Challenges and Opportunities for Expediting Environmental Analysis in Transportation Design-Build Projects

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ABSTRACT
Environmental planning and permitting is often seen as one of the top reasons for delays in transportation projects. In design-build projects, this process is treated as the critical path to advertising the project and on all projects many critical phases such as right-of-way acquisition, final design, and construction cannot begin until the environmental planning process is complete. The objective of this study is to identify and analyze challenges to the environmental planning and permitting process and opportunities for managing those challenges. To achieve this objective, a synthesis of transportation and design-build research was done along with interviews with agency leaders at seven state departments of transportation (DOTs). Once these challenges and opportunities were identified, several environmental planning documents and design-build requests for proposals were reviewed to document their usage. Additional follow-up interviews were conducted with environmental planning experts from six of the state DOTs that were interviewed. This study contributes to the state of knowledge by providing comprehensive information on environmental planning and permitting challenges that must be managed on design-build transportation projects and opportunities for managing these challenges. The results of this study can help transportation agencies achieve higher level of efficiency in the environmental planning and permitting process.

INTRODUCTION
The needs for expanding and repairing the nation’s network of roads, bridges, and tunnels have been constantly escalating over the past decades (ASCE 2013). The U.S. Department of Transportation (U.S. DOT) and state DOTs across the nation are unable to keep up with the rapidly rising demand for transportation infrastructure by relying on the traditional design-bid-build project delivery system. In design-bid-build, the owner hires a designer who performs design services (or performs in-house design) and a separate contractor who performs construction services (AGC 2011; AASHTO 2008). However, since the introduction of special experimental project number 14 (SEP-14), known as “Innovative Contracting” in 1990, the federal highway administration (FHWA) has allowed state DOTs to utilize innovative project
delivery systems, such as design-build for delivery of highway projects (FHWA 2006). Design-build is a project delivery system under which one entity, known as the design-build team, is contractually responsible for both the design and construction phases of the project (AGC 2011; AASHTO 2008). Although the design-build project delivery system provides state DOTs with expedited delivery and innovations in design and construction, still there is a need to accelerate delivery of design-build projects and achieve higher level of efficiency.

The delivery of large transportation projects involves a myriad of processes and requires a high level of coordination among all stakeholders. Hence, delivery of projects on-budget and on-schedule is subject to various issues. Although the time required to deliver projects varies with the size of the project, its complexity, and the public interest in the project, some projects may take as few as 3 years or as many as 20 years or more to complete (Mallett and Luther 2011). Delivery of projects can be delayed for several reasons, such as inefficient decision-making processes, time-consuming permit and approval processes, and shortage of experienced staff and funding. These issues can hinder the project development process for transportation projects, which is consisted of the following major phases: concept, preliminary design, final design, and construction. Within the project development process there are critical activities, such as the environmental planning and permitting process, right-of-way (ROW) acquisition, and utilities relocation that can significantly impact the project outcomes (Mallett and Luther 2011; AASHTO 2008).

The National Environmental Policy Act (NEPA) process is often identified as the critical path for delivery of federally funded projects. This process involves NEPA planning, environmental permitting, post-award NEPA analysis, and environmental re-evaluations (Wood 2011). Hence, initiation of other project phases, such as final design, row acquisition, and construction depends on the completion of the NEPA planning and acquisitions of the environmental permits. For projects that do not utilize federal funding, most State DOTs are required to follow their own state’s environmental planning process which often is similar in scope to the NEPA process. In design-build projects the environmental planning and permitting process, the critical path to delivery, becomes more prominent as the initiation of some project phases, such as final design, ROW acquisition, and construction cannot begin until the NEPA planning is complete and environmental permits are acquired. Any changes to project scope, design, and impact area can cause disruptions to this critical path and delay the overall delivery schedule. All NEPA steps must be completed in a project area before any project can proceed to the construction stage within that area (AASHTO 2005).

To fully utilize the entire potential benefits of the design-build project delivery system, state DOTs are required to identify and overcome various challenges in the environmental analysis and permitting process. The main goal of this study is to identify critical challenges in the environmental analysis and permitting process and propose opportunities as best practices that can help owners and design-build teams improve efficiency of current project delivery practices. This research project has been completed through a comprehensive literature review, a content analysis, and several structured interviews with design-build contacting and environmental studies specialists in 7 state DOTs (Colorado, Florida, Michigan, North Carolina,
Virginia, Washington, and Utah state DOTs), all of which have resulted in development of a set of challenges and opportunities for expediting environmental analysis in design-build projects. The findings of this study can help state DOTs optimize the project development process by accelerating lengthy and inefficient environmental analysis and permitting practices. For the purpose of this study the authors examined the project development life-cycle in the following phases: The concept phase, the preliminary design phase, the procurement phase, and the post-award phase. The upcoming sections present these four phases.

**CONCEPT PHASE**

Identifying and quantifying impacts to the environment should be completed during the concept phase of any project. By the completion of the scoping or concept phase, the State DOT should have defined potential impacts to streams and wetlands, endangered species habitat, historic buildings or properties, archaeology resources, air quality, environmental justice¹, and increased noise volumes (TxDOT 2004).

**Concept Phase Challenges**

In the project concept phase, two critical challenges can affect the environmental planning and permitting process of design-build projects.

**Challenge 1: Regulatory Agency Concerns with Incomplete Design in Design-Build Projects**

Regulatory agencies have limited staff to review and coordinate on projects (CEE 2008; Parametrix and Venner 2012). This limitation is more apparent on design-build projects where additional coordination and collaboration may be required to appropriately address and mitigate project risks and proposed alternatives. Design-build projects often involve accelerated delivery schedule and typically demand more of the regulatory agency staff time and resources. Regulatory agencies are not typically involved in the project scope development outside of the NEPA process (WSDOT 2004). During the typical NEPA process regulatory agencies are presented with set of known project alternatives (or the project corridor). These agencies are required to provide comments on the alternatives or the corridor. The need to properly manage environmental risks and resources on design-build projects may require agencies to identify additional areas of potential environmental resources which can cause a strain on resources.

**Challenge 2: Improper Identification of Resources**

Identifying impacts to environmental resources is the basic step to environmental studies and permit acquisition. Improper identification of resources affects the design-build team’s ability to manage the project environmental risks and to efficiently design and construct the project. Improper identification and failure to adequately link these elements with the project design elements can negatively impact the schedule of the project.

Concept Phase Opportunities

In the project concept phase the following two best practices can be considered as opportunities for efficiency enhancement in design-build projects.

**Opportunity 1: State DOTs should partner with, fund positions, or co-habitat with regulatory agencies**

State DOTs should partner with regulatory agencies to overcome fears that regulatory agencies will be pressured into lessening mitigation requirements (Louis Berger Group 2007). The partnering process will ensure that the State DOT and the agency are in alignment on the goals for the project. State DOTs and regulatory agencies have also found that the consultants on design-build teams that conduct the actual coordination with the regulatory agencies have incentive to maintain strong relationships with these agencies on future design-build and design-bid-build projects. Early and consistent coordination has been identified as a best practice on any project with complex environmental permitting (Parametrix and Venner 2012; PB Americas 2009; CEQ 2007). The interviewed state DOTs also identified that by partnering and coordination with regulatory agencies, they had achieved flexibility in the NEPA process and in some cases the permitting process. For instance, Washington State DOT (WSDOT) describes that coordination and outreach with regulatory agencies has led to their willingness to analyze project impacts without detailed design. One example is issuance of the “401 permit for the clean water act” by environmental protection agency (EPA)” based on 30% design plans.

**Opportunity 2: State DOTs should be flexible to utilize several strategies for acquiring environmental permits**

State DOTs have identified that early initiation of environmental permitting tasks that are known to have a long lead time in the concept phase will reduce their impact on the critical path of the project. When permitting is acquired in advance by the State DOT, risks associated with changing the permit should be transferred to the design-build team. The content analysis of various reports, design-build project request for proposals, and interviews with 6 state DOTs highlighted three valuable strategies for state DOTs that should be identified in the concept phase as follows (Louis Berger 2005, 2007):

- Acquiring permits in advance of the procurement of the design-build team and require the design-build team to comply with all commitments of the permit
- Acquiring permits after procurement of the design-build team and coordinate impacts and permit requirements based on their proposed design
- Require the design-build team to prepare all permits on behalf of the state DOT

PRELIMINARY DESIGN PHASE

Completing the NEPA process is the major goal of the preliminary design phase of a project. NEPA documents for design-bid-build projects have often been very prescriptive in each of the Special Studies that compile the document as well as in the alternative selected for the project. State DOTs have learned that adding flexibility to NEPA documents can prevent the need for NEPA re-evaluations after letting and accomplish the goals of the project without limiting innovation opportunities by design-build teams (ICF 2008).
Preliminary Design Phase Challenge

The preliminary design phase is the major step prior to contract advertisement and procurement of the design-build team. Permitting agencies rely heavily on the project design information to describe mitigation requirements for exact impacts to the environment (WSDOT 2004). This traditional approach does not always suit design-build projects that involve incomplete design plans.

**Challenge: Conventional Prescriptiveness Constraints of NEPA**

Regulatory agencies have been working with the NEPA process on design-bid-build projects for over 40 years. On a typical design-bid-build project, as the project design develops the design parameters are written into the NEPA document and corresponding “special studies” to document the exact impacts of the project’s design on the environment. Design-build team’s innovation is often constrained by the requirements written into the NEPA document that limit innovation opportunities or trigger a NEPA re-evaluation (Wood 2011). The NEPA process is a wide reaching process that is based on evaluating alternatives and balancing environmental impacts across alternatives and resources. The lack of guidance coupled with inconsistent mandates and variations and rigid interpretations in policy and regulations compound the time required for the NEPA planning process (Parametrix and Venner 2012).

Preliminary Design Phase Opportunities

The interviews with 6 state DOTs as well as the content analysis of several reports on environmental processes highlighted the following opportunities for efficiency enhancement in the preliminary design phase of design-build projects.

**Opportunity 1: State DOTs should add flexibility to the NEPA document and special studies by identifying alternative mitigation strategies, maximum impacts, and performance mitigation measures.**

State DOTs can encourage innovation in design-build teams by adding an appropriate level of flexibility to the NEPA document specifications. State DOTs have found that flexibility in the NEPA document and being less prescriptive in terms of design solutions results in higher levels of innovation (PB Americas 2009; CEQ 2008). This means that the focus of the NEPA document should be to clear a footprint for the construction of the project and not to design a solution to the project’s need and purpose. This innovative solution often leads to lower project cost and win-win outcome for the State DOT and the design-build team. State DOTs have identified that by using performance mitigation for NEPA commitments, they can increase design-build innovation. A common form of performance-based mitigation is for sound barriers for noise abatement. The content analysis of design-build RFPs as well as interviews with 6 state DOTs highlighted the importance of incorporating additional flexibility by using the following measures: (1) Use of Performance specification for Noise Abatement; (2) Use of performance based mitigation for other types of environmental impacts; and (3) Use of broad description of impacts in NEPA.

**Opportunity 2: State DOTs should establish programmatic agreements with federal and environmental agencies to streamline the environmental planning and permitting process and to provide flexibility in the NEPA document.**
Programmatic agreements with Federal and Environmental agencies can streamline the development of the NEPA document by providing pre-approved mitigation measures for various environmental impacts. The FHWA Every Day Counts (EDC) Initiative suggests continuous and expanded use of programmatic agreements to save time and streamline the processes for acquiring various permits (AASHTO 2013; EDC 2012). Programmatic agreements allow for project level decisions to be governed by a larger agreement that expedites decision making and streamlines project level agreements (Parametrix and Venner 2012). Programmatic agreements with federal and environmental agencies allow the state DOT to create performance measures for the mitigation of environmental impacts. Environmental impacts are typically quantified based on exact impacts according to actual impacts identified by the preliminary design (AASHTO 2013; Venner Consulting 2005).

DESIGN-BUILD PROCUREMENT PHASE

Design-build enables state DOTs to shift responsibilities that were traditionally managed by the state DOT to the design-build team. However, the state DOT is still responsible for establishing the project scope, definition, design criteria and performance measures, which altogether will form the request for proposals (RFP) package. Ensuring a clear and unambiguous RFP in regards to environmental permitting and mitigation requirements for Design-Build teams will reduce confusion and the potential for project delays after award due to the need for permit revisions and NEPA re-evaluations (ICF 2008).

Design-Build Procurement Phase Challenge

The procurement method, which delineates how an owner selects a design-build team for a project, has a significant impact on the outcome of the project. Among the several issues related to environmental analysis and permitting that can affect this process we describe permit agency concerns in this section.

Challenge: Permit Agency Concerns about Pressure from Design-Build Teams

Resource agencies in most projects will consider permitting for the worst case scenario as a solution. These agencies often prefer the level of mitigation to remain the same even if the environmental impacts are decreased. Regulatory agencies have a history of working with State DOTs and there is a familiarity and mutual trust between these two entities. Agencies are worried that design-build teams will attempt to reduce permitted mitigation requirements if their proposed design reduces impacts. Agencies prefer to permit for actual impacts and not for hypothetical situations without assurance that the design-build team may or may not choose to comply with contract requirements (ICF 2008; Louis Berger 2007). Interviews with state DOTs identified that each has received input from regulatory agencies on their comfort level with design-build projects. For instance, WSDOT highlighted that design-build teams are not always motivated for strict permit compliance and the typical monetary fines are seen as the cost of doing business. Regulatory agencies are pushing WSDOT to play a larger role in enforcing environmental compliance by design-build teams.
Design-Build Procurement Phase Opportunities

The design-build project delivery system enables state DOTs to share responsibilities and risks with design-build teams. Utilizing opportunities for risk allocation can result in better risk mitigation during construction of projects.

Opportunity 1: State DOTs should acquire time-consuming and high-risk permits early on and leave non-critical permits to be attained by the design-build team.

Environmental permits are typically required for a State DOT to comply with regulatory environmental agencies, state, federal, and local laws. In design-build projects, State DOTs are increasingly choosing to transfer the responsibility for preparing and obtaining environmental permits to design-build teams, especially those permits that are dependent on the final design solution proposed by the design-build team. State DOTs typically practice the following environmental permitting strategies (AASHTO 2008): (1) The State DOT secures permits and the design-build team is responsible for modifying and/or complying with permits; (2) The State DOT secures some early action high risk permits and the design-build team is responsible for modifying and complying with those permits; and (3) The design-build team is responsible for obtaining and complying with permits. State DOTs should consider acquiring the most critical permits prior to the advertisement of design-build projects, with responsibility transferred to the design-build team for any amendments and changes that must be approved by the sponsoring or regulatory agency (ICF 2008; Louis Berger 2005). The interviewed state DOTs indicated that they usually take the approach of acquiring most non-construction related permits in advance to reduce risk to design-build teams and to expedite design-build team’s ability to start construction.

DESIGN-BUILD POST-AWARD PHASE

The procurement phase of the design-build project results in selection of the design-build team, which will be responsible for both the design and construction of the project. After the contract award the role of the state DOT shifts from managing the delivery of the project to project review and aiding the design-build team in successful delivery of the project through final design and construction. During this phase it State DOTs are responsible to ensure that the design-build team’s proposed design complies with the approved NEPA document and the requirements of the RFP.

Design-Build Post-Award Phase Challenges

The State DOT and design-build team are both at risk for impacts to the environment even in situations where the State DOT transferred all permitting risks to the design-build team. Impacts to the environment typically result in fines and in some cases lawsuits, State DOTs can be held responsible for noncompliance by the design-build team as the project sponsor or the permittee (AASHTO 2008).

Challenge 1: Re-Evaluation of the NEPA Document Triggered by Proposed Design Changes

Many State DOTs and division FHWA offices are quick to assume that any proposed change to the NEPA document requires a re-evaluation of the NEPA document. While this can be avoided by adding flexibility to the NEPA document as
discussed in the preliminary design phase opportunities, no amount of flexibility will eliminate the need to re-evaluate the NEPA document on certain projects. Changes are especially common on design-build projects where the NEPA document is often completed based on 30% or less complete plans. Re-evaluations can be time consuming to complete and when triggered after a contract has been awarded, become a risk that is difficult for a design-build team to manage.

Challenge 2: Permit Modification Triggered by Proposed Design Changes

State DOTs should determine early in the development of a project which party is best suited to prepare and obtain required environmental permits. Permits obtained in advance of advertising the RFP for a design-build project are typically procured with plans that are 30 percent complete. While this level of design is preferable to design-build teams to allow them maximum flexibility in the final design of the project, regulatory agencies prefer to issue permits based on actual impacts and a higher level of design completion. State DOTs must balance the design advancement to provide enough information, while not limiting innovation.

Design-Build Post-Award Phase Opportunities

Several risk allocation strategies can be used to transfer certain responsibilities such as environmental compliance and administration to design-build teams.

Opportunity 1: State DOTs should require the design-build team to have an environmental management plan and an environmental compliance manager to oversee the environmental impacts of the project and ensure permit compliance

State DOTs should include requirements for design-build teams to develop and enforce environmental management or compliance plans as part of the design-build contract. The environmental management plan establishes procedures of how to manage incidents and accidents to minimize their impact to the environment. Studies and practice from State DOTs has identified that to properly manage environmental compliance, the State DOT and/or the design-build team should have an environmental compliance manager on site at all times during construction (Louis Berger Group 2005).

CONCLUSIONS

Design-build project development is a complex process that involves a myriad of issues in various critical areas, such as design development, procurement process, environmental analysis and permitting, right-of-way (ROW) acquisition, and utilities relocation. This study presents results of an in-depth analysis on environmental analysis and permitting in design-build projects. Qualitative analysis of design-build project RFPs and interviews with seven state DOTs (Colorado, Florida, Michigan, North Carolina, Virginia, Washington State, and Utah state DOTs) resulted in identification of several critical issues in four phases of the project development process. Table 1 presents a summary of the identified challenges and opportunities in various project phases along with follow-up responses from 6 of the interviewed state DOTs. This research contributes to the state of practice of transportation agencies and construction industry professionals by providing opportunities for streamlining
environmental analysis and permitting that is vital to accelerating the delivery of design-build projects.

Table 1. Summary of the Identified Challenges and Opportunities in the Environmental Analysis and Permitting Process of Design-Build Projects

<table>
<thead>
<tr>
<th>Concept Phase</th>
<th>State DOT</th>
<th>Colorado</th>
<th>Michigan</th>
<th>North Carolina</th>
<th>Utah</th>
<th>Virginia</th>
<th>Washington</th>
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<tbody>
<tr>
<td>Regulatory agency concerns with incomplete design in design-build projects</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Improper identification of resources</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State DOTs should partner with fund positions, or co-habit with regulatory agencies.</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
<td>Practice</td>
<td>Practice</td>
<td>Standard</td>
<td>Practice</td>
</tr>
<tr>
<td>State DOTs should be flexible to utilize several strategies for acquiring environmental permits.</td>
<td>Standard</td>
<td>Practice</td>
<td>Not</td>
<td>Considered</td>
<td>Not</td>
<td>Considered</td>
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<th>Washington</th>
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<tr>
<td>Conventional prescriptiveness constraints of NEPA</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
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<td>Standard</td>
<td>Practice</td>
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<td>State DOTs should establish programmatic agreements with federal and environmental agencies.</td>
<td>Standard</td>
<td>Practice</td>
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<td>Permit agency concerns about pressure from design-build team.</td>
<td>No</td>
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<td>Yes</td>
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<td>State DOTs should acquire time-consuming and high-risk permits early on and transfer non-critical permits.</td>
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<td>Standard</td>
<td>Practice</td>
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<tr>
<td>Re-Evaluation of the NEPA Document Triggered by Design Changes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td>Yes</td>
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<tr>
<td>Permit Modification Triggered by Proposed Design Changes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td>Yes</td>
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<td>Practice</td>
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ACKNOWLEDGMENTS

This study was sponsored by the Georgia Department of Transportation (GDOT) through Research Project 11-21 (RP 11-21). We would like to thank all those who helped us throughout the progress of this research project especially, Mr. Darryl D. VanMeter (GDOT); Mr. Nabil Haddad and Mr. Jordan Rudel (CDOT); Mr. Alan Autry (FDOT); Mr. Christian Youngs and Ms. Sheila Upton (MDOT); Mr. Rodger Rochelle and Ms. Teresa Bruton (NCDOT); Ms. Michelle Page and Mr. Richard Manser (UDOT); Mr. Shailendra Patel and Mr. James Cromwell (VDOT); and Mr. Derek Case and Ms. Christina Martinez (WSDOT) who kindly participated in the structured interviews.

REFERENCES


