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CHANGING PROJECT DELIVERY STRATEGY: AN IMPLEMENTATION FRAMEWORK

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ABSTRACT

For organizations such as departments of transportation, other public agencies, or private companies, adopting a new approach to procure services for delivery of construction projects requires significant organizational changes; modifications to both their work processes and existing organizational structures may be needed. These adjustments, encompassing many different aspects of the organization's interests, must occur for the change initiative to be successfully put into practice. Research at the Center for Construction Industry Studies is investigating the adoption of integrated project delivery methods within the transportation project sector to better understand the dynamics of this change. This paper will present findings from a study of Public Owner organizations that have implemented the design-build method for delivering highway projects.

Using as a case study the new $1.3 billion SH 130 tolled expressway project in Central Texas, we have analyzed project documentation, held a workshop and conducted 39 interviews with individuals affiliated with owner, legal, engineering consultants, and contractors. Findings suggest that project representatives institutionalize practices and routines connected to the new approach by adapting to new challenges, rather than "overwriting" previously existing practices. Consequently, the institutionalization of innovative approaches to project delivery happens concurrently with a deinstitutionalization of the previous approaches. This concurrency produces different effects on the project environment, depending on the mediating action of some emerging practices and the perspective of the involved parties.

Building upon these findings, we have developed a conceptual framework for helping Owner organizations implement a change in their project delivery strategy. In the context of this paper, an Owner's project delivery strategy is defined as the set of project delivery methods that are adopted for delivering capital projects. We further refined this framework by making a comparative study of four transportation projects in the United States. In addition, 35 experts in the implementation of the design-build method for transportation projects participated in a Delphi study in order to validate the developed framework. Findings from these studies, including application to the construction industry and to other industries will be presented in this paper.

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INTRODUCTION

The concept of "project delivery strategy" is fundamental to this research. A project delivery strategy is here defined as the set of project delivery methods that the Owner may adopt for delivering its projects. A change to this strategy may involve a broadening or a lessening of delivery options.

For an Owner organization, the adoption of a new approach to procure services needed in the delivery of a construction project requires comprehensive change, including significant modifications to both the work processes and the existing organizational structure. These adjustments encompass many different aspects of the Owner's responsibilities (e.g., provider selection procedures, standard contractual documentation, project organization and staffing, data/information interchange and communications procedures, and contract administration practices). For the change initiative to be successful, the modification to these project domains must be thorough. Owners must correctly identify the dimensions of the needed change in the delivery cycle to implement this type of paradigm shift; such perspective allows the Owner to establish new work relationships with contractors, suppliers, and consultants.

The infrastructure project sector offers an opportunity to study issues related to the implementation of a change in project delivery strategy. In the United States, highway projects have traditionally been delivered through a project delivery strategy based on a single project delivery method, the Design-Bid-Build (DBB) method. In this approach, engineering and construction services are procured separately. Recently, departments of transportation (DOTs) have begun evaluating several alternative delivery methods that integrate the delivery of more services under the umbrella of fewer service providers. Within the last decade, the Design-Build (DB) delivery method especially has been increasingly adopted by DOTs in the United States. This method, in contrast to DBB, combines the procurement of construction services with engineering services under one contract.

The introduction of this alternative delivery method as an option for DOT project delivery demands the development and implementation of several practices that represent for many agencies a paradigm shift away from their normal operating procedures. The problem of implementing such change has two main dimensions: (1) at the organizational level, the increase of delivery options provides both challenges and opportunities to DOT decision-makers; (2) at the project level, once a new delivery method has been selected there is a need to identify practices for its implementation. In an earlier research effort, Walewski and Gibson (2001) investigated challenges related to the first problem and provided recommendations for implementation at the organizational level. To investigate challenges at the second level of implementation and identify lessons learned, we studied management of the State Highway 130 (SH-130) project for three years. This project is a 49 mile long, new tolled expressway nearing completion in central Texas, with a price tag of approximately $1.3 billion. It presented a good test case since it was the first implementation of the DB method by the Texas DOT (TXDOT). Privileged access to the SH-130 project's organizational environment allowed us to make many observations on the implementation of the design-build approach.

Findings suggest that TXDOT employees assigned to the project developed some of the new DB practices and routines by adapting existing DBB practices. Consequently, the institutionalization of innovative approaches to project delivery happens concurrently with a deinstitutionalization of

previously used approaches. This concurrency produces different effects on the project environment, depending on the mediating action of emerging organizational practices and the various perspectives of the involved parties (O'Connor et al. 2004a, O'Connor et al. 2004b, O'Connor et al. 2006, Migliaccio et al. 2006).

This paper proposes a comprehensive approach for the implementation of changes in an Owner's project delivery strategy. Building upon the SH-130 study, we developed a conceptual implementation framework for helping owner organizations change their strategy for delivering projects. In the following sections of this paper, we describe the conceptual framework and the research process for validating it. In the section following this introduction, we explore the need for an implementation framework and elaborate a problem statement focused on the challenges associated with a change in project delivery strategy. The third section of this paper describes the research process we adopted for improving and validating the conceptual framework and its results. In the fourth section, we introduce the proposed framework for assisting Owners in changing their strategy for delivering projects. The implementation framework is based upon observations of actual field implementation and upon concepts developed within the academic disciplines studying organizational change. The proposed framework includes an inventory of actions needed (1) to implement the change, (2) to build knowledge on the newly introduced approaches, and (3) to assess the outcome of a change implementation. Finally, we provide recommendations to practitioners who are responsible for managing the project delivery process at several levels, including planning, procurement, and project management.

NEEDS AND MOTIVATIONS FOR AN IMPLEMENTATION FRAMEWORK

Trends in the Delivery of U.S. Infrastructure Projects

In the United States, the infrastructure sector has experienced a number of changes in the preferred project delivery approach over the last century. Until the end of the 19th century, concurrent delivery of design, construction, and long-term operations was mandated and facilitated largely by state statutes. Moreover, the fact that design professionals were not organized in strong professional organizations allowed for an environment in which designers were subordinates to constructors (Pietroforte and Miller 2002). These factors, among others, led to a wide application of integrated delivery methods.

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

Subsequently, the Great Depression "eclipsed [both] the private funding of public projects and the use of the combined project delivery methods" (Pietroforte and Miller 2002; pp.428). Thus, the government preference for using segmented approaches to delivering projects increased

through World War II. This shift was later reaffirmed in both the 1956 Federal Aid Highway Act (Rein et al. 2004) and the 1972 Brook Act, each furthering the separation of design and construction procurement activities (Pietroforte and Miller 2002). As a result of this sequence of events, governmental agencies developed their project delivery strategies around the low-bid procurement approach of a single delivery method, the Design-Bid-Build (DBB) method. In the transportation sector, after decades of continuous use, this method has became the institutionalized standard for delivering projects.

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

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

Potential Problems Associated with Changing Project Delivery Strategy

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

routines to support the procurement change (FHWA 2004). These time excesses are often justified by a wider concern that traditional safeguards embedded in traditional procurement and financing approaches can be lost in the change process (FHWA 2004).

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

Since the combined project delivery approach is a response to changes in the industry environment, owner organizations are compelled to seek ways to adapt their organization to the new approach. This adaptation requires the development of new work processes along the delivery cycle, and involves the implementation of these processes within new organizational structures. This research effort will develop and validate an organizational response to organizations wishing to adopt new project delivery systems, which we think will be extensible for other similar activities (Migliaccio 2007).

RESEARCH METHODOLOGY

Figure 1 shows the research methodology adopted to develop and validate the proposed implementation framework. In the initial phases, we defined the research boundaries and scope by performing a comprehensive review of previous studies. Subsequently a problem statement was articulated and a research methodology was outlined. This statement, presented in the previous section of this paper, affirms that Owner's organizations adapt their work processes and organizational structures to implement a change in their project delivery strategy. The adopted research methodology follows a two-step process, with an initial phase aiming at the formulation of a conceptual framework and a later phase seeking improvement and validation of this conceptual framework.

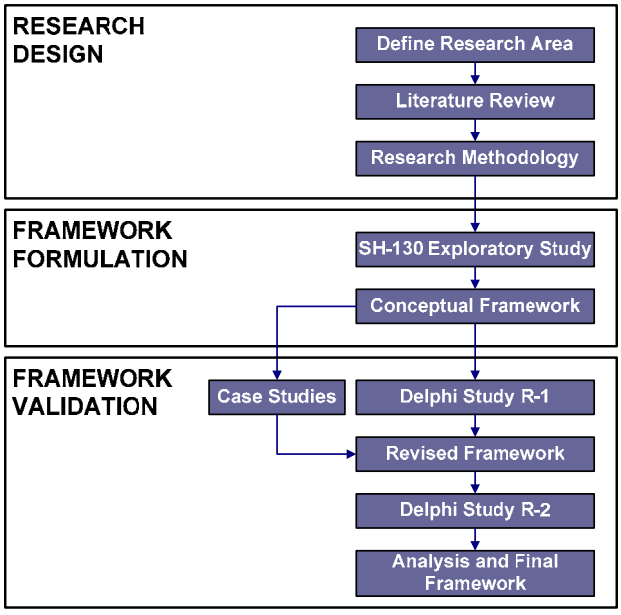

Figure 1: Research Methodology

In the literature review, we found little descriptive information on how a change in delivery strategy is implemented by Owner organizations. Subsequently, the Framework Formulation phase was designed to observe actual implementation of a change in project delivery strategy by TXDOT. The objective was to collect enough descriptive information to illuminate how this adaptation process takes place. Lessons learned by TXDOT during this early implementation were collected and used to populate a database system that included more than 100 lessons (O'Connor et al. 2004a, O'Connor et al. 2004b, O'Connor et al. 2006, Migliaccio et al. 2006). With this rich information, we outlined a conceptual implementation framework that includes the needed processes and the phases of implementation.

During the Framework Validation phase, this conceptual framework was improved and validated through two concurrent studies: a comparison of the framework of existing projects using a case study approach and through involvement of industry experts in a Delphi study. To improve the external validity of the framework, we identified other DOTs that have implemented the design-build method over the last few years. Information on four of these DOTs' projects was collected through interviews and questionnaires. This information provided suggestions for improving the initial framework. Concurrently, we initiated a Delphi study to solicit expert judgment on the developed framework (Linstone and Turoff 2002). First, we identified 90 potential experts in the implementation of the design-build method for transportation projects and invited them to participate in the Delphi study. Thirty-five experts accepted the invitation (39 percent invitation acceptance rate) and were asked to respond to an initial questionnaire in the first round of the study. This questionnaire contained four sections, including a section in which experts were asked to express their agreement with the importance and scope of each of the processes and phases. Their level of agreement was expressed on a 7-point scale, illustrated in the example shown in Figure 2.

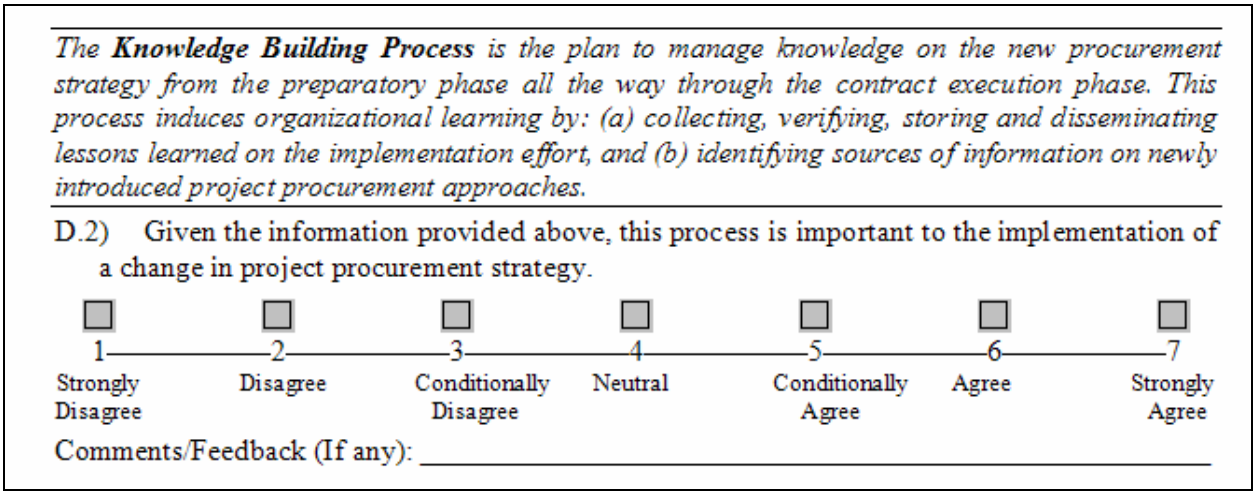

Figure 2: Delphi Round 1 – Sample Question and Scale

Other sections were designed to collect information on the experts' background, to assess their opinion on the need for a structured implementation approach, to assess a set of definitions on project delivery, and, finally, to provide an overall assessment on the framework usefulness. In addition to rating each item, panelists were asked to provide qualitative feedback on the

definitions and on the framework components, or to provide any conditions for agreement or disagreement. They were also asked to suggest (a) success factors, (b) barriers to implementation and (c) implementation activities.

Results from the first round of the Delphi study were used jointly with information from the comparative case studies to improve and better define the initial framework. For each item, we computed the average level of agreement with the provided definitions. This score provided a measure of the overall panel agreement with how specific items were formulated. Inter-rater reliability index, r_{wg}, was also computed to measure the panel's internal agreement on each of the items (James et al. 1984). Items that the panel disagreed with were modified and resubmitted for a second round of Delphi research. In addition, qualitative comments provided in response to open-ended questions were analyzed using Template Analysis (King 1994) and grouped into 25 themes. Each of these themes addressed a single success factor and included details on barriers to implementation of this factor, and actions necessary to overcome these barriers.

In the questionnaire distributed for the second round of the Delphi study, panelists were asked to rate for importance these 25 themes using the scale illustrated in Figure 3. A detailed description of each of these themes was provided. Twenty-one experts each submitted his or her questionnaire by the deadline (81 percent phase two response rate). Of the remaining five panelists, two had recently changed employment or retired and were unreachable. Information submitted through this second questionnaire was analyzed to determine both the average importance rating of each of the twenty-five themes and to assess the panel's internal agreement (measured by the inter-rater reliability).

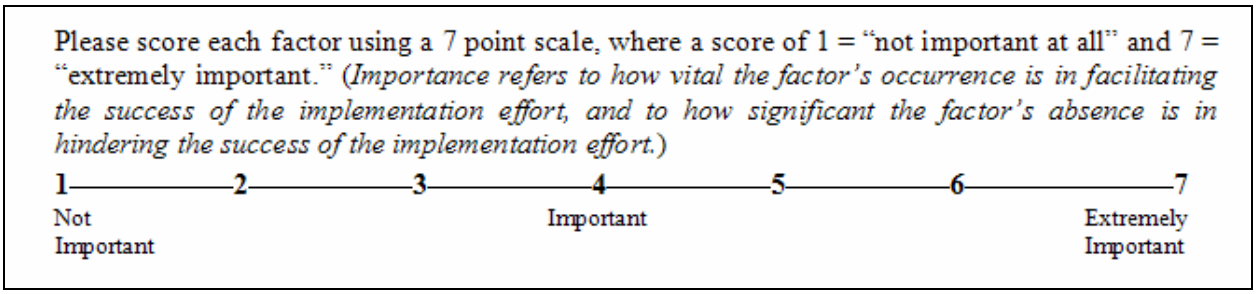

Figure 3: Delphi Round 2 – Sample Scale

IMPLEMENTATION FRAMEWORK FOR CHANGING PROJECT DELIVERY STRATEGY

Conceptual Framework Description

We developed the Changing Delivery Strategy (CDS) framework to help Owners implement changes in their project delivery strategies; it not only provides agencies with a conceptual map of decisions significant to the new scenario, but it also helps them manage the implementation process at the project level. In this context, an Owner's project delivery strategy is defined as the set of project delivery methods that the owner may adopt for delivering its projects (Migliaccio 2007). This framework was developed using input from the results of the SH 130 research investigation and information gleaned from the literature review. It went through several iterations prior to being evaluated by the Delphi panelists.

As illustrated in Figure 4, the proposed CDS framework is composed of the implementation process itself plus two supporting processes, the knowledge-building process and the implementation assessment process. The activities of these processes are divided into several phases as related to the life cycle of the delivery implementation. Definitions for the CDS implementation, knowledge-building, and implementation-assessment processes are given in Table 1.

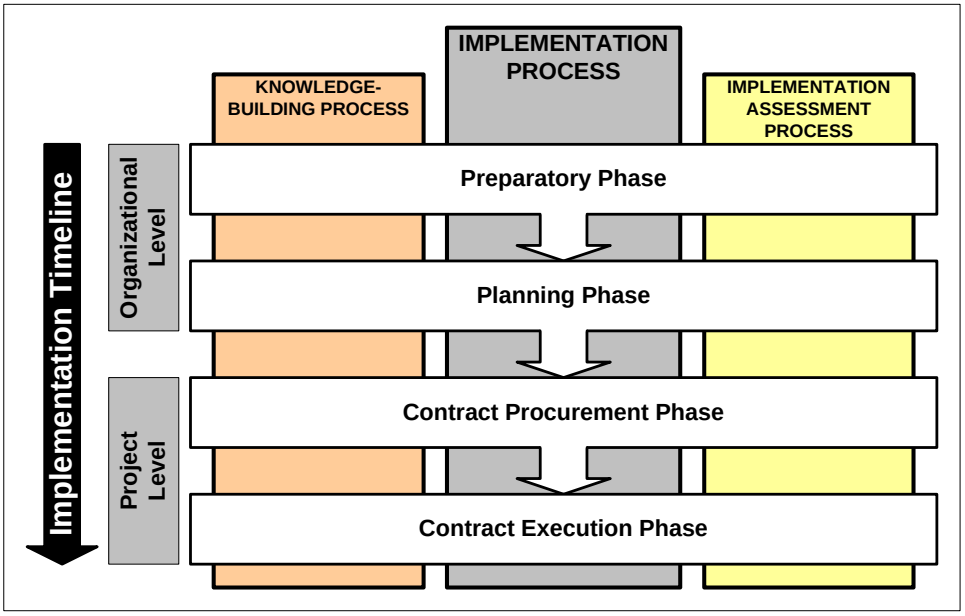

Figure 4: Changing Delivery Strategy (CDS) Implementation Framework

Table 1: Implementation Framework Concurrent Processes

Concurrent Processes	Description
Implementation	Plan to implement the new delivery and finance methods beginning from the preparatory phase through the contract execution phase. This process facilitates implementation of the new delivery and finance strategy by: (a) identifying decisions significant to the problem of changing delivery strategy, and (b) aligning project practices with organizational strategy.
Knowledge Building	Plan to manage knowledge of the new delivery strategy from the preparatory phase through the contract execution phase. This process facilitates acceptance among stakeholders (e.g., public, elected officers, industry providers, utilities, local agencies, etc.). Acceptance among organizational staff is also promoted through organizational learning which is pursued by: (a) collecting, verifying, storing and disseminating lessons learned on the implementation effort, and (b) identifying sources of information on newly introduced project delivery and finance methods.
Implementation Assessment	Plan to assess accomplishment of the new delivery strategy from the preparatory phase all the way through the contract execution phase. This process promotes continuous improvement by: (a) providing internal and external benchmarking, and (b) providing feedback on implementation progress to organizational decision-makers.

The CDS organizational-level components of the framework provide input for agency-wide change by identifying new decision paths that are generated by pursuing the new approach. The project-level components of the framework, conversely, affect organization-wide change because they are used repetitively on every project delivered with the new approach until the agency becomes familiar with it. Table 2 gives the definitions of these implementation framework phases. The first two phases comprise the implementation process at the organizational level; during these phases Owners need first to define the organizational project delivery strategy, and then to identify projects to be developed through a specific project delivery method. The next two phases comprise the implementation process at the project level, and depend on the specific project delivery method for their specifications. As the implementation of delivery methods varies, the project-level implementation process can be customized according to the specific delivery cycle.

Table 2: Implementation Framework Phases

Framework Phases	Description
Preparatory	This phase focuses on identifying information available at the organizational level that can be utilized at the planning and project level for implementing new delivery methods. The preparatory phase is driven by high-level organizational personnel and has five objectives: (1) to state reasons for the change, (2) to determine if new delivery approaches are available for use, (3) to define organizational project delivery strategy, (4) to initiate the information loop between organization and surrounding environment, and (5) to initiate the information loop between organization and project level.
Planning	This phase is performed by organizational-level personnel (i.e., districts and/or divisions personnel) and focuses on implementing organizational changes, selecting prioritized projects, drafting early risk allocation strategy and making early decisions on the project delivery method. The project planning phase leads to: (1) an initial project delivery and financing approach compatible with both the organizational and the project objectives, and (2) a project manager/champion for initiating and carrying out the procurement and eventually administering the contract.
Contract Procurement	This phase is performed by project and/or organizational-level personnel and focuses on selecting the project service providers, on implementing and reviewing risk allocation, and in establishing the project's necessary contractual relationships. The contract procurement phase leads to an established contractual framework between agency and the selected project service provider.
Contract Execution	This phase is performed by project-level personnel (i.e., project management team) and focuses on monitoring provider performance, managing the contract, making payments for work performed, and accepting the final deliverables. In order to reach these phase objectives, the project management team needs to set up all the project organization-and communications structures necessary for monitoring and assisting the provider during the project delivery. The contract execution phase leads to an established project execution framework between agency, the selected project service provider, and other interested parties.

Case Study Validation

To improve the external validity of the CDS framework, we collected information on four additional highway projects and compared this information with the lessons learned on SH-130. In identifying this sample for comparison, we looked for early implementations of the DB method.

In the first case study, we analyzed procurement activities and documentation for the $154 million contract for the State Highway 45 Southeast (SH-45 SE) tolled expressway, which was procured by TXDOT in 2004. This project involves design, right-of-way acquisition and construction of 7 miles of new highway segments in the Austin Metropolitan Area. It was chosen because it is the second application of the DB method by TXDOT (after their initial SH 130 effort). After collecting information on this project, we could confirm the importance of the knowledge-building process in overcoming internal resistance to change and the lack of knowledge about the design-build process in the Department. The experience of the SH-130 project team was very beneficial to the SH-45 SE procurement staff members, who often

consulted key SH-130 personnel to help them identify improvements to the process. The SH-45 SE procurement process was adjusted to make it more efficient. Following this rationale, SH-45 SE procurement staff shortened the duration of the procurement phase and the preparation of the Request for Proposals (RFP) package; this was partially achieved because private financing and maintenance options were not included in the SH-45 SE tendered contract as opposed to the SH-130 project.

As a second case study, we collected information on the Transportation Expansion (T-REX) Project in the Denver Metropolitan Area. This project is a multi-modal corridor project involving drainage and safety improvements and lane expansions on 17 miles of highway segments, construction of 19 miles new double track light rail lines, 13 new rail stations, and a new transit maintenance facility. The T-REX project is managed by a partnership between the Colorado Department of Transportation (CDOT) and the Denver Regional Transportation District (RTD). Whereas some minor components of the T-REX project were delivered using the design-bid-build method, new track lines and highway improvements were delivered using the design-build (DB) project delivery method. Focusing on the DB component of the project, we collected information on this project by analyzing project documentation and interviewing a project representative. We found that during the planning phase, CDOT and RTD decided to join their forces to design and build transit and highway elements together. This agreement was formalized under an Intergovernmental Agreement (IGA). In the same way, the Federal Highway Administration (FHWA) and the Federal Transit Authority (FTA) signed an Interagency Agreement to jointly oversee corridor delivery activities. The four agencies (CDOT, RTD, FHWA, and FTA) also constituted an "executive level project team," which established the project goals in November 1999, as follows:

- To minimize inconvenience to the public
- To meet or beat the total program budget of $1.67 billion
- To provide for a quality project
- To meet or beat the schedule to be fully operational by June 30, 2008

Using these objectives, owners were able to assess the overall success of the project during its life-cycle. According to a project representative, this project met all objectives. A main factor that facilitated the success in implementing DB was the decision of co-locating owners, federal agencies' representatives and the DB contractor. The project team also encountered several barriers related to organizational culture, complexity of project framework and education of third-party agencies.

As a third case study, we analyzed documentation and interviewed a project representative for the $47.5 million contract for delivering a segment of the I-405 corridor in the Seattle Metropolitan Area. This project was procured by Washington State DOT (WSDOT) in 2005 and includes design and construction for adding about 4.4 lane miles to the I-405 corridor. It was chosen because its DB contract will deliver a critical component of a larger corridor project.

As the fourth case study, we analyzed documentation and interviewed a project representative for the $185 million contract for delivering the I-5 High Occupancy Vehicle (HOV) Project in Everett, Washington. This contract was procured by WSDOT in 2005 and involves design and

construction for adding about 16.6 lane miles of HOV lanes to the I-5 corridor. This case project was chosen because its DB contract is being managed by a decentralized regional unit in Everett.

These two projects procured by WSDOT confirmed many of the SH-130 observations concerning process and assessment. They also provided additional insight on specific implementation activities and knowledge-building processes across the implementation phases.

Taken together, the information we gained from these case studies provided suggestions for improving the initial framework development. Findings from the comparative case studies also provided information that (1) confirmed SH-130 findings, and (2) provided additional insight and understanding. This additional knowledge was very helpful when we analyzed qualitative information that was collected from the first round of the Delphi study. The information from these comparative case studies was used in conjunction with the Dephi results to improve and better define the initial framework (Migliaccio 2007).

Conceptual Framework Validation (Delphi Round 1)

In September 2006, we distributed the first Delphi questionnaire to the 35 individuals in the target sample. These experts were given 60 days to return their questionnaire to the researchers. By the end of October 2006, 26 experts submitted completed questionnaires (74 percent round one response rate). Descriptive information giving the respondent's backgrounds is provided in Table 3 and many individuals had multiple areas of expertise (Migliaccio 2007).

Table 3: Delphi 1 – Panel Composition Summary

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

Rating of CDS Framework Components

Table 4 shows the results of the first round of the Delphi study as related to the validation of the framework components. Descriptive statistics for each of the components were computed. The mean was assumed as a measure of central tendency among the panelists. With average values between 5.9 and 6.2, all the framework components were validated, showing the panel's agreement with the importance assigned to each process and phase. Comments for improving the definitions and format were also provided by the panelists and these comments were used to slightly adjust definitions given in Table 1 and Table 2. To measure the panel's internal agreement, we also computed inter-rater reliability (r_{wg}) under three panel's bias scenarios: (1) no bias, (2) central tendency bias, and (3) panel's leniency bias (i.e., negatively skewed bias). Under the bias scenarios, values of the inter-rater reliability still show a high rate of true panel agreement (a value higher than 0.70 is considered good).

Table 4: Results of First Round of Delphi

Item	N	Mean[a]	Median	St. Dev.	r_{wg}[b]	r_{wg}[c]	r_{wg}[d]
Implementation process	26	5.9	6	0.77	0.85	0.77	0.71
Knowledge-building process	26	5.9	6	0.59	0.91	0.86	0.83
Implementation assessment process	26	6.0	6	0.57	0.92	0.87	0.84
Preparatory phase	26	6.0	6	0.77	0.85	0.76	0.70
Planning phase	26	6.0	6	0.58	0.92	0.87	0.84
Contract procurement phase	25	6.2	6	0.69	0.88	0.81	0.77
Contract administration phase	25	6.1	6	0.78	0.85	0.76	0.70

[a]Panelists rated an item description (including objectives and scope) on a 7-point scale expressing their agreement with the statement that "the item is important to the implementation of a change in project delivery strategy."

[b] Inter-rater reliability in absence of judge bias

[c] Inter-rater reliability adjusted for judge central tendency bias

[d] Inter-rater reliability adjusted for judge negatively skewed bias

Analysis of Qualitative Comments

In response to the questionnaire's open-ended questions, the panelists provided a large amount of qualitative information, contributing over 1,100 comments. Our analysis of this rich source of data was performed with a qualitative research technique known as template analysis (King 1994). Initially, this involved defining a set of themes emerging from the preliminary research. Later, we coded the comments of a sub-set of data (i.e., responses on overall success factors and overall barriers to implementation). As a result, an initial template was created by grouping related themes in the selected comments into a smaller number of higher-order codes that describe broader themes in the data.

We applied this template analysis to the three groups of comments (i.e., success factors, barriers to implementation, and implementation activities). The resulting categories were then compared (Migliaccio 2007). As a result, we were able to establish that success factors and barriers to implementation mirrored each other in such a way that an absence of success factors was categorized as a barrier to implementation. Subsequently, the three groups of comments were further grouped into the 25 themes that are shown in Table 5. Each of these themes addresses a single success factor; each also included details on barriers to implementation of this factor, and actions necessary to overcome these barriers (the 25 detailed themes are not given in this paper).

These themes were further subdivided into three groups, depending on the influence or affiliation it has in the CDS implementation process. The first group of themes is affiliated with success factors and barriers to implementation that are present at the agency-environment (external) interface. The other two groups of themes are affiliated, respectively, with the organization and the project level. The first theme (i.e., SF-1) may affect aspects of each of the three levels.

Table 5: Detailed Framework Themes

	SF-1	Change to the agency's delivery and finance strategy is driven by clear needs
External	SF-2	Support by elected officials
	SF-3	Support/acceptance by industry providers
	SF-4	Acceptance by general public
	SF-5	Acceptance by other relevant parties
	SF-6	Legislative authority for changing agency's delivery and finance strategy
Organization	SF-7	Agency's management vision and support for change
	SF-8	Comprehensive implementation plan at the organizational level
	SF-9	Assessment of the change's outcome
	SF-10	Redesigned staffing procedures
	SF-11	Availability of agency's staff for implementing change
	SF-12	Acceptance of change by agency staff
	SF-13	Knowledge of newly introduced approaches by agency staff
	SF-14	Communications with the external parties affected by change
	SF-15	Availability of a method for matching projects with delivery methods
Project	SF-16	Comprehensive implementation plan at the project level
	SF-17	Owner project team staffing level
	SF-18	Clear and fair approach to managing project risks
	SF-19	Procurement process efficiency
	SF-20	Competitive participation in procurement of qualified industry providers
	SF-21	Quality of contractual documentation
	SF-22	Project's organizational structure facilitating new approach
	SF-23	Project's communications facilitating new approach
	SF-24	Contract administration procedures facilitating new approach
	SF-25	Acceptance by project parties

As an example, Table 6 shows three sample themes, one for each analysis group. Each theme is named, including its affiliation; each also includes a short description, including details of how the theme affects the CDS framework and suggestions for implementing positive changes to overcome barriers. In the second Delphi round, we provided these thematic definitions to the respondents to rate in terms of importance and to comment upon. Their insight is included in the final framework and discussed in a subsequent section.

Table 6: Implementation Framework Sample Themes (Migliaccio 2007)

	Theme (Area)	Discussion
SF 6)	**Legislative authority for changing agency's delivery and finance strategy** (External)	Legislative authority is obtained by a change in the legislative framework allowing changes to the agency's project delivery and finance strategy. A transportation agency needs legislative authority before instituting changes to its procurement and finance strategy. Changes to the regulatory framework occur at different levels (federal/state), and affect different aspects including: (a) allowed degree of project services that can be outsourced; and (b) allowed project delivery methods. An absence of legislative authority constitutes a barrier to change. Suggestions for overcoming this barrier include: (1) work with and educate industry providers and elected officials; (2) inform general public; (3) advocate for legislative authority; and (4) draft legislation.
SF 7)	**Agency's management vision and support for change** (Organization)	A change to an agency's project delivery and finance strategy affects all the elements of the delivery system (i.e. procurement, contracting, financing, payment, and administration). Support by upper management is crucial for the success of the change initiative in many ways. This support may include: (1) championing for necessary legislative changes; (2) seeking support by legal counsel on legislative actions; (3) setting clear objectives for the change; (4) mandating needed internal adjustments (e.g., recruitment, outsourcing, creation of additional organizational units, etc.); (5) providing resources for implementing change (monetary and staff); (6) proclaiming commitment to agency's community (to mitigate agency's internal resistance); (7) manifesting commitment to knowledge-building (e.g., measures, time and money); (8) manifesting commitment to implementation assessment (e.g., measures, time and money); and (9) monitoring change implementation.
SF 18)	**Clear and fair approach to managing project risks** (Project)	A clear strategy for identifying, allocating, sharing, and managing project risks exists. Some potential problems include: (a) unreasonable allocation of risk with resulting high bid prices; (b) unwillingness to manage risk; and (c) unclear contractual language. Suggestions for overcoming these types of barriers include: (1) elicit input of industry associations on master contracts; (2) develop risk allocation matrices for projects; (3) have industry providers review the risk allocation during the procurement phase; and (4) develop a risk management plan with selected provider.

Detailed Framework Validation (Delphi Round 2)

In late January 2007, we distributed the second round Delphi questionnaire to the 26 individuals who responded to the first questionnaire. These participants were given 30 days to respond and by the end of February 2007, 21 had submitted their answers (71 percent round two response rate). Descriptive information on the respondents provided in Table 7 and shows that the new panel composition basically mirrored the first. The main difference was that the respondent pool had managed a larger total value of projects.

Table 7: Delphi 2 – Panel Composition Summary

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

Information submitted through this second questionnaire was analyzed to determine both the average importance rate of each of the twenty-five themes and to assess the panel's internal agreement (measured by the inter-rater reliability). Tables 8, 9 and 10 show results of the second round of the Delphi study as related to the validation of the success themes. Descriptive statistics for each of the themes were computed and the mean was assumed as a measure of central tendency among the panelists.

Table 8 shows results of the validation for themes at the external interface level (Agency-Environment). The Delphi panelists rated all the items with average values between 3.8 (4 = Important) and 6.5 (7= Extremely Important). As in the first Delphi round, we also computed inter-rater reliability. Under the "no bias" scenario, some of these themes (i.e., SF-2, SF-4 and SF-5) did not obtain a high panel agreement because of the high level of variance.

Table 8: Results of Second Round of Delphi – Importance of External Themes on the CDS Framework

Item	N	Mean[a]	Median	St. Dev.	r_{wg}[b]
(SF-1) Change to the agency's delivery and finance strategy is driven by clear needs	19	6.1	6	1.08	0.71
(SF-2) Support by elected officials	21	5.5	6	1.40	0.51
(SF-3) Support/acceptance by industry providers	21	5.4	5	0.98	0.76
(SF-4) Acceptance by general public	21	3.8	4	1.12	0.68
(SF-5) Acceptance by other relevant parties	21	4.1	4	1.26	0.60
(SF-6) Legislative authority	21	6.5	7	1.08	0.71

[a] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[b] Inter-rater reliability in absence of judge bias

It is apparent from the panel assessments that external themes or factors are critical in implementing a major organizational change such as described in this paper. The theme with the highest value among all 25 themes is, not surprisingly, legislative authority for changing an agency's delivery and finance strategy. This theme is closely followed by support from elected officials (SF-2) and support/acceptance by industry providers (SF-3); legislative authority is often a direct result of these two constituencies. Critical to implementing a major change to project delivery is the political ramifications of such changes and the amount of authority the agency is given. It should be noted that support by elected officials was the external theme with the most variation among the panelists.

As a final point, it is important to the entire CDS delivery process that the change to the agency's delivery and finance strategy be driven by a clear need (SF-1). This theme transcends all the issues discussed in this paper. The emergence of infrastructure deficits, aging and failing infrastructure, and the loss of expertise at the agency level to effectively manage large capital programs have all lead to a movement toward alternative delivery methods.

Table 9 shows the results of the validation for themes at the organization level. Delphi panelists rated all the items with average values between 4.8 (4 = Important) and 6.4 (7= Extremely

Important). Again, under the "no bias" scenario, some of these themes (i.e., SF-8, SF-10 and SF-11) did not obtain a high panel agreement because of the high variance in the responses.

Table 9: Results of Second Round of Delphi – Importance of Organizational Themes on the CDS Framework

Item	N	Mean[a]	Median	St. Dev.	r_{wg}[b]
(SF-7) Management vision and support for change	21	6.4	7	1.02	0.74
(SF-8) Organizational implementation plan	21	5.6	5	1.29	0.59
(SF-9) Assessment of the change's outcome	21	4.8	5	1.04	0.73
(SF-10) Knowledge of newly introduced approaches	21	4.9	5	1.48	0.45
(SF-11) Acceptance of change by agency staff	21	5.3	5	1.20	0.64
(SF-12) Redesigned staffing procedures	21	5.3	5	1.02	0.74
(SF-13) Availability of agency staff	21	5.1	5	1.15	0.67
(SF-14) Communication with external parties	21	5.0	5	1.10	0.70
(SF-15) Method for matching projects with delivery methods	21	5.4	5	1.12	0.69

[a] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[b] Inter-rater reliability in absence of judge bias

Management vision and support (SF-7) is clearly the most important organizational theme as identified by the panelists. It seems to be a cliché that top management support is needed, but the reality of such a radical change is the clear need for management to lead in this effort. Organizational implementation plans (SF-8) is the second most important organizational theme and is related to the leadership that top management must exhibit in order to make the change a reality. Of further note is the method for matching projects with delivery methods (SF-15) which is not an easy proposition, given the myriad factors influencing each project and the large number of variations to available delivery methods.

Table 10 shows the results of the validation for themes at the project level. Delphi panelists rated all the items with average values between 5.1 (4 = Important) and 6.0 (7= Extremely Important). Under the no bias scenario, some of these themes (i.e., SF-16, SF-21 and SF-24) did not obtain a high panel agreement because of the high variance in the responses.

Table 10: Results of Second Round of Delphi – Importance of Project Themes on the CDS Framework

Item	N	Mean[a]	Median	St. Dev.	r_{wg}[b]
(SF-16) Comprehensive implementation plan at the project level	21	5.2	5	1.33	0.56
(SF-17) Owner project team staffing level	21	5.3	5	1.02	0.74
(SF-18) Clear and fair approach to managing project risks	21	6.0	6	0.95	0.78
(SF-19) Procurement process efficiency	21	5.5	6	1.03	0.73
(SF-20) Competitive participation of qualified providers	21	5.6	6	1.03	0.74
(SF-21) Quality of contractual documentation	21	6.0	6	1.18	0.65
(SF-22) Project's organizational structure facilitating new approach	21	5.1	5	1.06	0.72
(SF-23) Project's communications facilitating new approach	21	5.1	5	0.94	0.78
(SF-24) Contract administration procedures facilitating new approach	21	5.5	5	1.12	0.68
(SF-25) Acceptance by project parties	21	5.8	6	0.98	0.76

[a] Panelists rated an item for importance on a 7-point scale. This scale used as extremes a score of 1 = "not important at all" and a score of 7 = "extremely important;" it also adopted a central score of 4 = "important." Importance refers to how vital the factor's occurrence is in facilitating the success of the implementation effort.
[b] Inter-rater reliability in absence of judge bias

All 10 of these themes scored at five or above, indicating that the panelists considered them important to extremely important. Of special note are a clear and fair approach to managing project risks (SF-18) and the quality of the contractual documentation (SF-21). These two themes are often cited in the literature as being important. Acceptance by project parties (SF-25) was also considered important by the panelists. Acceptance by the parties is probably closely related to the quality of contract documentation, contract administration procedures for facilitating the approach (SF-24), competitive participation of qualified providers (SF-20) and the fair approach to sharing risk.

CONCLUSIONS AND RECOMMENDATIONS TO INDUSTRY PRACTITIONERS

Many public owner organizations such as state's departments of transportation and Federal Agencies such as the General Services Administration are fundamentally changing the way they procure capital facilities. The emergence of wide-scale infrastructure deficits, aging and failing infrastructure, and the loss of expertise to effectively manage large capital programs have all lead to a movement toward alternative project delivery methods, such as design-build.

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

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

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

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

- preparatory,
- planning,
- contract procurement, and
- contract execution.

Our overall finding is that the draft CDS framework provides valid and valuable guidance to organizations changing their project delivery methods. Its detail, including definitions, processes and level of effort, is useful to industry practitioners and can provide an excellent starting point in facilitating a wide-scale change of this type.

Of particular note are the themes that emerged from the investigation, outlining both the facilitation of and barriers to implementation of alternative project delivery systems. Among these:

- the agency's delivery and finance strategy must be driven by a clear need to change
- management vision and support within the agency must be behind the effort
- elected officials need to be supportive of the effort
- support and acceptance by industry providers should be in place
- comprehensive legislative authority for changing the delivery and finance strategy must be gained

- organizational implementation plans to facilitate the change should be developed and used
- a method for matching projects with delivery methods should be in place
- a clear and transparent approach to managing project risks should be developed
- the quality of the contractual documentation should match the delivery method and project risks
- acceptance by project parties, both internally and externally, should be developed
- contract administration procedures for facilitating the approach should be well defined
- competitive participation of qualified providers should be encouraged

Based on the results from this analysis, we recommend that both practitioners and researchers build on the CDS framework for organizational change, with modification. We feel that the concurrent processes and phases of the framework are applicable to any organizational change. The themes, although specific to the procurement and delivery of capital facilities (in this case highway projects), are certainly extensible for use in other types of industries and/or organizational changes. Given the difficulties in making these types of changes occur, this framework provides a good first view of the steps needed to make this a reality.

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