ORGANIZATIONAL AND COMMUNICATION ISSUES FOR MANAGING DESIGN-BUILD HIGHWAY PROJECTS

G. Edward Gibson, Jr. [1], James T. O'Connor [2], Giovanni C. Migliaccio [3] and Pramen P. Shrestha [4]

[1] Professor, Department of Civil, Architectural and Environmental Engineering, the University of Texas at Austin, USA
[2] Professor, Department of Civil, Architectural and Environmental Engineering, the University of Texas at Austin, USA
[3] Ph.D. Student, Department of Civil, Architectural and Environmental Engineering, the University of Texas at Austin, USA
[4] Ph.D. Student, Department of Civil, Architectural and Environmental Engineering, the University of Texas at Austin, USA
Correspond to egibson@mail.utexas.edu

ABSTRACT: Effective communication flow is a fundamental for the success of any construction projects. The key role of communications among project parties is even more critical in the case of Design-Build (DB) projects. Previous research has shown that these projects have an environment where integration between different project team members and schedule constraints increase channels of communication, and require faster communication flows. This paper summarizes the findings from research analyzing organizational structures and communication flow of the Texas State Highway 130 (SH130) project. Awarded in 2002, the SH130 project, totaling $1.3 billion USD, constitutes the "pilot" application for the DB approach in the state of Texas. A set of observations pertaining to team organization and communication issues in the design-build environment is included.

Key words : Design-Build; Organizational Structure; Communication Flow; Lessons-Learned; Highway Projects

1. INTRODUCTION

The use of Design-Build (DB) in the transportation sector has increased over the past 10 years in the United States. The State of Texas modified its legislation to allow innovative contracting methods for highway projects in 2001. As a result, the state transportation department can statutorily use DB entering into a Comprehensive Development Agreement (CDA) with a Design-Builder. Since 2001, three projects are currently being constructed in Central Texas using this approach: State Highway 130 (SH130) and State Highway 45 Southeast (SH45 SE) by the Texas Department of Transportation (TxDOT), and US 183A by the Central Texas Regional Mobility Authority (CTRMA). These projects represent almost $1.7 billion United States Dollars (USD). Awarded in 2002, the SH130 project, totaling $1.3 billion USD, constitutes the "pilot" application for this new approach in the state.

Effective communication flow is a fundamental for the success of any construction projects. The key role of communications among project parties is even more critical in the case of DB projects. Previous research has shown that these projects have an environment where integration between different project team members and schedule constraints increase channels of communication, and require faster communication flows [1, 2].

This paper summarizes the findings from research analyzing organizational structures and communication flows of the SH130 project [3]. A set of observations pertaining to team organization and communication issues in the design-build environment is included. These observations from project experts were captured through an interview-based approach. To increase data richness, a qualitative interview-based research approach was chosen. This approach allowed interviewers to explore new topics and issues during the course of the interviews by employing a semi-structured interview guide. The same member of the research team conducted all the interviews in order to assure consistency. These interviews were recorded and transcribed. The anonymity of the 27 interviewees was guaranteed to encourage more input. Interview transcripts and the project documentation served as primary data sources for the analysis. Initially, data were segregated according to constituent parties, and were then grouped under topical categories (i.e. organization vs. communication) and subcategories (i.e. co-location vs. operating procedures), leading to the findings given in this paper.

2. OVERVIEW OF STATE HIGHWAY 130 PROJECT

State Highway 130 (SH130) is one of three new highways being built within the Central Texas Turnpike System (CTTS). The CTTS also includes State Highway 45 North and the Loop 1 Extension. At completion, SH130 will include six segments for a total of 91 miles (146.5 kilometers) 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 SH130 project. LSI is a joint venture created specifically for this project between Fluor Daniel, 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 for segments 1 to 4 (78.8 kilometers) have been issued for a total of approximately $ 1 billion USD.

The scope of work includes several project functions that are all performed within the lump-sum price (i.e. design, right-of-way (ROW) acquisition services, utility relocation, portions of environmental permitting, environmental compliance services, design QA/QC services, construction, and construction QA/QC services). TxDOT retained the cost of 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 for LSI to provide maintenance for an initial term with the opportunity for two extensions. The maximum term of the Maintenance Agreement, including both extensions, is 15 years.

3. FINDINGS

3.1 Project Organization

The State Highway 130 project is being managed by a dedicated office 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 that is delivering its project elements through different delivery methods. State Highway 45 North and the Loop 1 extension are being delivered through traditional design-bid-build contracts.

The turnpike office is directed by a TxDOT employee, the director of Turnpike construction, who reports directly to the Austin district engineer. In this office, a small TxDOT staff is being supported by two engineering firms, HDR Inc. and PBS&J. HDR provides program management services to the SH130 project, whereas PBS&J is providing construction management services on the Loop 1 and SH 45 projects. As the CTTS general engineering consultant (GEC), PBS&J is also reporting progress of all CTTS projects to the bond rating agencies in accordance with the Indenture of Trust governing the revenue bonds issued for the 2002 Project of the Central Texas Turnpike System.

As previously stated, the SH 130 DB contract was awarded in 2002 to Lone Star Infrastructure (LSI). They were required to locate their main project office in the same complex of buildings as TxDOT. In addition, LSI set up three segment area offices where personnel working on the construction 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 the diagram given in Appendix A, which also outlines relationships between project parties.

In the SH130 project organization, the Developer functions as the single point of contact for TxDOT for all the disciplines, including design, construction, right of way, utility, and environment permitting. Controlling activities regarding design and construction quality assurance and environmental compliance are 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 cannot be replaced by the Developer without TxDOT approval.

3.2 Co-location

The majority of interviews conducted for this research project underscored the advantages that co-location offered to the SH130 project in terms of communication. First, the co-location ensured an environment that enhanced communication effectiveness and intensiveness as required for a project of the SH130's size. In the initial phases of the project, project personnel got to know each other quickly and established the foundation for team working. On the owner team, the Program Manager component needed to understand TxDOT's expectations in order to perform its activities effectively. Having the owner team co-located (both TxDOT and Program Manager) in the same building, allowed the Program Manager to get into its role quickly by facilitating meetings at the project level.

Another positive aspect of co-location came from the enhanced communications between construction, designer and owner representatives. This aspect has been advantageous to many project disciplines because it allowed project personnel to interact easily and solve problems related to a particular discipline in a shorter time than in an environment that was not co-located. For instance, construction problems could be addressed rapidly by holding impromptu meetings between the various entities.

For the owner, the co-location with the Program Manager represented 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 SH130 setting, the Program Manager delivered the needed technical expertise to the project for any discipline in a more accessible and flexible way. Technical experts were provided as needed to the project based from 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 co-located organization is challenging because communication can easily occur at an "improper" level. This can be dangerous especially for the Developer because Developer subcontractors can be instructed by Owner's

representatives without Developer's 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 in case the design firm does not have an established presence in the project location. Second, once the design team is staffed up, the Developer needs to establish a detailed set of operating procedures for managing information flow between design components and the Owner team.

3.3 Partnering / Issue Escalation Ladder

The partnering program put in place for the SH130 project helped the communication flow. 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. Each cell of this matrix represented a level of authority for a discipline and includes project representatives for that 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 bimonthly survey for project employees. Questionnaires are distributed and results are analyzed by the firm supporting the partnering process. Disagreements are then solved in formal partnering sessions that are facilitated by this independent firm.

3.4 Information Technology / Information Management

Table 1 summarizes the information management systems in place. Several interviewees pointed out a few problems regarding the information management systems within the SH130 project. Among other problems, network security and system interoperability offered the major challenges. Integration of Owner and Developer networks was solved by using a DMZ (demilitarized zone) VPN (virtual private network) data tunnel between the two buildings. Using this system, the Developer's employees could 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 proposers in terms of information management systems. However, characteristics of compatibility of these 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 (drawing management and project management) whereas in others, it decided to adopt a different system (ProArc).

Table 1. Information Management Tools

	Drawing Management	***Project Management***	***Communication Management***	***Document Management***
TxDOT	ProjectWise	Primavera P3	DocMan through data tunnel	eManager / FileNET
Program Manager	ProjectWise	Microsoft Project		eManager / FileNET
Developer	ProjectWise	Primavera P3 / SureTrack		ProArc

3.5 Operating Procedures

The magnitude of the project required both project parties to setup detailed operating procedures. On the owner side, the Program Manager 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 is done, a joint meeting between Developer design sub, Developer design manager, TxDOT and Program Manager is scheduled. This meeting produces 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 need to issue a design task protocol when a decision on enhancing a design criterion above contract requirements is made such as in terms of slope ratios. These protocols allow consistency along segments; they also avoid that owner representatives "direct" design subcontractors above minimum requirements without the Developer management knowing.
- ROW:
  - A process for ROW activities was developed by the project parties. In accordance with this process, the Owner ROW team either approves (or rejects) a developer-submitted acquisition package within an assigned time. This established procedure affected the needed level of expertise of Owner team members because personnel needed to be capable of making decisions in a short time, and at the lower level within the organization.
  - The SH130 project takes advantage of expanded signature authority that allows the SH130 ROW team to process some of the paper work at the project office instead of sending it to ROW division. This approach increases the responsiveness of the ROW division to the SH130 project needs in term of schedule.
- Construction/Project Controls
  - To overcome ambiguity of existing specifications, the Developer has the flexibility to submit revisions to the standard specifications. TxDOT can accept, reject or ask clarifications on these submittals.

- The Developer provides TxDOT with two monthly updates on the project status that enhance communications. The first submittal is the monthly draw request for the recognition of earnings. The second is a monthly schedule update.

3.6 Meetings

One of the advantages of having the Developer entity 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 conduct separate meetings with the independent service providers, so resolving problems between them is time-consuming.

However, the size of the SH130 project requires personnel to attend many meetings following a fixed schedule, depending on the role and discipline of the project participant. Moreover, the fast-paced environment of the project requires the flexibility to have informal, as-needed meetings. Most of these as-needed meetings occur between project representatives at the same level in the "issue escalation" ladder. Table 2 gives an example of meetings attended by the TxDOT officer in charge for environmental aspects of the SH130 project.

Table 2. Meetings on a fixed schedule attended by SH130 TxDOT environmental manager

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 and Construction	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

ECF - Environmental Compliance Firm
FHWA - Federal Highway Administration
CQAF - Construction Quality Assurance Firm

A major category of meetings includes the Technical Work Groups (TWG). These are thematic meetings between representatives of the three major project parties (TxDOT, Program Manager, and Developer) on a specific discipline (e.g. structures, pavement, tolls, aesthetics, utilities, drainage, roadway, etc.). Initially, project parties 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 this category of meetings involving personnel at all levels. Moreover, TWG meetings are recorded and minutes are distributed in order to circulate information generated to all stakeholders. If a decision generated during a TWG pertains to some established procedure, then 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 different interpretations of existing specifications.

Another major category of meetings includes the weekly segment update where everyone on a segment can share information.

3.7 Improper Communication

As described by an interviewee, the main challenges for communication were: (1) "to make sure that proper people communicate at the proper level"; (2) "and that information was disseminated down to the lower levels" in order to keep consistency across the project. Early in the project, most of the communication happened 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 lower levels was not communicated to the top.

Regarding this first issue, a common problem for DB projects is that the Owner team and Developer's design consultants usually have a short-circuiting of communications [4]. According to the interviewees, this short-circuiting has occurred at the pre-construction stage of the SH130 process. Whereas Owner's representatives are used to manage the design, ROW and utility consultants in traditional DBB projects, this short-circuiting can make adversarial relationships between DB project parties based on a lump-sum agreement (such as in the SH130 project) when that communication costs the Developer money. A direct channel of communications between the Owner team and Developer's subcontractors is needed for decision purposes pertaining to pre-construction activities. During the initial phases of the SH130 project, the Developer structured its team in a way that did not allow such direct communication between the Owner team and its ROW and Utility subcontractors, and, according to some interviewees, that slowed down the process. Therefore, the Developer management had to re-adjust its structure as the project proceeded. The Owner team must, however, understand completely the difference between oversight and directing activities.

3.8 Other Communication Challenges

The complexity of the project made communications challenging for other reasons. 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 left the project because they could not fit into the non-traditional environment of the CDA-DB approach.

Second, interpreting the contractual obligations has been a major challenge for communications between the Owner team and the Developer's management. Moreover, project participants often feel that getting decisions made in a big project, like SH130 will be time-consuming, because of the huge bureaucracy involved in it, therefore, they do not communicate as needed.

A few other communication challenges involve the Developer's organizational structures. First, the communication between pre-construction 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 for the environmental aspect. Therefore, communications between design and environmental teams does not occur optimally.

Examples of discipline-specific communication problems:

- Utilities: initially, the Program Manager staff had communications problems with the Developer's subcontractor, who was not alerting the Owner representatives of the meetings they were having with the utility companies.
- Design / Construction: initially, the Developer 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 team presented the following challenges:

  a) Communication with resource agencies (e.g., U.S. Army Corps of Engineers, Texas Commission on Environmental Quality, Texas Historical Commission) pass through TxDOT; however, some exceptions were allowed in regard of the Environmental Compliance Firm (ECF). A deviation letter was issued to allow the ECF to contact the Corps of Engineers for specific issues related to submittals.

  b) During the initial phases of the project, the Owner team realized that there was a need to expedite communications with all the resource agencies in order to meet the schedule requirements. This was achieved through meetings with these agencies, helping to maintain a positive relationship. During these meetings, Owner team representatives communicated the project needs directly to decision makers within these agencies.

  c) The SH130 project has developed different communication procedures to manage the EPIC (Environmental Permits Issue and Commitments) sheets. Traditionally, the environmental staff at project level has to submit these sheets to the Design division for approval. In the SH130 project, these sheets are "incorporated as the design progresses", and the Design division does not get involved in their management even though they can review the resulting design.

4. CONCLUSIONS AND PATH FORWARD

This research improves existing knowledge of DB processes by documenting the unique project organization and capturing lessons learned of the SH130 project. Common issues pertaining to communications and organizational structure of this DB include:

- The co-located environment makes it possible to optimize communications through face-to-face meetings. It also avoids the bureaucracy (required for any mega-project) that could become a detriment to the pace of the process.
- Flexibility to change and improve communication structures and procedures is key to improving communications on a project such as this.
- Having the Developer 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 side.
- The environment on this project makes communications between the Owner team and service providers (the Developer and its subcontractors) simpler than in a traditional DBB setup.
- Making communications occur at the proper level, and setting up the information management systems and the operating procedures needed to encourage this exchange are the major challenges on a project such as this.
- A formal partnering approach is beneficial in overcoming many of these challenges and in regulating communication flows.

As a next step of this research investigation, a set of guidelines pertaining to team organization and communication improvement in the design-build environment will be developed.

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APPENDIX A
SH 130 PROJECT ORGANIZATION