that are on a fixed schedule, but co-location also allows for ad hoc side meetings. A first category of standing meetings is represented by the weekly technical work groups (TWGs) that include LSI, HDR, and TxDOT personnel and address specific areas. These meetings are very helpful in overcoming problems posed by conflicting specs interpretations of the general audience manuals supporting the contract. This flexibility leads to different interpretations. TWG meetings allow for the reconciliation of divergent opinions between contractors and the Owner’s team. A second group of standing meetings includes the weekly segment update meetings that allow everyone in each segment to share information. In another meeting that takes place every Friday, LSI and TxDOT senior management meet to discuss construction and design at the highest level but do not limit their focus to these topics if other important issues emerge. The first two lines of command identified in the escalation matrix attend this meeting. The turnpike team also has two other fixed meetings on an alternating week schedule. The first week the entire turnpike team meets to discuss "big picture" issues. At the following week's meeting, personnel beyond the first two tiers are invited to analyze the details of the project and are allowed to raise issues. On Thursdays, personnel at the highest level of design from Bridgefarmer & Associates, LSI, HDR, and TxDOT meet to discuss design production. During this meeting, participants make production level estimates for the following week in order to manage peaks and valleys in the workload. Another weekly meeting is the design team meeting during which details of design activities are analyzed and hot issues raised and documented. During this meeting, staff reports on its own activity for the past week.

[4.12] The relationship between TxDOT and the PM is good in this project. Every week, TxDOT sits with the PM in meetings to address the problems of the project. In these meetings, TxDOT makes sure that the PM is doing a good job of disseminating and executing TxDOT's directives. "I have nothing bad to say about the Program Manager. I think they have done a very good job."

[4.24] On this project, the Developer represents the only point of contact for TxDOT. Therefore, TxDOT can have meetings on a regular basis with the Developer's staff in every discipline (e.g., ROW, utility, environment, etc.). As a result of these meetings, Owner and Developer representatives can understand the status of the project, discuss critical issues, and make decisions quickly. On traditional projects, TxDOT conducts separate meetings with independent service providers such as designers, ROW surveyors, etc. Consequently, if there are issues involving more project parties, it is difficult and time-consuming to resolve problems.

[5.11] The main success of the CDA delivery approach in terms of project communication was to put in place weekly meetings (e.g., TWGs). Project parties have weekly meetings at the technical level. Initially, TxDOT, LSI, and HDR had meetings at higher levels, with the expectation that people in these meetings would communicate with lower level people. Since that created miscommunication, they created a set of meetings involving lower levels (TWGs).

[7.13] Due to the complexity of the SH-130 project, some overlapping responsibilities among teams are common. This redundancy might hinder project pace. For instance, if a bridge engineer were to put the pier of a bridge in the middle of the creek, the stormwater drain on that pier could create an erosion hazard for the creek. This would pose as both an environmental and structural issue. Therefore, there is a need for interaction and communication between the bridge engineer team and the environmental team. TWGs were created to achieve this goal. Every discipline has a TWG, and they have meetings to resolve the problems. The frequency of the meetings drop off once the group has chance to mature and they get to know each other. "Developing and using the technical work group was probably [the] most successful avenue of communication within the project."

[10.18] On this project, the Developer formed a TWG for each discipline. These TWGs interact with each other when there are common issues. They schedule frequent meetings to solve problems. TWG meetings solve lot of communication problems because they bring interdisciplinary people to one table where they hammer out decisions. Therefore, these meetings are a tool for resolving issues quickly.

[12.45] The TWGs, a series of weekly meetings regarding thematic area, design, and also for ROW and utility, were implemented. These documented meetings were the place where the contractor could raise items that needed clarification or direction. In these meetings, TxDOT and HDR personnel could also request specific details on how the Developer was approaching some kind of issue-specific issues.

a.6. Improper Communication

[12.46] The main challenges for communication were: (1) "to make sure that proper people communicate at the proper level" and (2) "that information was disseminated down to the lower levels" in order to keep consistency across the project. In the beginning, most communication occurred within the same level. There were exchanges of information at higher levels that did not flow down to the lower levels, and information exchanged at the lower level was not communicated to the top.

[12.51] On preconstruction activities, TxDOT personnel is accustomed to having a consultant working directly for them. Therefore, they (TxDOT) "constantly come over and talk to our consultants directly, giving them directions in some cases there, without our knowledge." The Developer's team has tried to warn its consultants about this, but they "still find out after the fact that a representative of TxDOT called in one of our guys over here, and set up … a meeting, and we find about it after that."

a.7. Other Communication Challenges

[6.12] The main difference regarding how the PM is organized for this CDA contract lies in the interaction between different project activities (e.g., ROW, utilities, environmental, design). In the traditional model, these activities are usually performed sequentially by different consultants. For instance, ROW used to begin when all design was complete. In this project, consultants in different technical areas need a high level of interaction to support the concurrency in the process.

[7.14] On this project, the Developer wanted to take the minimalist bottom line approach in meeting the contractual obligations, but TxDOT and the PM stated, "We set higher standards in the contract, and these standards are not necessarily the same as what [the Developer is] used to, so [the Developer group is going to] step up to meet those needs." In these situations, there is always a push and pull between the Owner's team and the Developer, and the communication becomes more challenging. Sometimes the communication "breaks [down] and sometimes people just are not willing to accept it." The interviewee reported that some people left the project because they could not fit into the nontraditional environment of this CDA. The interviewee believes that the Developer should understand that the Owner's team is not forcing them to do too much, only what is in the contract requirements.

[8.30] Communication has been challenged by virtue of the fact that there are numerous people working on the project. Because engineering is not an exact science, there will not be absolute answers. Therefore, there is a need for negotiation and compromise to resolve problems. For this project, there are many operating procedures, including an established plan for safety, a plan for change management, and one for inspection. Because personnel think that it will take a lot of time to get a decision from a large bureaucracy, they do not communicate. However, the interviewee believes that these established plans and procedures sped up the decision making process.

[10.19] Another issue that arose was that at a certain point the communication within the design/preconstruction consultants had to go through the director of this function. However, this person was quite busy and difficult to contact. Therefore, the project gave more authority to the deputy director, who acted as substitute when needed.

[11.15] This project has numerous entities, making it difficult to keep them informed. States an interviewee, "If you've got a problem, you almost have to call a meeting [with] … ten people … [so] you've got ten people trying to [find a common] schedule. If you've got a problem today and you cannot solve it today, you can't wait until two days from now to get together to have meeting."

[8.31] Single point of contact: The biggest difference in CDA and DBB projects is the advantage of having a single point of contact. "The Owner has one contract to bring design, ROW acquisition, construction, and project maintenance to the table. This single point of contact simplifies the contracting process, reduces the staff on the Owner side tremendously. It greatly simplifies the contract administration process in those respects."

[10.20] Single point of contact: In this project, the Developer represents the single point of contact for TxDOT on all the disciplines, including design, construction, ROW, and environment. In DBB delivery method, TxDOT deals with several entities for each discipline. Therefore, on DBB projects communication will be more complicated than on CDA-DB projects. In DBB projects, the contractor will communicate with TxDOT about day-to-day activities; in this project, there will be daily internal communication between different disciplines within the Developer's team, but not within TxDOT.

b. Comments Pertaining to Design Activities

b.1. Co-location

[1.18] On the design side, the co-location of project parties presents advantages and disadvantages. Co-locating project parties offers advantages in terms of communication. Being co-located with the PM function allows TxDOT to have necessary expertise at the local level, while in traditional projects this expertise is delivered to the project through TxDOT. This advantage would be most evident in projects based in more peripheral areas such as Lubbock and El Paso. Conversely, co-location presents a few disadvantages that can be critical to the design team setup. First, delivering personnel to the project can be problematic, especially if the design firm does not have an established local presence. Second, once the design team is established, a set of operating procedures must be defined in order to allow consistency throughout the design process. The interviewee underscored that the last problem would not exist if the design team was not co-located. In fact, normally design teams would operate in their own environment using established operating procedures.

b.2. Information Technology / Information Management

[12.47] Regarding drawing management, the Owner "anticipates the use of Bentley ProjectWise for drawing management" and required that the "Developer's file structure, file naming convention, and accommodation of reference files shall be compatible with ProjectWise." An interviewee initially complained about the Owner's team's expectations with respect to drawing management: "What they expected us to do was not the requirement in the contract and … [it] would cost us money to implement, and so we did implement [it], and there was a lot of frustration from that point of view. They said they wanted the right anytime to come to our design files and look at any file that is in progress and be able to comment on that. And we … are not providing that access, we … provide the files [upon completion and they can put their] review comments on [them]." However, the same interviewee recognized that the adoption of ProjectWise was very helpful because it helped the Developer maintain consistency throughout the work of a design team of more than 200 designers.

b.3. Operating Procedures

[9.18] In this project, the Developer has implemented an electronic files integration system. They use Microstation-Geopak for producing design files. Project Wise software tracks the versions of the files so that no one is able to pull the file and make changes on it without the design personnel's awareness. After the schematic design is completed for grading and drainage, the design team pulls together all these files and the Developer sits down with the PM and TxDOT representatives and discusses which elements should be included and which should be excluded. From these types of meetings evolved the detailed quality control check list for the design team. Similarly, in other fields of design, such as structures, the same type of meetings with the Owner and Developer's construction personnel helped design personnel understand what type of design would be easy to build. This helped solve constructability issues of the project.

[12.48] Design Task Protocol: In order to overcome the short-circuiting of communication between Owner and subcontractors, LSI management constantly reminds its design subcontractors of contract requirements, and that anytime subcontractors need a criterion above the contract requirement, they need to discuss it with the design manager. If a decision is made on this issue, they need to communicate it to the different segments. To achieve this, the Developer implemented a tool that was critical for internal communication: the design task protocol. Basically, anytime "they came up with an agreement… a design task protocol was developed, and then that was issued to all the roadway designers so that they knew, 'Ok, I always have to use this type of criteria when design in this type of scenario.'"

b.4. Meetings

[9.16] For this project, there are TWGs for structural, pavement, tolls, aesthetic, utility, drainage, roadway, design etc. A TWG is composed of all the stakeholders pertaining to a certain discipline. They have meetings on an established schedule. The purpose is to get all stakeholders together to make decisions. An initial success was that LSI "brought all stakeholders in together and really worked through initial design criteria issues."

[12.49] In order to circulate information generated during the TWG at the lower levels, TWG minutes are recorded and distributed. If during the meeting there is an issue to address concerning established procedures, a design task protocol is issued. Otherwise, if it results in the DBH to the design criteria, TxDOT then issues a DBH notice that, for instance, says "'Okay, instead of using a 55 mile-per-hour design speed here we are going to use 45,'" and that would be issued under a DBH and communicated back to everybody.

[12.50] Within the design component, the TWGs were broken down into structures, utility, and roadway groupings.

b.5. Improper Communication

[5.13] The interviewee noted two problems regarding communication. First, he pointed out that at the TxDOT/HDR level there is some miscommunication between construction and design personnel. He noted that at times construction personnel undermine design decisions in the field. Second, he said that sometimes HDR and DMJM (or its subcontractors at specialty levels) work on a solution only to later find out that LSI has decided on a different approach.

[8.32] In this project, there is lot of short-circuiting of communication. The PM's staff often talks directly with design subcontractors regarding technical issues. This can be problematic if that communication results in a financial loss to the developer. Thus, the PM is always careful to avoid direct communication with Developer's subcontractors if it results in a financial loss. However, this project is large and complicated, so it is very difficult to avoid having direct conversation with the Developer's subcontractors.

c. Comments Pertaining to Environmental Activities

c.1 Information Technology/Information Management

[7.15] The PM's team developed two applications for field inspections that work on personal digital assistants (PDAs), one for the environmental and the other for the construction inspections. TxDOT decided not to use the template for the environmental version. However, the interviewee said that because there are so many people in the field, it would be more simple and efficient to use a standardized recording process. Using the template version for environmental would help re-synthesize the site records in the office.

c.2. Meetings

[3.18] There are several meetings related to the environmental activities, as follows:

- Status Meeting:
    - When: Every Monday
    - Who: TxDOT, Hicks, LSI design, HDR, and FHWA
    - Topic: Weekly status, and current issues
    - Description: This is an internal meeting smaller than the TWG for environmental, during which the key players participate. This group of meetings is critical for communication.
- TWG for Environmental:
    - When: Biweekly on Wednesdays
    - Who: TxDOT, Hicks, Environmental Affairs Division, LSI design, and HDR
    - Topic: Environmental activities

- Description: This meeting involves all entities interested in environmental activities and is critical to keep everybody aware of issues and to stay at the same speed. Environmental affairs division personnel attend these meetings. This obviates the need to send documentation to the division by bringing the division into the process. However, applying this approach to a project based outside of Austin would be more difficult.

- Project Overview Meeting:
    - When: Biweekly on Wednesdays
    - Who: All of the Owner's team (TxDOT and HDR disciplines) except junior staff
    - Topic: "Big picture" of the project
- Other meetings:
    - Biweekly on Tuesdays: TxDOT, Hicks, LSI construction, Raba-Kistner, and HDR environmental and construction.
    - Biweekly on Wednesdays: Environmental component of the Owner's team with the project director; oriented to resolution of issues.
    - Monthly: TxDOT environmental component within the Owner's team and environmental affairs division; delivers a project update to the division and discusses internal TxDOT procedures.

[10.23] In this project, TxDOT and the PM's staff always sit together in meetings with the Developer. While they both can have different opinions about issues, TxDOT always "wins the battle."

c.3. Improper Communication

[7.16] In traditional projects, the environmental subcontractor (the ECM) will be invisible to the PM, but in the SH-130 project, the contract has explicitly stated that the environmental subcontractor must have two levels of communication. One level is comprised of direct communication with the PM regarding compliance-related issues, and the other is comprised of communication with the Developer. Therefore, any direct communication between the ECM's staff and the Owner's team is not a short-circuiting of communication and occurs due to contractual provisions. Nonetheless, the interview believes that generally the ECM leans more towards the Developer.

[10.25] In this project, short-circuiting happens most of the time. The ECM has the dual responsibility of reporting to the Developer, as well as to TxDOT, but sometimes TxDOT comes to the ECM and gives specific directives. This is not problematic because the ECM's staff is aware of what information should be passed on. Before passing the information off to relevant personnel, all staff should be cautious about information flow. However, personnel have become accustomed to the complicated communication environment of this huge project over time.

c.4. Other Communication Challenges

[10.9] A problem for project communication involves the environmental and design teams. The design quality control function of the Developer does not have any person dedicated for the environmental aspect. The reason is that all the environmental work was initially the responsibility of the ECM function. "The quality control of design was a design function, so there was nobody assigned on the design team for environmental QC." This was one of the most challenging communication issues between the ECM and the design group, DMJM.

c.5. Other Communication Aspects

[3.19] The communication flow with resource agencies such as the U.S. Army Corps of Engineers, Texas Commission on Environmental Quality (TCEQ), and Texas Historical Commission (THC) pass through TxDOT excluding "some exceptions where Hicks (ECF) can talk to the Corps for minor issues and clarifications." These exceptions were needed because the ECF was concerned that part of the information could be misinterpreted if communicated through the Owner's team. A deviation letter was issued to allow the ECF to contact the Corps for specific issues related to submittals, if they have a question, or if they want to know how they should package a submittal. The Owner's team was very successful in expediting communication with all resource agencies, including the Corps, TCEQ, and THC. This was achieved by communicating project needs in a way that allowed for maintaining a positive relationship. "For example, offering to drive up to Fort Worth to go meet with the Corps … we went there on a couple of occasions just to explain and sit down face to face instead [of using] the phone … and say, 'This is our process, this is what we are doing, this is what we would like you to consider to review in 15 days.'"

[3.21] Communication with divisions: The SH-130 project has developed different procedures to manage the Environmental Permits Issue and Commitments (EPIC) sheets that dictate how the project will manage environmental issues. Traditionally, the environmental staff at a project level must submit these sheets to the design division that checks and approves them. In the SH-130 project, "The EPIC sheets are actually incorporated as the design progresses, so the design division never gets involved. They have the opportunity to come in on our design, but they don't actually require that we submit the EPIC sheets."

d. Comments Pertaining to ROW/Utilities Activities

d.1. Information Technology/Information Management

[6.11] While working on the SH-130 project, HDR manages a dedicated software system (eManager). In the SH 45 SE project, TxDOT requires the input of data directly into its system (ROWIS). This could create a problem because external consultants will not be allowed to input data directly into the system, and TxDOT will need more staff for that purpose. For instance, TxDOT wants to export data in eManager (the SH-130 system) to ROWIS, but lacks personnel to achieve this task. Moreover, eManager is designed to work as a project tracker and ROWIS is not. Therefore, the SH 45 SE project team will still need a project tracker. A good idea would be to have an initial workshop that helps the PM's IT staff understand the TxDOT system and to enable the design of project software systems that are compatible.

[12.52] ROW/Utility tracker: The two contract parties are using two different trackers, but these two systems are able to import each other's data.

d.2. Operating Procedures

[2.19] Components of the ROW process, including the paperwork flow, approval processes, and maintenance of checks and balances necessary to assure compliance, are subject to a very quick turnaround. In the CDA process, ROW personnel had 10 days to approve an acquisition package. Consequently, it was imperative that ROW personnel be very well trained and ready to begin the process immediately without a training period.

[2.20] The SH-130 project takes advantage of expanded signature authority that allows the turnpike team to adopt a streamlined ROW process. Because TxDOT ROW managers are authorized to process some of the paperwork at the project office instead of sending it to the ROW division, the entire process has been expedited. On the traditional DBB projects, a ROW manager cannot incorporate some of the more expedient processes developed for the SH-130 project because of the absence of that waiver.

[2.21] The ROW division has been very responsive for all the turnpike team's needs, and they are always available for review and input.

[6.14] The allocation of responsibilities to HDR staff was much clearer for SH-130 than that outlined for the SH 45 SE project. This is because they did not need to go through the ROW division (on SH-130) due to an agreement between the turnpike ROW manager and the division. When needed, this manager consulted directly with the division (sole point of contact). Therefore, HDR solved any problem by interacting with TxDOT turnpike employees. In the SH 45 SE project, the interviewee thinks the division interaction will increase and thereby slow down the process.

d.3. Meetings

[6.15] Having weekly meetings within ROW and with design and environmental groups has been very beneficial. Conversely, the interviewee believes that LSI does not work as a team and its components act without synergy.

d.4. Improper Communication

[6.8] The LSI team had a problem regarding how they were structured. Initially they had a director of preconstruction who oversaw ROW, utility, environmental, and surveying issues. The director did not have experience with respect to ROW and utility issues and was also overloaded. His desk became a bottleneck in the process because he (and LSI) initially wanted direct oversight over their subcontractors without allowing the PM's staff to communicate directly with them. This barrier to communication was later eliminated and the organization was modified by grouping it under the design and preconstruction purview. The interviewee believed that a project the size of SH-130 would need a person dedicated only to ROW and utility issues (with expertise in this field), especially if the Developer were to want to maintain control of subcontractors.

d.5. Other Communication Challenges

[6.16] HDR staff had many communication problems with the TBE Group, LSI's subcontractor for utilities. Early in the project, TBE did not alert HDR to the meetings they were having. Although the interviewee understands that TBE did not want the Owner to be privy to discussion regarding monetary details of their agreements, he believes that the meetings could have been structured so that Owner representatives attended the initial portion of the meeting and then left when the discussion turned to financial matters.

[11.8] Areas of major concerns for the Developer's organization are ROW and utilities. These areas include too many variables that are out of the control of the Developer and TxDOT to make their performance predictable. For example, when ROW is purchased through condemnation, the amount of time and decision of the court cannot be predicted. And with respect to utilities, if a major entity such as SBC Communications, Inc. must be approached, there may be a problem obtaining SBC's cooperation, because even with the Developer paying the cost of the relocation, these entities are still sometimes unmotivated. Because that effort is not financially beneficial, relocation work is a low priority job for utilities.

e. Comments Pertaining to Construction / Project Controls Activities

e.1. Information Technology / Information Management

[4.25] The PM's staff has developed a method of managing field inspections on this project called the Inspection and Material Management System (I2MS). This database management system helps transfer field inspection data from the CQAF to TxDOT and to process the information easily. It also helps to verify the Owner's verification testing with the CQAF's result. On traditional projects, verification of test data and material management is cumbersome because it is generally carried out manually.

[12.54] Construction Division Material Section (CSTM): Traditionally, the CSTM of TxDOT performs testing services for material approval. The inspectors of CSTM visit construction plants, test the process, and put the approval stamp on produced material when they find the material good enough for use in construction. Onsite TxDOT inspectors do not have to visit the plant; they only have to see whether the material has the CSTM stamp. TxDOT tried to implement the CSTM system in this project, but they had a hard time integrating it into the Developer's system. CSTM has a specific way of functioning, and it becomes difficult to get test results on time when they try to modify it. Another problem is that HDR, who is responsible for oversight of the CQAF, could not access the CSTM test report because only TxDOT employees can log into this system and retain the information.

e.2. Operating Procedures

[4.26] In this project, parties are operating effectively in the gray area of specifications, because the Developer has the flexibility to submit revisions to standard specifications, and TxDOT can ask for clarifications on them. If TxDOT does not accept the Developer's suggestions, they can reject them. In some instances, the Developer came up with some very good specs modifications. TxDOT has streamlined the process and made its expectations very clear.

[11.16] The CQAF uses the Electronic Lab Verification Information System (ELVIS) for testing activities. This system was developed by CQAF firm. Data is input to this system daily and then sent to TxDOT or the PM. Data is uploaded to I2MS by the PM's staff.

[12.55] The role of the Developer's project control function includes gathering information on a monthly basis to update the overall master schedule. Moreover, the department monitors costs regarding labor, equipment, and project subcontractors. Monitored activities include construction operations that are performed without being subcontracted. Finally, the department also analyzes trends versus baselines.

[12.56] In terms of project control, the Developer provides TxDOT with two updates on a monthly basis. First, there is the monthly draw request for the recognition of the Developer's earnings wherein they identify percent complete for each activity and determine the earned value. There is then is a monthly schedule update that provides the schedule performance update versus the project baseline.

e.3. Improper Communication

[8.33] In this project, it is specifically stated in the contract that PM may talk directly to construction quality assurance, design quality assurance, and environmental compliance manager's firms. Therefore, short-circuiting of communication is not problematic if it does not result in a financial loss to the Developer. However, the PM reminds these firms of their independence: "We specifically feel sometimes that we have to take those folks aside and say, 'Good job, we are behind you, stand up for what is right, you are performing your scope.'"

e.4. Other Communication Challenges

[4.27] Early on in this project, a challenge to communication was the fact that the field change requests issued were not getting to the field quickly enough. To avoid this pitfall, the Developer should be sure that if they want to change the plan and have it reviewed by TxDOT, the Developer needs to send it to the guys in the field as soon as possible so that field inspection can inspect the work according to that plan. Commenting on the importance of this process, one interviewee explained, "Probably the biggest problem we have out here … is making sure that it's a design-build not a build-design job."

Appendix B: Initial Implementation Framework

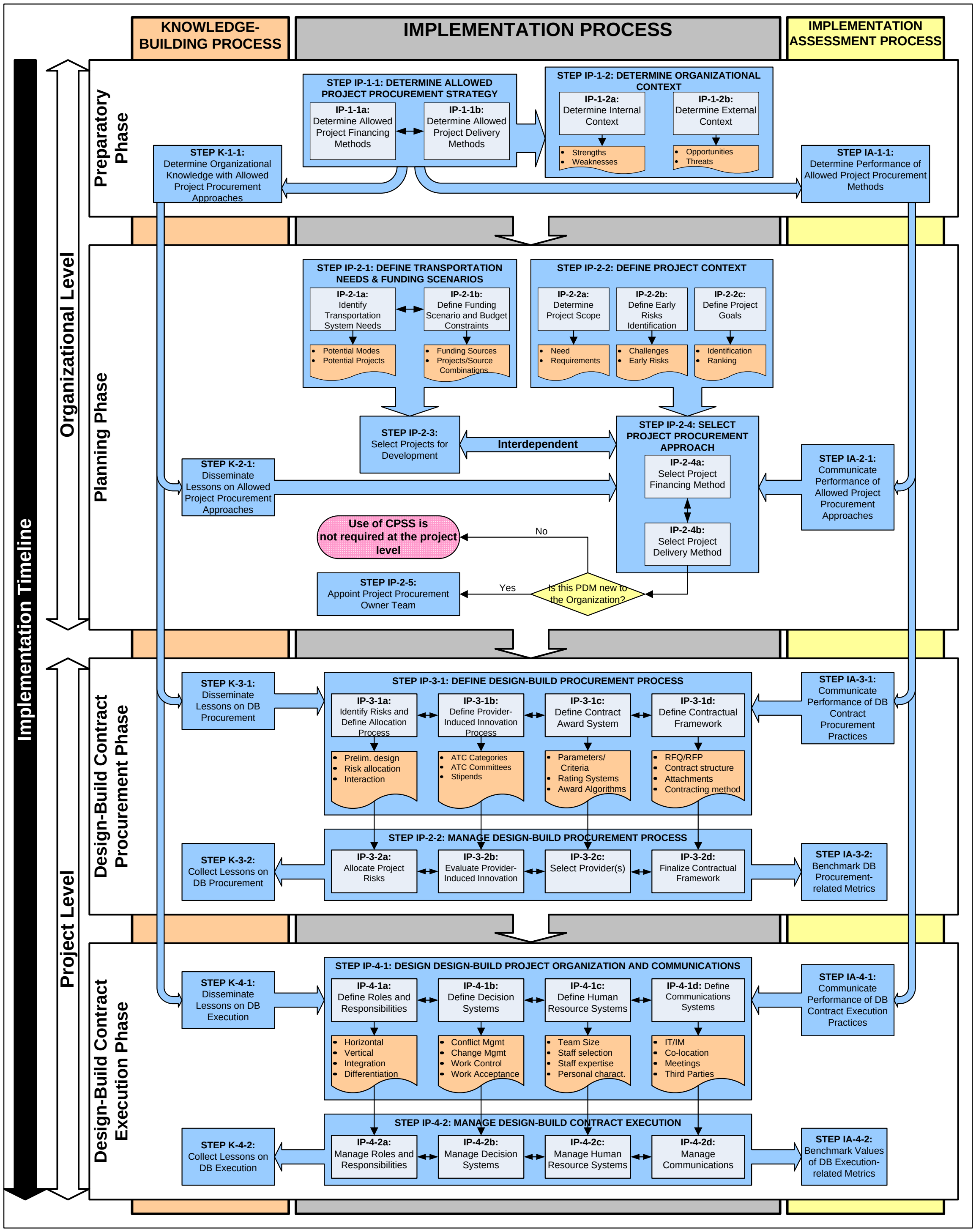

Figure B.1: Initial Implementation Framework.

PHASE 1: PREPARATORY PHASE

STEP IP-1-1: Determine Allowed Project Procurement Strategy

This step aims to identify the sets of project finance methods (sub-step IP-1-1a) and project delivery methods (sub-step IP-1-1b) allowed by the regulatory framework (e.g., federal and state legislation) and pursued by the state agency. This information can be visualized as a matrix tool indicating the compatibility of each pair of delivery and finance method.

STEP IP-1-2: Determine Organizational Context

During this step, organizational actors analyze both the STA's internal and external context. In sub-step IP-1-2b, the analysis of the external environment (i.e., provider market, local governmental entities, regulatory agencies, public outreach, etc.) focuses on identifying opportunities and threats to the implementation of each of the methods identified in step IP-1-1. Similarly, sub-step IP-1-2a aims at producing a comprehensive analysis of the internal organizational context (i.e., organizational structure, existing operating procedures, etc.) with a focus on strengths and weaknesses of implementing each of the methods identified in step IP-1-1.

STEP K-1-1: Determine Organizational Knowledge with Allowed Project Procurement Approaches

During this step, a list of available organizational knowledge sources is compiled to inventory a project's allowed project procurement approaches - both explicit (e.g. reports, knowledge repositories, etc.) and tacit (e.g. people). This knowledge-base can be organized in the form of an organizational memory database and can include lessons learned, organizational expert contact lists, and literature on topics related to the implementation effort.

STEP IA-1-1: Determine Organizational Performance with Allowed Project Procurement Approaches

This step aims to identify the available data on the overall and organizational performance of each of the allowed project procurement approaches. Internal and external benchmarking of the implementation effort will be based on these data. The internal benchmarking is based on the STA's historical performance while the external benchmarking is based on other organizations' performance. Available data can be tracked using a performance benchmarking tracking database. This database and the knowledge-base mentioned in step K.0.1 can constitute an information system supporting the implementation effort.

PHASE 2: PROJECT PLANNING PHASE

STEP IP-2-1: Define Transportation Needs and Funding Scenarios

This step aims to identify the transportation infrastructure needs of individual or collective (corridor) projects. This step also looks at constructing funding scenarios and determining budget constraints for potential projects.

STEP IP-2-2: Determine Project Context

This step focuses on identifying the project requirements, developing the project scope, defining project objectives and goals, and determining specific potential challenges to the project through an early risk identification effort (e.g. technical, environmental, public outreach, local government, involved parties etc.), and defining project objectives and goals.

STEP IP-2-3: Select Projects for Development

This step ranks and selects projects for development. If funding is a main concern, this phase must be performed simultaneously with the selection of the project procurement approach.

STEP K-2-1: Disseminate Knowledge on Allowed Project Procurement Approaches

This step facilitates the selection of project procurement approach by disseminating knowledge on allowed project procurement approaches. If the state agency established an organizational repository, this step is automatically performed.

STEP IA-2-1: Communicate Performance with Allowed Project Procurement Approaches

This step aims to communicate the expected performance of the allowed project procurement approaches in order to facilitate the selection of a project procurement approach. These expectations can be based on industry knowledge and/or organizational historical data.

STEP IP-2-4: Select Project Procurement Approach

This step aims to select the procurement approach for the project at hand. Planning officers use information from the preparatory phase (STEPS IP-1-1 & IP-1-2) and from other planning activities (STEPS IP-2-2 & IA-2-1) to make this decision. If there is a broad array of project procurement approaches available, the project selection phase may be tied into the process of selecting the project procurement approach. In such cases, the project procurement approach is selected depending on a compatible match between a state agency's budget and the project finance method; however, the viability of a specific project finance method is often dependant on the project delivery method. If the selection of a project (STEP IP-2-3) is based on a high expectation of private funding, planners need to incorporate flexibility into the project procurement approach in order to allow private parties to propose a financial framework during the procurement phase.

STEP IP-2-5: Select/Appoint Management for Project Owner Team

This step aims at selecting and appointing a project management team with the task of initiating and conducting the procurement phase. This team should be led by an individual with expertise that matches the project challenges. The team should also include at least one individual familiar with the selected procurement approach. The team is often constituted by STA officers, and legal, and technical consultants.

PHASE 3: DESIGN-BUILD CONTRACT PROCUREMENT PHASE

STEP K-3-1: Disseminate Knowledge on Contract Procurement under Selected Project Procurement Approach

This step aims at disseminating knowledge on the selected project procurement approach in order to develop the procurement process. If the state agency established an organizational repository, procurement officers can consult this knowledgebase during the design of the procurement process.

STEP IA-3-1: Communicate Performance of Procurement Practices under Selected Project Procurement Approach

During this step, the procurement officers have access to information on the performance metrics of different procurement practices. This performance information can be used to design the procurement process according to the project goals. For instance, if there is time pressure, procurement practices that streamline the procurement phase are preferable. On the other hand, if fair competition is critical for the specific situation, procurement officers can design a process that embeds traditional safeguards.

STEP IP-3-1: Define Procurement Process

During this stage, the procurement team needs to define the procurement process, including the activities, their sequencing and durations, and their outcomes. Defining this step's four sub-processes is required for identifying the procurement process.

Sub-Step IP-3-1a: Identify Risks and Define Risk Allocation Process

During this step, the procurement team completes the risk identification initiated in step IP-2-1, and defines a process for allocating risks between contracting parties. First, the necessary preliminary engineering information - both design and surveys data - needs to be obtained to evaluate project risks. When a high risk is expected to be taken by the provider, the procurement team should increase interaction with prospective service providers during the risk allocation phase (IP-3-2a). To minimize confusion, disputes, and litigation, the procurement team needs to define a risk allocation strategy for assigning risks to the party that can best control them.

Sub-Step IP-3-1b: Define Provider-Induced Innovation Process

This step identifies the process for regulating provider-induced innovation during the procurement phase. Issues such as payment of stipends to unsuccessful service providers, and alternative technical concepts (ATC) are discussed and defined at this point.

Sub-Step IP-3-1c: Define Contract Award System

This step identifies the system for selecting the provider and awarding the contract. Procurement officers should select a system that allows them to pursue the project goals as defined in Step IP-2-1. For instance, if the project goals are broad and diversified and a best-value system is preferred, then the procurement team will identify the selection parameters, the corresponding evaluation criteria, the rating systems, and the award algorithms (illustrated in the AASTHO Design-Build Procurement Guide) in order to measure each proposal's agreement to the project goals.

Sub-Step IP-3-1d: Define Contractual Framework

The procurement team will also identify and define the legal and procedural documentation required to support the procurement process. This documentation includes packages for the request for qualifications (RFQ) and requests for proposal (RFP) advertisements, and preliminary engineering information (depending on the risk allocation strategy defined in IP-3-1a). If the state agency develops a master contract for the newly established project procurement approach, procurement officers need to customize this document to the project context; this customization involves contracting approaches at hand and producing a draft contract to be inserted in the RFP package.

STEP IP-3-2: Manage Procurement Process

The procurement team manages the three previously defined groups of activities. Both lessons learned and procurement-related data prompt the knowledge-building and the implementation assessment processes for the procurement phase.

Sub-Step IP-3-2a: Allocate Project Risks

During this step, the procurement team interacts with prospective service providers in outlining an allocation of risks to be embedded in the contractual language. The rationale is to assign risks to the party that can best control them. Tools such as the risk allocation matrix described in the AASTHO Design-Build Procurement Guide help standardize the process.

Sub-Step IP-3-2b: Evaluate and Manage Provider-Induced Innovation

During this step, Owner technical committees evaluate and approve provider-induced innovative concepts (e.g., value-additive or cost-savings). Thus, prospective service providers are allowed to include these innovations in their proposals and to receive cost credit from cost-savings innovations and technical credit from value-additive innovations.

If allowed by the state regulatory framework, the state agency can “acquire” ownership on innovations from unsuccessful service providers by paying them for the work performed (e.g. stipends).

Sub-Step IP-3-2c: Select Provider

This step evaluates and selects a provider according to the contract award method previously identified. This step can include one or more steps for evaluation and eventual short-listing of prospective service providers.

Sub-Step IP-3-2d: Finalize Contractual Framework

At this stage, procurement officers can embed information developed during the previous steps (risk allocation and provider-induced innovation) into the contractual agreement with the selected provider.

STEP K-3-2: Collect Lessons Learned on Contract Procurement during Current Project

At the end of the procurement phase, the STA project management team compiles lessons learned during the procurement effort for the benefit of future implementations.

STEP IA-3-2: Benchmark Organizational Performance on Procurement-related Metrics during Current Project

This step, performed at the end of the procurement phase, aims at computing a set of procurement related metrics to allow for the internal and external benchmarking effort.

PHASE 4: CONTRACT EXECUTION PHASE

STEP K-4-1: Disseminate Knowledge on Contract Execution under Selected Project Procurement Approach

This step aims to disseminate knowledge on the selected project procurement approach in order to support the design of both the project organization and communications structure. If the state agency establishes an organizational knowledge repository, procurement officers can consult this knowledge-base during the design of the project organization.

STEP IA-4-1: Communicate Performance of Contract Execution Practices under Selected Project Procurement Approach

During this step, the STA project management team has access to information on the performance metrics of different contract execution practices under the selected project procurement approach. This performance information can help ensure that the project is organized according to the project goals. For instance, if time is of the essence, the control and acceptance decision systems that streamline the project execution can be chosen by using these performance metrics. On the other hand, if a "zero violations" environmental compliance policy is in place, project management officers can design project organization structures and system in order to better meet this goal.

STEP IP-4-1: Design Project Organization and Communications Structures

This step aims to design the project organization and outline its channels of communication. This phase is introduced at this point of the process because the owner group can design its team according to the selected provider team. Designing the owner project organization any sooner could impede innovation by the prospective service providers or could affect objectivity by owner evaluators (i.e., owner team members may tend to prefer proposals that assign more authority to their roles). Designing the project organization affects both the structures and systems necessary for monitoring the contract execution. Communication channels also need to be regulated to ensure that information flows to the proper levels; by regulating the communication flow, rework loops are avoided, and potential for conflicts is lowered. This step will benefit from organizational knowledge and performance data on contract execution.

Sub-Step IP-4-1a: Define Roles and Responsibilities

This step aims to develop roles and responsibilities between the extended project team (both owner and provider) members. Both horizontal (i.e., inter-functional) and vertical (i.e., hierarchical) structures of responsibilities need to be designed to create an optimal environment for communications and execution. At this stage, it is necessary to address the issues of differentiating/integrating activities between project functions and/or physical components of the projects (i.e., segments or sections). If full integration is not needed, interdisciplinary workgroups can be created to support complex decision-making; these situation-specific structures can be managed through specially designed communication and decision systems (IP-4-1b & IP-4-1d). Finally, there is a need to establish boundaries and/or overlapping areas of responsibility between hierarchical levels and between different contract parties.

Sub-Step IP-4-1b: Define Decision Systems

During this step, the contract parties must define operating procedures for managing conflict (e.g. formal partnering, issue escalation ladders, etc.) and project changes (e.g. cost-affecting, schedule-affecting, value engineering, etc.). Systems to regulate control and acceptance of work performed also need to be established.

Sub-Step IP-4-1c: Define Human Resource Systems

This step delineates the STA project management team in terms of member appointment criteria (expertise and personal characteristics) and team size. Additionally, systems for appraisals and recognition of expert STA officers need to be studied in order to ensure that their participation in the implementation effort is rewarded.

Sub-Step IP-4-1d: Define Communication Systems

During this step, the STA project management team defines the systems needed to communicate with the provider team. Early issues to be analyzed are the possibility to “co-locate” the contract parties in order to facilitate communications and to endorse a partnering team approach. In addition, systems to communicate periodically on project development, such as meetings and shared information technology and management systems, need to be agreed upon by the parties and put in place. Another issue of concern is the communication protocol with third parties (i.e., regulatory agencies, local government entities, utilities and railroads.

STEP IP-4-2: Manage Contract Execution

During this final, but essential step, the STA team monitors the project progress and the effectiveness of the four previously defined structures and systems. Lessons learned and execution-related data prompt the knowledge-building and the implementation assessment processes during this phase.

STEP K-4-2: Collect Lessons Learned on Contract Execution

During the contract execution phase, STA project management officers compile lessons learned on contract execution for the benefit of future implementations.

STEP IA-4-2: Benchmark Organizational Performance on Execution-related Metrics

This step establishes an ongoing effort during the contract execution phase, and aims to compute a set of contract execution–related metrics to allow for the internal benchmarking effort.

Appendix C: Case Studies

C.1. Sample Interview Guide for Phone Interview

Research Background

This interview is related to an ongoing research project that the Center for Transportation Research / University of Texas at Austin is conducting on behalf of TxDOT.

Interview Purpose

Gather information about design-build projects around the country with focus on contract procurement and contract administration practices.

Information Use

- Document and analyze your project practices and lessons
- Compare with other case studies
- Further develop and validate a framework, currently at the conceptual level, for implementing a change in project delivery strategy by State Transportation Agencies

Permission to record interview and interviewee anonymity

Because I want to be sure this report is as accurate as possible, I would like to ask your permission to tape-record this interview.

This also allows us more time for dialogue and minimizes the time required for written notes. You can choose to discontinue the recording at any time during this interview, and/or to request that portions of it not be used in any way. The confidentiality of this interview will be maintained and your identity will in no way be linked to the specific data provided, unless I ask your permission first. In addition, data will not be placed in any permanent record, and will be destroyed when no longer needed by the researchers. I would like to thank you in advance for the time and effort involved in your participation for this study.

Section A: Respondent Background Information

(A.1) Name (Last, First):

(A.2) Organization/Company name:

(A.3) Project:

(A.4) Role of your organization on this project (check all that apply):

☐ Owner ☐ Right-of Way Agent ☐ Contractor ☐Academic Institution

☐ Design Consultant ☐ Utility relocation Agent ☐ Program Manager ☐ Other: Click to insert

(A.5) How many years have you worked in the construction industry?

(A.6) Your areas of expertise (check all that apply):

☐Planning ☐Right-of Way ☐Environmental Permitting ☐Operations ☐Contract Procurement

☐Design ☐Utility relocation ☐Environmental Compliance ☐Maintenance ☐Other: Click to insert

(A.7) Please identify your direct experience on different sides of a project contractual framework.

Project Delivery Method	***Type of Projects***	***Personal Experience***	
	(i.e. buildings, highway, transit, etc.)	*Number of years*	*Number of projects*
Owner			
Designer			
Contractor			
Other: Click to insert			
Other: Click to insert			

(A.8) Please identify your direct experience (i.e. management, supervision or research investigation) with different project delivery methods.

Project Delivery Method	***Type of Projects***	***Personal Experience***	
	(i.e. buildings, highway, transit, etc.)	*Number of years*	*Number of projects*
Design-Bid-Build (DBB)			
CM at Risk (CMAR)			
Other: Click to insert			
Other: Click to insert			
Other: Click to insert			

(A.9) Please briefly describe your history on this project. When did you start (time and project phase)?

(A.10) What is your role on the project team?

Section B: Design-Build Implementation

(B.1) Did the project outsourced some project service that the owner was used to self-perform?

(B.2) Was some of these services procured through the design-build contract?

(B.3) Was the financing scheme new to the owner? Please describe it.

(B.4) Was the owner new to design-build?

(B.5) Why did the owner decide to consider using DB to deliver this project?

(B.6) Do you think the DB method was successfully implemented on this project?

(B.7) Please list and rank important overall factors that affected (or are believed to affect) a successful implementation of DB on this project:

Factors	***Rank for Importance***	***How this factor affect success***
Click to insert factor	Click to rank (1-5)	Click to provide your comments
Click to insert factor	Click to rank (1-5)	Click to provide your comments
Click to insert factor	Click to rank (1-5)	Click to provide your comments
Click to insert factor	Click to rank (1-5)	Click to provide your comments
Click to insert factor	Click to rank (1-5)	Click to provide your comments

(B.8) Please list and rank main overall barriers encountered in implementing DB on this project:

Barriers	***Rank for Importance***	***Key actions to overcome this barrier***
Click to insert barrier	Click to rank (1-5)	Click to suggest key action(s)
Click to insert barrier	Click to rank (1-5)	Click to suggest key action(s)
Click to insert barrier	Click to rank (1-5)	Click to suggest key action(s)
Click to insert barrier	Click to rank (1-5)	Click to suggest key action(s)
Click to insert barrier	Click to rank (1-5)	Click to suggest key action(s)

Section C: Design-Build Contract Procurement Phase

(C.1) What amount of design was provided in Request for Proposals?

(C.2) Can you describe processes for identifying, mitigating, and allocating risks (if any)?

(C.3) Can you describe the process for evaluating Alternative Technical Concepts (if any)?

(C.4) Can you describe the process for evaluating Technical Proposals (if any)?

Section D: Design-Build Contract Administration Phase

(D.1) Can you describe the partnering process (if any)?

(D.2) Can you provide approximate staff numbers at peak (owner, owner consultant, design-builder components)?

(D.3) Were project parties colocated in the same office?

(D.4) Can you describe the process for controlling work development (if any)?

(D.5) Can you describe the process for work acceptance (if any)?

(D.6) Can you describe tools that were implemented on this project for managing information and facilitating communications?

(D.7) Can you describe different aspects of communications (Formal, Informal, with third parties)?

Section E: Additional Questions

(E.1) Independently from the adoption of the design-build method, please suggest

- Some major innovations implemented on this project
- Some major challenges encountered on this project

(E.2) Promotion of design-build knowledge and culture

- Did the owner organization promote organizational learning on design-build?
- How?

(E.3) Measurement of DB implementation effectiveness

- Did the owner organization implement a program to evaluate success of DB implementation?
- How success of the DB implementation was measured?

C.2. SAMPLE FOLLOW-UP QUESTIONNAIRE

- Please review and complete following information on scope of work:

  <Table with pre-collected information on key elements of scope of work (if any available)>

- Please review and complete information on project parties:

  < Table with pre-collected information on project parties (if any available)>

- Please review and complete the following table with information on firms submitting Statement of Qualifications in response to a RFQ:

  < Table with pre-collected information on firms responding to the RFQ (if any available)>

- Please review and complete the following table with information on project milestones. When not applicable, please mark items as NA. If unknown leave blank.

  < Table with pre-collected information on project milestones (if any available)>

- Please review and complete the following table with information on ATC submittals:

  < Table with pre-collected information on ATC submittal (if any available)>

- Please review and complete the following table with information on proposal information (cost and technical ratings):

  < Table with pre-collected information on proposals evaluation (if any available)>

- Please review and complete the following table with financial information at DB contract award date:

  < Table with pre-collected information on proposals evaluation (if any available)>

- Please review and complete the following table with changes to financial plan (if any) following the DB contract award date:

  < Table with pre-collected information on changes to financial plan (if any available)>

- ❖ Please review and complete the following tables with information on change orders and value engineering:

  <Table with pre-collected key information on change orders (if any available)>

  < Table with pre-collected key information on change orders (if any available)>

C.3. CASE STUDIES

C.3.1. Case Study No.1: State Highway 45 Southeast Project

In the first case study, the author analyzed procurement activities and documentation for the $154 million contract for the State Highway 45 Southeast (SH-45 SE) tolled expressway. Several individuals involved in the procurement were also interviewed. This project was procured by the Austin district of TxDOT in 2004. The project scope includes design, right-of-way acquisition, and construction services for the delivery of 7 miles of new highway segments in the Austin metropolitan area. It was chosen because it is the second application of the DB method by TxDOT (after their initial SH-130 effort). The procurement of this DB contract was managed by personnel within the Austin district. In addition, a joint team between TXDOT (Austin district) and a Program Manager (i.e., HDR, Inc.) was appointed for managing the contract administration. Findings from this case study were used for developing the procurement process model that is described in Chapter 5.

In August 2004, Zachry Construction Corporation was awarded the $154 million DB contract for this project. Project goals were not stated in the RFP documents, but interviewees identified the following objectives as key for the choice of the DB approach: (1) Reduce delivery duration, and (2) Obtain early price certainty. After the contract was awarded, TXDOT issued the Notice to Proceed, but the execution of this project was slowed in Spring 2005 to conduct additional environmental studies. The Federal Highway Administration approved the revised environmental report in June 2006. Construction activities are expected to begin in mid-2007.

After collecting information on this project, the importance of the knowledge-building process in overcoming internal resistance to change and the lack of knowledge about the design-build process in the department could be confirmed. The experience of the SH-130 project team was very beneficial to the SH-45 SE procurement staff members, who often consulted key SH-130 personnel to help them identify improvements to the process. The SH-45 SE procurement process was adjusted to make it more efficient. Following this rationale, SH-45 SE procurement staff shortened the duration of the procurement phase and the preparation of the Request for Proposals (RFP) package; this was, however, partially achieved because private financing and maintenance options were not included in the SH-45 SE tendered contract as they were in the SH-130 contract.

C.3.2. Case Study No.2: Transportation Expansion (T-Rex) Project

As a second case study, information on the Transportation Expansion (T-REX) Project in the Denver metropolitan area was collected. This project is a multi-modal corridor project involving drainage and safety improvements and lane expansions on 17 miles of highway segments, construction of 19 miles new double track light rail lines, 13 new rail stations, and a new transit maintenance facility. The T-REX project is managed by a partnership between the Colorado Department of Transportation (CDOT) and the Denver Regional Transportation District (RTD). Whereas some components of the T-REX project were delivered using the design-bid-build method, new track lines and highway improvements were delivered using a design-build (DB) contract for the amount of $1.19 billion. Focusing on the DB component of the project, the author collected information on this project by analyzing project documentation and interviewing a project representative. It was found that during the planning phase, CDOT and RTD decided to join their forces to design and build transit and highway elements together. This agreement was formalized under an Intergovernmental Agreement (IGA). In the same way, the Federal Highway Administration (FHWA) and the Federal Transit Authority (FTA) signed an Interagency Agreement to jointly oversee corridor delivery activities. The four agencies (CDOT, RTD, FHWA, and FTA) also constituted an "executive level project team," which established the project goals in November 1999, as follows:

- to minimize inconvenience to the public,
- to meet or beat the total program budget of $1.67 billion,
- to provide for a quality project, and
- to meet or beat the schedule to be fully operational by June 30, 2008.

Using these objectives, owners were able to assess the overall success of the project during its life-cycle. These expected objectives were readjusted after contract award to include the expected September 1, 2006 completion date proposed by the selected design-build entity.

An important step for the implementation of DB is to identify what the owner believes represents a successful implementation. For the T-REX project, establishing the project objectives provides a way to assess the implementation during the project life cycle. According to the interviewed project representative, this project met all objectives. An additional aspect to assess was how different project parties were reacting to the new approach and if cultural barriers were affecting the project outcome. To this end, a survey was periodically distributed to project teams and functional groups. Responses to this survey were compiled in a partnering report that was delivered to the project director. This practice helped "understand how well the culture aspect was going." In addition, performance on different project practices (i.e., field design changes, RFI under DB) was assessed and changes were implemented when needed. This approach to performance assessment contributed to the T-REX project's winning of the Malcolm Baldridge Award by the Colorado Performance Excellence community (CPEx).

A main factor that facilitated successful implementation of DB was the decision to co-locate owners, federal agency representatives, and the DB contractor. According to the T-REX project interviewee, co-location benefited this project in three ways. First, having parties co-located allowed for more frequent communication as compared to percentage-based submittals (e.g., 30 percent complete design submittals). Therefore, this practice comports with the desire for speed that originally prompted the adoption of DB. Second, a DB contract requiring a provider delivering multiple project services and/or components necessarily involves a higher level of coordination among project teams. Co-location provided an environment that fostered this needed coordination. Finally, co-location allowed all contractual parties to establish the cooperative approach necessary to achieving the pre-established common project goals. This environment facilitated the implementation of the DB approach by overcoming many cultural barriers between organizations.

The project team also encountered several barriers related to organizational culture, complexity of project framework, and education of third-party agencies. Initially, the implementation of a new delivery approach for the T-REX project was hindered by cultural barriers. According to the T-REX project interviewee, these barriers were mostly small, but a main barrier to overcome was the traditional style of thinking that assumes an adversarial relationship between owner and industry provider. Without strong stance by the T-REX project leadership, that approach would have slow down the project and create claims, costs, and problems on a daily basis.

In addition, the interviewed project representative believed that the T-REX project was successful because owner top management (i.e., CDOT headquarters and

RTD board members) allowed the project directors to achieve the pre-established project goals within the master budget. While top management still provided executive-level direction when a problem occurred, they delegated most of the decisions to the project leadership. One of the rare instances in which top management needed to be involved was for the approval of a $17 million change order. Because cost of this change order significantly affected the initially allocated project contingency, this decision was taken to the executive director level for final approval. This type of relationship with executive management provided both the freedom to act that is necessary for these projects and the executive-level support behind such important decisions.

The T-REX project representative believed that a key to this project's success was the project directors' ability to educate and involve some of these parties; once they had bought in to the process they could understand the pace of project development under the new approach and were not inclined to block it. Yet in spite of this cooperation the interviewee reported that "we had some near critical path delays related to that specific problem." A successful application of this lesson was the collaboration with one of the most significant local authorities, the city and county administrations of Denver, which all recognized the project's need for speed. They actually provided two staff members who were co-located with the T-REX project team.

When implementing a change in delivery strategy, the owner should promote organizational learning of the new approach within its own organization. CDOT promoted organizational learning in three different ways. First, they facilitated communications among different project teams that were implementing DB. For instance, T-REX project representatives reached out to CDOT officers on the COSMIX project (i.e., about $150 million highway project in Colorado Springs) to help them develop project procurement (i.e., draft the request for proposals) and to help them implement the DB method over the life of the project. Second, a small group was established within CDOT to collect knowledge on innovative contracting methods and to implement them on smaller scale projects. The third way CDOT promoted organizational learning was by developing a Design-Build construction manual.

C.3.3. Case Study No.3: I-405 Kirkland Stage 1 Project

As a third case study, the author analyzed documentation and interviewed a project representative for the I-405 Kirkland Stage 1 project. This project was procured by Washington State DOT (WSDOT) in 2005 and includes design and construction for adding about 4.4 lane miles and reconfiguring an interchange to the I-405 corridor in the Seattle metropolitan area. It was chosen because its DB contract will deliver a critical component of a larger corridor project, the $12 billion I-405 corridor. The delivery of this corridor is managed by a joint team between WSDOT and a General Engineering Consultant (GEC). This team was headed by HNTB with additional consultants provided by HDR and Parsons PTG. At peak, the joint team includes about 100 individuals.

The Kirkland Stage 1 project is managed by a project team of nine staff members under the supervision of a WSDOT project engineer. In October 2005, Kiewit Construction Company was awarded the $47.5 million DB contract for this project. The project goals were established in the RFP documents, as follows:

- Quality of Design and Construction
    - Deliver the Project on time and within budget.
    - Meet or exceed technical quality requirements for design and construction, and provide evidence that all quality assurance and quality control requirements have been met.
- Maintenance of Traffic

    - Minimize inconvenience to the public and maximize safety during construction through effective phasing and staging of the work.
    - Provide seamless coordination with the I-405 Totem Lake/NE 128th Street HOV Direct Access project.
    - Open completed and logical sections of the new lanes on I-405 to the traveling public as soon as possible.
- Environmental Compliance and Innovation
    - Avoid and minimize impacts to natural resource through design and during construction.
        - Avoid or minimize temporary impacts to wetlands through construction methods and sequencing.
        - Avoid or minimize other in-water impacts through construction methods and sequencing.
    - Begin construction and installation of the wetland mitigation for the Kirkland Nickel project prior to, or concurrently with, project impacts to wetlands.
    - Meet or exceed environmental requirements and have no permit violations.
- Public Information and Community Involvement
    - Maintain community support during design and construction.

On this project, WSDOT adopted several innovative approaches. First, using the WSDOT-GEC joint team for managing the project over its life (from the environmental planning all the way through the contract administration) was an innovative approach for the organization.

In addition, owner, the owner consultant and the design-builder were co-located on the I-405 Kirkland Stage 1. According to the I-405 project interviewee, co-location contributed to project success in two ways. First, it facilitated communications between project parties, and, second, it promoted partnering.

According to the I-405 project interviewee, WSDOT used an innovative approach to gain acceptance from local permitting agencies. In order to streamline permitting on highway projects (not only DB projects), the state of Washington recently promoted a multi-agency permitting team (MAPT); this team included representatives from several permitting agencies, including the Washington Department of Transportation, the Washington Department of Ecology, the Washington Department of Fish and Wildlife, the U.S. Army Corps of Engineers, and later King county. As a result, WSDOT only had to submit a single permit application to all these agencies. This practice helped the communication and coordination between WSDOT and these permitting agencies.

In addition, the adoption of a "context sensitive solution" process is believed to promote acceptance of change initiatives and to build trust with the local agencies. Using this approach, WSDOT promoted the appointment of advisory committees that included representatives from all the local agencies and from the public living in the I-405 corridor. These advisory committees took part into the development of all the static elements of the project.

An additional approach was used by WSDOT to promote acceptance of the change initiative by industry providers. The agency and the local chapter of the AGC together appointed a DB policy team that was in charge of developing a master for the procurement and contractual documentation. This approach helped build consensus on the change initiative. In addition, it helped promote participation of local firms in the procurement process because the contract was based on a mutually agreed upon allocation of risks.

WSDOT also promoted organizational learning of the DB approach by creating at the headquarters level an innovative contracting office during the early implementation phase. WSDOT staff affiliated with this office collected and distributed knowledge on innovative contracting approaches, collected lessons learned on the implementation, developed internal policies on the newly adopted delivery methods, and offered training to other WSDOT units by means of publications and workshops. Therefore, the role of capturing knowledge was managed at headquarters level through this unit. A drawback to this approach is that lessons learned at the project level may be lost or may not reach other individuals on the same project.

C.3.4. Case Study No.4: I-5 HOV Everett Project

As the fourth case study, the author analyzed documentation and interviewed a project representative for the I-5 High Occupancy Vehicle (HOV) project in Everett, Washington. This contract was procured by WSDOT in 2005 and involves design and construction for adding about 16.6 lane miles of HOV lanes to the I-5 corridor. This case study project was chosen because its DB contract is being managed by a decentralized regional unit in Everett.

In September 2006, the HOV Everett project was managed by a project team of twenty-one staff members under the supervision of a WSDOT chief project engineer. This team includes thirteen WSDOT employees allocated to the project, two consultants, one representative of the City of Everett and a varying number of individuals (both WSDOT and FHWA) with a part-time commitment to the project. At peak the owner project team included twenty-six FTE. In October 2005, a joint venture between Guy F. Atkinson, and CH2M Hill was awarded the $185 million DB contract for this project. The project interviewee identified the following objectives as key for the choice of the

DB approach: (1) Reduce delivery duration to guarantee opening to traffic by 2009, and (2) Minimize the number of WSDOT personnel (the agency workforce was stretched out over three large infrastructure programs).

The project goals were established in the RFP documents, as follows:

- deliver the project within budget,
- achieve substantial completion by December 1, 2008 or sooner,
- achieve quality of design and construction equal or better than traditional design-bid-build,
- provide a safe construction site for workers and the traveling public,
- meet or exceed environmental requirements and expectations with no permit violations,
- foster confidence with the environmental permitting community in the design-build process,
- manage traffic to minimize disruption and inconvenience to the public during construction, and
- maintain community support during design and construction.

As for the other project procured by WSDOT, the I-5 HOV Everett project confirmed many of the SH-130 observations concerning co-location, leadership action, and communications with industry providers and other local actors. It also provided additional insight into specific implementation activities and knowledge-building processes across the implementation phases.

Appendix D: Delphi Study

D.1. Invitation Letter for Participating in the Delphi Validation

Subject: Invitation to Participate in Delphi Forum

Topic: Changing Project Procurement Strategy - An Implementation Framework for the Transportation Project Sector

Dear <<Title of Expert, Last Name of Expert>>:

In response to an increasing demand for new capacity, several transportation agencies (TAs) are evaluating alternative procurement approaches, including Design-Build among others, for delivering infrastructure projects. However, as recognized by the U.S. Department of Transportation owners "not accustomed to this method of procurement can find it difficult to oversee these types of projects." As a result, TA employees and consultants are spending extensive amounts of time experimenting and developing new organizational routines to support these procurement change initiatives.

Researchers affiliated with the Center for Transportation Research (CTR) and the Center for Construction Industry Studies (CCIS) at the University of Texas at Austin are performing a study that seeks to address the problem of implementing a change in project procurement strategy. We would like to invite you as to participate in a Delphi forum on this topic.

Considering your professional commitment to the transportation project sector, we believe that your participation in this study will prove to be interesting and rewarding. Therefore, we would encourage you to participate in this effort. The relevant details regarding the Delphi exercise are provided in the following pages for your information and reference. We expect that 30 to 40 key representatives from transportation agencies, consulting firms and academic institutions will participate in this exercise and that by way of your participation, you will benefit from the contribution made by other experienced individuals from these parties around the country. We will, of course, provide you with feedback from the results as the project is completed. Any information you provide as part of this study will remain confidential in accordance with the CTR guidelines. We look forward to your participation and request that you indicate your willingness to participate, by answering to this email. If you have any further questions, please do not hesitate to contact the research team at (512) 923-8681 or e-mail to gcmigliaccio@mail.utexas.edu.

Sincerely,

Giovanni C. Migliaccio, MSCE

Ph.D. Candidate in Civil Engineering at the University of Texas at Austin

Prof. James T. O'Connor, Ph.D., P.E.

Director for the Center for Construction Industry Studies at the University of Texas at Austin

Prof. G. Edward Gibson Jr., Ph.D., P.E.

Research Director for the Aging Infrastructure Systems Center of Excellence at the University of Alabama

D.2. STATEMENT OF CONSENT FOR DELPHI PARTICIPATION

Title: Changing Project Procurement Strategy - An Implementation Framework for the Transportation Project Sector

Conducted By:

Giovanni Ciro Migliaccio of University of Texas at Austin

Department: Civil, Architectural and Environmental Engineering Department

Office: ECJ5.402A

Telephone: +1(512)923-8681

You are being asked to participate in a research study. This form provides you with information about the study. The person in charge of this research is also available to describe this study to you and answer all of your questions. Please read the information below and ask any questions you might have before deciding whether or not to take part. Your participation is entirely voluntary. You can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. You can stop your participation at any time and your refusal will not impact current for future relationships with UT Austin or participating sites. To do so simply tell the researcher you wish to stop participation. The researcher will provide you with a copy of this consent for your records.

The purpose of this study is to address the problem of implementing a change in project procurement strategy. This Delphi exercise proposes to further develop and validate a framework, currently at the draft level, for implementing a change in project procurement strategy by TAs. This framework, when fully developed, can serve as an effective basis for identifying how to: (i) transfer organizational goals for procurement change initiatives into project practices; (ii) establish new organizational routines supporting these change initiatives; and (iii) help owners in planning them.

If you agree to be in this study, we will ask you to do the following things:

- ❖ Respond to the first Delphi questionnaire and submit your responses to the researchers (about 60 minutes)
- ❖ Read the summary of responses provided by other panelists, respond to the second Delphi questionnaire and submit your responses to the researchers (about 60 minutes)

Total estimated time to participate in this study includes 120 minutes over next three months.

Risks of being in the study:

There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. If you wish to discuss any concerns you may arise, you may ask questions at any time by calling the Researcher listed on the front page of this form. It is very important for us to learn your opinions.

Benefits of being in the study include the possibility of sharing your views on the topic of implementing a change in project procurement strategy with industry peers. We expect that 30 to 40 key representatives from transportation agencies, consulting firms and academic institutions will participate in this exercise and that by way of your participation, you will benefit from the contribution made by other experienced individuals from these parties around the country. In addition, after completion of all rounds, we will send you a summary of the results, as well as the final report when it is complete.

Compensation:

Your participation in this study is completely voluntary and does not include any compensation.

Confidentiality and Privacy Protections:

- ❖ The confidentiality of this survey will be maintained and your identity will in no way be linked to the specific data provided, unless we ask your permission first. Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. In addition, data will not be placed in any permanent record, and will be destroyed when no longer needed by the researchers.
- ❖ All publications will exclude any information that will make it possible to identify you as a subject. Throughout the study, the researchers will notify you of new information that may become available and that might affect your decision to remain in the study.

Contacts and Questions:

If you have questions about the study, want additional information, or wish to withdraw your participation call the researcher conducting the study. His name, phone number, and e-mail address are at the top of this page.

D.3. DELPHI ROUND 1 DISTRIBUTION EMAIL

To: <<Title of Expert, Last Name of Expert>>

From: Giovanni Ciro Migliaccio, the University of Texas at Austin

Subject: Changing Project Procurement Strategy – An Implementation Framework for the Transportation Project Sector

Reference: Email correspondence dated <<date>>

Dear <<Title of Expert, Last Name of Expert>>:

I want to thank you for agreeing to be one of the expert panelists. Your participation in this study is greatly appreciated.

To date 35 individuals have accepted the invitation to participate in this Delphi panel and are receiving this email.

Two versions of the questionnaire are available:

- A Microsoft Word (DOC) file allows you to fill the questionnaire in a computer and save your responses (email submittal),
- An Adobe Acrobat (PDF) file allows you to print the questionnaire (fax or mail submittal).

Please return your response to me by September 29, 2006. Information for returning the questionnaire is included in the covering letter. If you need any further information, please do not hesitate to contact me at (512) 923-8681 or e-mail to gcmigliaccio@mail.utexas.edu

Thanks in advance.

Sincerely,

Giovanni Ciro Migliaccio, MSCE

D.4. DELPHI ROUND 1 INFORMATION PACKET

Research Background

For decades, transportation agencies (TAs) have conducted a large part of their project delivery activities using a single delivery method procurement strategy. This strategy delivers capital projects by combining Design-Bid-Build (DBB) project delivery with financing methods that are based mostly on direct state appropriations and federal-aid grant programs. Recently, TAs have begun evaluating several alternative delivery methods that integrate the delivery of more services under the umbrella of fewer service providers. This trend is increasing as impediments in federal and state laws, regulations, and practices are removed; its momentum has resulted in the diffusion of multiple delivery method procurement strategies used by agencies across the United States.

This strategic shift in transportation project procurement approach is a response to several environmental drivers, principle among which are an increasing demand for new capacity and the financial limitations of existing public programs. Indeed, most of these alternative methods, including Design-Build, are often recognized for their benefits in both reducing project delivery time and consequently making alternative financing options available. Because the use of alternative delivery methods demands the development and implementation of several practices associated with project delivery (e.g., delivery method selection procedures, contracting approach customization, contract award systems development, project control procedure establishment, etc.), a change in project procurement strategy constitutes, for many agencies, a paradigm shift away from their normal operating procedures.

This Delphi exercise proposes to further develop and validate a framework, currently at the draft level, for implementing a change in project procurement strategy by TAs. The Changing Project Procurement Strategy (CPPS) implementation framework, developed with this exercise, intends to assist transportation agencies in implementing this change by providing a map of decisions significant to the new scenario. The problem of implementing such change has two main dimensions: (1) at the organizational level, the increase of delivery options provides challenges and opportunities to TA decision-makers; (2) at the project level, once a new delivery method has been selected there is the need to identify practices for its implementation. Thus, the proposed framework is divided into two levels to help TAs manage and regulate the implementation process and to provide project-induced input for organization-wide changes.

The organizational level tries to identify new decision paths originated from the change while the project level component is intended to be used repetitively on a project-by-project basis until the agency becomes familiar with the newly introduced project procurement approach. Additionally at the organizational level, TA personnel must both define the organizational project procurement strategy/process for identifying target projects and develop corresponding project procurement approaches. At the project level, if a project procurement approach new to the agency has been selected, the TA project team must also implement the new approach. Consequently, the project level implementation depends on the selected project delivery method. In the proposed framework, this level focuses on the implementation of the Design-Build (DB) delivery method and follows this method's cycle (i.e., DB contract procurement and DB contract execution). The project-level implementation process can, however, be customized to implement other delivery methods.

List of Acronyms

CPPS	Changing project procurement strategy
TA	Transportation agency
DBB	Design-bid-build

DB	Design-build
DBM	Design-build-maintain
CMAR	Construction management at risk
IP	Implementation process
K	Knowledge-building process
IA	Implementation-assessment process

Delphi Method Overview

The Delphi method will be used to validate and provide expert feedback on the Changing Project Procurement Strategy (CPPS) implementation framework developed for helping owner organizations in planning and implementing procurement change initiatives. The Delphi method was developed by researchers at the RAND Corporation in the 1960s for structuring a group communication process to deal with complex problems that do not lend themselves to precise analytical techniques. Delphi applications have evolved over the years, providing a method that involves significantly less effort by the participant than, for example, participating in an expert panel. Whereas this method serves as an effective mechanism for creating a dialogue among the participants, it also provide an opportunity to learn from other participants, and help the researchers build consensus on the necessary steps in the CPPS implementation framework. The Delphi exercise, in addition to be designed to minimize the time you may have to devote, offers several potential benefits, as described in the following paragraphs.

The first round, involving steps 1 and 2, is scheduled to begin in late August, 2006 and end after 30 days. This round will require around 60 minutes of your time. During this first round of the exercise:

1. You will receive a questionnaire instrument divided in five sections. Sections B, C, D and E include the architecture of the CPPS framework. They also include a short response protocol with about 25 statements concerning the various issues pertaining to the proposed CPPS framework. You will provide your rating of the argument in each statement — on a 1 to 7 scale, with any supporting explanation you may wish to provide. In addition, you are invited to list (a) important factors affecting the success of the implementation effort, (b) main barriers encountered or expected during project procurement change initiatives, and (c) key activities to be performed during the implementation process. At least 20 other professionals in the industry will also receive the same material as you, and you will be given a synthesis of their comments and the recommendations on the CPPS implementation framework.
2. Researchers will compare and analyze responses from all informants including yours.

The second round, involving steps 3 & 4 will be conducted over the months of October, and November 2006. This round will require around 60 minutes of your time. During the second round of the exercise:

1. You will receive a summary of the modified CPPS implementation framework, and a synthesis of responses from other informants. You will be required to compare those to your own response. This will serve as an opportunity to revisit and possibly change your response, by completing another response protocol similar to the previous one.
2. The Delphi process normally ends when there is sufficient agreement among all participants, on various aspects of the approach proposed by the research team. If the responses from participants differ significantly from each other, another round will be

conducted. Based on our knowledge of this methodology, we expect that two rounds will be required. Any subsequent round, if required, will be conducted over the months of December 2006, and January 2007.

After completion of all rounds, we will send you a summary of the results, as well as the final report when it is complete.

D.5. DELPHI ROUND 1 QUESTIONNAIRE

Please answer the questions in the following sections to the best of your knowledge. Your detailed responses will allow us to understand to what extent the architecture of the proposed CPPS framework addresses concerns on project procurement strategy changes.

Your validation of the proposed framework will include the rating of multiple statements on a one to seven point Likert scale where one represents "Strongly Disagree" and seven "Strongly Agree." Please note that your written comments in addition to your numeric ratings will assist us and the other experts on the panel to fully understand your perspective. Your comments are encouraged especially if you choose to rate a statement with a score of three (option "Conditionally Disagree"), four (option "Neutral"), or five (option "Conditionally Agree"). In these cases, an explanation of your "condition" is required. In addition, you are invited to identify (a) important factors affecting the success of the implementation effort, (b) key processes to be performed during the implementation process, and (c) main barriers encountered or expected during project procurement change initiatives. If not enough space is available for your comments, please feel free to attach extra sheets as necessary.

The questionnaire is divided into five sections: (A) Background information; (B) Project procurement definitions endorsement; (C) Assessment of affecting factors and barriers; (D) CPPS implementation framework validation; and (E) Overall assessment. Sections B, C, D, and E seek your direct feedback on the proposed CPPS framework.

The confidentiality of this questionnaire will be maintained and your identity will in no way be linked to the specific data provided, unless we ask your permission first. In addition, data will not be placed in any permanent record, and will be destroyed when no longer needed by the researchers. We would like to thank you in advance for the time and effort involved in your participation for this study.

Please return this questionnaire via email, by fax, or by mail to the following address:

Giovanni C. Migliaccio
The University of Texas at Austin
Civil Engineering Department ARE/CEPM/ICAR
1 University Station C1752, Austin, Texas 78712-0276
Email: gcmigliaccio@mail.utexas.edu
Phone Number: (512) 923-8681
Fax Number: (512) 471-3191

Section A: Background Information

A.1) Your name :____

A.2) Organization/Company name: __________________________________

A.3) Current position/title: _____________________________________

A.4) Role of your organization (check all that apply):

☐ Owner ☐ Right-of Way Agent ☐ Contractor ☐ Academic Institution
☐ Design Consultant ☐ Utility relocation Agent ☐ Program Manager ☐ Concessionaire
☐ Other: ______________________________

A.5) How many years you have worked in the construction industry?

Number of years: ____________

A.6) Your areas of expertise (check all that apply):

☐ Planning ☐ Right-of Way ☐ Environmental Permitting ☐ Operations ☐ Contract Procurement
☐ Design ☐ Utility relocation ☐ Environmental Compliance ☐ Maintenance ☐ Project Management
☐ Other: ________________

A.7) Please identify the approximate total dollar value of projects that you were directly involved in (i.e. management, supervision or research investigation):
$ __________ million

A.8) Please identify below your direct experience (i.e. management, supervision or research investigation) with different project delivery methods.

Project Delivery Method	**Personal Experience (approximate numbers)**	
	Number of years	***Number of projects***
Design-Bid-Build (DBB)		
CM at Risk (CMAR)		
Design-Build (DB)		
Design-Build-Maintain (DBM)		
Other:		
Other:		

Section B: Definition Endorsement

This section includes definitions of several concepts related to changing project procurement strategies. Please devote sufficient time to read and understand these definitions as you will also be asked to endorse these definitions and/or provide your feedback on them.

In the context of this study, a broad concept of project procurement is adopted. According with this approach, ***project procurement*** *is the acquisition process leading up to the purchase of good and services needed for the delivery of a project*. This process may include several activities including: identifying a need, specifying the requirements to fulfill the need, identifying potential providers, soliciting bids and proposals, evaluating bids and proposals, awarding contracts, tracking progress and ensuring compliance, taking delivery, inspecting and inventorying the deliverable, and paying the supplier.

A ***Project Delivery Method*** *is defined as a system for organizing and achieving the procurement of the different services (e.g., design, construction, right-of-way, utility relocation, etc.) necessary for the delivery of a project.*

B.1) The definition of **project delivery method** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

Project delivery methods can be categorized by both the ***degree to which a transportation agency outsources the different project services****, and the* **degree to which** ***different project services are combined*** *in contractual relationships with project service providers. Combined methods integrate the delivery of more services under the umbrella of fewer service providers (e.g. design-build method) whereas segmented methods separates procurement activities of different services (e.g. design-bid-build method).*

B.2) The framework to categorize a **project delivery method** given above adequately classifies different methods and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Project Finance Method** is defined as a system for providing funds (e.g., direct appropriation, federal-aid grants, private funding, etc.) required for financing a project.*

B.3) The definition of **project finance method** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*Project finance methods can be categorized by the **degree to which private funding is raised** for producing the project.*

B.4) The framework to categorize a **project finance method** given above adequately classifies different methods and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*Anecdotal evidence leads one to believe that the **degree to which private funding is raised depends on the project delivery method.** Public owners are believed to attract more private funding if (a) they outsource more project services and if (b) they integrate the delivery of these services under the umbrella of fewer service providers.*

B.5) The above statement (Part a) is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

B.6) The above statement (Part b) is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

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*A **Project Procurement Approach** is defined as the combination of project delivery method and project finance method adopted for a specific project, as illustrated in Figure 1.*

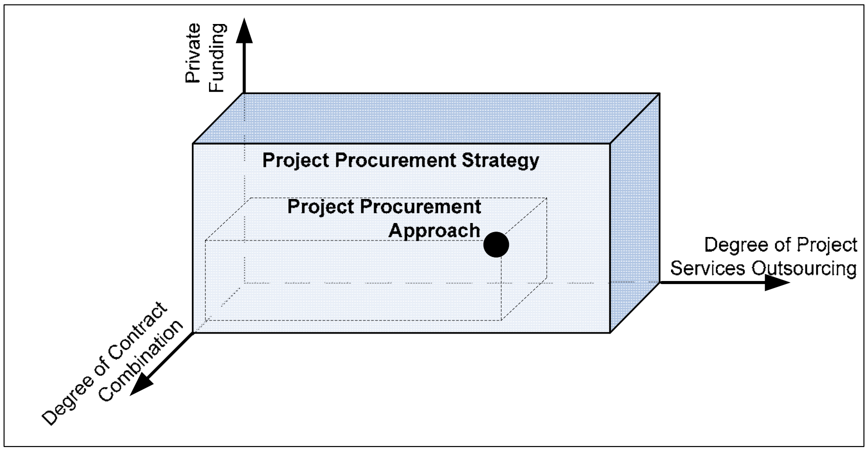


Figure 1 - Project Procurement Approach

B.7) The definition of **project procurement approach** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Project Procurement Strategy** is defined as the set of project procurement approaches allowed by the agency's regulatory and institutional environment and pursued through specific actions. As illustrated in Figure 1, this set can be represented as the region of possible combinations of delivery method and financing option.*

B.8) The definition of **project procurement strategy** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Change in Project Procurement Strategy** is defined as the broadening of options in project delivery and financing options, as illustrated in Figure 2.*

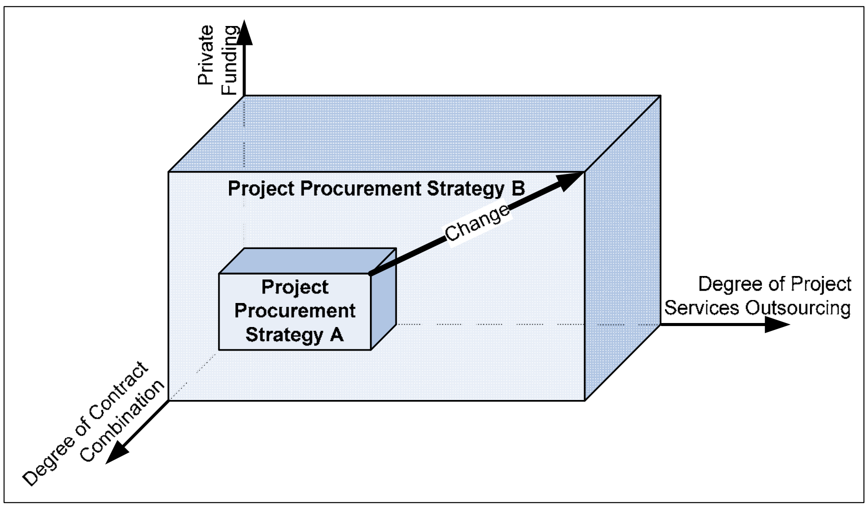


Figure 2 - Project Procurement Strategy Change

B.9) The definition of **change in project procurement strategy** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Project Procurement Process** includes a combination of four systematic actions necessary to prepare for the execution of a project: (a) the allocation of project risks between owner and provider (regulated by the risk allocation process); (b) the management of interaction with providers for promoting innovation (regulated by the provider-induced innovation process); (c) the selection of project providers (regulated by the contract award method); and, (d) the establishment of contractual relationships between parties (regulated by the contractual framework definition process).*

B.10) The definition of **project procurement process** given above adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Contract Award Method** (or procurement method, or evaluation method) is defined as a system for selecting the provider of a tendered project service (i.e., design, construction, etc.) or component (i.e., road segment A, bridge B, etc.). Low bid, Best-value, and Qualification-Based Selection (QBS) are examples of contract award methods.*

B.11) The definition of **contract award method** adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*A **Contracting Approach** identifies specific legal language used under the larger umbrella of a procurement approach to target specific activities or objectives of a project. Examples of contracting approaches include clauses on unit price, lump sum, incentive/disincentive, lane rental, partnering, among many others.*

B.12) The definition of **contracting approach** adequately describes the concept and is meaningful within the context of the transportation project sector.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

Section C: Implementing a Change in Project Procurement Strategy for Delivering Transportation Projects

C.1) Given the information provided beforehand, do you think defining an implementation process is important for the success of a new project procurement strategy?

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

C.2) Please list and rank for relative importance overall factors affecting (or believed to affect) a successful implementation of a change in project procurement strategy:

Factors	Rank for Relative Importance	How this factor affects success

C.3) Please list and rank for relative importance main overall barriers expected in implementing a change in project procurement strategy:

Barriers	Rank for Relative Importance	Key actions to overcome this barrier

Section D: CPPS Framework Validation

This section includes the descriptions of processes and phases constituting the suggested CPPS Framework illustrated in Figure 3. Please devote sufficient time to reading these descriptions since your understanding of the role of the corresponding processes and phases in the implementation framework will help you to judge them and to provide suggestions for improvement.

As illustrated in Figure 3, the proposed CPPS framework is composed of the implementation process (IP) itself plus two supporting processes, the knowledge-building process (K) and the implementation assessment process (IA). The activities of these processes are divided into several phases. The first two phases define the implementation process at the *organizational level* where transportation agency (TA) personnel need to define initially the organizational project procurement strategy, and later to identify projects to be developed through a specific project procurement approach. The next phases define the implementation process at the *project level*, and depend on the specific project delivery method to be implemented. In this proposed implementation process map, the project level includes two phases inherent to a Design-Build delivery cycle (i.e., DB contract procurement and DB contract execution). As the implementation of delivery methods varies, the project-level implementation process can be customized according to the specific delivery cycle.

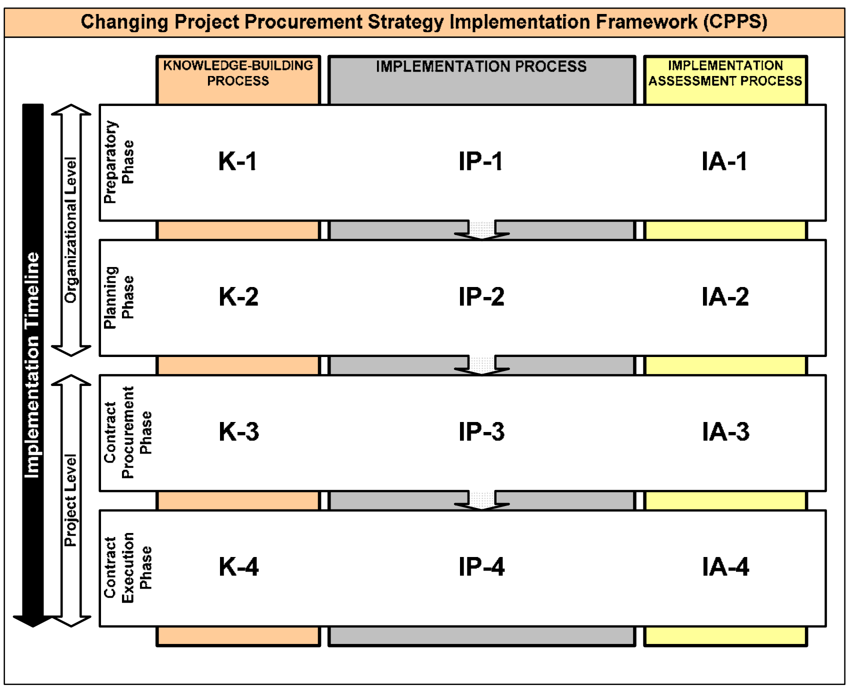


Figure 3 - CPPS Framework

CPPS FRAMEWORK CONCURRENT PROCESSES

*The **CPPS Implementation Process (IP)** is the plan to implement the new procurement strategy beginning from the preparatory phase all the way through the contract execution phase. This process facilitates implementation of the new procurement strategy by: (a) identifying decisions significant to the problem of changing procurement strategy, and (b) aligning project practices with organizational strategy.*

D.1) Given the information provided above, the CPPS-IP process is important to the implementation of a change in project procurement strategy.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*The **CPPS Knowledge Building Process (K)** is the plan to manage knowledge on the new procurement strategy from the preparatory phase all the way through the contract execution phase. This process induces organizational learning by: (a) collecting, verifying, storing and disseminating lessons learned on the implementation effort, and (b) identifying sources of information on newly introduced project procurement approaches.*

D.2) Given the information provided above, the CPPS-K process is important to the implementation of a change in project procurement strategy.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

*The **CPPS Implementation Assessment Process (IA)** is the plan to assess accomplishment of the new procurement strategy from the preparatory phase all the way through the contract execution phase. This process promotes continuous improvement by: (a) providing internal and external benchmarking, and (b) providing feedback on implementation progress to organizational decision-makers.*

D.3) Given the information provided above, the CPPS-IA process is important to the implementation of a change in project procurement strategy.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

ORGANIZATIONAL LEVEL IMPLEMENTATION PHASES

Preparatory Phase: *This phase focuses on identifying information available at the organizational level that can be utilized at the planning and project level for implementing new procurement approaches. The preparatory phase is driven by high-level organizational personnel and has three objectives: (1) to determine if new delivery approaches are available for use, (2) to define organizational project procurement strategy, and (3) to initiate the information loop between organization and project level.*

D.4) Given the information provided above, the CPPS-1 preparatory phase is important to the implementation of a change in project procurement strategy.

☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6	☐ 7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

D.5) Please list key factors affecting the success of the implementation effort during the CPPS-1 preparatory phase (e.g. legislative environment, etc.):

CPPS Process	**Factors affecting the success of the implementation effort (separated by commas)**
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

D.6) Please list main barriers expected during the CPPS-1 preparatory phase (e.g. industry lobbying, etc.):

CPPS Process	**Main barriers to the implementation (separated by commas)**
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

D.7) Please list key activities to be performed during the CPPS-1 preparatory phase (e.g. identification of procurement sourcing of knowledge on new approaches, etc.):

CPPS Process	**Key activities to be performed for the implementation (separated by commas)**
IP-1: Implementation process	
K-1: Knowledge-building process	
IA-1 Implementation-assessment process	

Project Planning Phase: *This phase is performed by organizational-level personnel (i.e., districts and/or divisions personnel) and focuses on identifying transportation needs and constraints, selecting prioritized projects, and making early decisions on the project procurement approach. The project procurement phase led to (1) an initial project procurement approach compatible with both the organizational and the project objectives, and (2) a project management team for initiating and carrying out the procurement.*

D.8) Given the information provided above, the CPPS-2 planning phase is important to the implementation of a change in project procurement strategy.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

D.9) Please list key factors affecting the success of the implementation effort during the CPPS-2 planning phase (e.g. availability of established industry practices, etc.):

CPPS Process	**Factors affecting the success of the implementation effort (separate by commas)**
IP-2: Implementation process	
K-2: Knowledge-building process	
IA-2 Implementation-assessment process	

D.10) Please list main barriers expected during the CPPS-2 planning phase (e.g. organizational culture, etc.):

CPPS Process	**Main barriers to the implementation (separated by commas)**
IP-2: Implementation process	
K-2: Knowledge-building process	
IA-2 Implementation-assessment process	

D.11) Please list key activities to be performed during the CPPS-2 planning phase (e.g. identification of procedures for delivery method selection, etc.):

CPPS Process	**Key activities to be performed for the implementation (separated by commas)**
IP-2: Implementation process	
K-2: Knowledge-building process	
IA-2 Implementation-assessment process	

PROJECT LEVEL IMPLEMENTATION PHASES

Design-Build Contract Procurement Phase: *This phase is performed by project and/or organizational-level personnel and focuses on selecting the project service providers, on allocating project risks, and in establishing the project's necessary contractual relationships. The contract procurement phase led to an established contractual framework between agency and the selected project service provider.*

D.12) Given the information provided above, the CPPS-3 DB contract procurement phase is important to the implementation of the DB delivery method on a project-by-project basis.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

D.13) Please list key factors affecting the success of the implementation effort during the CPPS-3 DB contract procurement phase (e.g. use of professional consultants, etc.):

CPPS Process	**Factors affecting the success of the implementation effort (separated by commas)**
IP-3: Implementation process	
K-3: Knowledge-building process	
IA-3 Implementation-assessment process	

D.14) Please list main barriers expected during the CPPS-3 DB contract procurement phase (e.g. local group lobbying, etc.):

CPPS Process	**Main barriers to the implementation (separated by commas)**
IP-3: Implementation process	
K-3: Knowledge-building process	
IA-3 Implementation-assessment process	

D.15) Please list key activities to be performed during the CPPS-3 DB contract procurement phase (e.g. identification of procedures design-builder selection, etc.):

CPPS Process	**Key activities to be performed for the implementation (separated by commas)**
IP-3: Implementation process	
K-3: Knowledge-building process	
IA-3 Implementation-assessment process	

Design-Build Contract Execution Phase: *This phase is performed by project-level personnel (i.e., project management team) and focuses on monitoring provider performance, managing the contract, making payments for work performed, and accepting the final deliverables. In order to reach these phase objectives, the project management team needs to set up all the project organization-and communications structures necessary for monitoring and assisting the provider during the project delivery. The contract execution phase led to an established project execution framework between agency, the selected project service provider, and other interested parties.*

D.16) Given the information provided above, the CPPS-4 contract execution phase is important to the implementation of the DB delivery method on a project-by-project basis.

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

D.17) Please list key factors affecting the success of the implementation effort during the CPPS-4 DB contract execution phase (e.g. teamwork, etc.):

CPPS Process	Factors affecting the success of the implementation effort (separated by commas)
IP-4: Implementation process	
K-4: Knowledge-building process	
IA-4 Implementation-assessment process	

D.18) Please list main barriers expected during the CPPS-4 DB contract execution phase (e.g. previously established organizational procedures, etc.):

CPPS Process	Main barriers to the implementation (separated by commas)
IP-4: Implementation process	
K-4: Knowledge-building process	
IA-4 Implementation-assessment process	

D.19) Please list key activities to be performed during the CPPS-4 DB contract execution phase (e.g. partnering and conflict management, change management, etc.):

CPPS Process	Key activities to be performed for the implementation (separated by commas)
IP-4: Implementation process	
K-4: Knowledge-building process	
IA-4 Implementation-assessment process	

Section E: Overall Assessment

Proposition I: *The set of proposed definitions is comprehensive and is meaningful to the transportation sector.*

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

Proposition II: *The CPSS framework will be useful for implementing a change in project procurement strategy by providing a structured approach for (a) an organizational-wide change implementation, (b) a project-by-project implementation, (c) an organizational-wide learning process, and (d) an implementation assessment process.*

☐	☐	☐	☐	☐	☐	☐
1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

Comments/Feedback (If any): ____

Given the information provided beforehand, please rank for relative importance the proposed CPPS processes:

Process	**Rank for Relative Importance**
CPPS-IP: Implementation process (page 9)	
CPPS-K: Knowledge-building process (page 9)	
CPPS-IA: Implementation-assessment process (page 9)	

Given the information provided beforehand, please rank for importance the proposed CPPS phases:

Phase	**Rank for Relative Importance**
Preparatory Phase (page 10)	
Planning Phase (page 11)	
Design-Build Contract Procurement Phase (page 12)	
Design-Build Contract Execution Phase (page 13)	

D.6. DELPHI ROUND 1 SYNTHESIS OF RESPONSES

Thirty-five individuals were given the questionnaire at the beginning of September, 2006. Initially, one month was provided for responding the questionnaire with the submittal deadline fixed at September 29, 2006. However, this tentative deadline conflicted with several panelists' schedule. Therefore, the deadline for submittal was extended to the end of October. At the end of this extended period, twenty-six experts had sent in their completed questionnaires, giving the excellent result of a 75% response rate. Delphi panelists are all individuals with considerable industry experience. Table 1 includes information on panel composition. This document reports the salient findings available at this stage of the study. The final report will be a comprehensive analysis of the entire set of data.

Analysis of Quantitative Information

Panelists provided quantitative information with their ratings of (1) project delivery and finance definitions and (2) components of the implementation framework. At the end of the questionnaire, they also provided an overall assessment of these two sets of data. Each element of the questionnaire was rated on a 7 point scale, where a score of 1 = "strongly disagree" and 7 = "strongly agree." Analysis was conducted based on two statistics: mean and inter-rater reliability (IRR). A mean-value of five was set as the threshold of agreement on each element (definitions of framework components). An IRR-value of 60% was set as the threshold for identifying elements with high random measurement-error variance between panelists. Histograms of each element rating were also produced to analyze the distribution of responses.

The analysis of this quantitative information and of the accompanying feedback suggests that:

1. Panelists interpreted some of the terms related to changing project procurement and delivery strategy in different ways. As a result, a wide disagreement on selected concepts among panelists was found (see Table 2). Comments and resulting changes to the terminology are proposed in Table 4 whereas a modified set of definitions is proposed in the Information Packet (D2-Information.doc, pp. 9-11). This modified set will be validated in the second phase of the Delphi study.

2. Panelists widely agreed on the components of implementation framework, but they suggested a simplification of the overall architecture to "a format that is easily comprehended and can easily be applied by the industry" (see Table 3). Comments and simplifications to the framework components are summarized in Table 5. A modified version of the framework will be provided in the final report.

Analysis of Qualitative Information

In addition to rating each item, panelists were asked to provide qualitative feedback on the definitions and on the framework components. They were also asked to suggest (a) success factors, (b) barriers to implementation and (c) implementation activities. Panelists provided a large amount of information, contributing a total of above 1,100 comments (see Table 6 for details).

To thoroughly analyze this rich information, the researchers needed more time than expected. The analysis was conducted with a qualitative research technique known as template analysis. Initially, this involved defining a set of themes emerging from the preliminary research. Later, the researchers read and coded the comments of a sub-set of data (responses on overall success factors and overall barriers to implementation). As a result, an initial template was created by grouping themes that were identified in the selected comments into a smaller number of higher-order codes that describe broader themes in the data.

This template analysis was conducted on the three groups of comments (i.e., success factors, barriers to implementation, and implementation activities). The resulting categories were then compared. As a result, researchers were able to establish that success factors and barriers to implementation mirrored each other in such a way that an absence of success factors was believed to be a barrier to implementation. In addition, most of the implementation activities were related to the occurrence of some of the success factors. Therefore, the three groups of comments were further grouped into 25 themes identifying the success factors, the potential problems from their absence, and a set of potential activities to be performed during the implementation. In the first section of the questionnaire that follows, you are asked to rate for importance these 25 themes. A detailed description of each of these themes is provided in the first section of the enclosed information packet (D2-information.doc).

Table 1: Panel Composition Summary

Average industry experience	22 years
Average total value of projects managed	$2.2 billion
Role of organization	14 owners, 2 design-builders, 6 consultants, 4 academics
Area of expertise of panelists	Planning, ROW, environmental permitting and compliance, operations, contract procurement, design, utility relocation, maintenance, project management, construction, geotechnical engineering, business development, financial, organizational management, public policy, construction and procurement law
Experience with different delivery methods	Design-bid-build (DBB), design-build (DB), CM at risk (CMAR), design-build-maintain (DBM), design-build-transfer-operate (DBFO), design-build-finance-operate (DBFO), design-sequencing (1 individual), pre-development agreement (1 individual)

Table 2: Quantitative Assessment of Terminology and Concepts

#	Item	Mean (*)	IRR (**)
E1	Comprehensiveness and meaningfulness of set of definitions	5.2	77%
B1	Definition: Project delivery method (PDM)	4.9	46%
B2	Definition: Factors differentiating PDMs	5.3	61%
B3	Definition: Project finance method (PFM)	5.5	74%
B4	Definition: Factors differentiating PFMs	4.0	38%
B5	Relationship: Outsourcing and private funding	4.2	27%
B6	Relationship: Contract integration and private funding	4.4	38%
B7	Definition: Project procurement approach=PDM-PFM combination for a specific project	5.0	62%
B8	Definition: Project procurement strategy (PPS) = PDM-PFM combinations available	5.5	86%
B9	Definition: Change in PPS = change in PDM-PFM combinations available for use	4.8	46%
B10	Definition: Project procurement process = Actions for selecting industry providers	5.2	63%
B11	Definition: Contract award method=System for selecting industry provider	5.9	71%
B12	Definition: Contracting approach=legal language to target specific project objectives	5.4	74%

Gray-shaded values identify items lacking panel agreement.
(*) A mean-value of five (on the given 1-7 scale) was set as the threshold of agreement on each definition.
(**) An IRR-value of 60% was set as the threshold for identifying elements with high random measurement-error variance between panelists.

Table 3: Quantitative Assessment of Framework Components

#	Item	Mean (*)	IRR (**)
C1	Need of implementation process	6.3	88%
E2	Usefulness of implementation framework	5.2	78%
D1	Implementation process	5.9	85%
D2	Knowledge-building process	5.9	91%
D3	Implementation assessment process	6.0	92%
D4	Preparatory phase	6.0	85%
D5	Planning phase	6.0	92%
D6	Design-Build procurement phase	6.2	88%
D7	Design-Build administration phase	6.1	85%

(*) A mean-value of five (on the given 1-7 scale) was set as the threshold of agreement on each definition.
(**) An IRR-value of 60% was set as the threshold for identifying elements with high random measurement-error variance between panelists.

Table 4: Comments and Changes to Definitions

Definition/ Relationship	Comments from Panelists		Changes Implemented
	No.	Main Suggestions	
OVERALL COMMENTS ON: Comprehensiveness and meaningfulness of set of definitions	8	• Need simplification • Address comments to each definition on wording and hierarchy of definitions • Definitions alone do not guarantee success. There is a need to go beyond by establishing relationships between concepts.	• Reduction of the total number of definitions • Development of several examples • Addition of new definitions for: risk allocation method (DEF-2), contract packaging method (DEF-3), ATC process (DEF-7) and industry review process (DEF-8) • Further research is needed to establish relationships and control for additional variables
DEFINITION: Project delivery method (PDM)	14	• Need to reword • Include other services in definition options • Include after-procurement delivery aspects • Use "risk transfer" versus "project service outsourcing"	• The two definitions were reworded and merged in a single definition (DEF-1), which includes after-procurement delivery aspects and additional services. • The term "risk transferring" was used instead of "project service outsourcing." • Examples are now provided.
DEFINITION: Factors differentiating PDMs	7	• Need to reword • Use of word "outsourcing" triggers controversial issues	
DEFINITION: Project finance method (PFM)	9	• Need to reword • Include other finance sources in definition options	• The two definitions were reworded and merged in a single definition (DEF-4), which includes additional sources and other categories of financing. • Examples are now provided.
DEFINITION: Factors differentiating PFMs	13	• Need to reword • Need to expand beyond "private sources"	
RELATIONSHIP: Outsourcing and private funding	14	• Need to re-elaborate the cause-effect logic • Need to include other variables into the equation (i.e. expected revenue, scale of state delivery program, method of payment, private equity to debt market ratio)	• These suggested relationships have been dropped. • Further research is needed to control for additional variables.
RELATIONSHIP: Contract integration and private funding	10	• Need to re-elaborate the cause-effect logic • Need to include other variables into the equation (i.e. expected revenue, flexibility to implementation, method of payment, private equity to debt market ratio)	

Definition/ Relationship	Comments from Panelists		Changes Implemented
	No.	Main Suggestions	
DEFINITION: Project procurement approach = PDM-PFM combination for a specific project	7	• Need to reword • Use "delivery" versus "procurement": hierarchical inconsistency • Use "risk transfer" versus "project service outsourcing"	• This definition has been dropped to simplify the set of definitions. • Suggestion on use of "risk transfer" terminology has been embedded into the new set of definitions.
DEFINITION: Project procurement strategy (PPS) = PDM-PFM combinations available	4	• Need to reword • Hierarchical inconsistency between the words "delivery" and "procurement" • Use of "toolkit" or "toolbox" instead than "strategy"	• The two definitions were reworded and merged in a single definition (DEF-5), which addresses the panel's comments. • Examples are now provided.
DEFINITION: Change in PPS = change in PDM-PFM combinations available for use	8	• Use "change of options" versus "broadening of options" • Use "organizational strategy for project delivery" versus "project procurement strategy"	
DEFINITION: Project procurement process = Actions for selecting industry providers	5	• Use "alternative technical concept" versus "provider-induced innovation" • Use "review risk allocation" (or "industry review") versus "allocation of project risks" • Merge "review of risk allocation" with "contractual framework definition"	• This definition has been reworded (DEF-6) to address these comments. • Definition of Alternative Technical Concept Process (DEF-7) has been added. • Definition of Industry Review Process (DEF-8) has been added.
DEFINITION: Contract award method = system for selecting industry provider	3	• Need slight rewording	• This definition has been reworded (DEF-9) to address these comments.
DEFINITION: Contracting approach = legal language to target specific project objectives	5	• Term contracting approach has many different interpretations in highway industry • Use of "procurement" versus "delivery": hierarchical inconsistency	• This definition has been dropped to simplify the set of definitions.

Table 5: Comments and Changes to Framework Components

Framework Components	Comments from Panelists		Changes Implemented
	No.	Main Suggestions	
OVERALL COMMENTS ON: Usefulness of implementation framework	8	• Need simplification • Use specific language to contextualize • Solve overlaps between different processes and different phases • Results of study need to be in a format that is easily comprehended and can easily be applied by the industry	Researchers plan to simplify framework. Additional information to achieve this goal is being collected with this questionnaire.
Need of implementation process	3	• None relevant	No changes
Implementation process	3	• The biggest part of that process is consistent communication with industry to gain credibility. Credibility is key to the success of innovative procurement. If the private does not believe that a public agency is really committed, then the private will not participate • Add other key stakeholders outside of the agency for knowledge dissemination • Add disseminating knowledge & building support/acceptance from organizational level	Process description and objectives were changed to address suggestions
Knowledge-building process	1	• None relevant	No changes
Implementation assessment process	4	• Definition is missing the motivating component: goals/reason/vision for the change	Phase description and objectives were changed to address suggestions.
Preparatory phase	5	• Add selection of project manager/champion • Risk allocation need to occur here	Phase description and objectives were changed to address suggestions.
Planning phase	3	• At this phase there is a review of risk allocation previously defined • Setting project goals would be done earlier	Phase description and objectives were changed to address suggestions.
Design-Build procurement phase	2	• None relevant	Phase description and objectives were changed to address suggestions.

Table 6: Qualitative Comments Summary

	No. of comments
Feedback Comments on Definitions	107
Feedback Comments on Framework Components	29
Overall Success Factors	95
Overall Barriers to Implementation	68
Success Factors by Phase and Process (see Table 7 for details)	285
Barriers to Implementation by Phase and Process (see Table 8 for details)	277
Implementation Activities (see Table 9 for details)	252
TOTAL	**1,113**

Table 7: Factors affecting the success of the implementation effort

	No. of comments on SUCCESS FACTORS				
	PHASES				**Total**
	Preparatory	**Planning**	**Procurement**	**Contract Administration**	
Implementation	41	19	25	29	**114**
Knowledge-building	32	20	25	21	**98**
Assessment	25	13	22	13	**73**
Total	**98**	**52**	**72**	**63**	**285**

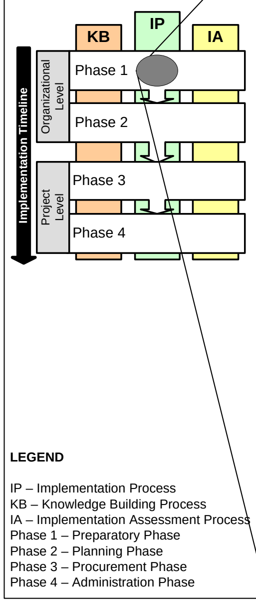
Table 8: Main barriers to the implementation

	No. of comments on BARRIERS				
	PHASES				**Total**
	Preparatory	**Preparatory**	**Preparatory**	**Preparatory**	
Implementation	36	19	30	32	**117**
Knowledge-building	26	20	20	18	**84**
Assessment	26	16	20	14	**76**
Total	**88**	**55**	**70**	**64**	**277**

Table 9: Key activities to be performed for the implementation

	No. of comments on ACTIVITIES				
	PHASES				**Total**
	Preparatory	**Preparatory**	**Preparatory**	**Preparatory**	
Implementation	30	25	29	28	**112**
Knowledge-building	26	18	15	15	**74**
Assessment	19	13	16	18	**66**
Total	**75**	**56**	**60**	**61**	**252**

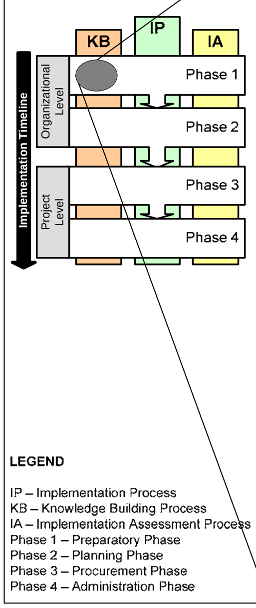
D.7. Delphi Round 1: Success Factors by Process and Phase



Success Factors

- Political support
- Comprehensiveness of the project risk identification and management plan
- Need to have staff that is knowledgeable on new delivery approaches and on what type of projects they are best suited for.
- Champion; legislation; incentive
- Support by the management
- Skilled people to teach
- Identify goals, identify barriers, develop strategic approach
- Developing support from all sectors of the industry including consultants, contractors, sureties and government agencies
- Decision maker in place
- Legal environment, legislative acceptance, AEC community acceptance, public acceptance
- Statutory authority, so enabling legislation
- Dedicated staff, organizational acceptance
- Participation of MPO, facilitation of owner, advance preparation / identification of program projects, funding
- Legislative attitude, internal (DOTD) acceptance, champion
- Good plan
- Employees understanding of reasons for change and of the key vision behind the change
- Insure the in-house staff has the skills and temperament needed for the effort, demonstrate to them that their careers will be positively affected by a successful change to a new process, and develop relationships with consultants who can fill critical gaps in your in-house capabilities.
- Change readiness (preparing the organization and stakeholders for the change), communication, alignment and buy-in of key stakeholders
- Identify all possible delivery approaches available
- Legislative support, industry support, experience
- Committed personnel with a variety of skills that are able to think "outside the box", knowledgeable and experienced advisors, management support

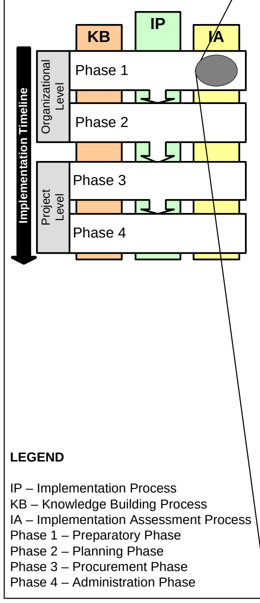
Figure D.7.1: Success Factors – Implementation at Preparatory Phase.



Success Factors

- Knowing ALL regulatory constraints; defining current procurement cultural biases; identify political/technical opposition to change
- There needs to be feedback from previous projects and way to disseminate this information through either lessons learned or good documentation of past experience.
- An impetus to learn; a smart person
- Age & experience of personnel.
- Patience with time, money and commitment
- Contact with industry experts and peers
- Convincing legislators of the importance and fairness of change
- Communication
- Understanding legal environment, educating regulatory authorities, educating AEC community, educating public
- Having access to people who will be involved in the program to explain the attributes of the program so that they can accept and embrace the new direction
- Dedicated staff
- Eligible programs and projects, understanding process, understanding funding constraints
- Must have the right champion
- Good data base development
- Employees understanding of reasons for change and of the key vision behind the change
- Knowledge is developed formally and informally. The informal development can subvert formal efforts. A communication plan must address this, getting out solid information in advance of the diffusion of bad news by cynics. Credibility is essential.
- Collection of best practices, training, key advisors who have actually been involved on both the owners and the contractor/developers side
- Lessons learned
- Availability of appropriate resources (i.e. studies, reports, etc.)
- Committed personnel with a variety of skills that are able to think "outside the box", knowledgeable and experienced advisors, management support Please list factors affecting the success of this sub-process

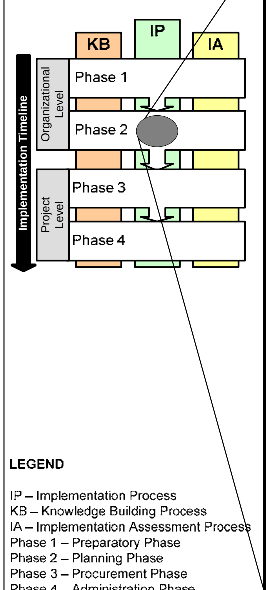
Figure D.7.2: Success Factors – Knowledge Building at Preparatory Phase.



Success Factors

- Quantitative metrics; ability to capture performance data
- I think that this phase is usually overlooked and rarely to people set back from what they are doing and assess how the implementation is going. Therefore you need to have people dedicated to assessing the implementation and providing the feedback to the decision makers.
- Honesty
- Adequate number of personnel assigned to this element
- legislative and resistance to change mentality
- Feedback from stakeholders, lessons learned
- Please list factors affecting the success of this sub-process
- Timely decisions are being made
- Assessment of opposition and need to change legal environment to allow use of alternative procurement processes
- Making sure that the measures are objectives and sufficiently meaningful that we can really use them after you gather the information
- Dedicated staff, organizational acceptance
- Understanding and completing process requirements, support and consensus
- Champion must analyze procurement and advise stakeholders
- Good Plan
- Employees understanding of reasons for change and of the key vision behind the change
- Tied to my comment above - assessments need to be candid, credible and consistent with all other efforts.
- Objectivity (not feedback from parties who have a vested interest in implementation going a certain way), key advisors who have actually been involved on both the owners and the contractor/developers side, 360 degree feedback
- Setting and tracking goals
- Ability to benchmark
- Committed personnel with a variety of skills that are able to think "outside the box", knowledgeable and experienced advisors, management support Please list factors affecting the success of this sub-process

Figure D.7.3: Success Factors – Assessment at Preparatory Phase.



Success Factors

- Identify strategies that are a good fit for the type of project in question.
- People, culture, incentives
- Support by the management
- Organizational skills,
- Developing policies and procedures
- Project staff that understands the goals, process
- Availability of established industry practices, acceptability of alternative procurement process to AEC community and legislature
- To succeed, in this stage of the project, if you have experienced people doing detailed analyses of risks and detailed analyses of constraints and clear understanding of both and objectives of a district
- Decisions made at project scoping, made early
- Buy-in by organization, success by others
- Good plan
- Appropriateness of the project and of the team
- Preparation of the project for implementation (environmental clearance, public outreach/involvement, etc.), stakeholder identification / involvement / support, selection of the right personnel on the owners' side, selection of key personnel with the right knowledge and incentive to make the project a success
- Identify potential projects, budgets, schedules
- Receive buy-in/ support from management & politicians

Figure D.7.4: Success Factors – Implementation at Planning Phase.

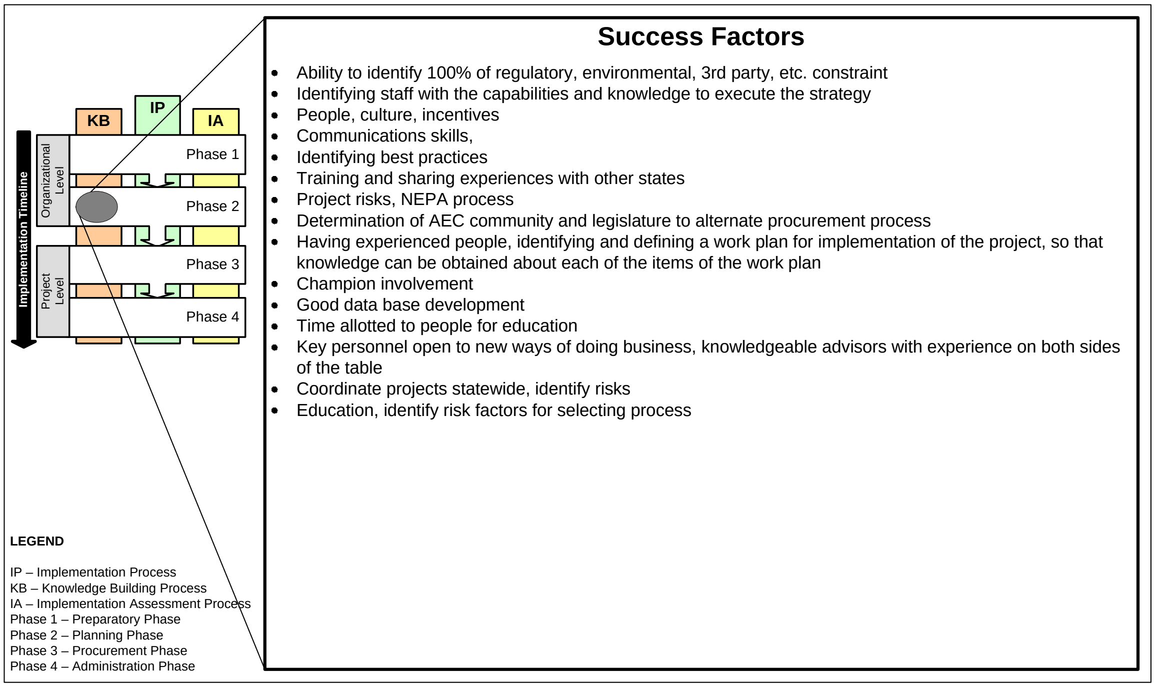


Figure D.7.5: Success Factors – Knowledge Building at Planning Phase.

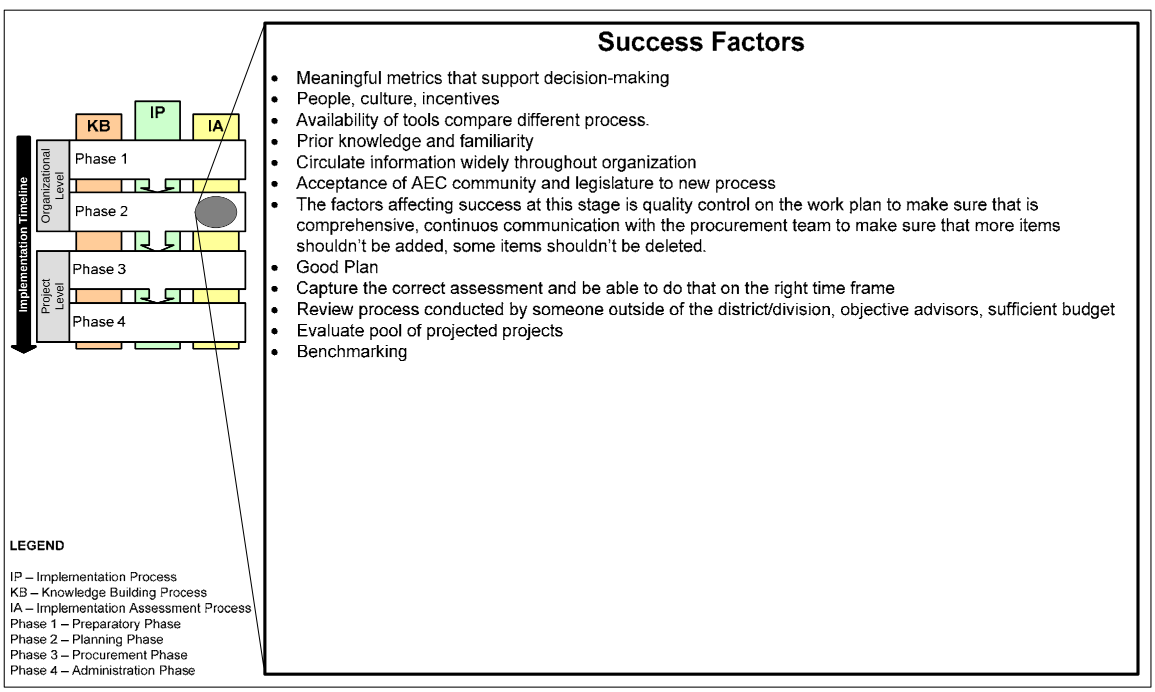


Figure D.7.6: Success Factors – Assessment at Planning Phase.

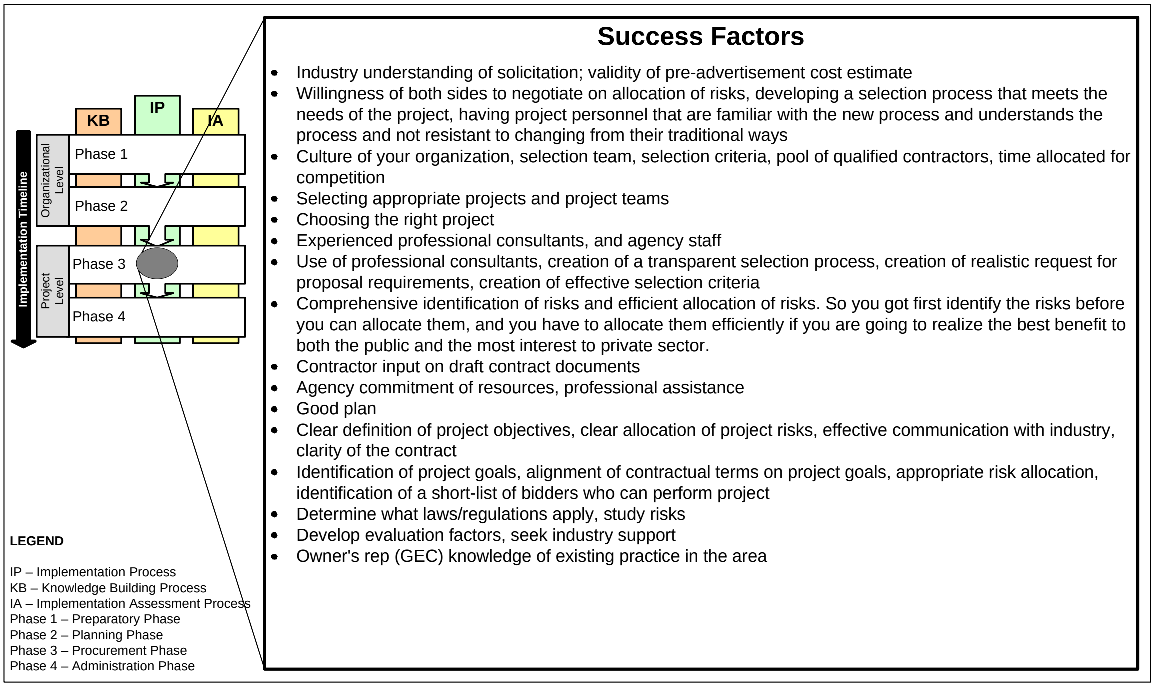


Figure D.7.7: Success Factors – Implementation at Procurement Phase.

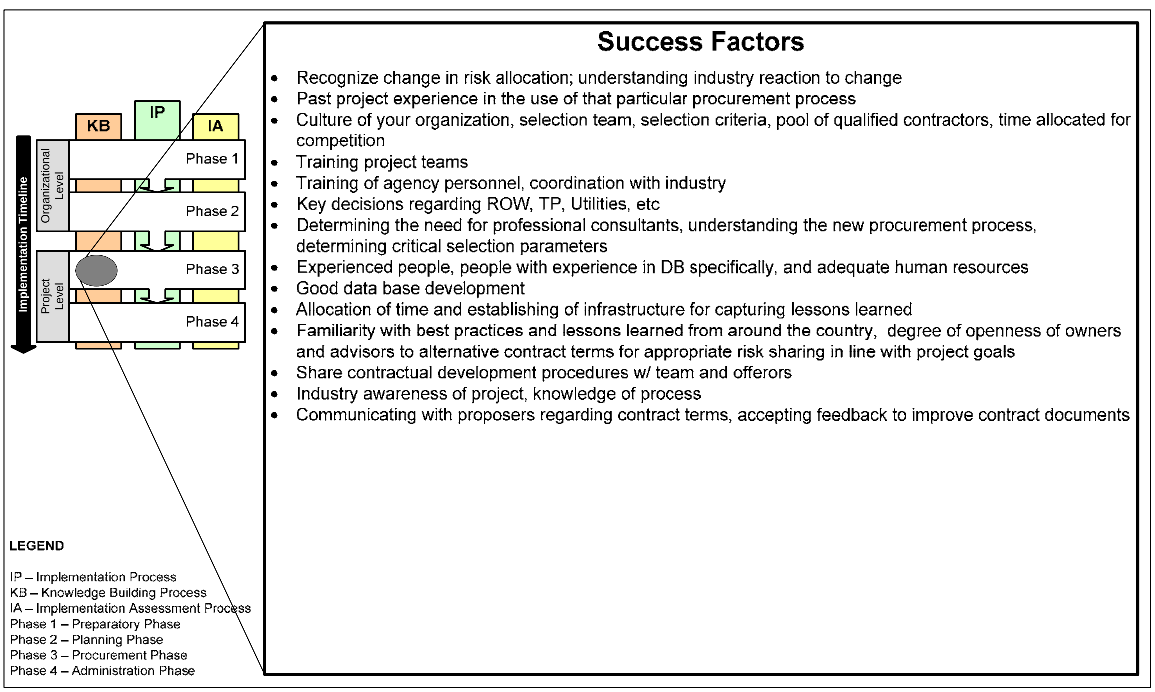


Figure D.7.8: Success Factors – Knowledge Building at Procurement Phase.

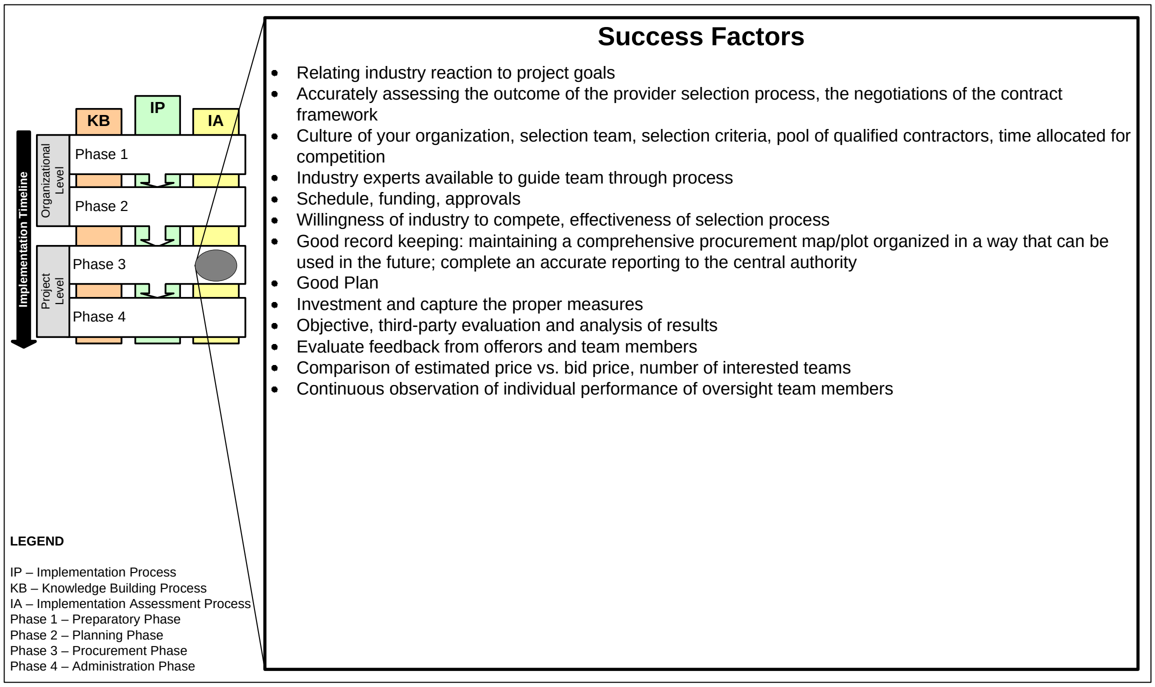


Figure D.7.9: Success Factors – Assessment at Procurement Phase.

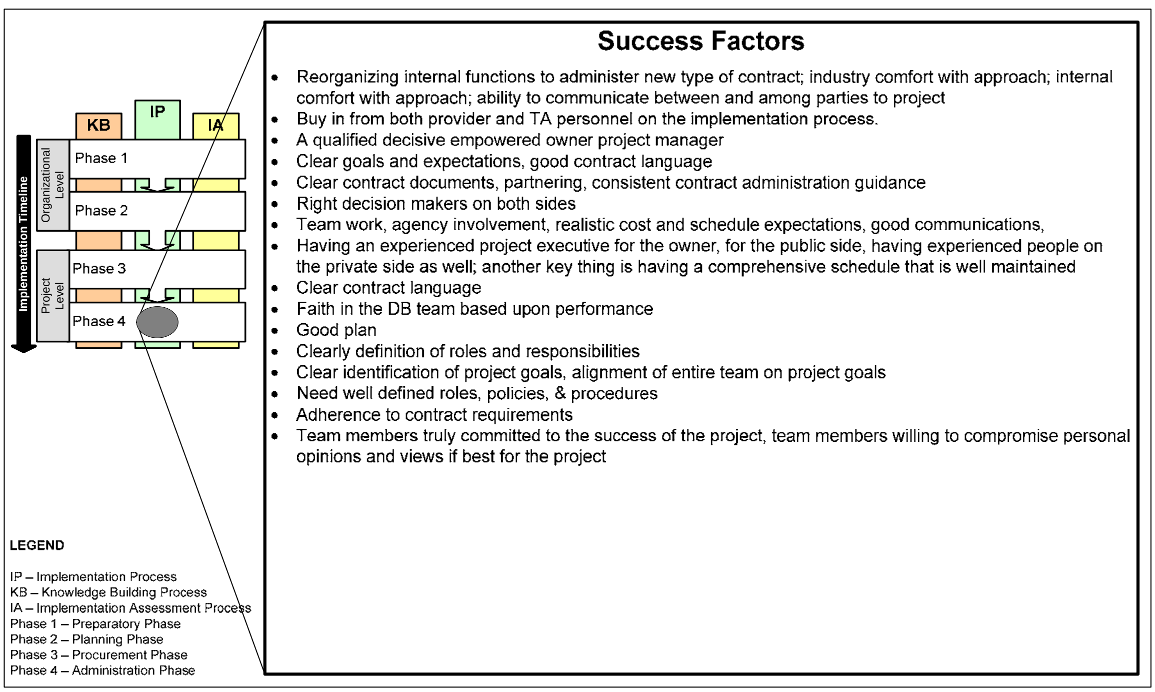


Figure D.7.10: Success Factors – Implementation at Administration Phase.

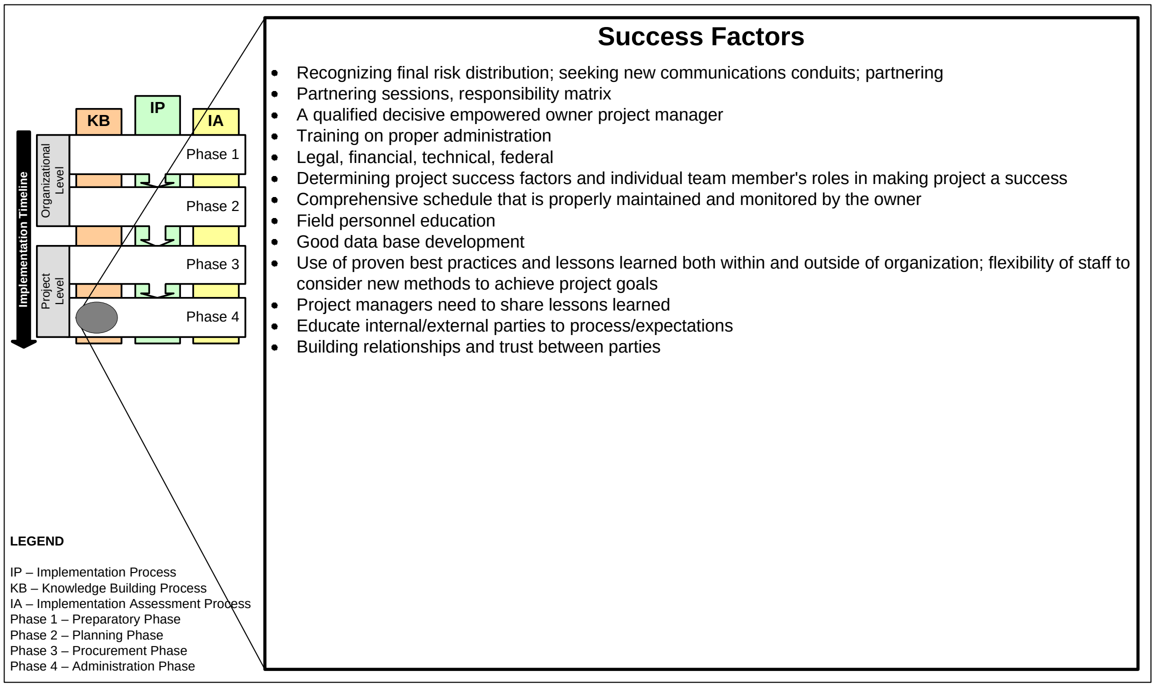


Figure D.7.11: Success Factors – Knowledge Building at Administration Phase.

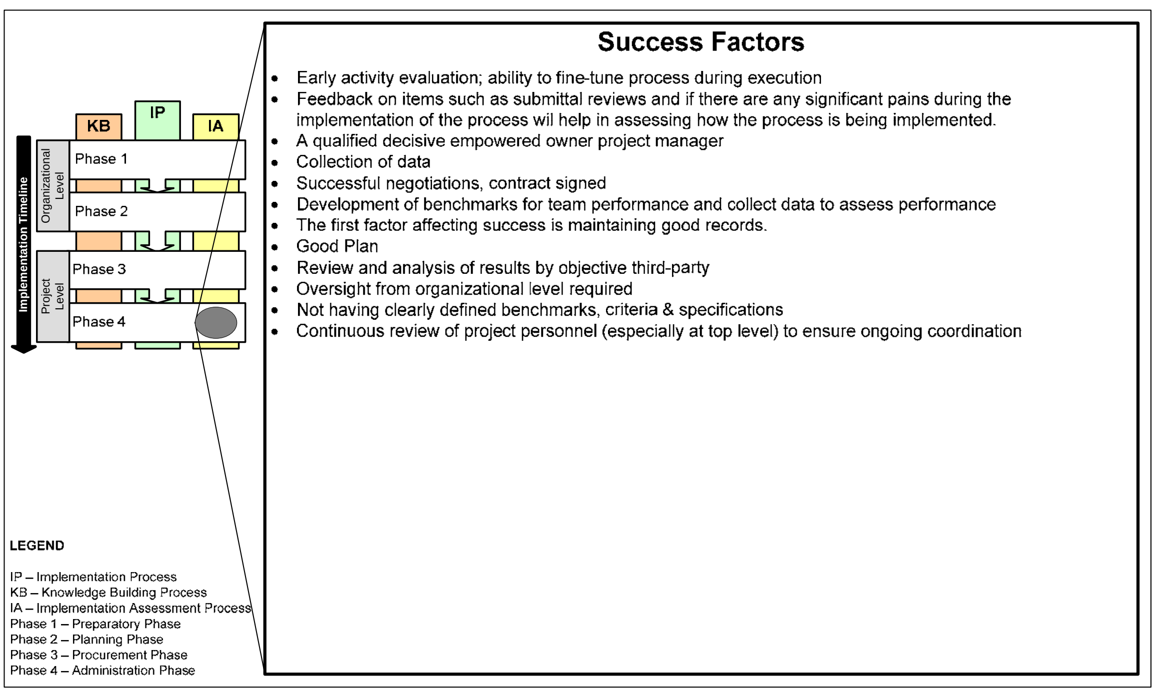
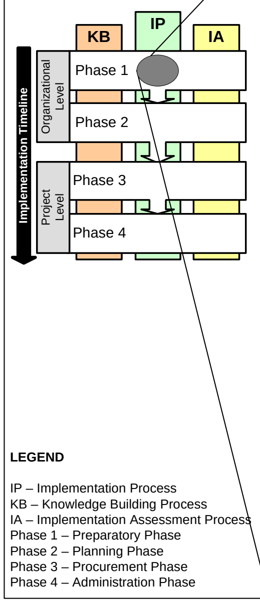


Figure D.7.12: Success Factors – Assessment at Administration Phase.

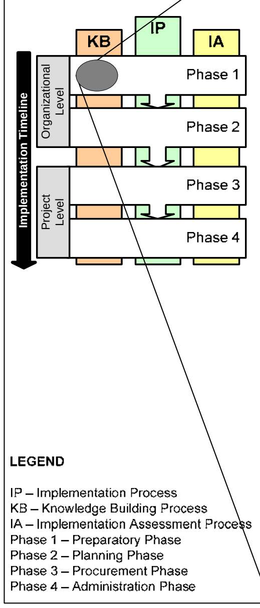
D.8. Delphi Round 1: Barriers to Implementation by Process and Phase



Barriers to Implementation

- Lack of knowledge of alternative strategies
- No sense of urgency at this early date
- Legislative authority to use DB
- Organizational strategies are usually well ingrained and difficult to modify.
- People; culture; laws
- Adequate advanced preparation
- Skill sets of individuals
- Stakeholder resistance, politics
- Resistance to change
- No decision maker in place
- Industry lobbying, public opposition, legislative opposition
- legislative authority
- Lack of staff, lack of funding
- Lack of support by MPO or COG, insufficient funding,
- Not having legislative attitude, internal (DOTD) acceptance, champion
- Lack of Communications
- [Fights] at the organization [level]
- Inertia and fear of unknown.
- Fear of change, misinformation, lack of support from key stakeholders
- Communication with project level personnel
- Lack of legislative support, industry support & experience
- Industry lobbying, political opposition especially during election years, contracting and personnel challenges

Figure D.8.1: Barriers – Implementation at Preparatory Phase.



Barriers to Implementation

- Failure to include all constraints in plan
- Institutional inertia and mistrust amongst the parties.
- Lack of documentation of past performance of implementation effort
- People
- Budget and advance commitment
- Patience with time, money and commitment
- Lack of objective information
- Resistance to change
- No communication
- Acquiring perspectives of each opposing constituency
- conservatism among the staff and unwillingness to change
- Lack of staff
- Lack of preparation or understanding of process and connstraints
- Not having the right champion
- Faulty Information
- People ability and time to contribute to the KB process
- When new ideas conflict with established wisdom. "Everybody knows this won't work, isn't legal, or will get me fired."
- Pressure to move forward quickly without collecting and analyzing best practices, key advisors whose contractual interest does not drive better practices, lack of money for training
- Lessons learned not documented and shared
- Lack of available resources
- Industry lobbying, political opposition especially during election years, contracting and personnel challenges

Figure D.8.2: Barriers – Knowledge Building at Preparatory Phase.

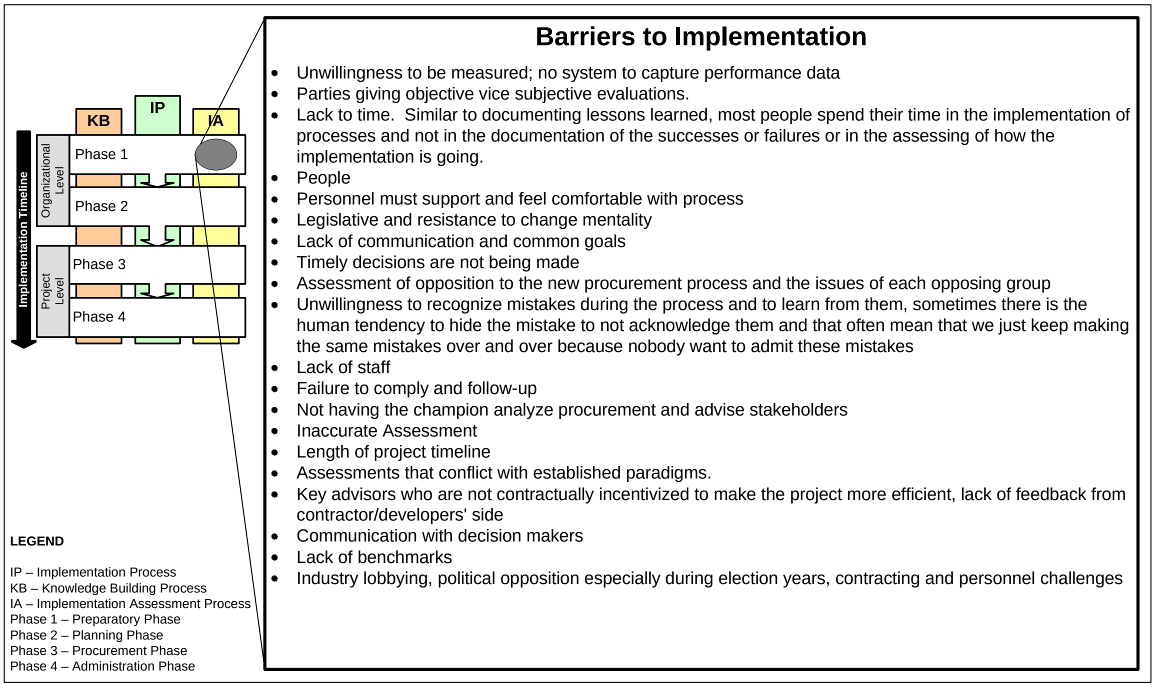


Figure D.8.3: Barriers – Implementation Assessment at Preparatory Phase.

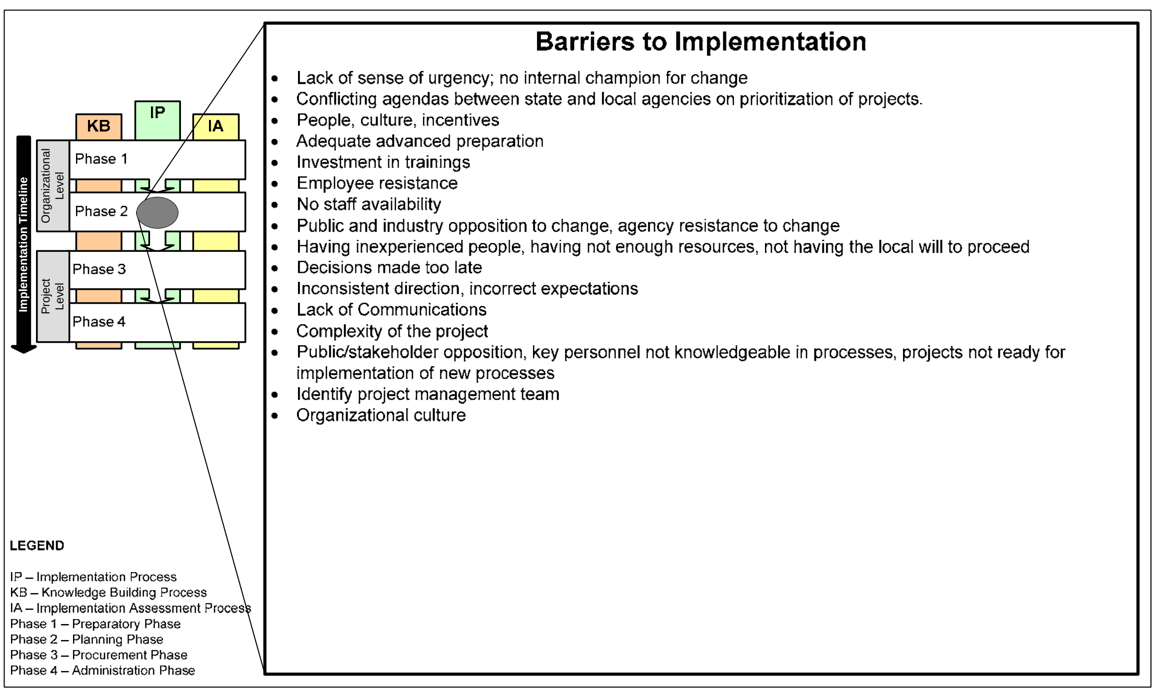


Figure D.8.4: Barriers – Implementation at Planning Phase.

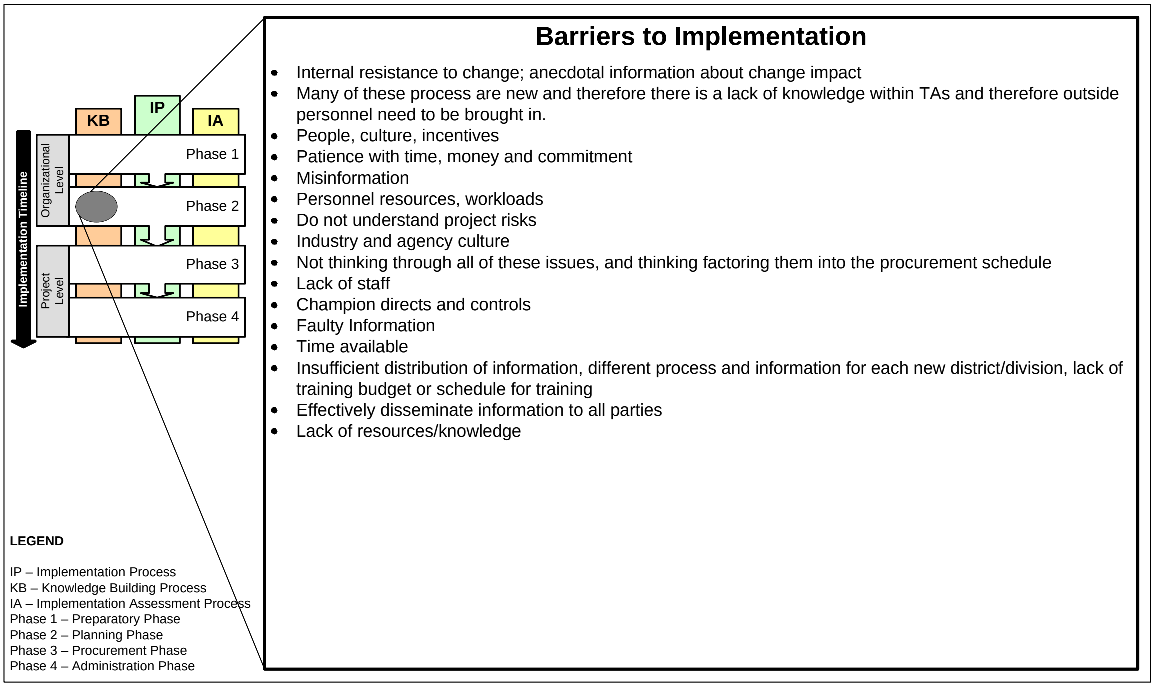


Figure D.8.5: Barriers – Knowledge Building at Planning Phase.

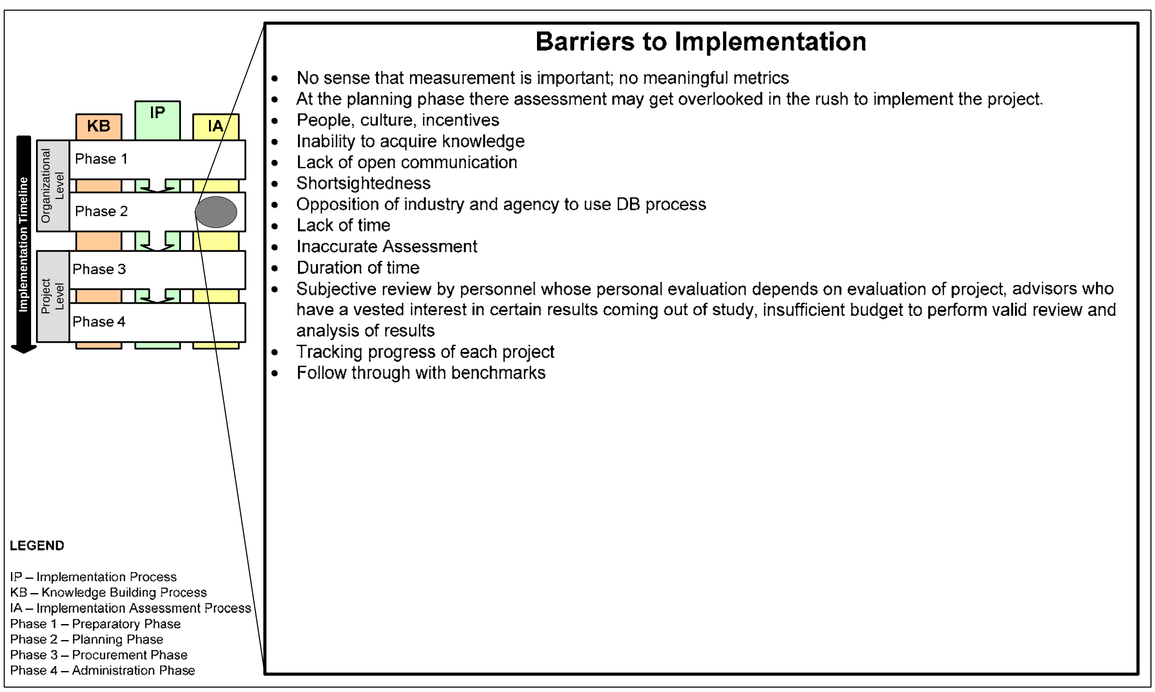


Figure D.8.6: Barriers – Assessment at Planning Phase.

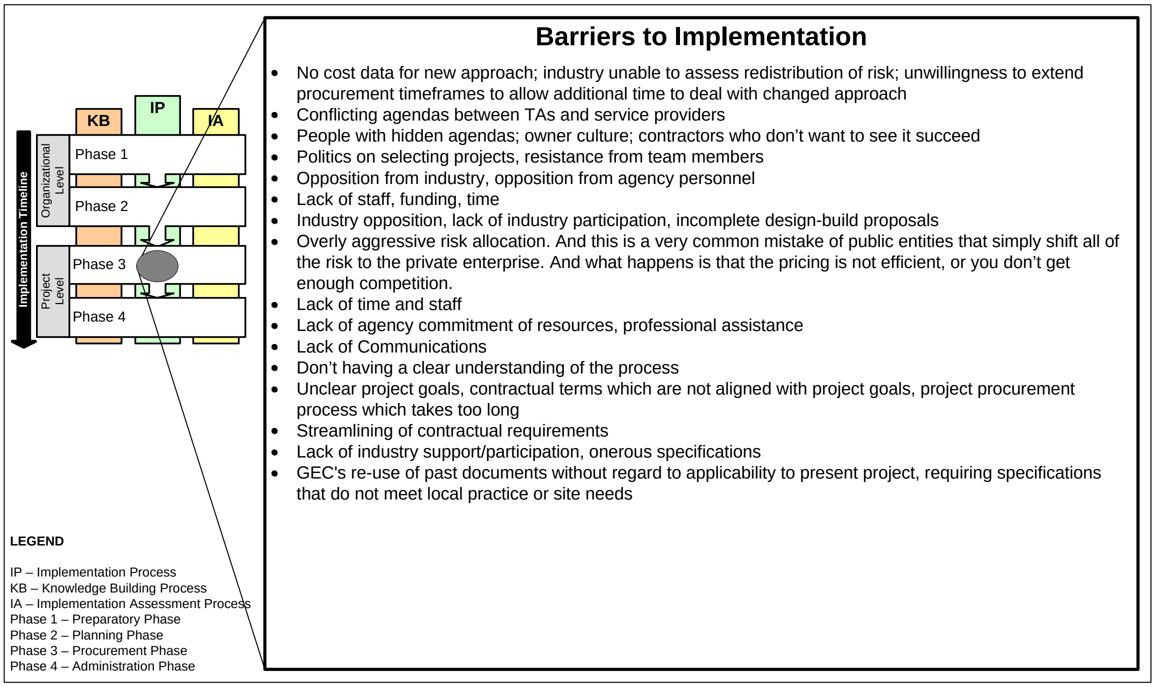


Figure D.8.7: Barriers – Implementation at Procurement Phase.

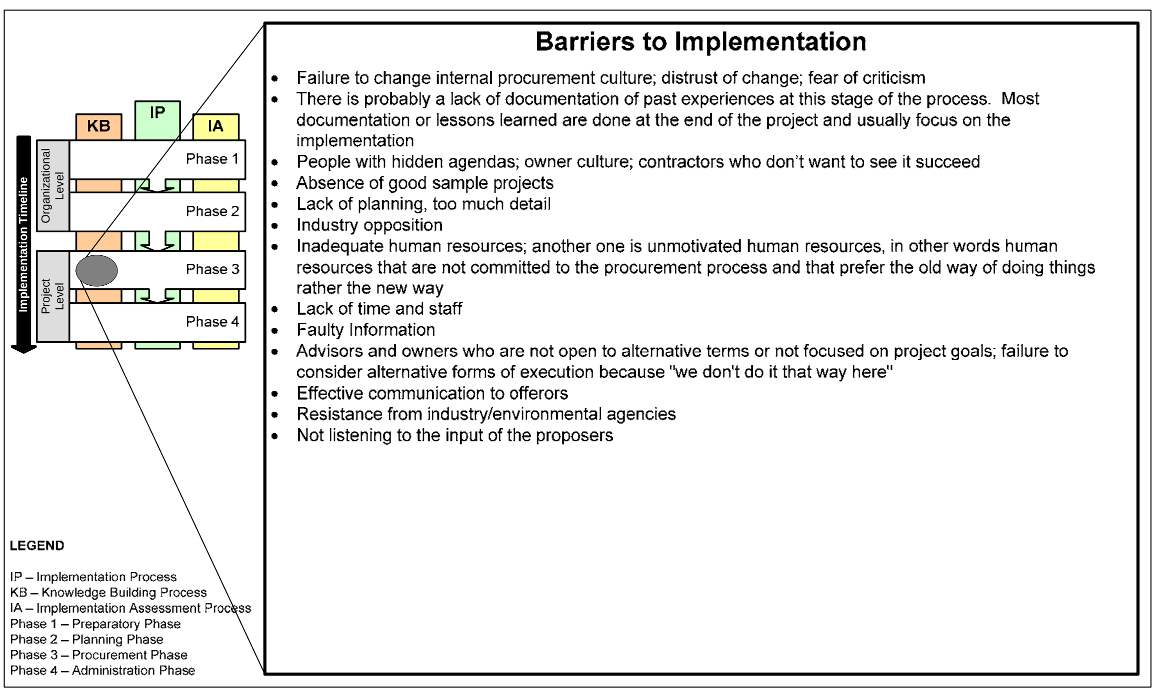


Figure D.8.8: Barriers – Knowledge Building at Procurement Phase.

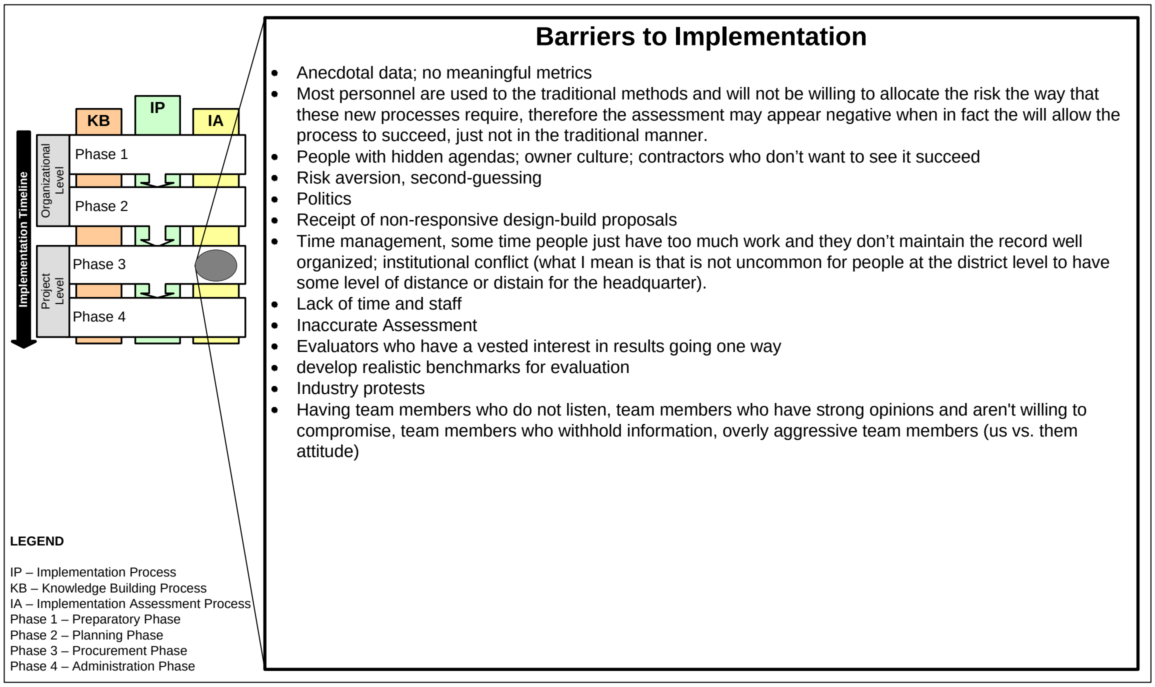


Figure D.8.9: Barriers – Assessment at Procurement Phase.

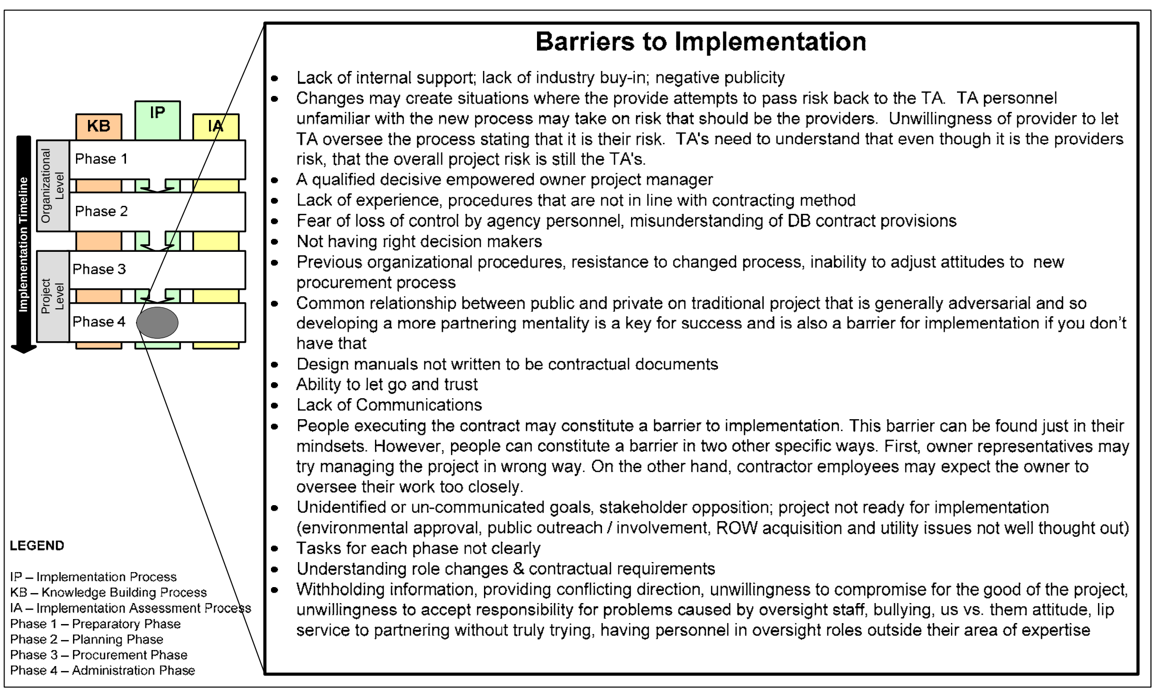


Figure D.8.10: Barriers – Implementation at Administration Phase.

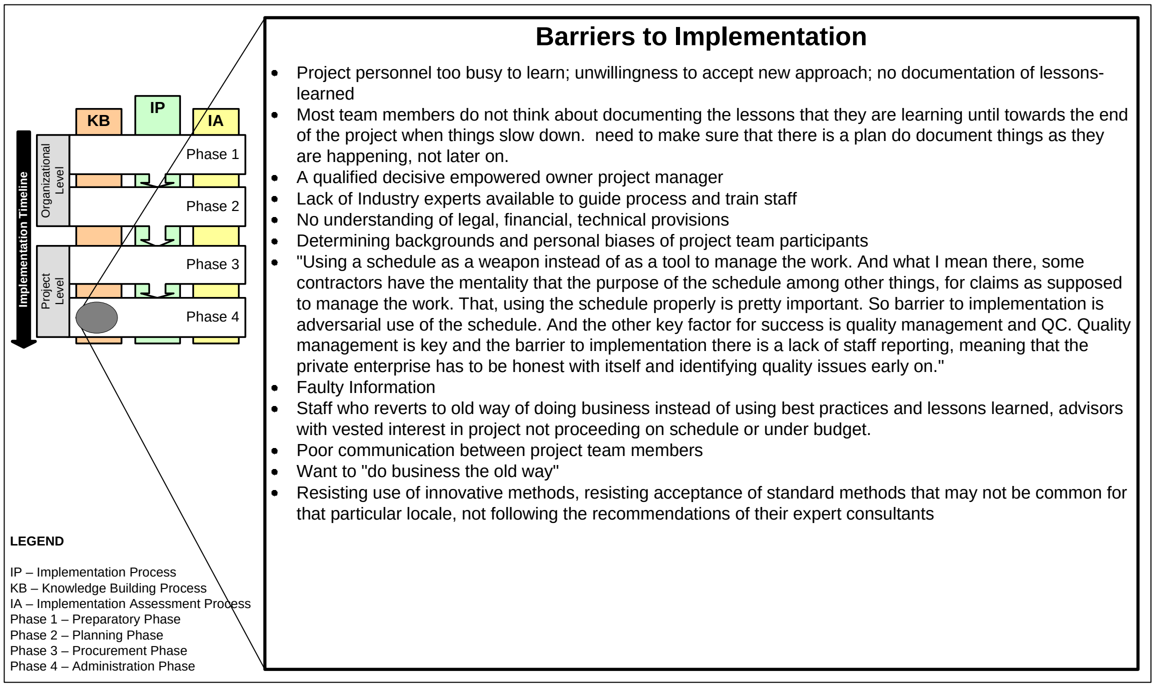


Figure D.8.11: Barriers – Knowledge Building at Administration Phase.

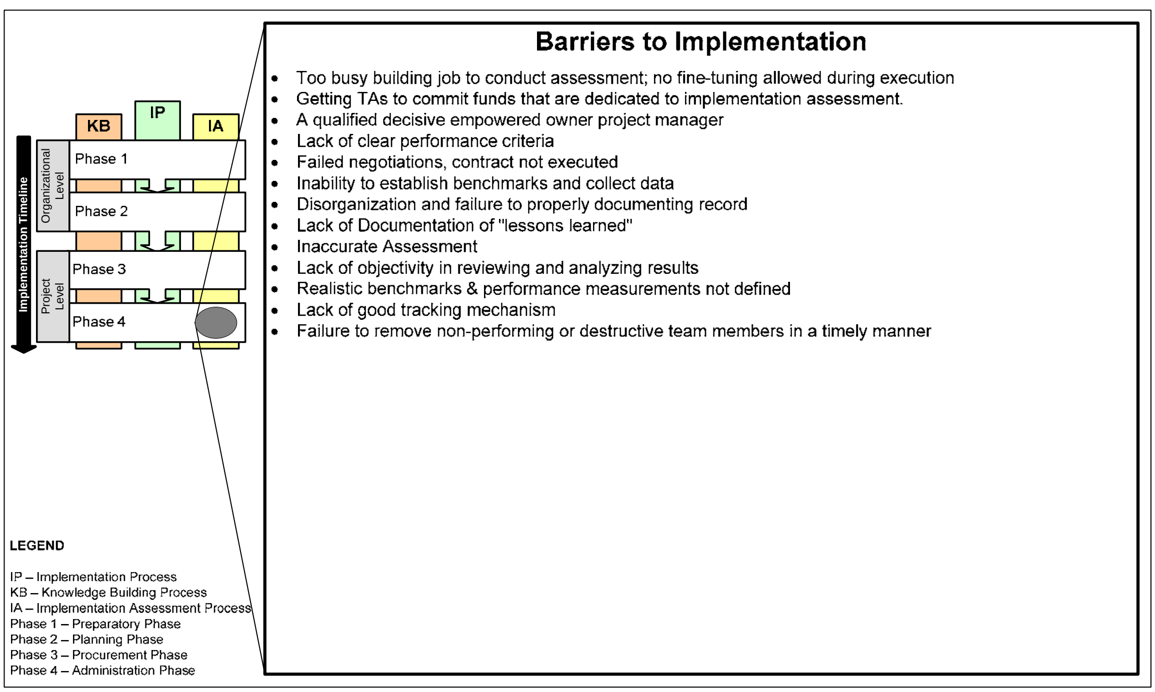


Figure D.8.12: Barriers – Assessment at Administration Phase.

D.9. Delphi Round 1: Activities to Be Performed by Process and Phase

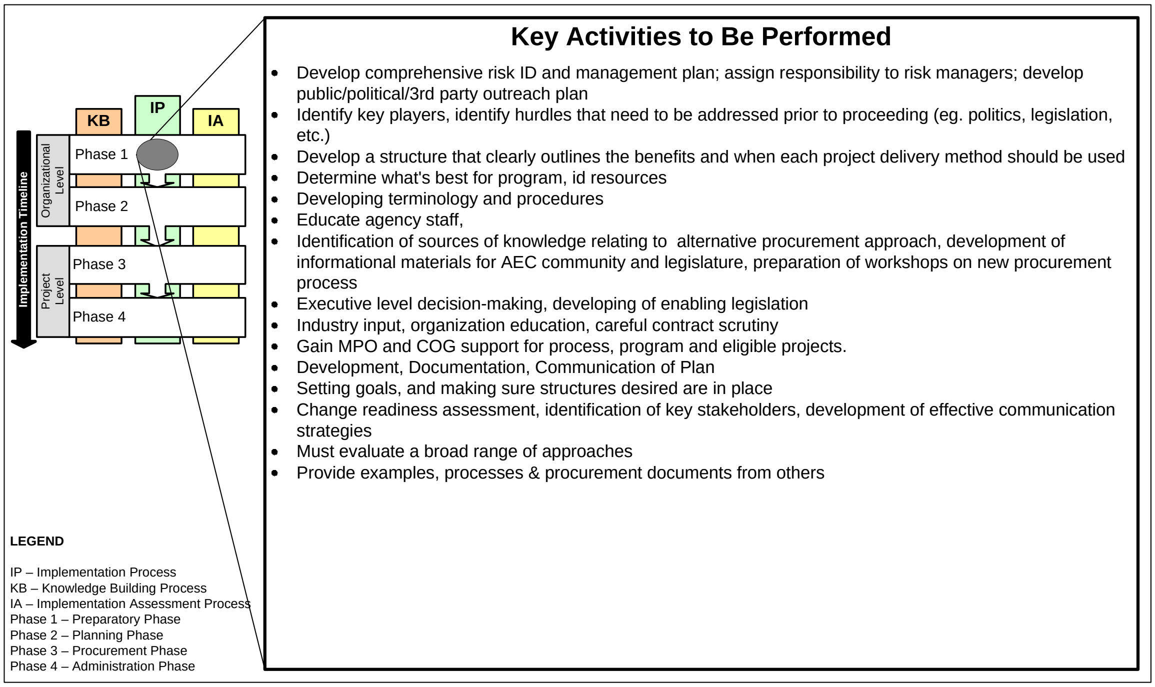


Figure D.9.1: Activities – Implementation at Preparatory Phase.

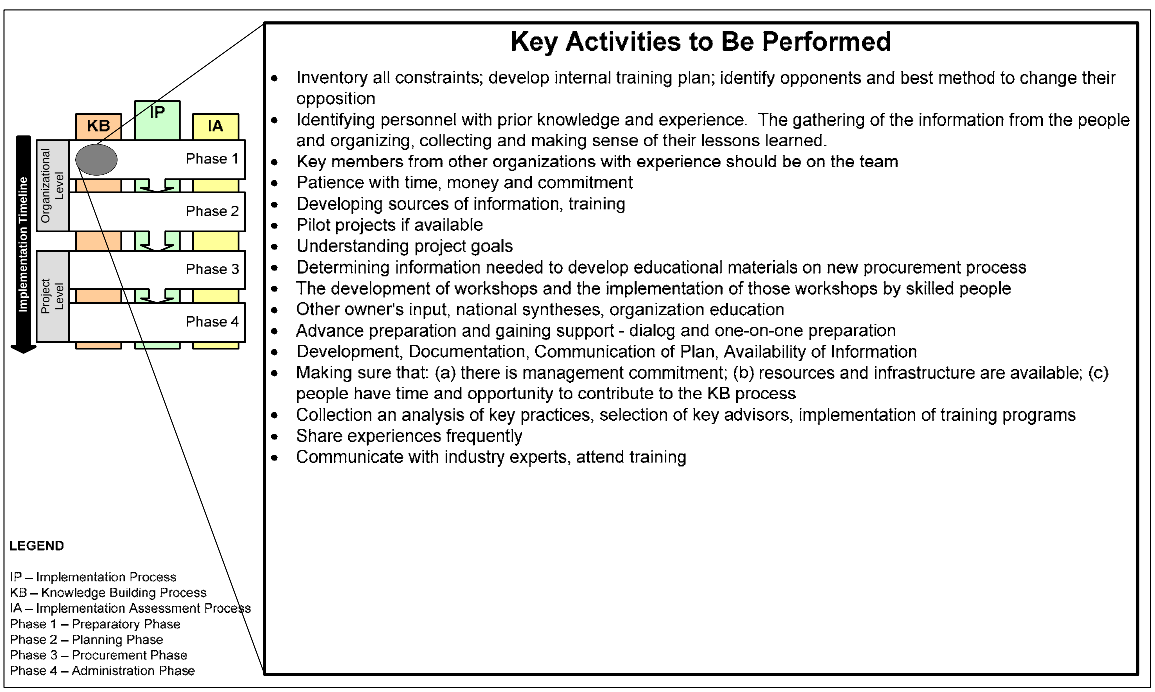


Figure D.9.2: Activities – Knowledge Building at Preparatory Phase.

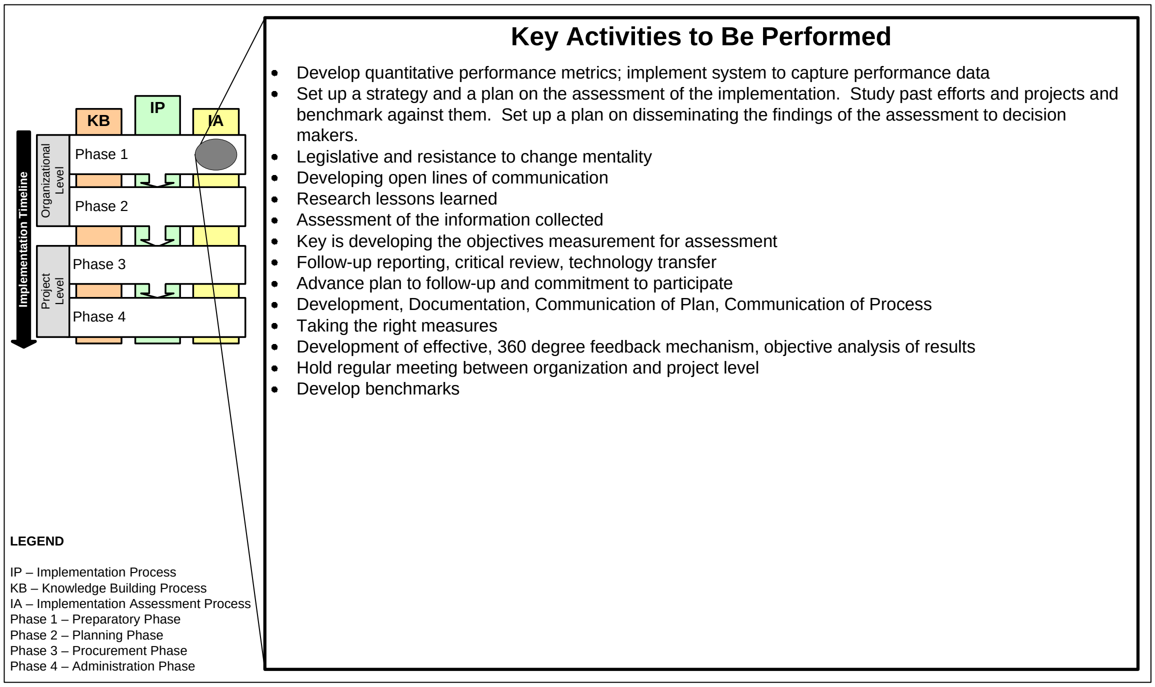


Figure D.9.3: Activities – Assessment at Preparatory Phase.

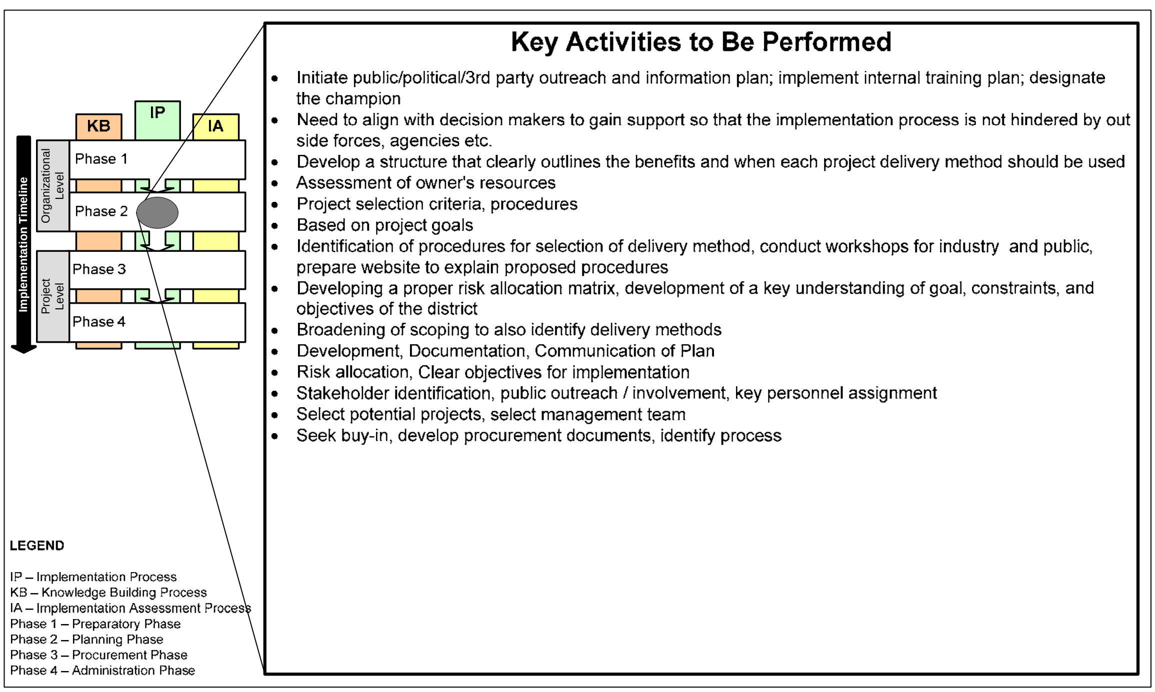


Figure D.9.4: Activities – Implementation at Planning Phase.

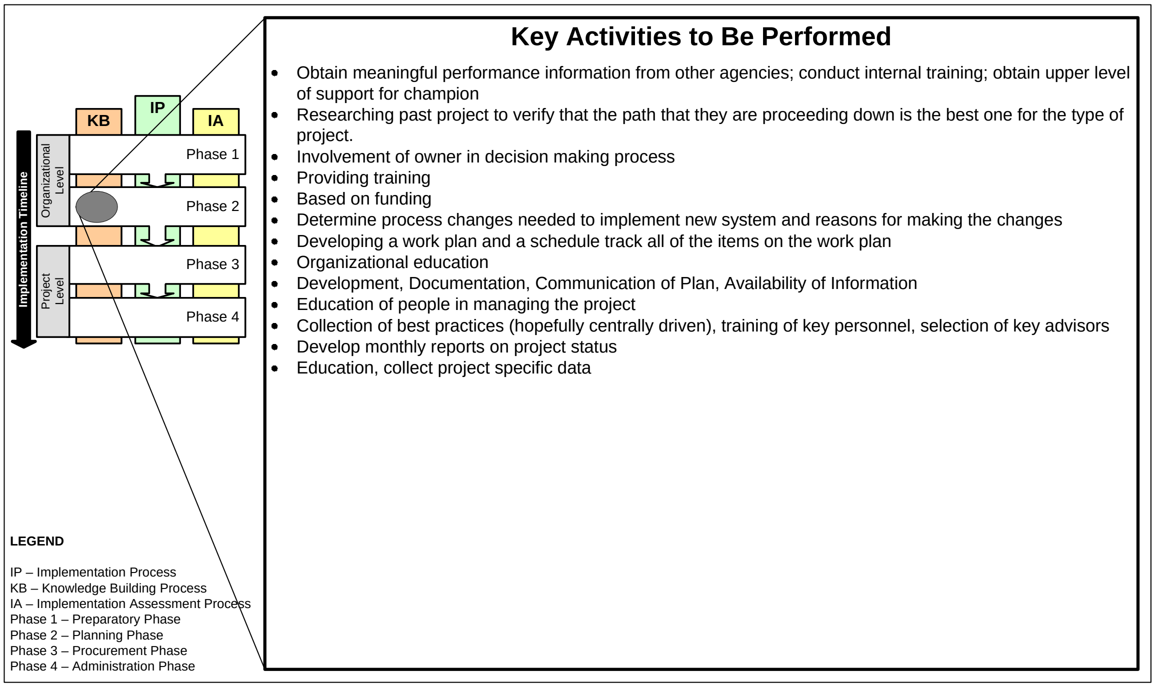


Figure D.9.5: Activities – Knowledge Building at Planning Phase.

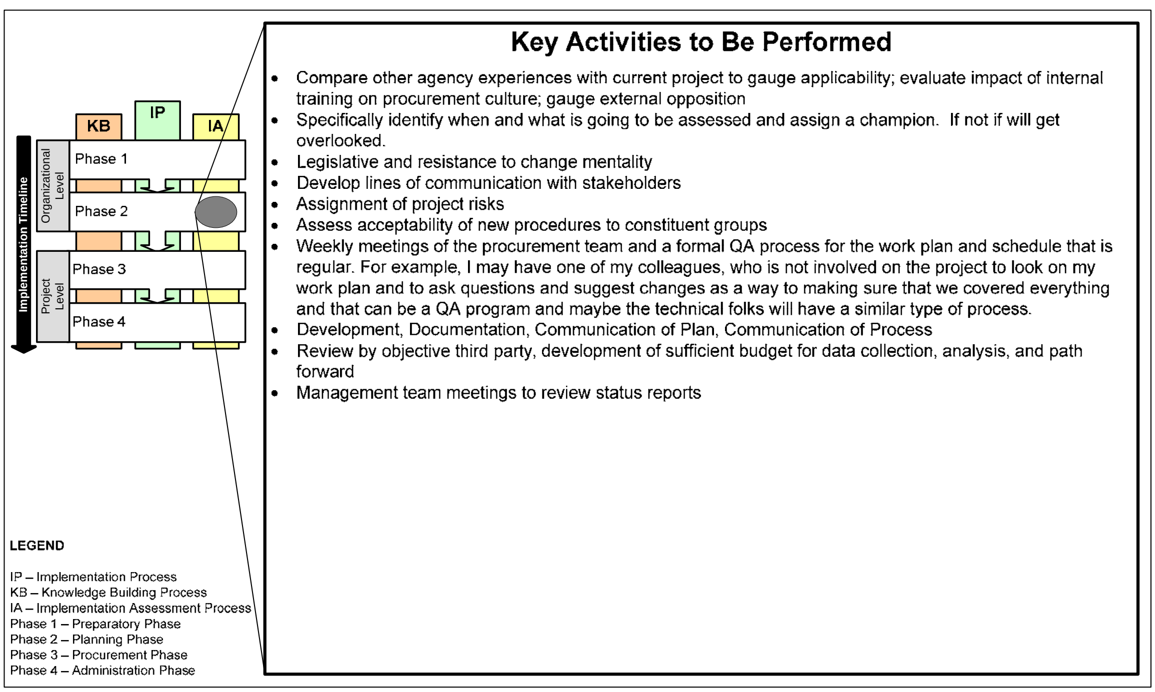
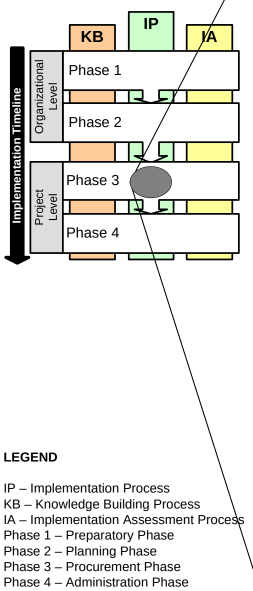


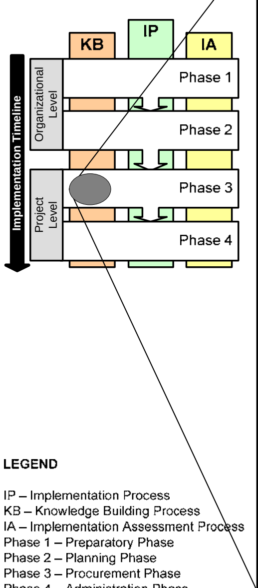
Figure D.9.6: Activities – Assessment at Planning Phase.



Key Activities to Be Performed

- Industry outreach and education; extending procurement timeframes;
- Identifying personnel to lead the process, developing a selection process that is in line with the project goals
- Competition basis; rules; selection team; selection criteria; weights
- Screen projects to develop good candidates
- development of selection criteria, use of criteria in the selection process, debriefings for unsuccessful offerors
- Develop evaluation manual, technical procurement documents
- Identification of procedures for design-builder selection, identification of specific criteria for design-builder selection, identification of selection team members, issuance of requests for qualification and requests for proposals, evaluation of proposals received
- To develop a risk allocation matrix, and to carefully allocate risk to the party most able to manage the risk. This is the way to get efficient pricing and to also to attract public enterprise
- Provider input, field input, provider presentations
- Development, Documentation, Communication of Plan
- Clarity of project objectives and of risk allocation at a more defined level than previously
- Decision on whether or not to use external legal advisor, the actual selection of a legal advisor, identification of desired outcomes, alignment of procurement team on project goals
- Evaluate/modify existing forms of contract
- Develop document, industry outreach
- Obtain candid feedback from proposers

Figure D.9.7: Activities – Implementation at Procurement Phase.



Key Activities to Be Performed

- Honest understanding of internal culture at this point; actively managing distrust and fear when it is identified
- Once phase is complete, need to document the outcome for use in future negotiations and developments of projects
- Competition basis; rules; selection team; selection criteria; weights
- Perform training of management and team members
- Industry review, one-on-one meetings
- Determining process changes needed to accommodate BD procurement process
- Development of the documents i mentioned before (ITP, contract)
- Provider input, field input
- Development, Documentation, Communication of Plan, Availability of Information
- Training on key success factors, best practices, and lessons learned from other places,
- Share draft contractual framework w/ offerors
- Industry outreach
- Research comments from proposers to find ways to address their issues, find out if other contractual methods can be used, propose alternatives

Figure D.9.8: Activities – Knowledge Building at Procurement Phase.

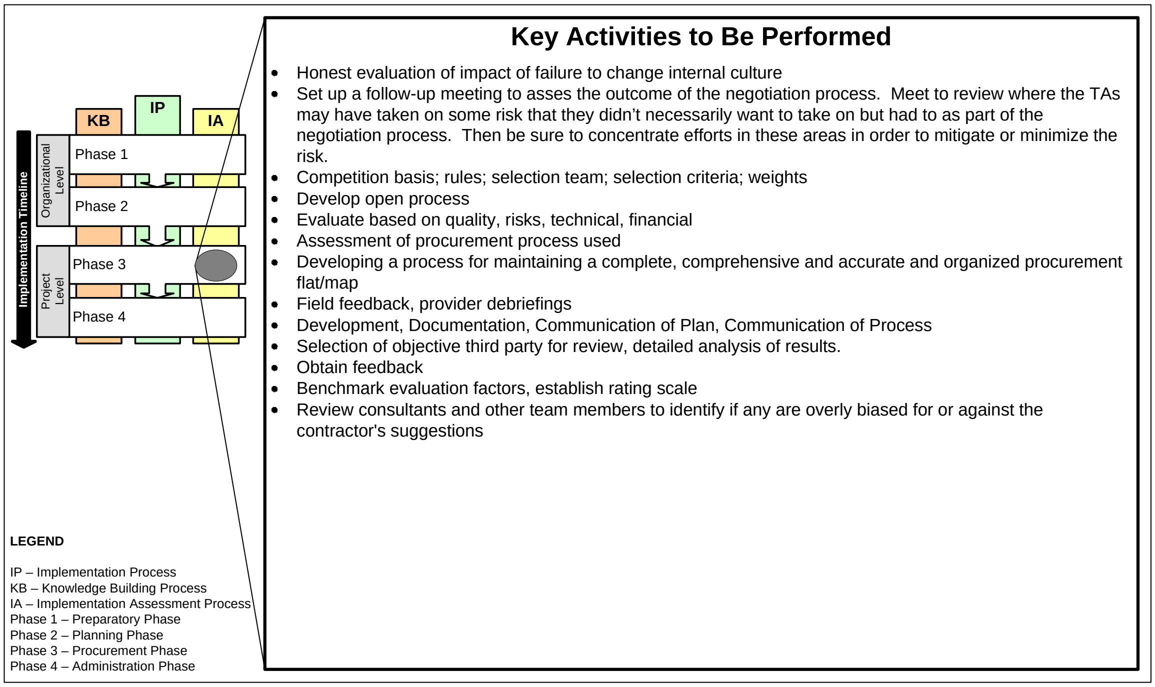


Figure D.9.9: Activities – Assessment at Procurement Phase.

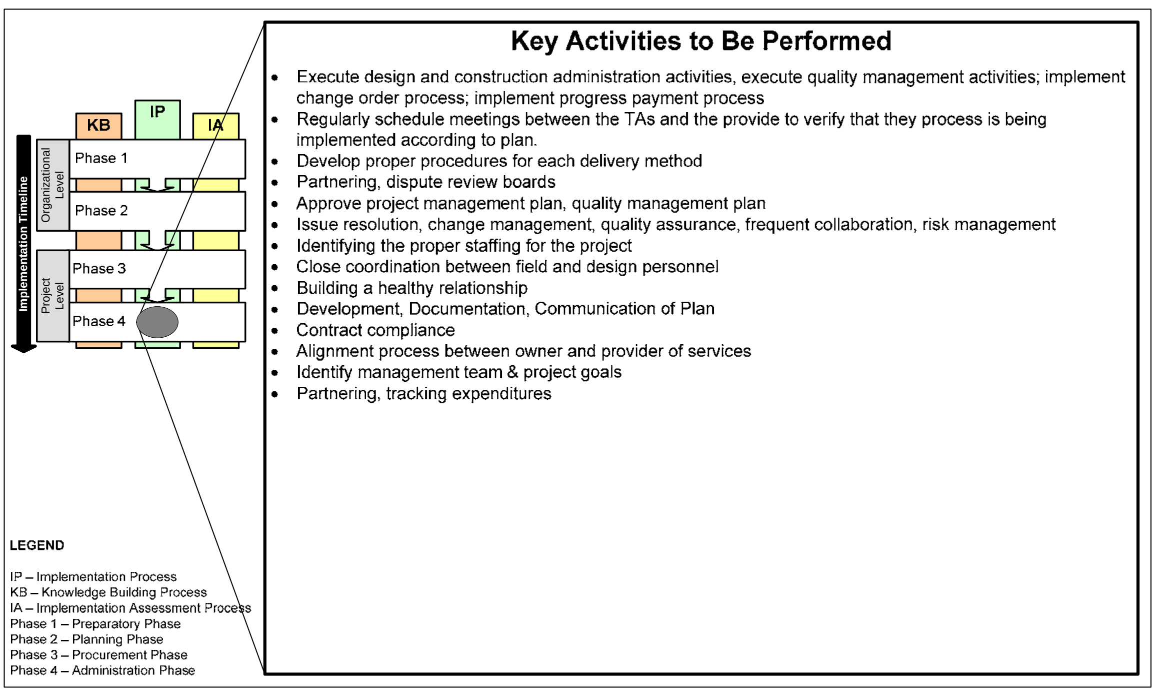


Figure D.9.10: Activities – Implementation at Administration Phase.

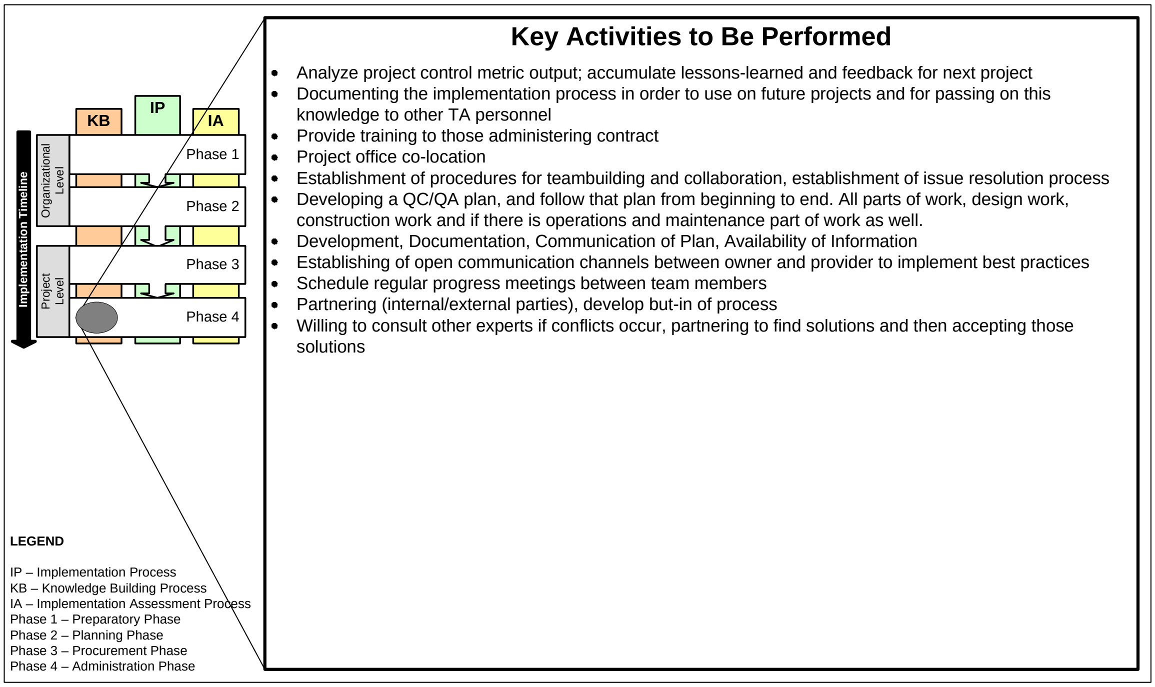


Figure D.9.11: Activities – Knowledge Building at Administration Phase.

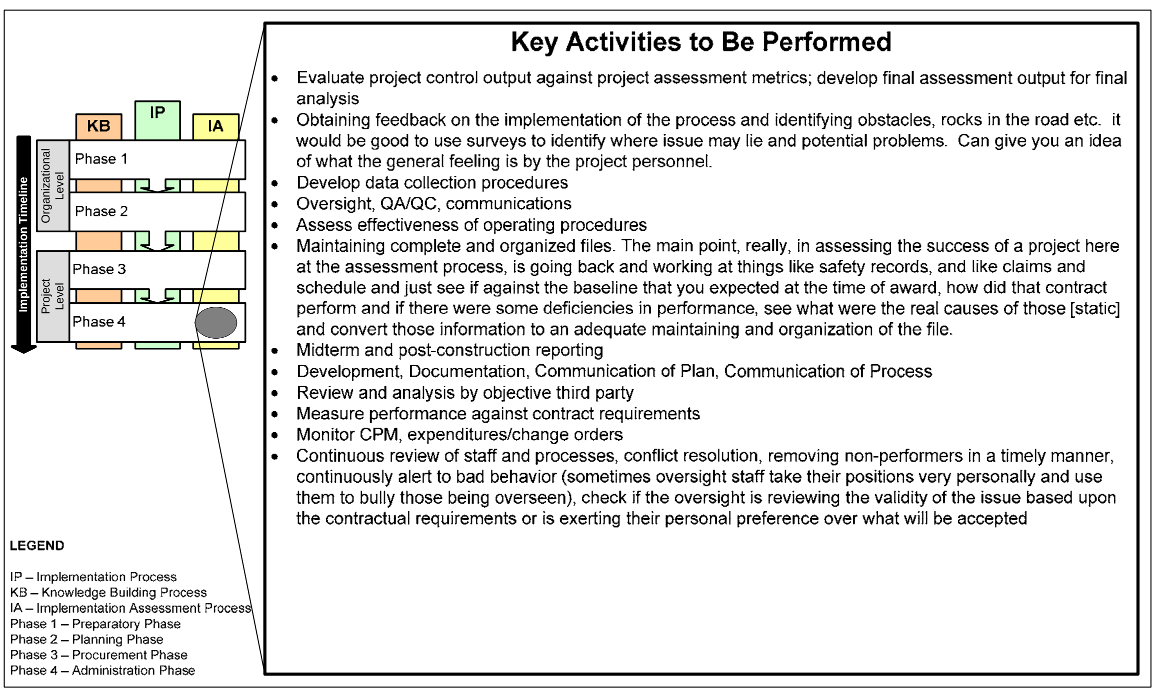


Figure D.9.12: Activities – Assessment at Administration Phase.

D.10. DELPHI ROUND 2 COVER LETTER

Date: January 23, 2007
To: <<Name of Expert>>
From: Giovanni Ciro Migliaccio, University of Texas at Austin
Subject: Changing Project Delivery Strategy – An Implementation Framework (Delphi Study, Round No. 2)

We greatly appreciate your willingness to participate in the Delphi study by responding to our previous questionnaire. A total of twenty-six experts responded, giving us the excellent result of a 75% response rate. The Delphi panel includes individuals with considerable industry experience who, like you, have generously shared their wisdom. In addition to having rated each item, panelists provided helpful suggestions with their qualitative comments.

Using the panel's comments as a guide, we identified some additional issues to be addressed in the enclosed second questionnaire. Your responses to this second questionnaire will help us to finalize the final framework, which we will send to each panelist in the spring.

We encourage your ready participation to this second round since it will allow us to make the most of the information provided in the initial phase. It should only take about 30 minutes to respond to the questions.

The questions are divided into two sections:

- SECTION I: Rate for importance factors believed to affect a successful implementation
- SECTION II: Assess a modified collection of definitions

Please return your response to the address provided on the first page of the questionnaire, by February 25, 2007. If you have any questions, please do not hesitate to contact us at (512) 923-8681 or e-mail us at gcmigliaccio@mail.utexas.edu.

Many thanks for your time and attention.

Sincerely,
Giovanni C. Migliaccio, MSCE, Ph.D. Candidate, the University of Texas at Austin
James T. O'Connor, Ph.D., P.E., Professor, the University of Texas at Austin
G. Edward Gibson Jr., Ph.D., P.E., Professor, the University of Alabama

Enclosed Documents:

1) D2-Questionnaire: Second questionnaire
2) D2-Information: Support information
3) D1-Summary: Summary of previous questionnaire's responses

D.11. DELPHI ROUND 2 INFORMATION PACKET

Descriptive Rationale of Success Factors
In this section, factors believed to affect the success of changes to project delivery and finance strategy are described. An absence of these factors is believed to hinder the change implementation.

You have the opportunity to provide comments and suggestions on each of the factors. Please note that your written comments will help us improve the framework and will allow the other experts on the panel to fully understand your perspective.

SF 1) **Change to agency's delivery and finance strategy is driven by clear needs:** Needs/reasons for changing can be found at different levels: environmental (opportunities/constraints), organizational (funding), and project (schedule). Potential reasons include: (a) cost, (b) schedule, (c) financing, (d) commitments, and (e) benefits to transportation users and taxpayers. Without a motivating factor to change, it is difficult to obtain authorization or resources to implement the change. Moreover, in order to substantiate the action plan, agency staff needs to know why a change is necessary.

Comments (optional): ____

SF 2) **Support by elected officials:** Elected officials promote and/or support change. Political support can be vision-driven (political champions with a vision) or environment-driven (lobbying of groups or public perception). Having political support is important because a transportation agency needs support from elected officials to effect a change to the legislative framework. In addition to provide legislative authority, elected officials have the power to support the change by controlling funds, attracting media coverage, and driving public perception of a project. An absence of support by elected officials constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) develop a clear and concise message explaining need; (2) assess opposition; and (3) dialogue with and educate leaders.

Comments (optional): ____

SF 3) **Support/acceptance by industry providers:** Industry providers promote and/or support change. Participation from industry providers is crucial for the success of a change initiative. If industry providers support the change, they will lobby elected officials and drive public perceptions. Conversely, their opposition will hinder a truly competitive bid environment. An absence of support by industry providers constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) have a champion for the cause; (2) seek and keep credibility on change actions; (3) involve key industry groups early in the process (e.g., CEC, AGC, etc.); (4) update industry providers on change initiative (e.g., workshops, website, etc.); (5) seek input from industry providers on risk allocation strategy; and (6) partner during project implementation.

Comments (optional): ____

SF 4) **Acceptance by public:** Public is not believed to provide active support for a change initiative, but public opposition to a proposed change may endanger the effort because actions of elected officials are believed to be driven by public perception. Support from public is more likely to occur if agency provides a clear and concise message on the benefits of the change. An absence of acceptance by the general public constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) develop a clear and concise message explaining need; (2) assess opposition and identify strategy to mitigate it; and (3) use public workshops conducted by expert individuals to promote dialogue and educate public.

Comments (optional): ____

SF 5) **Acceptance by other relevant parties:** Other relevant parties affected by change accept change. Other parties (e.g., local agencies, other governmental agencies, utilities, environmental groups, railways, real property, cities, counties, etc.) involved in the project delivery are not believed to provide active support for a change initiative, but their resistance to the new approach may hinder the implementation effort. A lack of acceptance by these parties constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) develop a plan for third party input early in project development process; (2) educate on change initiative; and (3) use partnering and role making during project implementation.

Comments (optional): ____

SF 6) **Legislative authority for changing agency's delivery and finance strategy:** Legislative authority is obtained by a change in the legislative framework to allow changes to the agency's project delivery and finance strategy. A transportation agency needs legislative authority before instituting changes to its procurement and finance strategy. Needed changes to the regulatory framework occur at different levels (federal/state), and affect different aspects including: (a) allowed degree of project services that are outsourced; and (b) allowed project delivery methods. An absence of legislative authority constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) work with and educate to industry providers and elected officials; (2) inform general public; (3) advocate for legislative authority; and (4) draft legislation.

Comments (optional): ____

SF 7) **Agency's management vision and support for change:** A change to an agency's project delivery and finance strategy affects changes to all the elements of the system (i.e. procurement, contracting, financing, payment, and administration). Support by upper management is crucial for the success of the change initiative in many ways. This support may include: (1) championing for necessary legislative changes; (2) seeking support by legal counsel on legislative actions; (3) setting clear objectives for changing; (4) mandating needed internal changes (e.g., recruitment, outsourcing, creation of additional organizational units, etc.); (5) providing resources for implementing change (monetary and staff); (6) proclaiming commitment to agency's community (to mitigate agency's internal resistance); (7) manifesting commitment to knowledge-building (e.g., measures, time and money); (8) manifesting commitment to implementation assessment (e.g., measures, time and money); and (9) monitoring change implementation.

Comments (optional): ____

SF 8) **Comprehensive implementation plan at the organizational level:** There is a clear, timely, and comprehensive implementation plan at the organizational level. A lack of organizational planning on the change initiative constitutes a barrier to change because it may hinder the implementation process. To overcome this barrier, a plan should clearly define: (a) requirements (what needs to be accomplished by changing strategy); (b) boundaries (what practices are not being changed); and (c) a process for implementation. The plan should also address necessary procedures for evaluating change implementation, building organizational knowledge, and improving implementation process.

Comments (optional): ____

SF 9) **Assessment of the change's outcome:** A lack of assessment constitutes a barrier to change because without solid examples of success with the new process doubt about the new approach may result. Suggestions for overcoming this barrier include: (1) promote willingness to internally benchmark and (2) compare performance of other organizations that underwent the change.

Comments (optional): ____

SF 10) **Redesigned staffing procedures:** Agency procedures and policies for staffing are redesigned to facilitate the change initiative. Teams working on projects delivered with alternative methods require a different set of skills. Keeping staffing procedures unchanged may constitute a barrier to implementation. Suggestions for overcoming this barrier include: (1) use flexible allocation of staff; (2) build project teams with technical, management, and financial expertise; (3) select staff with knowledge of new approach or positive attitude to adoption; (4) provide career incentives to believers in the new approach; (5) use incentive strategies to promote a proactive approach to internal bureaucracy; (6) appoint expert program advisors external to the transportation agency's organization; and (7) use external advisors with experience in the new delivery strategy for both training of staff and support for project teams.

Comments (optional): ____

SF 11) **Availability of agency's staff for implementing change:** Agency staff is available for implementing change at the organizational level. Allocating insufficient resources to implement change constitutes a barrier to implementation. This problem may be due to: (a) a lack of upper management support; (b) a chronic lack of resources within the organization; or (c) non-availability of staff to participate in the implementation effort. Suggestions for overcoming this barrier include: (1) identify expert individuals; (2) establish organizational unit focused on innovative delivery methods; (3) allocate dedicated staff; (4) use this unit's expertise to develop a programmatic approach to provide consistency; and (5) use this unit's expertise to support the implementation of newly introduced delivery methods at the project level.

Comments (optional): ____

SF 12) **Acceptance of change by agency staff:** A widespread resistance to change by agency staff may also hamper the change. This problem may be due to: (a) cultural bias against change; (b) feeling of loss of control; (c) tradition; and (d) fear of the unknown. Suggestions for overcoming these barriers include: (1) develop organizational knowledge on newly introduced approaches; (2) use pilot projects to build consensus; (3) communicate information on the status of implementation; and (4) empower change through leadership actions.

Comments (optional): ____

SF 13) **Knowledge of newly introduced approaches by agency staff:** A thorough understanding of newly introduced approaches by agency staff will contribute to both a reduced resistance to change and a more efficient implementation. Actions to be pursued include: (1) allocate specific human and monetary resources to staff training; (2) train staff before implementation; and (3) focus training on procedural aspects of activities under the new approach.

Comments (optional): ____

SF 14) **Communications with the external parties affected by change:** External parties affected by change are informed on change initiative (e.g., industry providers, utilities, local agencies, etc.). A lack of information on the change initiative and on the new approach constitutes a barrier to change because it may trigger misinformation about the new approach and thereby generate resistance. Suggestions for overcoming this barrier include: (1) identify procedures necessary to inform all interested parties and (2) establish a schedule of letting dates to build up credibility within the community of industry providers.

Comments (optional): ____

SF 15) **Availability of a method for matching projects with delivery methods:** A change in project delivery and finance strategy introduces a set of new options to the organization. Using the wrong delivery method may hinder the implementation process by fostering cultural resistance. Suggestions for overcoming this barrier include: (1) carefully select pilot projects to avoid endangering the entire change initiative; (2) employ expert consultants; and (3) seek advice from other agencies, which underwent the change.

Comments (optional): ____

SF 16) **Comprehensive implementation plan at the project level:** There is a detailed and comprehensive master plan for the implementation of the newly introduced approach at the project level. An absence of planning may delay and endanger the implementation effort at the project level. Potential problems include: (a) delays from incomplete preliminary work (e.g., environmental clearance, ROW issues, utilities agreements, and public hearings); (b) incorrect estimation with resulting budget crises; and (c) initiation of procurement on project lacking funding. Suggestions for overcoming these types of barriers include: (1) define project goals, expectations, objectives, and constraints, early on; (2) as much as possible, keep consistent project goals throughout the life of the project; (3) perform due diligence to leverage public funding; (4) promote public support; (5) assess the status of early milestones (early decisions, environmental clearance, public outreach/involvement, etc.); (6) establish agreements with local agencies and third parties; and (7) obtain cost data for the new approach from expert consultants or other agencies that have undergone the change.

Comments (optional): ____

SF 17) **Owner project team staffing level:** Owner project team is adequately staffed to manage the procurement process and to administer the contract under the new approach. Some potential problems with owner teams include: (a) inexperienced project manager; (b) lack of staff; (c) lack of professional assistance; (d) having personnel in oversight roles outside their area of expertise; (e) absence of clear understanding in new processes; and (f) inconsistent direction to industry providers. Suggestions for overcoming these types of barriers include: (1) appoint an expert team leader who is empowered to make decisions; (2) have owner project personnel experienced, familiar, or adaptable to the new process, and with prior experience working as a team; (3) use professional consultants experienced in the new approach to fill team requirements; and (4) establish performance measures for team evaluation early on.

Comments (optional): ____

SF 18) **Clear and fair approach to managing project risks:** There is a clear strategy for identifying, allocating, sharing, and managing project risks. Some potential problems include: (a) unreasonable allocation of risk with resulting high bid prices; (b) unwillingness to manage risk; and (c) unclear contractual language. Suggestions for overcoming these types of barriers include: (1) elicit input of industry associations on master contract; (2) develop a risk allocation matrix; (3) have industry providers review the risk allocation during the procurement phase; and (4) develop risk management plan with selected provider.

Comments (optional): ____

SF 19) **Procurement process efficiency:** There is an efficient procurement process designed for the new approach. Lengthy and inefficient project procurement processes may hinder agency credibility and result in lower industry competition. Suggestions for an efficient procurement process include: (1) identify procedures to improve accuracy of pre-advertisement cost estimate; (2) customize the process to meet project needs; (3) identify method for awarding contracts; (4) identify procurement schedule by allocating right amount of time to procurement; (5) use shortlisting to select providers with ability to perform the project; and (6) acknowledge need for extended timeframes.

Comments (optional): ____

SF 20) **Competitive participation in procurement of qualified industry providers:** A main problem may be the industry's inability to assess redistribution of risk. Suggestions for overcoming this type of barrier include: (1) allocate project risks clearly; (2) adopt unambiguous contract award method; (3) seek input on draft contract documents by industry providers; and (4) seek industry providers who appoint project personnel who are expert in the new approach.

Comments (optional): ____

SF 21) **Quality of contractual documentation:** Arriving at the project procurement stage with contractual documents that are not ready or are not suitable for the new approach may result in inefficient pricing. Some potential problems include: (a) use of onerous specifications; (b) incomplete DB proposals; (c) contractual terms that are not aligned with project goals; (d) use of documents from other projects that do not meet local practice or site needs; (e) unclear contract language; and (f) excessive reference to design manuals (which were not written as contractual documents). Suggestions for overcoming these types of barriers include: (1) keep contractual document aligned to project goals; (2) adopt realistic requirements in request for proposals; and (3) use clear contract language.

Comments (optional): ____

SF 22) **Project's organizational structure facilitating new approach:** Agency should customize its team's organizational structure to the new approach. Suggestions for structuring project organization include: (1) allocate adequate resources to project beginning at the procurement phase; (2) define roles and responsibilities; and (3) make individuals accountable.

Comments (optional): ____

SF 23) **Project's communications facilitating new approach:** A lack of communications at the project level also constitutes a barrier to a successful implementation of the new approach because it may result in lower project performance and lower industry competition. Suggestions for improving project communications include: (1) promote continuous participation/collaboration of project parties; (2) inform project stakeholders including public and third parties (e.g., cities, utilities, metropolitan planning organizations, etc.); (3) keep the entire team aligned with project goals; and (4) identify partnering/dispute resolution procedures.

Comments (optional): ____

SF 24) **Contract administration procedures facilitating new approach:** Contract administration procedures are tailored to the new approach. Arriving at the contract administration phase without having designed procedures suitable for the new approach also constitutes a roadblock. Suggestions for designing contract administration procedures include: (1) seek input from selected provider and other TA personnel on project implementation and contract administration; (2) keep the administration of the contract consistent; (3) adhere closely to contractual documents; and (4) have and maintain a comprehensive schedule.

Comments (optional): ____

SF 25) **Acceptance by project parties:** There is a general acceptance of the new approach by all project personnel (both owner and industry providers). The implementation of the new approach at the project level may encounter resistance by certain project parties. Potential problems include: (a) unwillingness of individuals to compromise; (b) unwillingness by industry providers to adapt; (c) opposition by people with hidden agendas; (d) conflicting agendas between agency and service providers; (e) insincere commitment to partnering; (f) adversarial attitude; and (g) fear of loss of control by agency personnel. Suggestions to overcome these types of barriers include: (1) buy-in from both provider and TA personnel on the implementation process; (2) have project personnel (both owner representatives and consultants) who are able to work as a team and to compromise for the good of the project; and (3) have project personnel who are committed to the success of the project.

Comments (optional): ____

Modified Definitions of Terms

DEF-1: A **Project Delivery Method** is defined as a system for managing the delivery of a project. Project delivery methods can be differentiated by (i) the *project life span,* which identifies the period of facility life covered by the project delivery; (ii) the *risk allocation method,* which identifies the degree to which owners transfer risks to industry providers;
(iii) the *contract packaging method,* which identifies the degree to which contracts for different project services are combined; and (iv) the presence of a *funding component acquired by industry providers* in the adopted project finance method.

Examples:

- The design-bid-build (DBB) method administers a project life that is concluded with the physical execution of the project work. The DBB method allocates many of the risks associated with construction to industry providers. Finally, this method neither combines contracts for design and construction services, nor includes funding acquired by the industry providers.
- The design-build (DB) method administers a project life that is concluded with the physical execution of the project work. The DB method allocates the risks associated with design and construction to industry providers. While this method does combine contracts for design and construction services, it does not include funding acquired by the industry providers.
- The design-build-finance-operate (DBFO) method administers a project life that is extended beyond the physical execution of the project work to include a certain period of operations. The DBFO method allocates the risks associated with design, construction, and operation services in addition to allocating a variable amount of the risks associated with financing. Finally, this method combines contracts for design, construction, and operation services. It also uses finance methods that include a funding component acquired by industry providers.

Comments (optional): ____

DEF-2: A **Risk Allocation Method** is defined as a system for allocating the risks associated with specific project services to industry providers (e.g., planning, environmental clearance, permitting, financing, design, construction, right-of-way, utility relocation, operation, maintenance, etc.). Risk allocation methods can be differentiated by the *amount of risks transferred* by owners to industry providers. This transfer of risks also determines which project services are outsourced.

Example:

- Some delivery methods (e.g., design-build-maintain) tend to transfer a larger amount of risk (and to outsource corresponding services) to industry providers, whereas other methods entail that the owner retain the risk (e.g., design-bid-build).

Comments (optional): ____

DEF-3: A **Contract Packaging Method** is defined as a system for organizing the procurement of the different services necessary for the delivery of a project.

[Examples of such basic project services are planning, environmental clearance, permitting, financing, design, construction, right-of-way, utility relocation, operation, maintenance, etc. Examples of project components are segments, bridges, interchanges, etc.]

Contract packaging methods can be differentiated by (i) the degree to which different *project services are combined* in contractual relationships with industry providers; and (ii) the degree to which different *project physical components are combined* in contractual relationships with industry providers.

Example:

- Packaging involves the aggregation of contracts for different project services: Combined-service methods integrate the procurement of more services under the umbrella of fewer service providers (e.g. the design-build method) whereas segmented-service methods separate procurement activities of different services (e.g. the design-bid-build method). The examples provided (i.e., DBB and DB methods) show that the packaging method is independent from which services are transferred to industry providers. Both methods may transfer the risks of design and construction services while managing the contract packaging in different way.
- Packaging also involves the aggregation of contracts for different physical components: combined-component methods integrate the procurement of the entire project, whereas segmented-component methods separate procurement activities of different physical components (e.g., by segment).

Comments (optional): ____

____

DEF-4: A **Project Finance Method** is defined as a system for acquiring or providing funds from different sources and combining them for financing a project during its delivery. Project finance methods can be differentiated by (i) the **project life span,** which identifies the part of the life of the corresponding facility that is financed by the method, (ii) the types of **financing sources** that provide funding to the project (e.g., state, federal, local, private, etc.); and (iii) the types of **financing vehicles** that are used (e.g., direct appropriation, federal-aid grants, project revenue bonds, private equity, debt financing, tax exempt financing, Private Activity Bonds, etc.).

Examples:

- <u>Relationship between project life and project finance method:</u> The project finance method for a design-build (or design-bid-build) project aims at providing and combining different funds for the design and construction of the project, whereas a design-build-maintain method would require funds for the additional life span covered by the maintenance period.

- Relationship between funding sources and project finance method: Publicly funded projects use finance methods that acquire and combine different funds from public sources (e.g. federal, state, and local) whereas public-private partnership projects use finance methods that include a private funding component.

Comments (optional): ____

____

DEF-5: A Transportation Agency's **Strategy for Financing and Delivering Projects** is defined as the toolbox including all the delivery and finance options allowed by the agency's regulatory and institutional environment and pursued through specific actions. A change to this strategy may involve a broadening or a lessening of options that is the result of a change in the legislative/regulatory framework at the federal and/or state level.

Example:

- Difference between traditional and innovative delivery strategies: A transportation agency with a traditional delivery strategy allows its officers to adopt only the design-bid-build delivery method, whereas a transportation agency with an innovative delivery strategy provides a larger number of delivery options.
- Difference between traditional and innovative finance strategies: A transportation agency with a traditional finance strategy is allowed to finance its projects only through traditional funding sources (i.e. state and federal), whereas a transportation agency with innovative finance strategy provides a larger number of finance options.

Comments (optional): ____

DEF-6: A **Project Procurement Process** includes a combination of four systematic actions necessary to prepare for the execution of a project: (a) the owner review of provider-suggested innovations (regulated by the alternative technical concept sub-process); (b) the provider review of the owner-identified risk allocation method (regulated by the industry review sub-process); and (c) the selection of industry providers (regulated by the contract award method). Sub-processes (a) and (b) produce a contract between the owner and the selected provider that adjusts a master contract to meet project-specific needs.

Comments (optional): ____

DEF-7: The **Alternative Technical Concept (ATC) Process** is an interactive process for owners to solicit innovations by industry providers during the procurement phase. This process is mostly used during the procurement of combined services (e.g. design-build, design-build-maintain, etc.). Under this process, providers are invited to submit innovative ideas. Usually, they are technical solutions that diverge from the owner-provided technical provisions. There are two categories of ATCs: cost-saving and value-added.

Comments (optional): ____

DEF-8: The **Industry Review Process** is an interactive process which allows owners to solicit feedback on the proposed risk allocation from industry providers. There are two types of industry reviews: (a) at the program level and (b) at the project level.

Examples:

- Program-level review: Some transportation agencies perform an early industry review of the contractual draft when they are implementing a new delivery method through a program-level approach. This approach aims to build industry consensus on the change initiative by generating dialogue on the proposed risk allocation. The outcome is an allocation of risks that is negotiated within the industry.
- Project-level review: Transportation agencies may also perform an industry review at the project level by releasing a draft of the contractual document to providers during the procurement. In such a case, the goal is to achieve a trade-off with the proposers in terms of risk allocation.

Comments (optional): ____

DEF-9: A **Contract Award Method** (also called "industry provider selection method" or "source selection process") is defined as a system for selecting the provider of a tendered project service (e.g., design, construction, etc.) or component (e.g., road segment A, bridge B, etc.). Low bid, Best-value, and Qualification-Based Selection (QBS) are examples of contract award methods.

Comments (optional): ____

D.12. DELPHI ROUND 2 QUESTIONNAIRE

Please answer the questions in the following sections to the best of your ability. If needed, use the enclosed *D2-Information* document for more detailed information on each of the items to be evaluated.

The questionnaire is divided into two sections: (1) SECTION I – Rating of success factors; and (2) SECTION II – Overall assessment of a modified collection of definitions. In the first section, you are asked to Rate for Importance factors believed to affect the success of a state transportation agency in implementing a change in the project delivery strategy. In the final section, you are asked to Assess the collection of definitions recently modified to meet the panel's previous suggestions.

Without asking prior permission, the confidentiality of this questionnaire will be maintained and your identity will in no way be linked to the specific data provided. In addition, data will not be placed in any permanent record and will be destroyed when no longer needed by the researchers. Nevertheless, we would like to recognize your participation on this panel. Please use the space below to express your preference.

If you are filling this questionnaire electronically, please express your preference by double-clicking the appropriate check box and selecting "Checked".

Can we recognize your participation on this panel in our final report?

☐	☐	☐	☐
Yes Name, Job Title and Affiliation	**Yes** Job Title and Affiliation Only	**Yes** Affiliation Only	**No**

We would like to thank you in advance for the time and effort involved in this study.

Please return this questionnaire by email, fax, or mail by February 25, 2007

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SECTION I: Rating of Success Factors

Please rate for importance the following factors believed to affect the implementation of a change to the agency's delivery and finance strategy. These factors were drawn from the panel's responses to the first questionnaire. Many panelists suggested that an absence of these same factors constitutes a barrier to the implementation effort. The first part of the enclosed information packet includes a detailed description of each factor, including problems resulting from their absence and actions to be taken.

Please score each factor using a 7 point scale, where a score of 1 = "not important at all" and 7 = "extremely important." (*Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort, and to how significant the factor's absence is in hindering the success of the implementation effort.*)

1———2———3———4———5———6———7

Not Important — Important — Extremely Important

	#	Factors believed to affect the success of the implementation effort	Score
	SF-1	Change to the agency's delivery and finance strategy is driven by clear needs	
External	SF-2	Support by elected officials	
External	SF-3	Support/acceptance by industry providers	
External	SF-4	Acceptance by general public	
External	SF-5	Acceptance by other relevant parties	
External	SF-6	Legislative authority for changing agency's delivery and finance strategy	
Organization	SF-7	Agency's management vision and support for change	
Organization	SF-8	Comprehensive implementation plan at the organizational level	
Organization	SF-9	Assessment of the change's outcome	
Organization	SF-10	Redesigned staffing procedures	
Organization	SF-11	Availability of agency's staff for implementing change	
Organization	SF-12	Acceptance of change by agency staff	
Organization	SF-13	Knowledge of newly introduced approaches by agency staff	
Organization	SF-14	Communications with the external parties affected by change	
Organization	SF-15	Availability of a method for matching projects with delivery methods	
Project	SF-16	Comprehensive implementation plan at the project level	
Project	SF-17	Owner project team staffing level	
Project	SF-18	Clear and fair approach to managing project risks	
Project	SF-19	Procurement process efficiency	
Project	SF-20	Competitive participation in procurement of qualified industry providers	
Project	SF-21	Quality of contractual documentation	
Project	SF-22	Project's organizational structure facilitating new approach	
Project	SF-23	Project's communications facilitating new approach	
Project	SF-24	Contract administration procedures facilitating new approach	
Project	SF-25	Acceptance by project parties	

SECTION II: Modified Project Delivery and Finance Definitions

Previous definitions were modified to meet the panel's suggestions. The new definitions, proposed here are presented in Section C of the enclosed *D2-Information* document. Please devote sufficient time to reading each definition statement and then rate your level of agreement in the table below. Use the provided 7-point scale to express your agreement or disagreement with the italicized statement for each definition.

The definition adequately describes the concept and is meaningful within the context of the transportation project sector.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Conditionally Disagree	Neutral	Conditionally Agree	Agree	Strongly Agree

#	Definition	Score
DEF-1	Project Delivery Method	
DEF-2	Risk Allocation Method	
DEF-3	Contract Packaging Method	
DEF-4	Project Finance Method	
DEF-5	Agency's Strategy for Financing and Delivering Projects	
DEF-6	Project Procurement Process	
DEF-7	Alternative Technical Concept (ATC) Process	
DEF-8	Industry Review Process	
DEF-9	Contract Award Method	

Appendix E: Implementation Framework

E.1. Overall Architecture

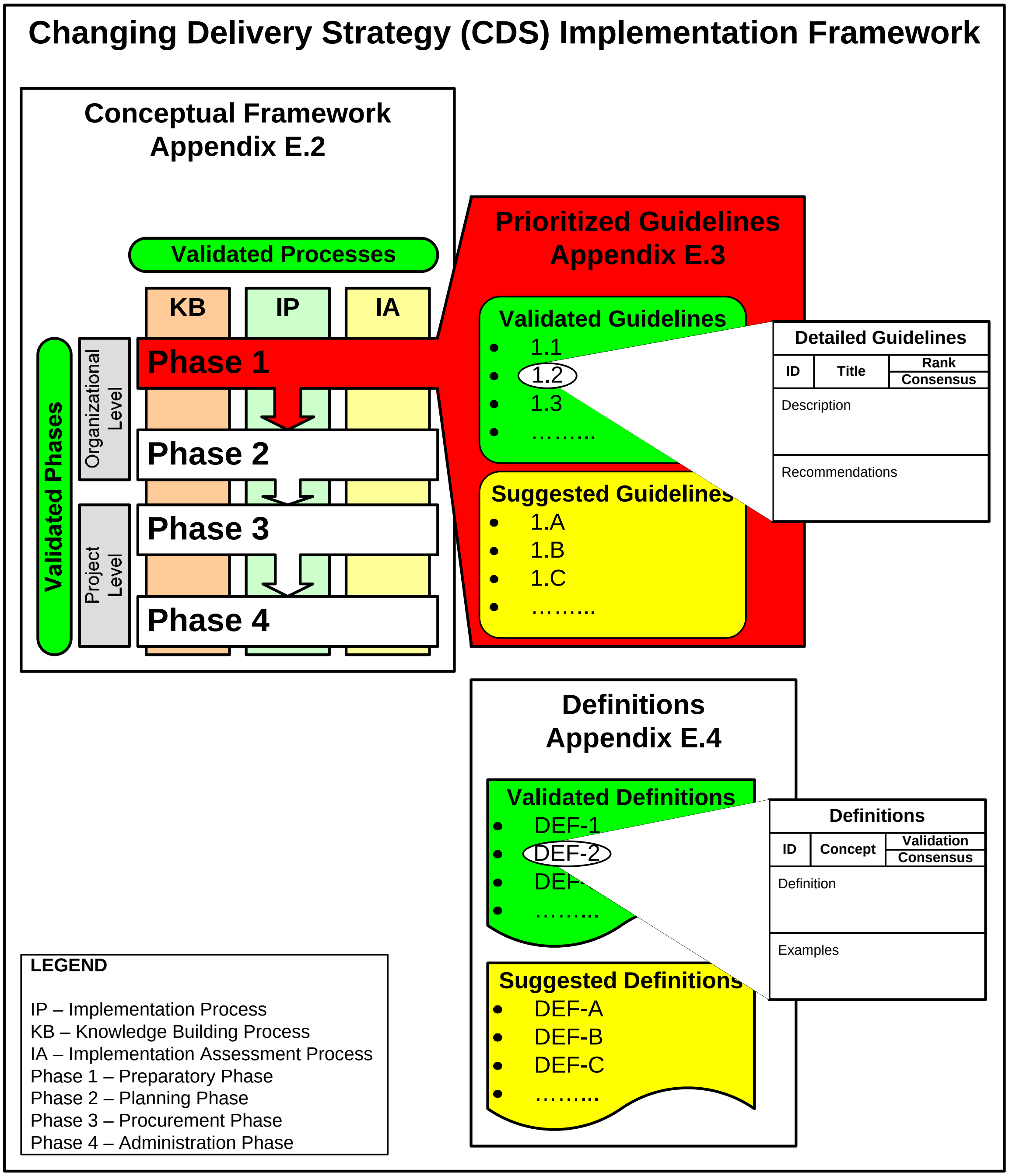

Figure E.1.1: CDS Framework Overall Architecture.

E.2. Conceptual Framework

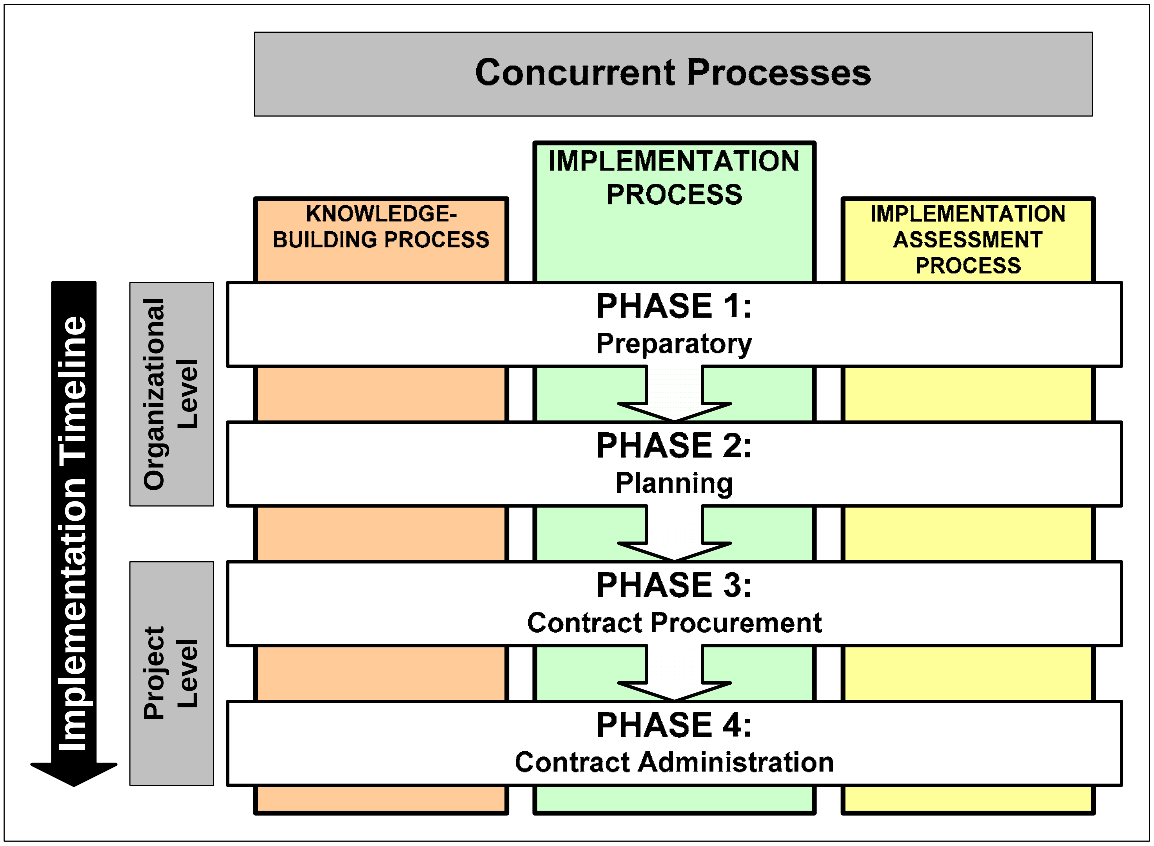

Figure E.2.1 Conceptual Implementation Framework.

Table E.2.1: Implementation Framework Concurrent Processes.

Concurrent Processes	Description
Implementation Process (IP)	Plan to implement the new delivery and finance methods starting from the preparatory phase through to the contract administration phase. This process facilitates implementation of the new delivery and finance strategy by: a. identifying decisions significant to the problem of changing delivery strategy, and b. aligning project practices with organizational strategy.
Knowledge Building Process (KB)	Plan to manage knowledge of the new delivery strategy from the preparatory phase through the contract administration phase. This process facilitates acceptance among stakeholders (e.g., public, elected officers, industry providers, utilities, local agencies, etc.). Acceptance among organizational staff is also promoted through organizational learning, which is pursued by: a. collecting, verifying, storing, and disseminating lessons learned on the implementation effort, and b. identifying sources of information on newly introduced project delivery and finance methods.
Implementation Assessment Process (IA)	Plan to assess accomplishment of the new delivery strategy from the preparatory phase all the way through the contract administration phase. This process promotes continuous improvement by: a. providing internal and external benchmarking, and b. providing feedback on implementation progress to organizational decision-makers.

Table E.2.2: Implementation Framework Concurrent Phases.

Framework Phases	Description
Phase 1: Preparatory	This phase focuses on identifying information available at the organizational level that can be utilized at the planning and project level for implementing new delivery methods. The preparatory phase is driven by high-level organizational personnel and has five objectives: (1) to state reasons for the change, (2) to determine if new delivery approaches are available for use, (3) to define organizational project delivery strategy, (4) to initiate the information loop between the organization and the surrounding environment, and (5) to initiate the information loop between the organization and the project.
Phase 2: Planning	This phase is performed by organizational-level personnel (i.e., district and/or division personnel) and focuses on implementing organizational changes, selecting prioritized projects, drafting early risk allocation strategy and making early decisions on the project delivery method. The project planning phase leads to: (1) an initial project delivery and financing approach compatible with both the organizational and the project objectives, and (2) a project manager/champion for initiating and carrying out the procurement and eventually administering the contract.
Phase 3: Contract Procurement	This phase is performed by project and/or organizational-level personnel and focuses on selecting the project service providers, on implementing and reviewing risk allocation, and in establishing the project's necessary contractual relationships. The contract procurement phase leads to an established contractual framework between agency and the selected project service provider.
Phase 4: Contract Administration	This phase is performed by project-level personnel (i.e., project management team) who focus on monitoring provider performance, managing the contract, making payments for work performed, and accepting the final deliverables. In order to reach these phase objectives, the project management team needs to set up all the project organization- and communications structures necessary for monitoring and assisting the provider during the project delivery. The contract administration phase leads to an established project execution framework between the agency, the selected project service provider, and other interested parties.

E.3. DETAILED FRAMEWORK

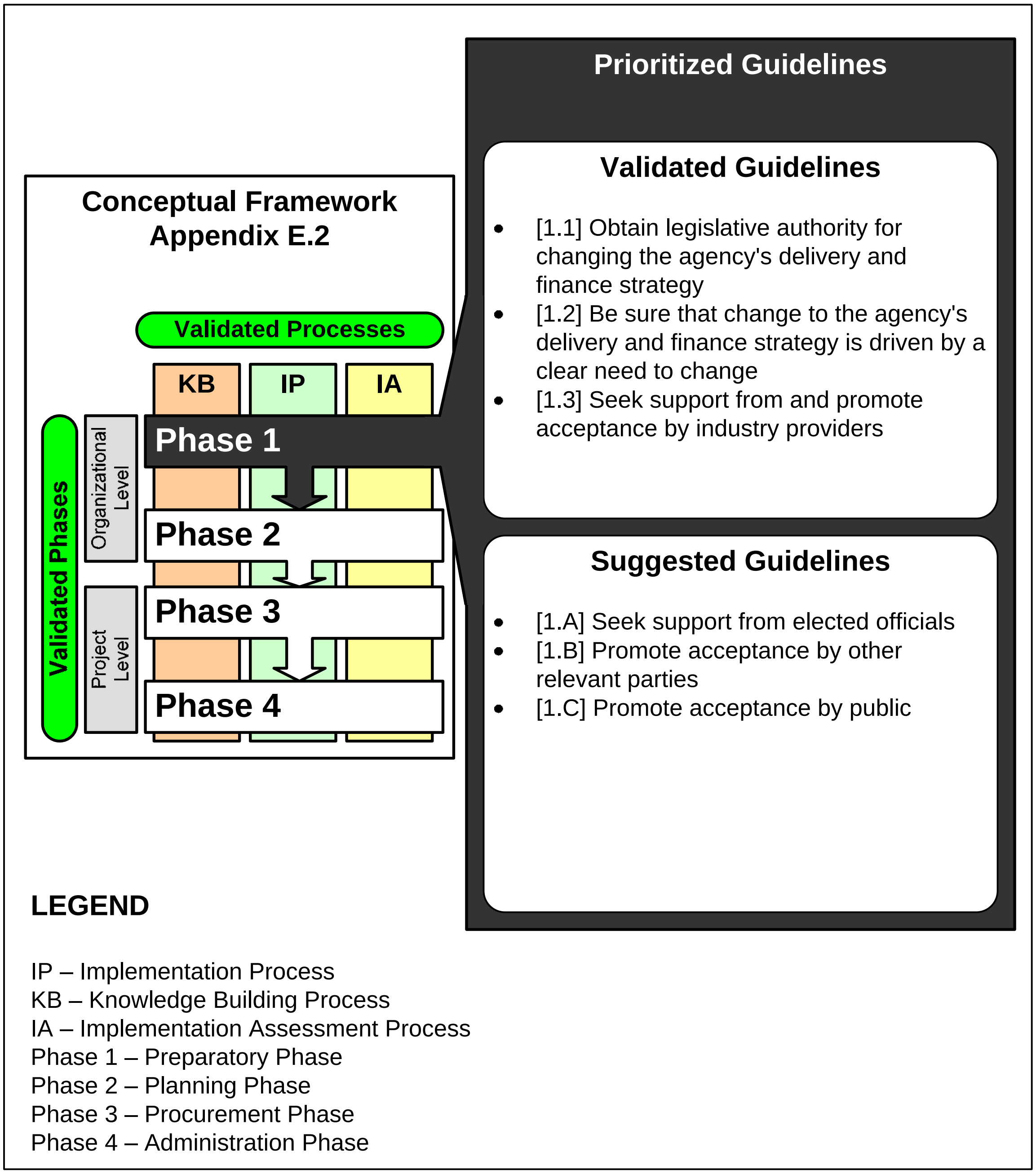

Figure E.3.1: Detailed Framework Recommendations by Phase (Phase 1).

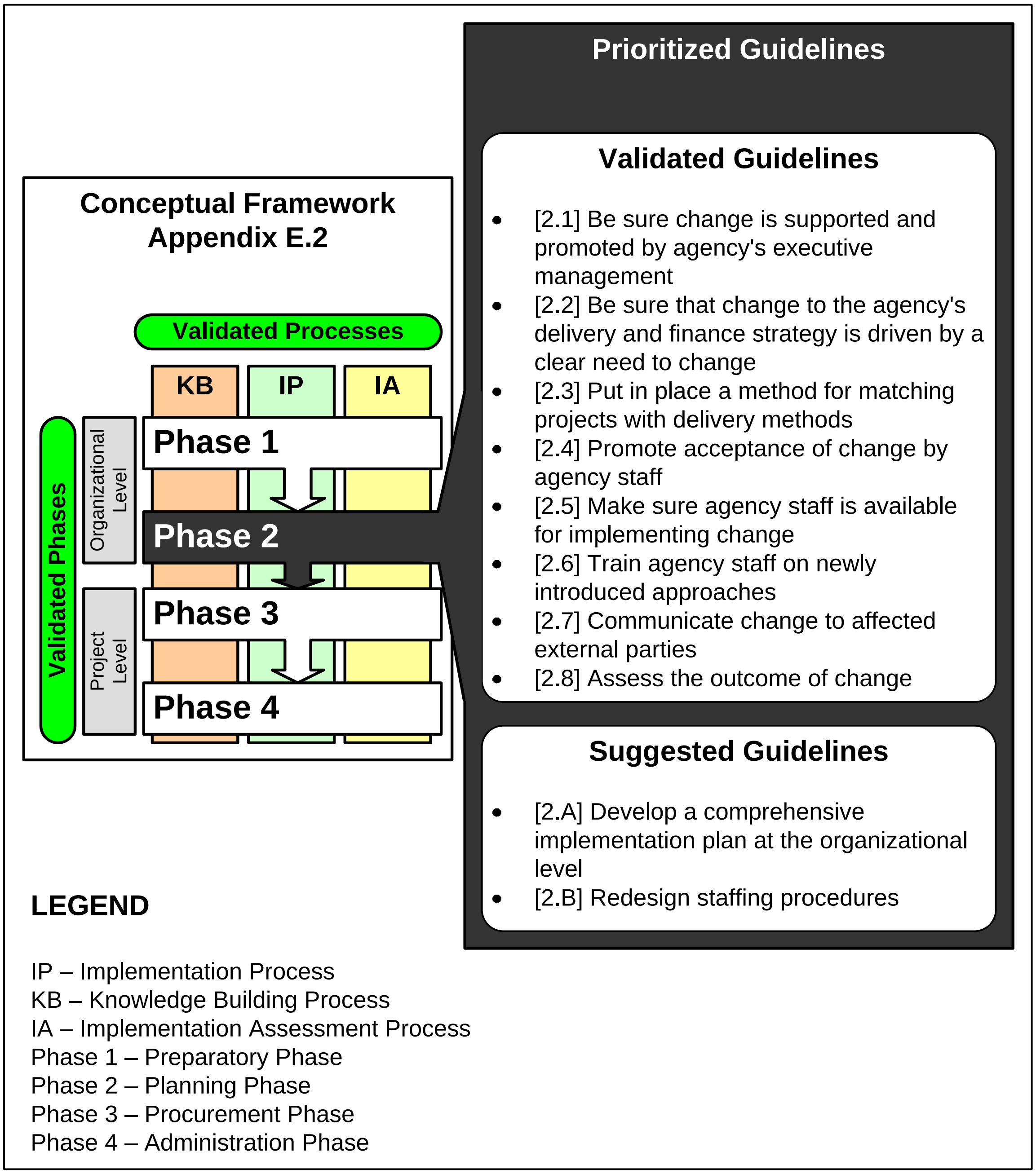

Figure E.3.2: Detailed Framework Recommendations by Phase (Phase 2).

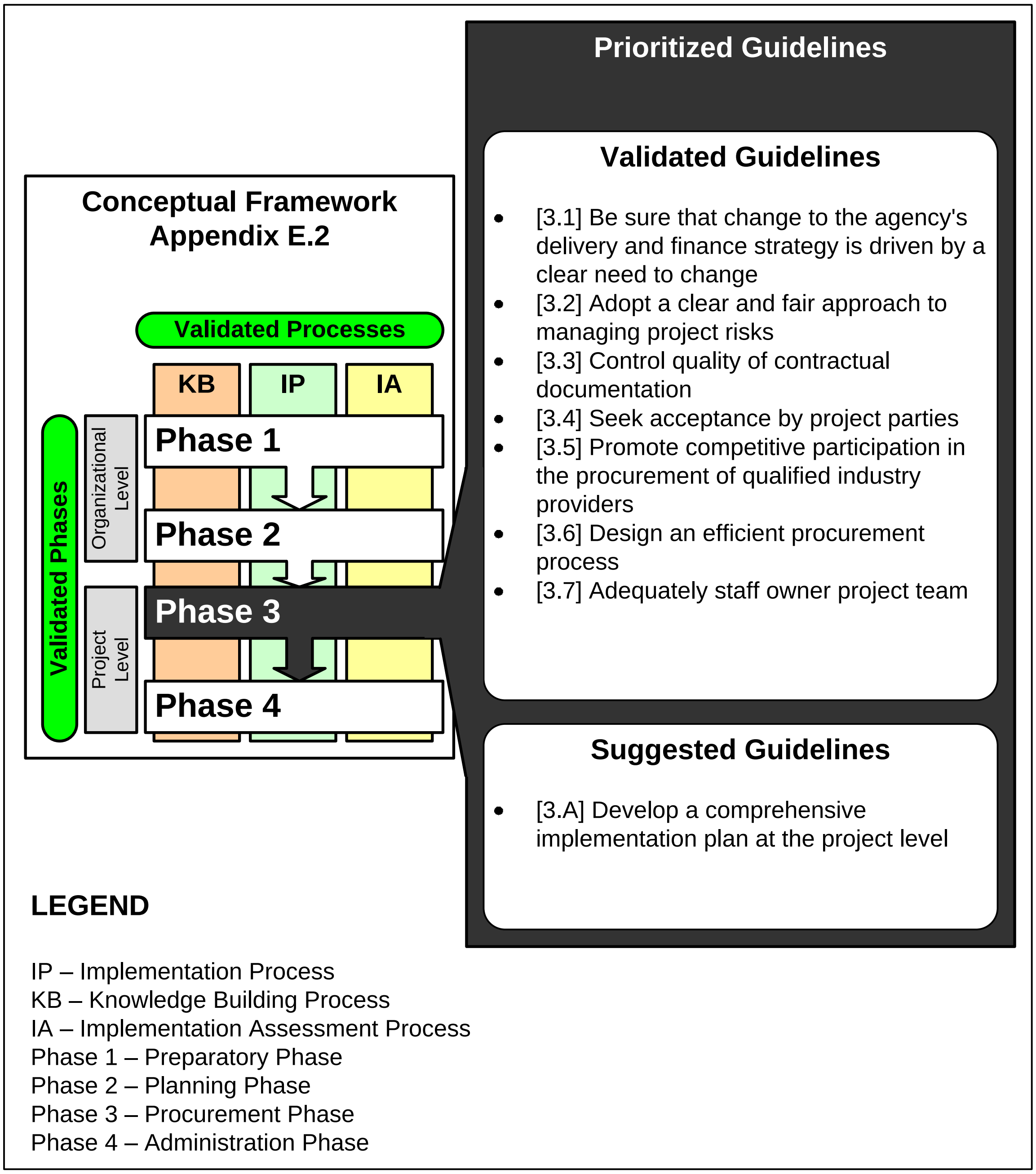

Figure E.3.3: Detailed Framework Recommendations by Phase (Phase 3).

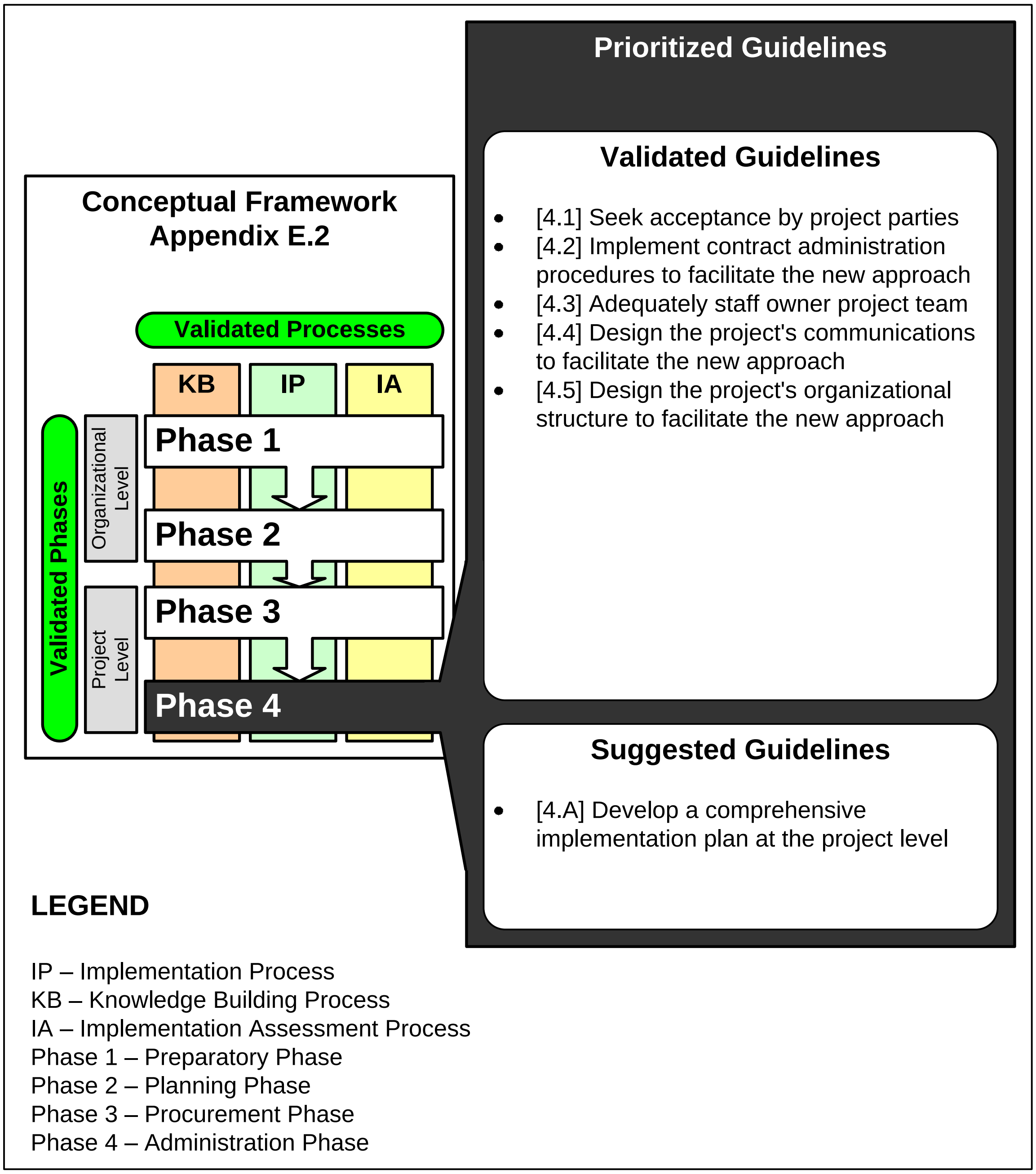

Figure E.3.4: Detailed Framework Recommendations by Phase (Phase 4).

Table E.3.1: Validated Implementation Guidelines (External Level).

1.1	**Obtain legislative authority for changing the agency's delivery and finance strategy**	**Overall Rank**	**1**
		Strong consensus	

Description

Legislative authority is obtained by a change in the legislative framework allowing changes to the agency's project delivery and finance strategy. A transportation agency needs legislative authority before instituting changes to its procurement and finance strategy. Changes to the regulatory framework occur at different levels (federal/state), and affect different aspects including: (a) allowed degree of project services that can be outsourced; and (b) allowed project delivery methods. An absence of legislative authority constitutes a barrier to change.

Recommendations

(1) Work with and educate industry providers and elected officials
(2) Inform general public
(3) Advocate for legislative authority
(4) Draft legislation

1.2	**Be sure that change to the agency's delivery and finance strategy is driven by a clear need to change**	**Overall Rank**	**3**
		Strong consensus	

Description

Needs/reasons for changing can be found at different levels: environmental (opportunities/constraints), organizational (funding), and project (schedule). Potential reasons include: (a) cost, (b) schedule, (c) financing, (d) commitments, and (e) benefits to transportation users and taxpayers. Without a motivating factor to change, it is difficult to obtain authorization or resources to implement the change. Moreover, in order to substantiate the action plan, agency staff needs to know why a change is necessary.

1.3	**Seek support from and promote acceptance by industry providers**	**Overall Rank**	**10**
		Strong consensus	

Description

Industry providers promote and/or support change. Participation from industry providers is crucial for the success of a change initiative. If industry providers support the change, they will lobby elected officials and drive public perceptions. Conversely, their opposition will hinder a truly competitive bid environment. An absence of support by industry providers constitutes a barrier to change.

Recommendations

(1) Have a champion for the cause
(2) Seek and keep credibility on change actions
(3) Involve key industry groups early in the process (e.g., CEC, AGC, etc.)
(4) Update industry providers on change initiative (e.g., workshops, website, etc.)
(5) Seek input from industry providers on risk allocation strategy
(6) Partner during project implementation

Table E.3.2: Suggested Implementation Guidelines (External Level).

1.A	**Seek support from elected officials**
Description Elected officials promote and/or support change. Political support can be vision-driven (political champions with a vision) or environment-driven (lobbying of groups or public perception). Having political support is important because a transportation agency needs support from elected officials to effect a change to the legislative framework. In addition to providing legislative authority, elected officials have the power to support the change by controlling funds, attracting media coverage, and driving public perception of a project. An absence of support by elected officials constitutes a barrier to change. *Recommendations* (1) Develop a clear and concise message explaining need (2) Assess opposition (3) Dialogue with and educate leaders	
1.B	**Promote acceptance by other relevant parties**
Description Other relevant parties affected by change accept change. Other parties (e.g., local agencies, other governmental agencies, utilities, environmental groups, railways, real property owners, cities, counties, etc.) involved in the project delivery are not believed to provide active support for a change initiative, but their resistance to the new approach may hinder the implementation effort. A lack of acceptance by these parties constitutes a barrier to change. *Recommendations* (1) Develop a plan for third party input early in the project development process (2) Educate on change initiative (3) Use partnering and role making during project implementation	
1.C	**Promote acceptance by public**
Description Public is not believed to provide active support for a change initiative, but public opposition to a proposed change may endanger the effort because actions of elected officials are believed to be driven by public perception. Support from public is more likely to occur if agency provides a clear and concise message on the benefits of the change. A lack of acceptance by the general public constitutes a barrier to change. *Recommendations* (1) Develop a clear and concise message explaining the need for the change (2) Assess opposition and identify strategy to mitigate it (3) Use public workshops conducted by expert individuals to promote dialogue and educate the public	

Table E.3.3: Validated Implementation Guidelines (Organization Level).

2.1	**Be sure change is supported and promoted by agency's executive management**	**Overall Rank**	**2**
		Strong consensus	

Description
A change to an agency's project delivery and finance strategy affects all the elements of the delivery system (i.e. procurement, contracting, financing, payment, and administration). Support by upper management is crucial for the success of the change initiative in many ways.

Recommendations

(1) Champion for necessary legislative changes
(2) Seek support by legal counsel on legislative actions
(3) Set clear objectives for the change
(4) Mandate needed internal adjustments (e.g., recruitment, outsourcing, creation of additional organizational units, etc.)
(5) Provide resources for implementing the change (monetary and staff)
(6) Proclaim commitment to agency's community (to mitigate agency's internal resistance)
(7) Manifest commitment to knowledge-building (e.g., measures, time and money)
(8) Manifest commitment to implementation assessment (e.g., measures, time, and money)
(9) Monitor change implementation

2.2	**Be sure that change to the agency's delivery and finance strategy is driven by a clear need to change**	**Overall Rank**	**3**
		Strong consensus	

Description
Needs/reasons for changing can be found at different levels: environmental (opportunities/constraints), organizational (funding), and project (schedule). Potential reasons include: (a) cost, (b) schedule, (c) financing, (d) commitments, and (e) benefits to transportation users and taxpayers. Without a motivating factor to change, it is difficult to obtain authorization or resources to implement the change. Moreover, in order to substantiate the action plan, agency staff needs to know why a change is necessary.

2.3	**Put in place a method for matching projects with delivery methods**	**Overall Rank**	**11**
		Strong consensus	

Description
A change in project delivery and finance strategy introduces a set of new options to the organization. Using the wrong delivery method may hinder the implementation process by fostering cultural resistance.

Recommendations

(1) Carefully select pilot projects to avoid endangering the entire change initiative
(2) Employ expert consultants
(3) Seek advice from other agencies that previously underwent the change

Table E.3.3: Validated Implementation Guidelines (Organization Level continued).

2.4	**Promote acceptance of change by agency staff**	**Overall Rank**	**13**
		Strong consensus	

Description

A widespread resistance to change by agency staff may also hamper the change. This problem may be due to: (a) cultural bias against change; (b) feelings of loss of control; (c) tradition; and (d) fear of the unknown.

Recommendations

(1) Develop organizational knowledge on newly introduced approaches
(2) Use pilot projects to build consensus
(3) Communicate information on the status of implementation
(4) Empower change through leadership actions

2.5	**Make sure agency staff is available for implementing change**	**Overall Rank**	**14**
		Moderate Consensus	

Description

Agency staff is available for implementing change at the organizational level. Allocating insufficient resources to implement change constitutes a barrier to implementation. This problem may be due to: (a) a lack of upper management support; (b) a chronic lack of resources within the organization; or (c) non-availability of staff to participate in the implementation effort.

Recommendations

(1) Identify expert individuals
(2) Establish organizational unit focused on innovative delivery methods
(3) Allocate dedicated staff
(4) Use this unit's expertise to develop a consistent programmatic approach
(5) Use this unit's expertise to support the implementation of newly introduced delivery methods at the project level

2.6	**Train agency staff on newly introduced approaches**	**Overall Rank**	**17**
		Moderate Consensus	

Description

A thorough understanding of newly introduced approaches by agency staff will contribute to both a reduced resistance to change and a more efficient implementation.

Recommendations

(1) Allocate specific human and monetary resources to staff training
(2) Train staff before implementation
(3) Focus training on procedural aspects of activities under the new approach

Table E.3.3: Validated Implementation Guidelines (Organization Level continued).

2.7	**Communicate change to affected external parties**	**Overall Rank** **18** Strong Consensus

Description

External parties affected by change are informed on change initiative (e.g., industry providers, utilities, local agencies, etc.). A lack of information on the change initiative and on the new approach constitutes a barrier to change because it may trigger misinformation about the new approach and thereby generate resistance.

Recommendations

(1) Identify procedures necessary to inform all interested parties
(2) Establish a schedule of letting dates to build up credibility within the community of industry providers.

2.8	**Assess the outcome of change**	**Overall Rank** **19** Strong Consensus

Description

A lack of assessment constitutes a barrier to change because without solid examples of success with the new process doubt about the new approach may result.

Recommendations

(1) Promote internal benchmarking
(2) Compare performance of other organizations that underwent the change

Table E.3.4: Suggested Implementation Guidelines (Organizational Level).

2.A	**Develop a comprehensive implementation plan at the organizational level**
Description There is a clear, timely, and comprehensive implementation plan at the organizational level. A lack of organizational planning on the change initiative constitutes a barrier to change because it may hinder the implementation process. *Recommendations* (1) Define requirements (what needs to be accomplished by changing strategy) (2) Identify boundaries (what practices are not being changed) (3) Outline a process for implementation (4) Define procedures for evaluating change implementation (5) Define procedures for building organizational knowledge (6) Define procedures for improving implementation process	
2.B	**Redesign staffing procedures**
Description Agency procedures and policies for staffing are redesigned to facilitate the change initiative. Teams working on projects delivered with alternative methods require a different set of skills. Keeping staffing procedures unchanged may constitute a barrier to implementation. *Recommendations* (1) Use flexible allocation of staff (2) Build project teams with technical, management, and financial expertise (3) Select staff with knowledge of new approach or positive attitude to adoption (4) Provide career incentives to believers in the new approach (5) Use incentive strategies to promote a proactive approach to internal bureaucracy (6) Appoint expert program advisors external to the transportation agency's organization (7) Use external advisors with experience in the new delivery strategy for both training of staff and support for project teams.	

Table E.3.5: Validated Implementation Guidelines (Project Procurement).

<table>
<tr><td rowspan="2">3.1</td><td rowspan="2">Be sure that change to the agency's delivery and finance strategy is driven by a clear need to change</td><td>Overall Rank</td><td>3</td></tr>
<tr><td colspan="2">Strong consensus</td></tr>
<tr><td colspan="4">Description
Needs/reasons for changing can be found at different levels: environmental (opportunities/constraints), organizational (funding), and project (schedule). Potential reasons include: (a) cost, (b) schedule, (c) financing, (d) commitments, and (e) benefits to transportation users and taxpayers. Without a motivating factor to change, it is difficult to obtain authorization or resources to implement the change. Moreover, in order to substantiate the action plan, agency staff needs to know why a change is necessary.</td></tr>
<tr><td rowspan="2">3.2</td><td rowspan="2">Adopt a clear and fair approach to managing project risks</td><td>Overall Rank</td><td>4</td></tr>
<tr><td colspan="2">Strong Consensus</td></tr>
<tr><td colspan="4">Description
A clear strategy for identifying, allocating, sharing, and managing project risks exists. Some potential problems include: (a) unreasonable allocation of risk with resulting high bid prices; (b) unwillingness to manage risk; and (c) unclear contractual language.

Recommendations
(1) Eliciting input of industry associations on master contracts
(2) Developing risk allocation matrices for projects
(3) Having industry providers review the risk allocation during the procurement phase
(4) Developing a risk management plan with selected provider</td></tr>
<tr><td rowspan="2">3.3</td><td rowspan="2">Control quality of contractual documentation</td><td>Overall Rank</td><td>5</td></tr>
<tr><td colspan="2">Moderate Consensus</td></tr>
<tr><td colspan="4">Description
Arriving at the project procurement stage with contractual documents that are not ready or are not suitable for the new approach may result in inefficient pricing. Some potential problems include: (a) use of onerous specifications; (b) incomplete DB proposals; (c) contractual terms that are not aligned with project goals; (d) use of documents from other projects that do not meet local practice or site needs; (e) unclear contract language; and (f) excessive reference to design manuals (which were not written as contractual documents).

Recommendations
(1) Keep contractual document aligned to project goals
(2) Adopt realistic requirements in request for proposals
(3) Use clear contract language</td></tr>
</table>

Table E.3.5: Validated Implementation Guidelines (Project Procurement continued).

3.4	**Seek acceptance by project parties**	**Overall Rank**	**6**
		Strong Consensus	

Description
There is a general acceptance of the new approach by all project personnel (both owner and industry providers). The implementation of the new approach at the project level may encounter resistance by certain project parties. Potential problems include: (a) unwillingness of individuals to compromise; (b) unwillingness by industry providers to adapt; (c) opposition by people with hidden agendas; (d) conflicting agendas between agency and service providers; (e) insincere commitment to partnering; (f) adversarial attitude; and (g) fear of loss of control by agency personnel.

Recommendations

(1) Buy-in from both provider and agency personnel on the implementation process
(2) Have project personnel (both owner representatives and consultants) who are able to work as a team and to compromise for the good of the project
(3) Have project personnel who are committed to the success of the project

3.5	**Promote competitive participation in the procurement of qualified industry providers**	**Overall Rank**	**7**
		Strong Consensus	

Description
A main problem may be the industry's inability to assess redistribution of risk.

Recommendations

(1) Allocate project risks clearly
(2) Adopt an unambiguous contract award method
(3) Seek input on draft contract documents by industry providers
(4) Seek industry providers who appoint project personnel who are expert in the new approach

3.6	**Design an efficient procurement process**	**Overall Rank**	**8**
		Strong Consensus	

Description
There is an efficient procurement process designed for the new approach. Lengthy and inefficient project procurement processes may hinder agency credibility and result in lower industry competition.

Recommendations

(1) Identify procedures to improve accuracy of pre-advertisement cost estimate
(2) Customize the process to meet project needs
(3) Identify method for awarding contracts
(4) Develop a realistic schedule that allocates an adequate amount of time to procurement
(5) Use shortlisting to select providers with the ability to perform the project
(6) Acknowledge the need for extended timeframes

Table E.3.5: Validated Implementation Guidelines (Project Procurement continued).

3.7	**Adequately staff owner project team**	**Overall Rank**	**8**
		Strong Consensus	

Description

Owner project team is adequately staffed to manage the procurement process and to administer the contract under the new approach. Some potential problems with owner teams include: (a) inexperienced project manager; (b) lack of staff; (c) lack of professional assistance; (d) having personnel in oversight roles outside their area of expertise; (e) absence of clear understanding in new processes; and (f) inconsistent direction to industry providers.

Recommendations

(1) Appoint an expert team leader who is empowered to make decisions
(2) Hire owner project personnel who are experienced, familiar, or adaptable to the new process, and have prior experience working as a team
(3) Use professional consultants experienced in the new approach to fill team requirements
(4) Establish performance measures for team evaluation early on

Table E.3.6: Suggested Implementation Guidelines (Project Procurement).

3.A	**Develop a comprehensive implementation plan at the project level**

Description

There is a detailed and comprehensive master plan for the implementation of the newly introduced approach at the project level. An absence of planning may delay and endanger the implementation effort at the project level. Potential problems include: (a) delays from incomplete preliminary work (e.g., environmental clearance, ROW issues, utility agreements, and public hearings); (b) incorrect estimation with resulting budget crises; and (c) initiation of procurement on project without adequate funding.

Recommendations

(1) Define project goals, expectations, objectives, and constraints early on
(2) Keep consistent project goals throughout the life of the project as much as possible
(3) Perform due diligence to leverage public funding
(4) Promote public support
(5) Assess the status of early milestones (early decisions, environmental clearance, public outreach/involvement, etc.)
(6) Establish agreements with local agencies and third parties
(7) Obtain cost data for the new approach from expert consultants or other agencies that have undergone the change

Table E.3.7: Validated Implementation Guidelines (Project Administration).

4.1	**Seek acceptance by project parties**	**Overall Rank**	**6**
		Strong Consensus	

Description

There is a general acceptance of the new approach by all project personnel (both owner and industry providers). The implementation of the new approach at the project level may encounter resistance by certain project parties. Potential problems include: (a) unwillingness of individuals to compromise; (b) unwillingness by industry providers to adapt; (c) opposition by people with hidden agendas; (d) conflicting agendas between agency and service providers; (e) insincere commitment to partnering; (f) adversarial attitude; and (g) fear of loss of control by agency personnel.

Recommendations

(1) Buy-in from both provider and agency personnel on the implementation process
(2) Have project personnel (both owner representatives and consultants) who are able to work as a team and to compromise for the good of the project
(3) Have project personnel who are committed to the success of the project

4.2	**Implement contract administration procedures to facilitate the new approach**	**Overall Rank**	**9**
		Moderate Consensus	

Description

Contract administration procedures are tailored to the new approach. Arriving at the contract administration phase without having designed procedures suitable for the new approach also constitutes a roadblock.

Recommendations

(1) Seek input from selected provider and other agency personnel on project implementation and contract administration
(2) Keep the administration of the contract consistent
(3) Adhere closely to contractual documents
(4) Have and maintain a comprehensive schedule

4.3	**Adequately staff owner project team**	**Overall Rank**	**12**
		Strong Consensus	

Description

Owner project team is adequately staffed to manage the procurement process and to administer the contract under the new approach. Some potential problems with owner teams include: (a) inexperienced project manager; (b) lack of staff; (c) lack of professional assistance; (d) assignment of personnel in oversight roles operating outside their area of expertise; (e) absence of clear understanding of new processes; and (f) inconsistent direction to industry providers.

Recommendations

(1) Appoint an expert team leader who is empowered to make decisions
(2) Have owner project personnel experienced, familiar, or adaptable to the new process, and with prior experience working as a team
(3) Use professional consultants experienced in the new approach to fill team requirements
(4) Establish performance measures for team evaluation early on

Table E.3.7: Validated Implementation Guidelines (Project Administration continued).

4.4	**Design the project's communications to facilitate the new approach**	**Overall Rank**	**15**
		Strong Consensus	

Description

A lack of communications at the project level also constitutes a barrier to a successful implementation of the new approach because it may result in lower project performance and lower industry competition.

Recommendations

(1) Promote continuous participation/collaboration of project parties
(2) Inform project stakeholders including public and third parties (e.g., cities, utilities, metropolitan planning organizations, etc.)
(3) Keep the entire team aligned with project goals
(4) Identify partnering/dispute resolution procedures

4.5	**Design the project's organizational structure to facilitate the new approach**	**Overall Rank**	**16**
		Strong Consensus	

Description

Agency should customize its team's organizational structure to the new approach.

Recommendations

(1) Allocate adequate resources to project beginning at the procurement phase
(2) Define roles and responsibilities
(3) Make individuals accountable

Table E.3.8: Suggested Implementation Guidelines (Project Administration).

3.A	**Develop a comprehensive implementation plan at the project level**

Description

There is a detailed and comprehensive master plan for the implementation of the newly introduced approach at the project level. An absence of planning may delay and endanger the implementation effort at the project level. Potential problems include: (a) delays from incomplete preliminary work (e.g., environmental clearance, ROW issues, utilities agreements, and public hearings); (b) incorrect estimation with resulting budget crises; and (c) initiation of procurement on project lacking funding.

Recommendations

(1) Define project goals, expectations, objectives, and constraints, early on
(2) Keep consistent project goals throughout the life of the project as much as possible
(3) Perform due diligence to leverage public funding
(4) Promote public support
(5) Assess the status of early milestones (early decisions, environmental clearance, public outreach/involvement, etc.)
(6) Establish agreements with local agencies and third parties
(7) Obtain cost data for the new approach from expert consultants or other agencies that have undergone the change

E.4. DEFINITIONS OF CONCEPTS

Table E.4.1: Validated Definitions of Concepts.

<table>
<tr><td rowspan="2">DEF-1</td><td rowspan="2">Project Delivery Method</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Strong</td></tr>
<tr><td colspan="4">A Project Delivery Method is defined as a system for managing the delivery of a project. Project delivery methods can be differentiated by
i) the project life span, which identifies the period of facility life covered by the project delivery;
(ii) the risk allocation method, which identifies the degree to which owners transfer risks to industry providers;
(iii) the contract packaging method, which identifies the degree to which contracts for different project services are combined; and
(iv) the presence of a funding component acquired by industry providers in the adopted project finance method.</td></tr>
<tr><td colspan="4">Examples:
• The design-bid-build (DBB) method administers a project life that is concluded with the physical execution of the project work. The DBB method allocates many of the risks associated with construction to industry providers. Finally, this method neither combines contracts for design and construction services, nor includes funding acquired by the industry providers.
• The design-build (DB) method administers a project life that is concluded with the physical execution of the project work. The DB method allocates the risks associated with design and construction to industry providers. While this method does combine contracts for design and construction services, it does not include funding acquired by the industry providers.
• The design-build-finance-operate (DBFO) method administers a project life that is extended beyond the physical execution of the project work to include a certain period of operations. The DBFO method allocates the risks associated with design, construction, and operation services in addition to allocating a variable amount of the risks associated with financing. Finally, this method combines contracts for design, construction, and operation services. It also uses finance methods that include a funding component acquired by industry providers.</td></tr>
</table>

Table E.4.1: Validated Definitions of Concepts (continued).

<table>
<tr><td rowspan="2">DEF-2</td><td rowspan="2">Project Finance Method</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Strong</td></tr>
<tr><td colspan="4">A Project Finance Method is defined as a system for acquiring or providing funds from different sources and combining them for financing a project during its delivery. Project finance methods can be differentiated by
i) the project life span, which identifies the part of the life of the corresponding facility that is financed by the method;
(ii) the types of financing sources that provide funding to the project (e.g., state, federal, local, private, etc.); and
(iii) the types of financing vehicles that are used (e.g., direct appropriation, federal-aid grants, project revenue bonds, private equity, debt financing, tax exempt financing, Private Activity Bonds, etc.).</td></tr>
<tr><td colspan="4">Examples:
• Relationship between project life and project finance method: The project finance method for a design-build (or design-bid-build) project aims at providing and combining different funds for the design and construction of the project, whereas a design-build-maintain method would require funds for the additional life span covered by the maintenance period.
• Relationship between funding sources and project finance method: Publicly funded projects use finance methods that acquire and combine different funds from public sources (e.g. federal, state, and local) whereas public-private partnership projects use finance methods that include a private funding component.</td></tr>
<tr><td rowspan="2">DEF-3</td><td rowspan="2">Strategy for Financing and Delivering Projects</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Moderate</td></tr>
<tr><td colspan="4">A Transportation Agency's Strategy for Financing and Delivering Projects is defined as the toolbox including all the delivery and finance options allowed by the agency's regulatory and institutional environment and pursued through specific actions. A change to this strategy may involve a broadening or a lessening of options that is the result of a change in the legislative/regulatory framework at the federal and/or state level.</td></tr>
<tr><td colspan="4">Examples:
• Difference between traditional and innovative delivery strategies: A transportation agency with a traditional delivery strategy allows its officers to adopt only the design-bid-build delivery method, whereas a transportation agency with an innovative delivery strategy provides a larger number of delivery options.
• Difference between traditional and innovative finance strategies: A transportation agency with a traditional finance strategy is allowed to finance its projects only through traditional funding sources (i.e. state and federal), whereas a transportation agency with innovative finance strategy provides a larger number of finance options.</td></tr>
</table>

Table E.4.1: Validated Definitions of Concepts (continued).

<table>
<tr><td rowspan="2">DEF-4</td><td rowspan="2">Alternative Technical Concept (ATC) Process</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Moderate</td></tr>
<tr><td colspan="4">The Alternative Technical Concept (ATC) Process is an interactive process for owners to solicit innovations by industry providers during the procurement phase. This process is mostly used during the procurement of combined services (e.g. design-build, design-build-maintain, etc.). Under this process, providers are invited to submit innovative ideas. Usually, they are technical solutions that diverge from the owner-provided technical provisions. There are two categories of ATCs: cost-saving and value-added.</td></tr>
<tr><td rowspan="2">DEF-5</td><td rowspan="2">Industry Review Process</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Strong</td></tr>
<tr><td colspan="4">The Industry Review Process is an interactive process which allows owners to solicit feedback on the proposed risk allocation from industry providers. There are two types of industry reviews:
(a) at the program level, and
(b) at the project level.</td></tr>
<tr><td colspan="4">Examples:
• <u>Program-level review:</u> Some transportation agencies perform an early industry review of the contractual draft when they are implementing a new delivery method through a program-level approach. This approach aims to build industry consensus on the change initiative by generating dialogue on the proposed risk allocation. The outcome is an allocation of risks that is negotiated within the industry.
• <u>Project-level review:</u> Transportation agencies may also perform an industry review at the project level by releasing a draft of the contractual document to providers during the procurement. In such a case, the goal is to achieve a trade-off with the proposers in terms of risk allocation.</td></tr>
<tr><td rowspan="2">DEF-6</td><td rowspan="2">Contract Award Method</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Moderate</td></tr>
<tr><td colspan="4">A Contract Award Method (also called “industry provider selection method” or “source selection process”) is defined as a system for selecting the provider of a tendered project service (e.g., design, construction, etc.) or component (e.g., road segment A, bridge B, etc.). Low bid, Best-value, and Qualification-Based Selection (QBS) are examples of contract award methods.</td></tr>
<tr><td rowspan="2">DEF-7</td><td rowspan="2">Contracting Approach</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Strong</td></tr>
<tr><td colspan="4">A Contracting Approach identifies specific legal language used under the larger umbrella of a procurement approach to target specific activities or objectives of a project. Examples of contracting approaches include clauses on unit price, lump sum, incentive/disincentive, lane rental, and partnering, among many others.</td></tr>
</table>

Table E.4.2: Suggested Definitions of Concepts.

<table>
<tr><td rowspan="2">DEF-A</td><td rowspan="2">Risk Allocation Method</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>Yes</td><td>Lack</td></tr>
<tr><td colspan="4">A Risk Allocation Method is defined as a system for allocating the risks associated with specific project services to industry providers (e.g., planning, environmental clearance, permitting, financing, design, construction, right-of-way, utility relocation, operation, maintenance, etc.). Risk allocation methods can be differentiated by the amount of risks transferred by owners to industry providers. This transfer of risks also determines which project services are outsourced.</td></tr>
<tr><td colspan="4">Example:
• Some delivery methods (e.g., design-build-maintain) tend to transfer a larger amount of risk (and to outsource corresponding services) to industry providers, whereas other methods entail that the owner retain the risk (e.g., design-bid-build).</td></tr>
<tr><td rowspan="2">DEF-B</td><td rowspan="2">Contract Packaging Method</td><td>Validated</td><td>Consensus</td></tr>
<tr><td>No</td><td>Strong</td></tr>
<tr><td colspan="4">A Contract Packaging Method is defined as a system for organizing the procurement of the different services necessary for the delivery of a project. [Examples of such basic project services are planning, environmental clearance, permitting, financing, design, construction, right-of-way, utility relocation, operation, maintenance, etc. Examples of project components are segments, bridges, interchanges, etc.] Contract packaging methods can be differentiated by
(i) the degree to which different project services are combined in contractual relationships with industry providers; and
(ii) the degree to which different project physical components are combined in contractual relationships with industry providers.</td></tr>
<tr><td colspan="4">Example:
• Packaging involves the aggregation of contracts for different project services: Combined-service methods integrate the procurement of more services under the umbrella of fewer service providers (e.g. as does the design-build method) whereas segmented-service methods separate procurement activities of different services (e.g. as does the design-bid-build method). The examples provided (i.e., DBB and DB methods) show that the packaging method is independent from services that are transferred to industry providers. Both methods may transfer the risks of design and construction services while managing the contract packaging in a different way.
• Packaging also involves the aggregation of contracts for different physical components: combined-component methods integrate the procurement of the entire project, whereas segmented-component methods separate procurement activities of different physical components (e.g., by segment).</td></tr>
</table>

Table E.4.2: Suggested Definitions of Concepts (continued).

DEF-C	Project Procurement Process	Validated	Consensus
		No	***Moderate***
A **Project Procurement Process** includes a combination of four systematic actions necessary to prepare for the execution of a project: (a) the owner review of provider-suggested innovations (regulated by the alternative technical concept sub-process); (b) the provider review of the owner-identified risk allocation method (regulated by the industry review sub-process); and (c) the selection of industry providers (regulated by the contract award method). Sub-processes (a) and (b) produce a contract between the owner and the selected provider that adjusts a master contract to meet project-specific needs.			

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Vita

Giovanni Ciro Migliaccio was born in Taranto, Italy on December 25, 1968, the son of Giuseppe Migliaccio and Adriana Lanzo. After completing his high school education at *Liceo Scientifico* Galileo Galilei, Manduria, Italy, in 1986, he entered the *Politecnico di Bari* in Bari, Italy. He received the degree of *Laurea di Dottore in Ingegneria Edile* from *Politecnico di Bari* in May 2000 by defending a thesis on the topic of Urban Energy Management. During the following years, he worked at different levels in the project management of construction projects for telecommunication companies, including Nokia Networks, Nortel Networks and IPSE2000. In January 2003, he entered the Graduate School at The University of Texas at Austin to attend the Construction Engineering and Project Management graduate program. He was awarded the degree of Masters of Science in Civil Engineering from The University of Texas at Austin in May 2006. He stayed in Austin to work on his doctorate in Civil Engineering. He is a licensed Professional Engineer in Italy since 2000.

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