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ORGANIZATIONAL STRUCTURES AND COMMUNICATIONS ON THE SH 130 PROJECT

Authors:
James T. O'Connor
G. Edward Gibson Jr.
Giovanni C. Migliaccio
Pramen P. Shrestha

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Center for Transportation Research The University of Texas at Austin 3208 Red River, Suite 200 Austin, Texas 78705-2650	Texas Department of Transportation Research and Technology Implementation Office P.O. Box 5080 Austin, Texas 78763-5080

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Abstract:	**Keywords:**	**No. of Pages:**
This product summarizes the findings from research analyzing SH 130 organizational structures and communication flows. A set of guidelines pertaining to team organization and communication improvement and the design-build environment is also included.	Organizational Structure, Communication Flows, Design-Build, Comprehensive Development Agreement	124

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1. Introduction

1.1 Research Motivation

In 2001, the Texas State Legislature enacted House Bill 3588, which allows the Texas Department of Transportation (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 in 2003 to the Comprehensive Development Agreement (CDA). The terms "CDA-DB" and "DB" are used throughout this report to identify design-build (DB) procurement under the CDA approach.

In 2002, a contract totaling $1.3 billion was awarded to Lone Star Infrastructure (LSI), a consortium of engineering and construction firms, for the 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 has initiated research with 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 already produced three reports pertaining to the procurement process and contractual documents (O'Connor et al., 2004a; O'Connor et al. 2004b; and O'Connor et al., 2004c). This report is the third research deliverable and focuses on organizational and communication innovations.

1.2 Research Objectives

The research effort is subdivided into several tasks that can be grouped according to two general research goals. This report contributes to the first research goal to consolidate and synthesize certain lessons learned and to organize them in a database. These lessons are being collected and recorded thematically. To date, researchers have collected lessons pertaining to the procurement process and contractual documents. This report addresses lessons learned pertaining to project organization and communications.

Establishing effective communication flow is fundamental for the success of construction projects and is critical to DB mega-projects. These projects require faster communication flows

because of the schedule-driven, multi-organizational environment of the DB approach. Thus, among other themes, the research team investigated the successes of unique organizational, decision-making, and communications structures put in place for the SH 130 project. This report represents the research deliverable for this research task.

1.3 Research Scope and Limitations

The report documents the SH 130 organizational structure and makes recommendations for improved CDA-DB project organization. During the investigation, the authors analyzed project documentation and conducted numerous interviews with project representatives, including TxDOT, HDR Engineering, Inc., and LSI representatives.

The main challenge in performing this research task has been the Developer's busy work schedule, which made it challenging to schedule interviews. Consequently, submittal of this deliverable was delayed until sufficient input from the Developer was obtained.

1.4 Structure of Report

This report is comprised of seven chapters and six appendices, including this introductory chapter. The succeeding sections of this report are structured in the following manner:

- Chapter 2 focuses on background issues on DB project organization and communication and includes a brief literature review.
- Chapter 3 lays out the research methodology.
- Chapter 4 presents analysis of findings, including a set of guidelines pertaining to team organization and communication improvement in the DB environment. Potential lessons learned as related through interviews are also identified.
- Chapter 5 summarizes the findings and recommendations of this research report.

2. Background

2.1 Summary of Literature Review

Existing literature offers few studies that have investigated organizational and communications aspects of DB projects. However, 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 the current investigation (Appendix D) includes items on these research issues. 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 (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
- *Version control*: the need to communicate on the most up-to-date version while maintaining the flexibility to refer to previous or alternative versions
- *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.

- *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).

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 (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" 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" because it "causes confusion to the contractor (i.e., design-builder) and the architect." 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 owner to draw out his/her needs.
- Designers often lack familiarity with the DB approach. This lack of knowledge is often translated into an unwillingness to realign the role with DB procurement.
- 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.
- 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.

In a work published in 2003, George Elvin emphasized the need for team building as an important factor for successful DB projects. Here, the author related "the increased integration of project teams and project schedules in design-build" 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
    - 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."
    - Constructors need to "provide designers with deadlines and content requirements for information production milestones."
- Adopting flexible project organization
    - 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" 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.).
- Adopting synchronized workflow planning for simultaneous activities
    - In DB projects, workflow planning needs to integrate activities other than those associated with construction. 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. 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. 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.

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 to 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.

2.2 SH 130 Project Background

2.2.1 Overview of State Highway 130 Project

State Highway 130 (SH 130) is one of three new highways being built within the Central Texas Turnpike System (CTTS). The CTTS also includes State Highway 45 North (SH 45 N) and the Loop 1 Extension. 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.

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 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.

2.2.2 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 (CTTS) 2002 project 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 2.1, 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.

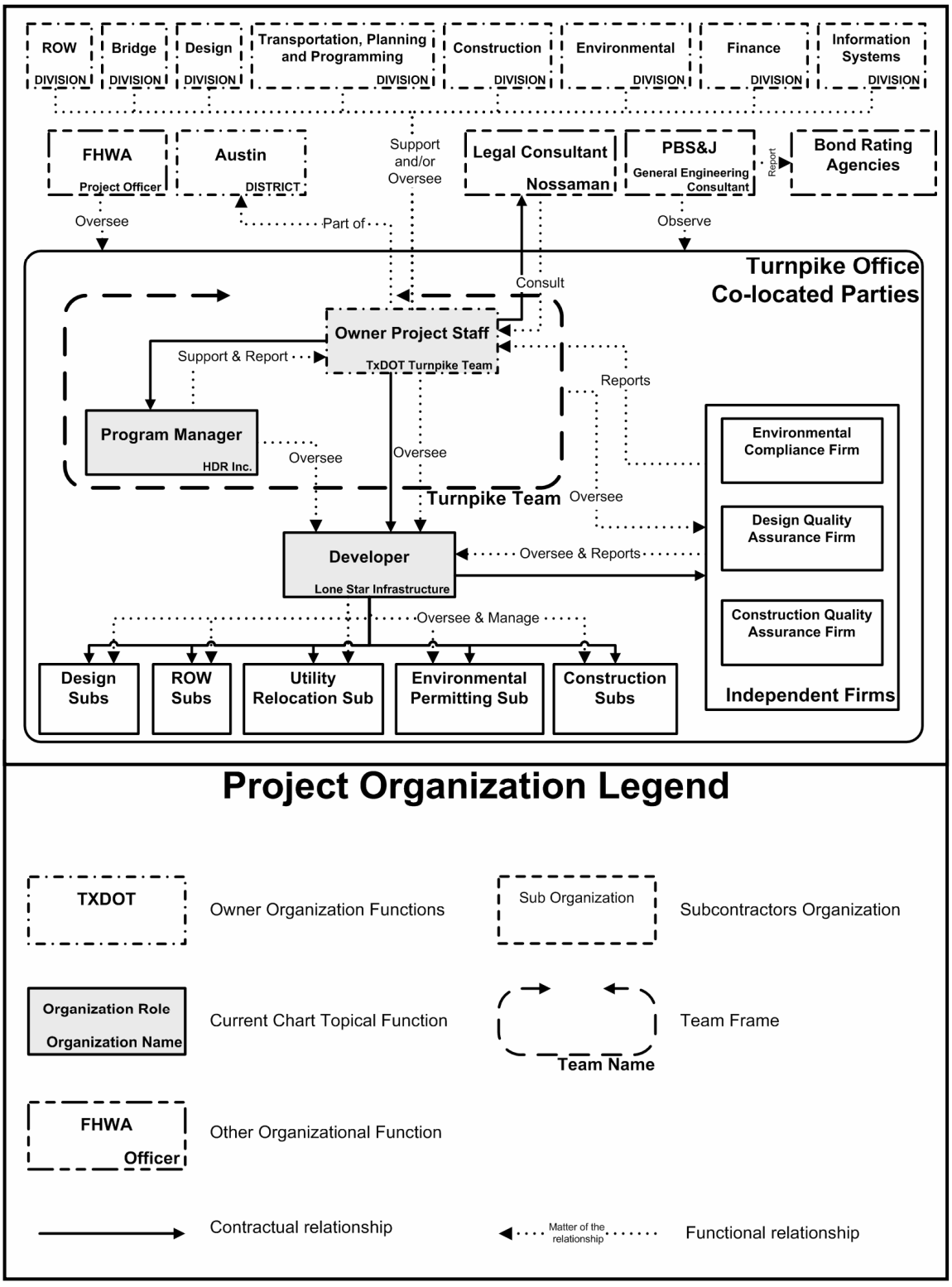

Figure 2.1 SH 130 Project Organization

3. Research Methodology

The research on the SH 130 project aims to improve existing knowledge of DB processes. While the main goal is to consolidate and synthesize lessons learned in a database, collecting these lessons learned is being done concurrently with several other research tasks. This section describes the 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 the research methodology is presented in Figure 3.1.

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 (Appendix D). Then, thirteen interviews were scheduled and performed. The same member of the research team conducted all the interviews in order to assure 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 3.1.

Interview transcripts from twelve interviews and the project documentation served as primary data sources for the analysis that was conducted (Cassel and Symon, 1994). 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 E and F and summarized in Chapter 4. Differing opinions on similar issues were analyzed to point out conflicts, surface issues, and problems in the organizational and communications structures that need resolution. Moreover, positive aspects and communication successes were highlighted.

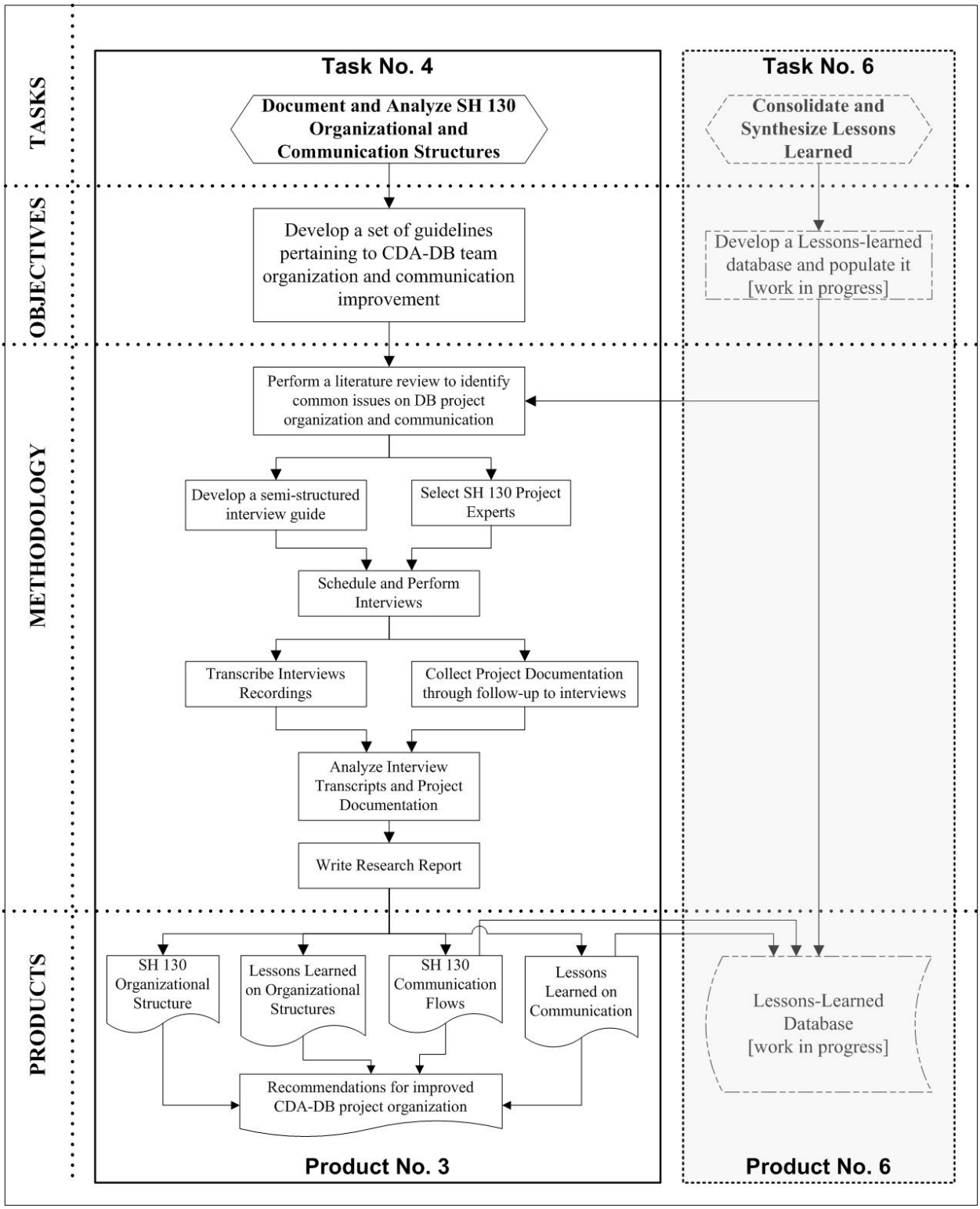

Figure 3.1 Research Task No. 4 - Methodology

Table 3.1 List of attended meetings, events, and research interviews

Date	Type	Place	Topic
08/24/04	Meeting	Turnpike Office, Pflugerville	*Discuss study progress with P.D. and plan short-term priorities and activities. P3, P5, P6, and P7 timing adjusted to Spring 2005.*
09/09/04	Meeting	LSI 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 (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on design activities.*
10/22/04	Interview (*)	Turnpike Office, Pflugerville	*Collect lesson learned on organizational structures and communication flow with focus on construction activities.*
11/04/04	Interview (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on ROW activities.*
11/16/04	Interview (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on environmental activities.*
01/26/05	Interview (*)	LSI Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on construction and project control activities.*
02/02/05	Interview (*)	LSI Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on environmental activities.*
02/28/05	Interview (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on design activities.*
03/02/05	PMC meeting	SH 130 Office, Pflugerville	*Review study progress and finalize plans for workshop (P7).*
03/15/05	Interview	Turnpike Office, Pflugerville	*Gain understanding on FHWA role for SH 130 project.*
03/16/05	Interview (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on environmental activities.*
03/17/05	Interview	Turnpike Office, Pflugerville	*Gain understanding on Information Technology implemented for SH 130 project.*
03/18/05	Interview (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on construction activities.*
03/25/05	Interview (*)	LSI 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 (*)	Turnpike Office, Pflugerville	*Collect lessons learned on organizational structures and communication flow with focus on ROW activities.*
04/29/05	Interview (*)	LSI 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 E and F.			

4. Analysis and Synthesis of Interview Findings

4.1 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 Appendix E.

4.1.1 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.

Figure 4.1 Responsibilities in the SH 130 project versus a traditional DBB project

Following is an outline of the roles of the major actors for the SH 130 project:

TxDOT

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" (TxDOT, 2001, p.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 is 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" (TxDOT, 2001, 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." (TxDOT, 2001, p. 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 is overstaffed in some areas relative to its responsibilities. Some interviewees also believe that the PM's staff is 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.

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 subcontractors (i.e., design and construction firms). Additionally, the Developer's managers

interact with the independent firms (design and construction quality assurance and environmental compliance) to implement the proper QA/QC systems.

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.

4.1.2 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 4.1. Again, these observations are based on comments during the interviews.

Table 4.1 Observations regarding team staffing

	Understaffed	**Overstaffed**
TxDOT	• Design (current) • Environmental (current) • ROW/Utility (current) • Construction (early)	• None
Program Manager	• ROW clerks (early)	• Construction (current)
Developer	• Project Management (current) • Environmental permitting (early) • Pre-construction management (early)	• None

TxDOT

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."

4.2 Major Communications Issues

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

4.2.1 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.

4.2.2 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 Appendix G. 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. 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.

Another successful tool was a bi-monthly survey for project employees that 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.

4.2.3 Information Technology / Information Management

Table 4.2 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 demilitarized zone (DMZ), 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.

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 4.2 Information Management Tools

<table>
<tr><th>Organization</th><th>Drawing Management</th><th>Project 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>

4.2.4 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.

4.2.5 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 4.3 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 4.3 Meetings on a Fixed Schedule for TxDOT Environmental Function

Meeting Type	***Frequency***	***Participants***			
		TxDOT	***Program Manager***	***Developer***	***Other Project Parties***
Overall environmental project issues	Every Monday	Turnpike Environmental	Environmental	Design	ECF, FHWA
TWG environmental	Every other Wednesday	Turnpike Environmental and Environmental Affairs Division representative	Environmental	Design	ECF
Construction issues	Every other Tuesday	Turnpike 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	Turnpike director and environmental	Environmental	None	None
Overall Environmental update on procedures	Monthly	Turnpike 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

4.2.6 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.

Regarding this first issue, a common problem for DB projects is that the Owner's team and Developer's design consultants usually have a short-circuiting of communications [Section

2.1]. 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.

4.2.7 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:
  a) 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.
  b) 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.
  c) 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.

4.3 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

1. Outline a chart comparing allocation of responsibilities between traditional projects and the selected CDA-DB project (such as Figure 4.1). 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).
2. Clearly define the role of the PM team in the contract by identifying its responsibilities.
3. 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:
    a. Develop guidance on legal and procedural requirements (e.g., gain understanding of activities that can be outsourced) for each discipline.
    b. Develop guidance on how to assign decision-making responsibilities to the PM.
    c. 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.
4. 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).
5. Assign environmental functions (e.g., environmental compliance and stormwater) to a group to allow for a more effective decision-making process.
6. 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

7. Increase presence of personnel with DB experience within the Owner's team (both in TxDOT and the PM's teams).
8. 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.
9. Continue to select individuals for the TxDOT component who are able to work under pressure, to be flexible, and to multi-task.

10. Identify level of expertise needed for TxDOT employees early on in the project in order to select personnel in time.
11. Include some individuals knowledgeable in project control practices within the Owner's team.
12. Staff the Owner's team (both TxDOT and the PM's teams) with individuals with high levels of expertise in their respective technical areas.
13. 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.
14. 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.
15. 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.
16. Use independent quality assurance firms to relieve the Owner of part of the responsibility for the Developer's schedule.
17. 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

18. Allow developer-sourced innovations through a flexible acceptance process (e.g., management of design manuals' gray zones through issuance of design task protocols).

19. 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.
20. Allow a flexible organizational structure by expanding and shrinking the project team through consultants hired by the PM's personnel.

5. Conclusions and Recommendations

This report 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 4.3. Highlights of these recommendations are:

- Outline a chart comparing allocation of responsibilities between traditional projects and the selected CDA-DB project (Figure 4.1).
- 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).

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Appendix A
TxDOT Organizational Chart for SH 130 Team

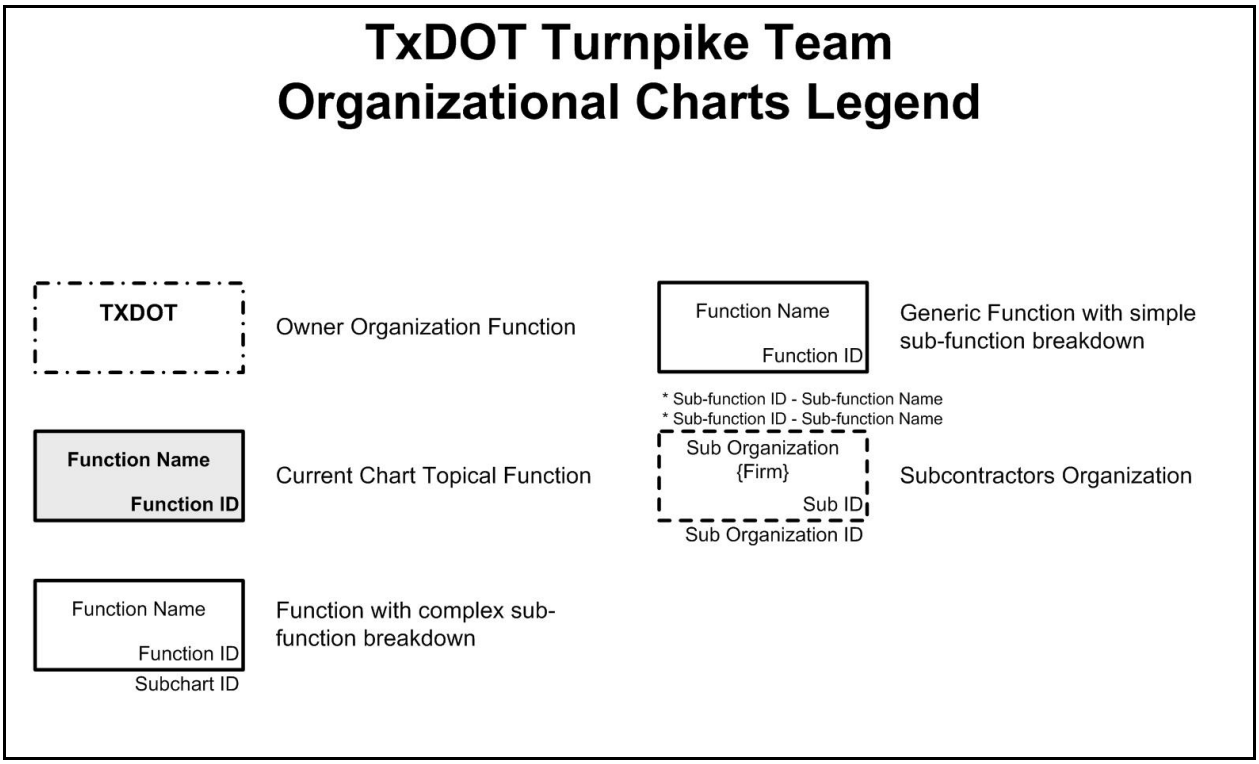

Figure A.1 TxDOT Turnpike Team Legend

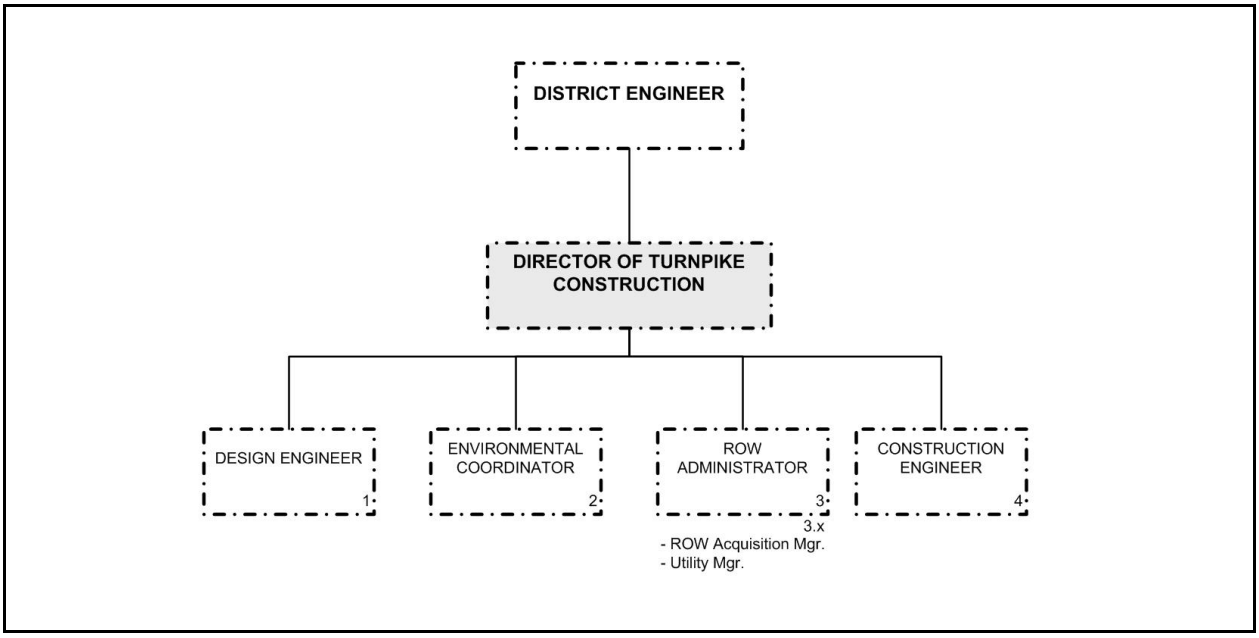

Figure A.2 TxDOT Turnpike Team Organizational Chart

Appendix B
SH 130 Program Manager Organizational Chart

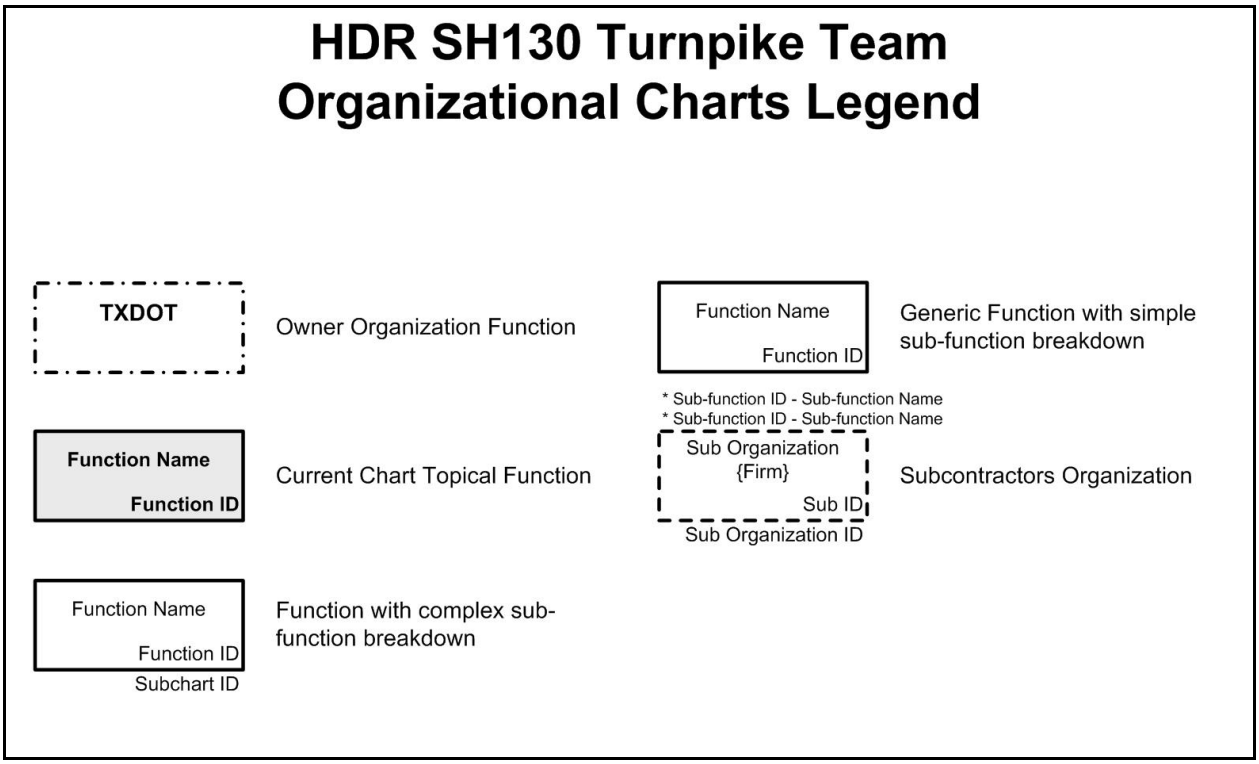

Figure B.1 HDR SH 130 Team Organizational Chart Legend

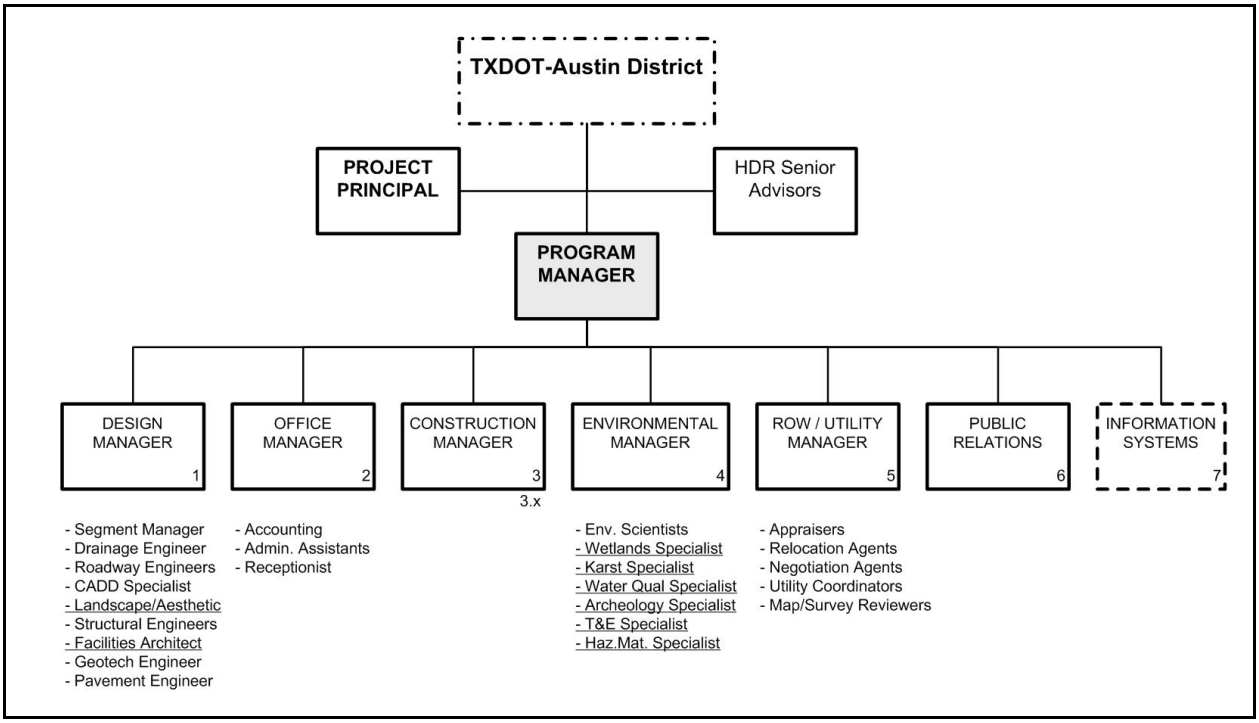

Figure B.2 HDR SH 130 Team Organizational Chart

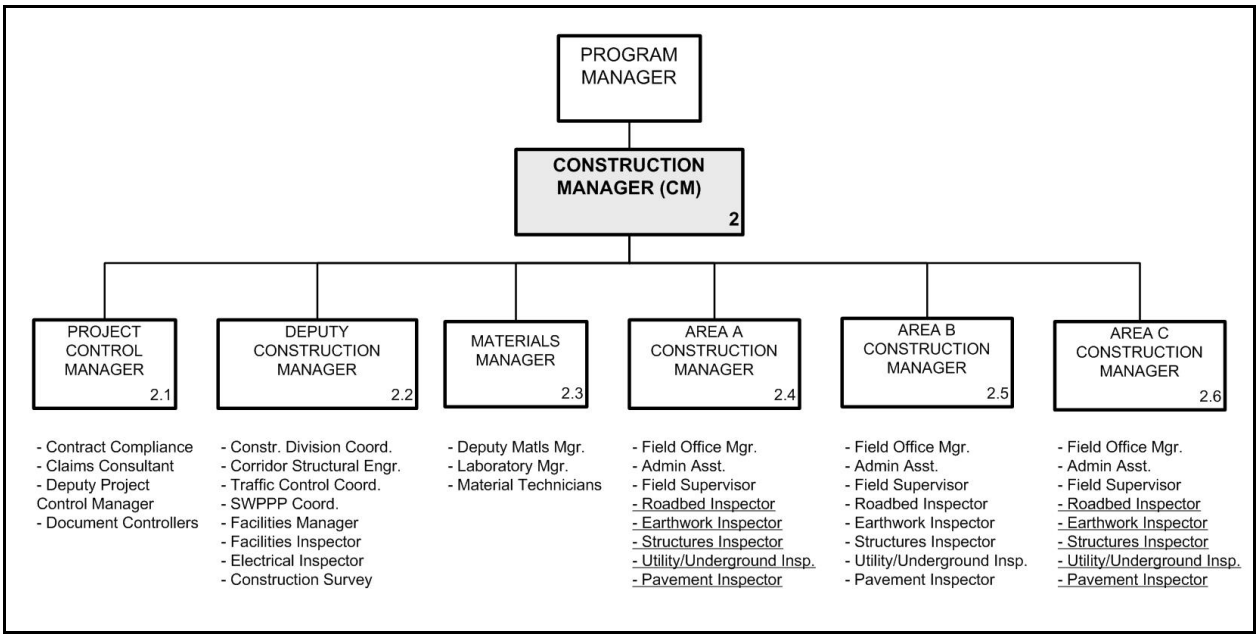

Figure B.3 HDR SH 130 Construction Team Organizational Chart

Appendix C
SH 130 Developer Organizational Chart

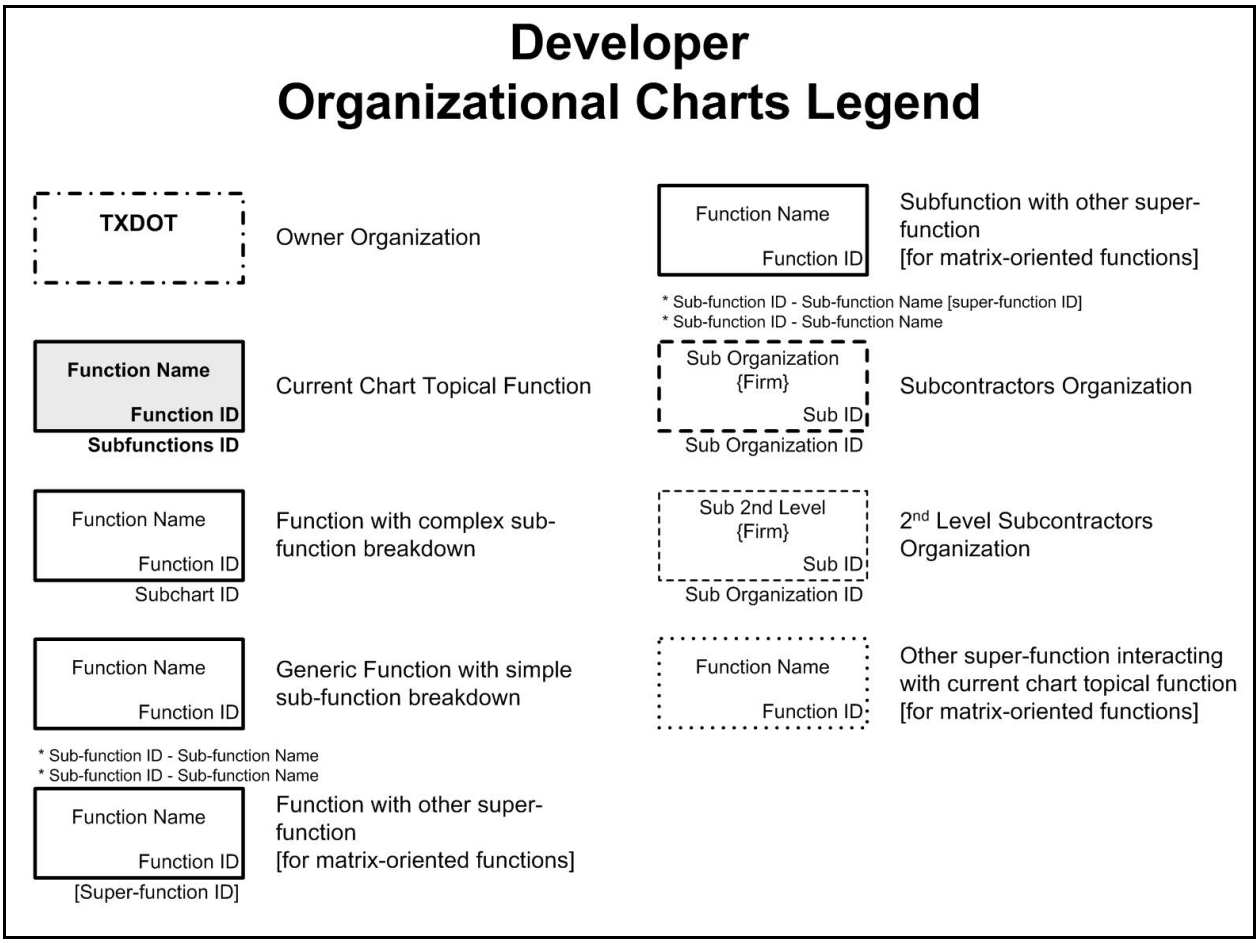

Figure C.1 LSI Team Organizational Chart Legend

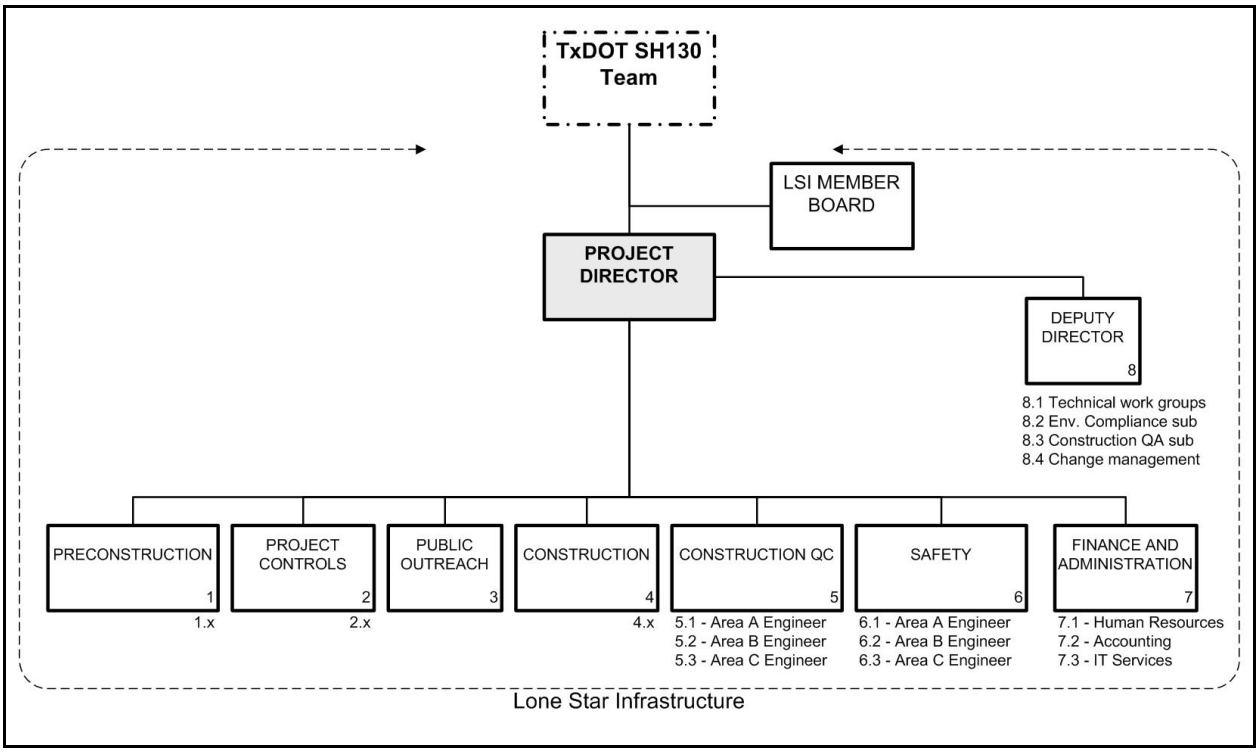

Figure C.2 LSI Team Organizational Chart

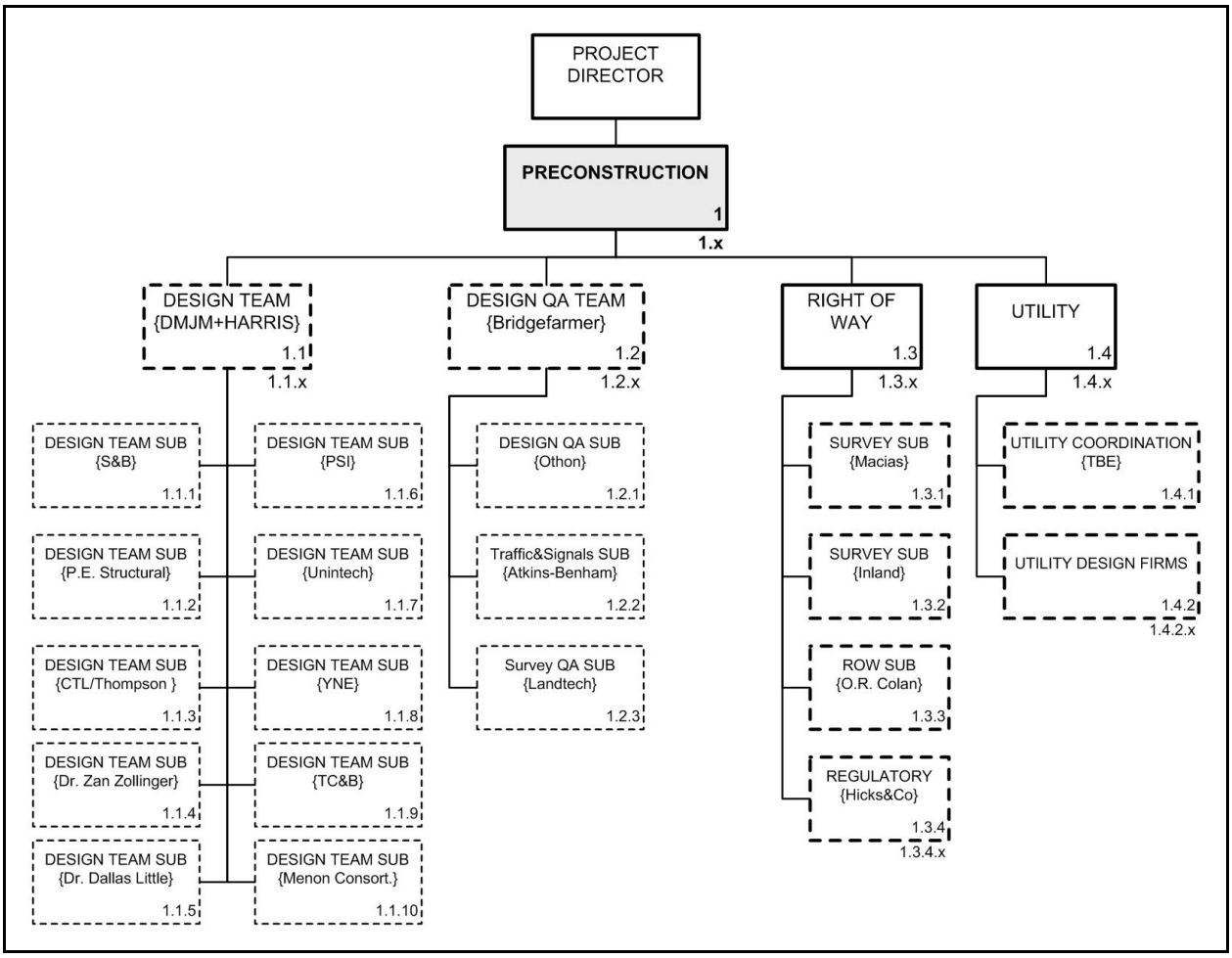

Figure C.3 LSI Preconstruction Team Organizational Chart

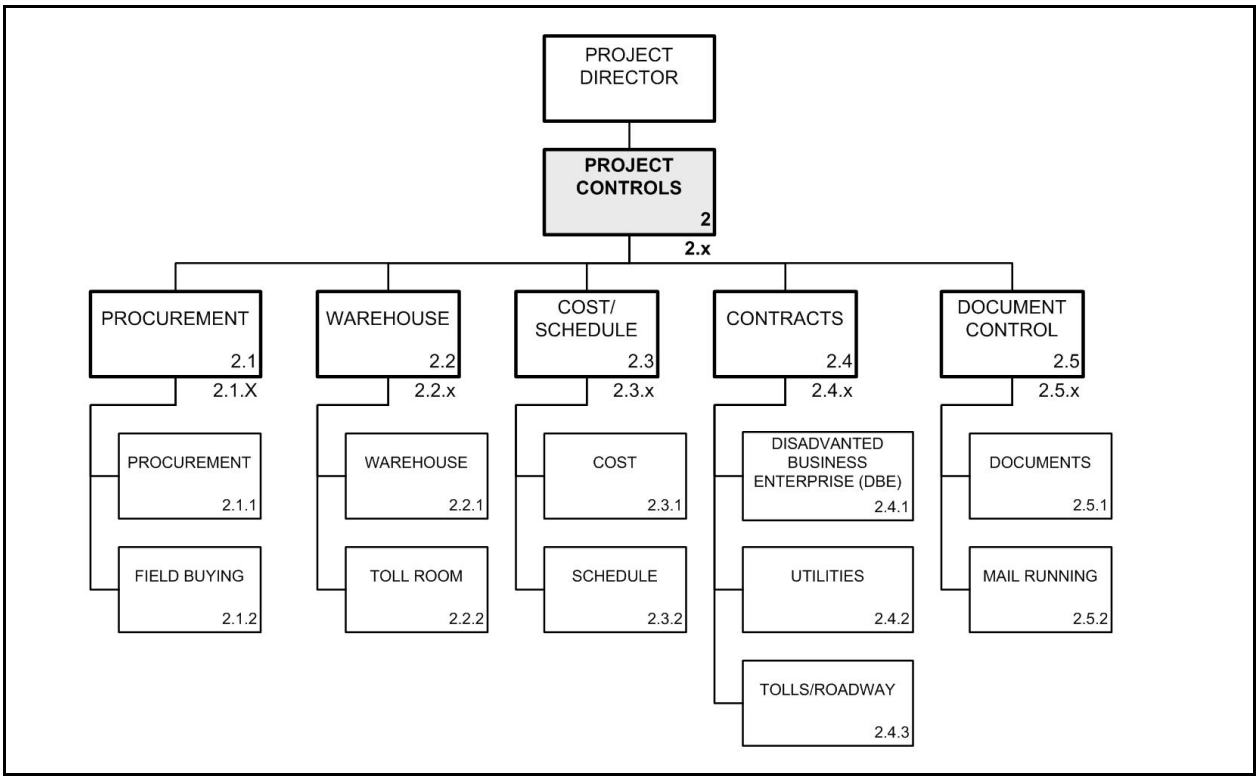

Figure C.4 LSI Project Controls Team Organizational Chart

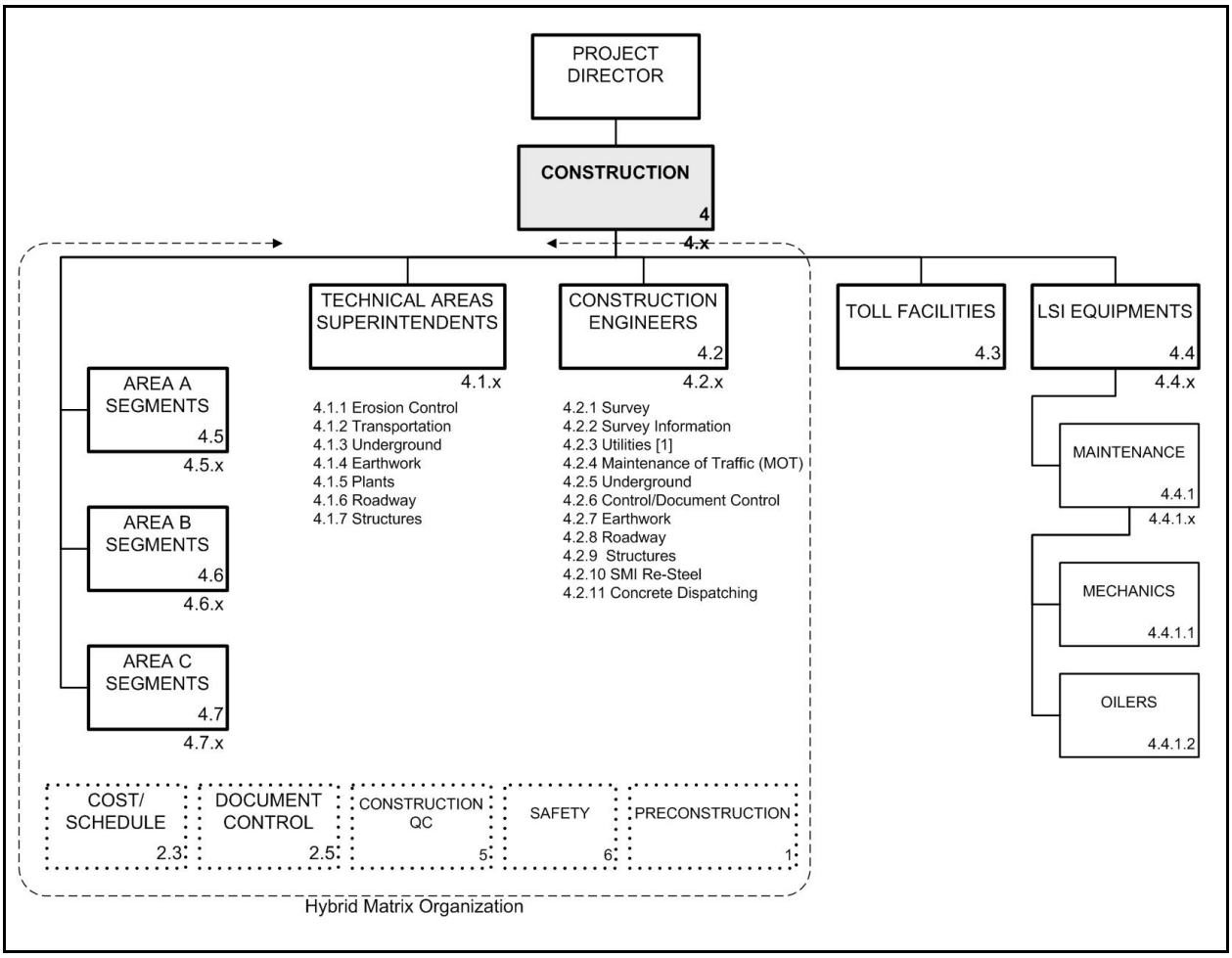

Figure C.5 LSI Construction Team Organizational Chart

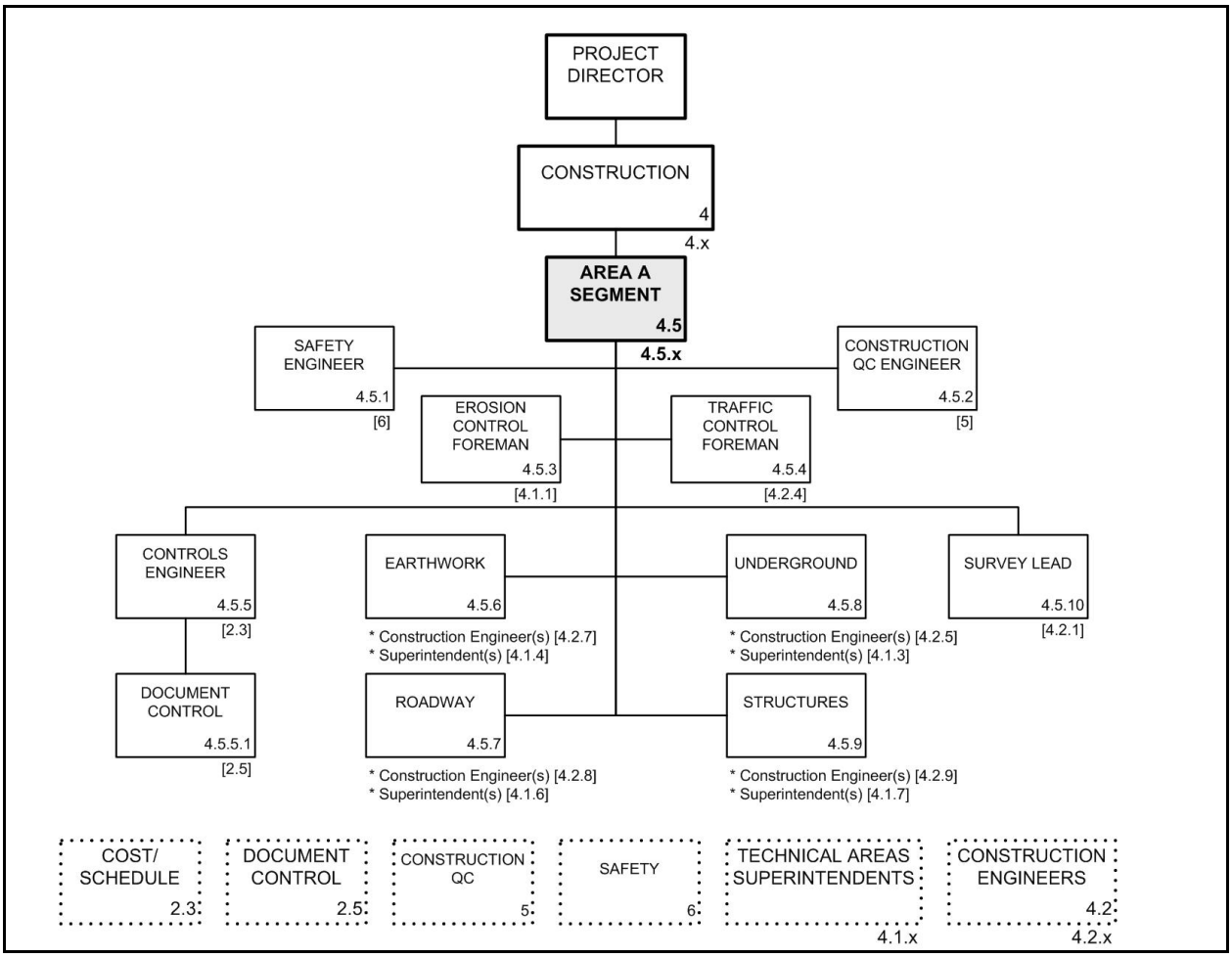

Figure C.6 LSI Area Segment Construction Team Organizational Chart

Appendix D
Interview Guide

1. <u>Significant Organizational Differences</u>

1.1. **TxDOT: Owner**

1.1.1. 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)?

1.1.2. How/why has each *difference* been significant?

1.1.3. Regarding *TxDOT's organizational structure*, what specifically would you do differently on the next CDA?

a. Any area where *overstaffing* was a problem?

b. Any area where *understaffing* was a problem?

c. Any critical role/responsibility *not well defined* or understood?

1.2. **HDR: Program Manager (PM)**

1.2.1. 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)?

1.2.2. How/why has each *difference* been significant?

1.2.3. Regarding *HDR's organizational structure*, what specifically would you do differently on the next CDA?

a. Any area where *overstaffing* was a problem?

b. Any area where *understaffing* was a problem?

c. Any critical role/responsibility *not well defined* or understood?

1.3. **LSI: Developer**

1.3.1. 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)?

1.3.2. How/why has each *difference* been significant?

1.3.3. Regarding *LSI's organizational structure*, what specifically would you do differently for the next CDA?

a. Any area where *overstaffing* was a problem?

b. Any area where *understaffing* was a problem?

c. Any critical role/responsibility *not well defined* or understood?

2. <u>Program Manager (HDR) – TxDOT Relationship</u>

2.1.1. Any *lesson learned* thus far in setting up/operating under this relationship?

a. Misallocation of duties?

b. Compatibility of operating procedures/systems?

c. Sufficiency of staff?

2.1.2. What would you do differently on the next CDA?

3. <u>Communication Flows</u>

3.1.1. Where/in what way have project team *communications* been most challenged?

3.1.2. How significant has colocation between TxDOT, HDR, and LSI been in achieving effective *communication*? If possible, please describe some specific examples.

3.1.3. Has short-circuiting of *communications* between TxDOT/HDR and LSI subcontractors been problematic?

3.1.4. Have there been any unique aspects of *communications* notably successful for this CDA?

a. Any notable *communication* successes or lessons learned in the design area?

b. Any notable *communication* successes or lessons learned in the ROW area?

c. Any notable *communication* successes or lessons learned in the utility relocation area?

d. Any notable *communication* successes or lessons learned in other project processes?

Appendix E
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 Appendix A.

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 preproject 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 resubmittal. 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 realignments 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 overinvolvement 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.

Appendix F
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 1.x – General Comments
Section 2.x – Comments Pertaining to Design Activities
Section 3.x – Comments Pertaining to Environmental Activities
Section 4.x – Comments Pertaining to ROW/Utilities Activities
Section 5.x – Comments Pertaining to Construction/Project Control Activities

Each of these sections is further subdivided according to two subheadings:
x. [a] Co-location
x. [b] Partnering/Issue Escalation Ladder
x. [c] Information Technology/Information Management
x. [d] Operating Procedures
x. [e] Meetings
x. [f] Improper Communication
x. [g] 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.

1. General Comments

1.[a] 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.

1.[b] 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.

1.[c] 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, ProjectWise, 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.

1.[d] 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.

1.[e] 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.

1.[f] 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."

1.[g] 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.

2. Comments Pertaining to Design Activities

2.[a] 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.

2.[b] 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.

2.[c] 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.'"

2.[d] 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.

2.[e] 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.

3. Comments Pertaining to Environmental Activities

3.[a] 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.

3.[b] 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 Kinstner, 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."

3.[c] 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.

3.[d] 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.

3.[e] 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."

4. Comments Pertaining to ROW/Utilities Activities

4.[a] 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.

4.[b] 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.

4.[c] 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.

4.[d] 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.

4.[e] 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.

5. Comments Pertaining to Construction / Project Controls Activities

5.[a] 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.

5.[b] 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.

5.[c] 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.'"

5.[d] 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 G
Issue Escalation Ladder

Level	**Survey**	**ROW**	**Utilities**	**Environmental**	**Public Relations**	**Project and Document Control**	**Design** (broken down in disciplines	**Construction** (broken down in disciplines	**Safety**
5	Executive Team								
4	Project Leadership Team								
3									
2									
1									