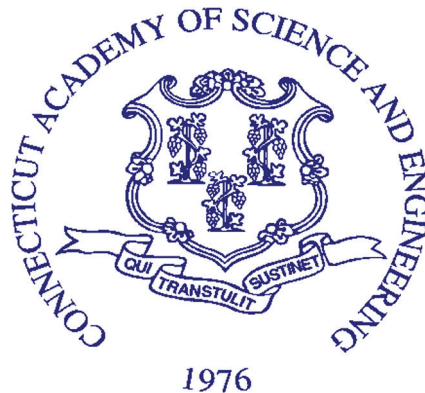


# STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE

SEPTEMBER 2016

A REPORT BY

THE CONNECTICUT  
ACADEMY OF SCIENCE  
AND ENGINEERING



FOR

THE  
CONNECTICUT DEPARTMENT OF  
TRANSPORTATION



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This study was initiated at the request of the Connecticut Department of Transportation on August 3, 2015. The project was conducted by an Academy Study Committee with the support of faculty from the Institute of Technology and Business Development, Central Connecticut State University (Brenda Zhou, PhD, PE; and Jacob Kovel, PhD, PE) and Study Consultants David Gransberg, PhD, David Pines, PhD, and Jane Stahl. The content of this report lies within the province of the Academy's Transportation Systems Technical Board. The report has been reviewed on behalf of the Academy's Council by Academy Members Robert Hermann, PhD, John N. Ivan, PhD, and Ralph Lewis. Martha Sherman, the Academy's Managing Editor, edited the report. The report is hereby released with the approval of the Academy Council.

Richard H. Strauss  
Executive Director

#### Disclaimer

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STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE

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## TABLE OF CONTENTS

TABLE OF CONTENTS.....	vii
LIST OF ACRONYMS.....	ix
EXECUTIVE SUMMARY.....	xi
INTRODUCTION .....	1
<b>PART A: PROJECT DELIVERABILITY .....</b>	<b>3</b>
1.0 PART A: LITERATURE REVIEW .....	4
2.0 PART A: SUMMARY OF STATE PRACTICES FROM INTERVIEWS OF SELECTED STATES.....	29
3.0 PART A: EFFECTIVE PRACTICES – FOUND IN THE LITERATURE	39
4.0 PART A: OVERVIEW OF CTDOT’S USE OF ALTERNATIVE CONTRACTING METHODS: PILOT PROJECTS.....	45
5.0 PART A: ENGINEERING PIPELINE AND CTDOT STAFFING .....	57
6.0 PART A: FINDINGS AND RECOMMENDATIONS.....	65
7.0 PART A: REFERENCES.....	81
PART A: APPENDICES .....	103
<b>PART B: EFFECTIVE ENVIRONMENTAL APPROVALS AND PERMITTING     STREAMLINING STRATEGIES .....</b>	<b>113</b>
1.0 PART B: LITERATURE REVIEW AND OTHER STATES’ EXPERIENCES .....	113
2.0 PART B: EXISTING ENVIRONMENTAL REVIEW PRACTICES IN CONNECTICUT.....	136
3.0 PART B: CTDOT ENVIRONMENTAL PERMITTING PROCESS .....	143
4.0 PART B: FINDINGS .....	153
5.0 PART B: RECOMMENDATIONS.....	162
PART B: APPENDICES .....	168



## LIST OF ACRONYMS AND ABBREVIATIONS

§	Section
5DPM	5-Dimensional Project Management
AASHTO	American Association of State Highway and Transportation Officials
ACMs	Alternative Contracting Methods
AGC	Associated General Contractors of America
ATCs	Alternative Technical Concepts
BTC	Base Technical Concept
CGS	Colorado Department of Transportation
CEPA	Connecticut Environmental Protection Act
CMAR	Construction Manager-at-Risk
CM/GC	Construction Manager/General Contractor
CRE	Constructability Review and Estimating
CWA	Clean Water Act
D-B	Design-Build
DBB	Design-Bid-Build
DEEP	Connecticut Department of Energy and Environmental Protection
EA	Environmental Assessment
ECI	Early Contractor Involvement
EDC	Every Day Counts
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
EPC	CTDOT Environmental Permit Coordination Unit
FAR	Federal Acquisition Regulation
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FMC	Flood Management Certification
GDOT	Georgia Department of Transportation
GMP	Guaranteed Maximum Price
ICE	Independent Cost Estimator
IDIQ	Indefinite Delivery/Indefinite Quantity
IWRD	DEEP Inland Water Resources Division
MassDOT	Massachusetts Department of Transportation
MnDOT	Minnesota Department of Transportation

MOU	Memorandum of Understanding
MTA	Maine Turnpike Authority
NCDOT	North Carolina Department of Transportation
NCHRP	National Cooperative Highway Research Program
NDDDB	National Diversity Data Base
NEPA	National Environmental Protection Act
NHDOT	New Hampshire Department of Transportation
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
OEP	CTDOT Office of Environmental Planning
OLISP	DEEP Office of Long Island Sound
OPM	Connecticut Office of Policy Management
PA	Programmatic Agreement
P3	Public Private Partnerships
PGP	Programmatic General Permit
PDM	Project Delivery Method
PBR	Permit By Rule
RFP	Request for Proposals
PNDF	Permit Need Determination Form
QA	Quality Assurance
QC	Quality Control
RFQ	Request for Qualifications
ROW	Rights-of-Way
TDOT	Tennessee Department of Transportation
UDOT	Utah Department of Transportation
USACE	US Army Corps of Engineers
U.S.C.	United States Code
USFWS	National Marine Fisheries Service
VDOT	Virginia Department of Transportation
VTrans	Vermont Transportation Agency
WQC	Water Quality Certifications
WQS	Water Quality Standards
WSDOT	Washington State Department of Transportation



## EXECUTIVE SUMMARY

This study was conducted for CTDOT by the Connecticut Academy of Science and Engineering (CASE) to identify practices for improving transportation project delivery performance for the various contracting methods used by the Connecticut Department of Transportation (CTDOT) and other transportation agencies that are applicable for CTDOT's use.

### BRIEF STATEMENT OF PRIMARY CONCLUSION

Nationwide, state DOTs are addressing challenges and complexities of an aging infrastructure, with many using alternative contracting methods (ACMs) and other strategies to improve project deliverability. CTDOT has undertaken several initiatives to improve project deliverability such as piloting ACMs and utilizing working groups to assess environmental review and permitting processes both internally and with environmental regulators. An overview of considerations to further CTDOT's efforts include the following:

- Leadership should articulate the department's vision and objectives for project delivery performance and continue to foster and improve internal relations to instill a shared production culture and team orientation among designers, engineers, environmental regulators and associated construction entities.
- To achieve the goals as set forth in the state's *Let's GO CT!: Connecticut's 5 Year Transportation Ramp-Up Plan* and *Let's GO CT!: Connecticut's Bold Vision for a Transportation Future*, it is expected that CTDOT and the Connecticut Department of Energy and Environmental Protection (DEEP) will require additional staffing and flexibility to engage consultants to fill staffing gaps, especially to meet short-term needs.
- Key project delivery performance measures should be established to monitor processes using data-driven analysis to identify areas for improvement, and to justify needed funding and staffing levels to effectively implement CTDOT's capital project program. It is expected that the department's experience with ACMs may result in examination of and changes to other existing project delivery practices. This assessment process should be open and transparent to all stakeholders to provide awareness of, and public support for, efforts to improve project deliverability.
- A useful strategy for improving constructability and ensuring the success of all projects, regardless of the project delivery method used, is early and continuous contractor and regulator involvement from concept through delivery to enable design and constructability to be considered concurrently.
  - To enhance environmental benefits and minimize environmental impacts of a project, a holistic design approach should be used that includes early and collaborative discussions between designers, construction managers and environmental regulators. The practice of sequential design reviews for environmental considerations should be replaced with over-the-shoulder reviews where environmental considerations are integrated into overall project design.

- CTDOT should use the project delivery method and contractor selection method that best fits a project’s challenges and objectives to achieve potential benefits such as price certainty, constructability, reduction of overall project delivery and construction schedules, innovation, and risk transfer.
- A consultant should be engaged to guide the development and implementation of ACM processes, and for training CTDOT staff in all aspects of scoping, procurement and contracting, and management of the relationships between the CTDOT and design and construction project teams in the use of ACMs.

## OVERVIEW

The report is structured in two parts. Part A covers overall project deliverability and Part B is focused on environmental review processes and permitting. Report chapters are as follows:

- Part A: Project Deliverability – Chapter 1: Literature Review; Chapter 2: Summary of State Practices from Interviews of Selected States; Chapter 3: Effective Practices – Found in the Literature; Chapter 4: Overview of CTDOT’s Use of ACMs: Pilot Projects; Chapter 5: Engineering Pipeline and CTDOT Staffing; Chapter 6: Findings and Recommendations; Chapter 7: References; Appendices
- Part B: Effective Environmental Approvals and Permitting Streamlining Strategies – Chapter 1: Literature Review and Other States’ Experiences; Chapter 2: Existing Environmental Review Practices in Connecticut; Chapter 3: CTDOT Environmental Permitting Process; Chapter 4: Findings; Chapter 5: Recommendations; Appendices

## RECOMMENDATIONS

The recommendations are presented for Part A: Project Deliverability and Part B: Effective Environmental Approvals and Permitting Streamlining Strategies, as follows.

### *Part A: Project Deliverability*

Generally, Connecticut’s experience regarding the need to improve transportation project delivery is consistent with other states. This is evidenced by the multiple studies and efforts aimed at identifying effective practices and efficiencies for aspects of project delivery, including initiatives under the auspices of the Federal Highway Administration’s *Every Day Counts* (EDC) program. Among those aspects of project delivery identified as either impediments to certainty of cost or scheduling or opportunities for improving cost or scheduling certainty are contracting methodologies, integration of utility and rights-of-way operations, and environmental reviews. Findings and recommendations regarding environmental reviews are addressed in Part B of this report.

Contracting practices have been identified as a focus area for transportation agencies seeking to deliver projects in the most efficient and expeditious manner possible. ACMs constitute “a smarter way of doing business” by bringing the collective experience and creativity of all project stakeholders to bear on a given project at the earliest opportunity. This allows state

transportation agencies to focus on maximizing cost and scheduling certainty via thoughtful solutions to typical design and construction problems. ACMs are not intended to, nor are they likely to, supplant traditional design-bid-build (DBB) as the main method of delivering transportation projects. States that have fully endorsed and implemented ACMs typically utilize them for a small percentage of their projects, but in many cases these projects are larger and consequently costlier, and thus represent a much greater percentage of a department's capital budget. It is important to identify the types of projects in which ACMs will improve scheduling and/or price certainty or solve complex or complicated issues.

A consistent lesson among all ACMs is that early contractor involvement is key to improved project delivery performance. It is also clear that certain techniques or mechanisms associated with ACMs may be incorporated for use in traditional DBB contracting and improve the performance of those projects. These may include, for example, use of an independent cost estimator (ICE) and alternative technical concepts (ATCs).

To be effective, CTDOT should consider the following three objectives in its implementation of ACMs:

- Increase the integration of the project team.
- Focus on maximizing cost and schedule certainty.
- Leverage the first two objectives to accomplish more with available capital.

Sufficient human capital in both quality and quantity must be available to implement transportation projects. Regardless of the contracting methodology, either staff or consultant services must be available and able to manage the complexities associated with projects from conception through completion.

Finally, specific performance measures or metrics and supporting data can help identify which aspects of project delivery provide the greatest opportunities for improvement. While development of a system of metrics may be resource consumptive, the data collection input and report creation need not be. In addition to providing the information base for systematic, continuous assessment and improvements, metrics can be used to support specific budgetary, legislative or policy changes that might be otherwise difficult to achieve.

### **ORGANIZATIONAL STRUCTURE: POLICIES AND PRACTICES FOR IMPLEMENTING AND INSTITUTIONALIZING ALTERNATIVE CONTRACTING METHODOLOGIES**

CTDOT should establish a small, dedicated ACM office/unit conceptually based upon the Minnesota Department of Transportation (MnDOT) model, and others.

- The department should engage a general engineering consultant with ACM expertise to help accelerate the effectiveness of the ACM office and project success.
- To prepare for and assure that sufficient project management resources are available, the ACM office should conduct a needs assessment for the different qualities/roles

required by managerial staff for utilizing the various ACMs. As CTDOT completes the ACM pilot projects and determines the methods for project and contractor selection, the department will be able to better identify areas where specific ongoing expertise is necessary and then determine whether specialty groups within existing units should be established.

- The specific roles and responsibilities of department staff, consultants and contractors associated with various aspects of ACM development, specifications, selection and implementation should be identified and outlined in CTDOT ACM manuals.
- To institutionalize ACMs, junior level staff need to be trained and be involved in over-the-shoulder reviews with any general engineering consultants that are utilized so as to gain experience in request for qualifications (RFQ) and request for proposals (RFP) preparation, contractor selection, and management of ACMs.

Led by the new ACM office, experienced CTDOT staff should be used to guide initial ACM program development (beyond the existing pilot projects) and subsequently for review, interviewing, responding to questions, and scoring of ACM proposals. As previously suggested, a general engineering consultant should be used to supplement existing staff and to provide expertise in ACM aspects with which CTDOT has limited experience. Consultant engagement for specific aspects of ACM projects should include a “training” component to prepare CTDOT staff to transition from using consulting services to assuming responsibility for tasks internally.

- Junior staff should be exposed to all available training to both build in-house capabilities and promote organizational culture change.
- Timing the transition from use of a consultant to use of in-house staff for the procurement function should take into consideration the volume of projects and preparedness of staff to assume these responsibilities. A determination of staffing needs specifically related to ACM program development and operation should similarly take into consideration the volume of projects likely to be procured through ACMs.

### **PROCESS FOR SELECTING A CONTRACTING METHODOLOGY**

While there is no “best” method for selecting an ACM for projects, it is recommended that CTDOT first develop a set of initial screening criteria for the types of projects that would or would not be considered for ACMs. For those projects that pass this initial threshold, a selection matrix process should be used for making the final decision. This could be the methodology developed by the University of Colorado or a modified version that best meets CTDOT requirements.

In general, for projects conducted using design-build (D-B), CTDOT will be accepting less control in exchange for the benefits of transfer of risk to the contractor, innovation, improving constructability, schedule, and price certainty. Also, the use of construction manager/general contractor (CM/GC) or construction manager-at-risk (CMAR) enables CTDOT to be at the table throughout the design process, has the benefit of early contractor involvement to improve project constructability, and can include innovative design and construction methods by having the designer, contractor, and owner working together to meet project goals and objectives.

Given the importance of selecting the “best” contract methodology to achieve a project’s goals most efficiently, it is important for senior staff to be included on the selection process team. This is especially critical since ACMs will likely be considered for the most complex and highest cost projects where innovations can have the most impact.

### CONTRACTOR SELECTION

It is recommended that CTDOT follow a two-phase (RFQ and RFP) contractor selection process for D-B, CM/GC and CMAR projects. This process should include the following:

- Sufficient time for potential D-B proposers to develop teams and respond to RFQs/RFPs
- Quick and confidential responses to ATCs when used
- Stipends paid to the responsive unsuccessful proposers for D-B
- Scoring of proposals based on best value – not solely on price. Scoring formula percentages for the technical proposal/qualifications and price should be flexible, and determined on a project-to-project basis taking into consideration various factors such as project complexity and innovation. Therefore, the greater the importance of the technical proposal/qualifications for a project, the higher the percentage assigned to the technical proposal/qualifications component of the best value score.

Stipends should be calculated based on the expected level of design work needed to provide a high-quality proposal that addresses specific project objectives instead of using a simple percentage of a project’s cost. The following is an example of one method for estimating the stipend payment.

Stipend Payment = (#1) \* (#2) \* (#3) \* (#4)

Where:

#1 = *Estimated Project Cost (\$)*

#2 = *Average Percent Design Fee (%). (Shown as a percentage of project cost based on typical projects)*

#3 = *Percent of Design Required to Respond to RFP (%). This is an estimate of the percentage of the full design that the design-builder must complete to guarantee price and performance, including ATCs, if any, to meet specific project objectives*

#4 = *Percent of the calculated design fee [(#1)\*(#2)\*(#3)] not including profit to respond to the RFP. For example, if typical design profit is 20% then the calculated design fee is multiplied by 80%*

For CM/GC and CMAR projects, it is critical that the designer and contractor collaborate during the pre-construction phase to achieve the benefits of these project delivery methods. While it is recommended that this relationship be stipulated in contractual agreements, it is important that the owner play an active role in facilitating this relationship.

Early contractor involvement (ECI) in project design is integral in the use of ACMs. ATCs, an aspect of ECI, are mostly used in conjunction with D-B projects to provide an opportunity to increase innovation and may lead to higher-quality projects. ECI for CM/GC and CMAR



projects is achieved through designer/contractor collaboration during the design phase of a project. Additionally, strategies to incorporate ECI into DBB should also be considered, such as use of ATCs as a component of contractor selection. CTDOT should monitor how ATCs are being incorporated into the best value selection process for CM/GC and CMAR projects, and DBB projects by other state DOTs.

## HUMAN RESOURCES

CTDOT should:

- Work with the Connecticut Office of Policy and Management (OPM) to fill new and refill vacant positions to assure the capacity needed to achieve the state's transportation goals.
- Engage OPM in chartering a LEAN<sup>1</sup> assessment specific to CTDOT hiring and retention, recognizing that CTDOT is in a somewhat unique position relative to the competitive nature of hiring engineers, and in particular, mid-level engineers capable of quickly becoming experienced project managers.

To the extent that Conn. Gen. Stat. §4e-16 may restrict use of consultants by CTDOT for certain work efforts, CTDOT should clarify areas where use of consultants could enhance its capacity and where such use is not prevented by the statutory requirement to conduct cost-benefit analyses prior to such use, and explore with OPM proposing a legislative amendment that might lessen this constraint.

## RIGHTS-OF-WAY (ROW)

CTDOT should:

- Incorporate ROW appraisal and acquisition early in project planning processes.
- Investigate with Federal Highway Administration (FHWA) and review any state limitations regarding the availability of appraisal waivers above currently authorized levels and the feasibility of having the same person conduct appraisals and acquisition negotiations under defined circumstances.
- Review its ability to hire consultants for aspects of ROW acquisition beyond appraisals.
- In consultation with the Office of the Attorney General, determine its authority to delegate ROW acquisition to design-build contractors, and if so develop protocols for such delegation.
- Through its EDC coordinator, continually monitor EDC newsletters and reports to identify innovations that enhance ROW professionals' ability to meet challenges associated with acquiring real property as may be applied to projects.

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<sup>1</sup> LeanCT is the program within the Office of Finance, Office of Policy and Management that is responsible for the daily management and coordination of Connecticut's statewide process improvement initiative. The program assists agencies in using organizational, process and programmatic improvement techniques, such as Lean, to help create a sustainable, customer-focused, and more efficient future for Connecticut; [http://www.ct.gov/opm/cwp/view.asp?a=4595&q=538306&opmNav\\_GID=2162](http://www.ct.gov/opm/cwp/view.asp?a=4595&q=538306&opmNav_GID=2162)

## UTILITIES

CTDOT should:

- Review its Utility Accommodation Policy, if it has not already done so, to identify opportunities to address issues underlying utility asset relocation delays.
- Review the best practices identified in the Transportation Research Board's report, "Integrating the Priorities of Transportation Agencies and Utility Companies," and identify those that are implementable and valuable to its programs. Among the strategies that parallel best practices in other aspects of deliverability that should be considered are conducting design as a team, including appropriate CTDOT staff and those involved in project design on behalf of CTDOT, and utility companies; early communication with and involvement of utilities to inform decision making and avoid conflicts; and training CTDOT designers, engineers and contractors on utility relocation processes.
- Meet with and enlist the assistance of the Connecticut Public Utility Regulatory Authority (PURA) to evaluate opportunities to utilize PURA's rate-setting and operational oversight of utilities as mechanisms to set expectations for utility responsiveness to transportation project requirements.
- In its development of ACM selection processes, recognize the value of CM/GC for projects with utility issues that can affect the overall project schedule.
- Through its EDC coordinator, continually monitor EDC newsletters and reports to identify innovations that enhance its ability to meet challenges associated with relocation of utilities and other utility coordination issues.

## EVALUATING PROJECT AND PROGRAM PERFORMANCE

CTDOT should establish and implement a system of performance measures that will provide the data necessary to identify with greater precision opportunities for improving all project delivery methods. It is recommended that CTDOT review FHWA's project entitled "Quantification of Cost, Benefits, and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications" when it is published as a guide for developing a methodology for quantifying performance measures across project delivery methods.

Pinpointing lessons learned with some level of accuracy and data integrity will support ongoing process improvement initiatives throughout the department and among its partners in the public and private sectors.

While development of a system of performance measures may be resource consumptive, the data collection input and report creation need not be. Performance measures could support not only improvements in project delivery, but also provide the legislative and statewide support needed to effectively achieve the goals of *Let's GO Connecticut!* Further, it is recommended that CTDOT review Utah DOT's (UDOT) Project Development Performance Management system. While it is expected that UDOT's system may be more extensive than that which CTDOT can or should undertake initially, a review of the system will identify those measures and approaches directly related to major areas included in this study – the effectiveness of ACMs and the impediments to timely project delivery.

## ***Part B: Effective Environmental Approvals and Permitting Streamlining Strategies***

The following recommendations are applicable to all project delivery methodologies. As an overarching recommendation, each agency must rethink and change its current view of the transportation-environmental compliance relationship. For its part, CTDOT must ensure its environmental compliance paradigm incorporates environmental compliance and natural resource protection and enhancement as an integral part of design. This will require additional training and vetting of both staff and consultant engineers. It will additionally require significant integration of and communication between environmental and transportation experts, on an inter- and intra-agency basis. For DEEP's part, its management must assess its streamlining paradigms to consider its clients' (i.e., CTDOT and other major development entities) processes. In other words, DEEP needs to understand and accommodate the development sector's need for some level of authorization certainty prior to achieving the level of certainty DEEP desires and/or is required to find as a matter of final authorization.

The following recommendations offer some vehicles for implementing the above cultural and paradigm shifts, in addition to others currently being developed in detail through ongoing inter- and intra-agency efforts. In summary fashion, the recommendations all speak to (1) close and continual communication between the environmental and natural resource professionals and transportation professionals; (2) increased use of technology to assist in coordinating schedules, sharing technical information and deployment of resources; and (3) the need to establish meaningful and implementable metrics to assist in both outward public messaging and inward data collection to support maintaining or changing programs and processes.

### **ISSUE: PERMIT ACQUISITION WITHIN SCHEDULED TIME FRAME TO MAINTAIN ESTABLISHED PROPOSAL/BID DATES** *(Initiation of multi-agency involvement; shared scheduling/project management databases; iterative feedback/input loops)*

CTDOT Engineering and the Office of Environmental Planning (OEP), in consultation with DEEP, should identify categories of projects for which OEP will provide contemporaneous, ongoing, collaborative participation with design engineers from project inception through final design. Other states and the literature have described this as "over-the-shoulder" reviews. It seems, for example, that culvert replacements are often both logistically complex from a construction perspective and an opportunity for either improving fisheries passage, maintaining the status quo or providing meaningful mitigation. It would therefore appear that as a category, these projects (or some subset of same) would benefit from such over-the-shoulder reviews so that realistic options regarding natural resources could be incorporated at an early design stage.

CTDOT should use its annual capital project plan to begin early multi-agency involvement. As in Maine, CTDOT OEP should establish and implement a preliminary screening process to identify types of projects unlikely to raise environmental or natural resource concerns (historic and cultural issues should be screened for at this level as well). Appropriate designated representatives from CTDOT Engineering/OEP and DEEP should begin discussions at project inception. Based upon an initial assessment, CTDOT Engineering and OEP should identify projects (in addition to those identified categorically per above) for which OEP will provide contemporaneous, ongoing, collaborative participation with design engineers from project inception through permit application preparation and final design. Ideally, a specific OEP staff person would be assigned to each identified project from its inception through permit acquisition. Such partnered, over-the-shoulder participation is intended to replace sequential,



iterative reviews between or among CTDOT engineers, OEP staff and DEEP. DEEP involvement should be sought and provided at any stage.

CTDOT should use shared project scheduling software so that all divisions are aware of project status/deadlines. The scheduling software should be used by DEEP as well so that they can assure involvement at appropriate times.

Beyond scheduling, CTDOT and DEEP should be able to share planning files. Electronic access to project plans and data could identify issues earlier in the design process, obviate the need for certain issues to await placement on meeting agendas, and potentially reduce the staff time involved in iterative requests and responses for information.

Agendas for both the CTDOT/DEEP Environmental Review meeting and Project Manager monthly meeting should be developed to discuss projects in which at least one representative believes there will be technical and/or scheduling challenges in acquiring environmental approvals. Criteria should be established to determine which projects are brought forth at monthly meetings. Sensitivity should be built in to the attendance lists based upon the specific project(s) challenges.

- To the extent that over-the-shoulder reviews and/or partnering between designers and OEP staff as well as shared project files are instituted, input from environmental and natural resource representatives should be sought and received as needed. Agenda items could then be reserved for more complex issues or sophisticated discussions. Similarly, projects that would still benefit from collaborative interagency review should be placed on an agenda so that project schedules can be maintained.
- Preparation of agendas should, to the extent known at the time, identify the purpose for the item's inclusion, i.e., issue(s) or questions of concern.
- For items that have been presented at prior meetings or been the subject of prior inter- or intra-agency discussions, preparation for the meeting should, as appropriate, include follow-up or documentation of resolved issues.
- Staff from the CTDOT OEP and Environmental Permit Coordination Unit (EPC) should work together with in-house and consultant designers to present projects to the regulatory agencies from both the engineering and environmental perspectives.

Any of the appropriate parties should be able to request additional items or iterative sessions.

Given the almost universal agreement regarding the value of both the CTDOT/DEEP Environmental Review Monthly meeting and Project Manager Meetings held monthly, there should be more time or additional sessions made available so that more projects can benefit. Implementation of several of the above recommendations should provide efficiencies for the individual meetings such that staff resources are not unduly affected.

Consider establishing routine training modules regarding environmental application requirements and permit authorization compliance for engineering staff, and make them available to consultants. Depending on an individual consultant's experience and/or track record, participation in training sessions may be mandated.

CTDOT project managers need to take an active role in preparation and review of presentations by consultants at monthly meetings.

CTDOT should maximize utilization of the monthly meetings – assure documentation of agreements and commitments arrived at, and incorporate documentation in permit application/documents.

**ISSUE: LEVEL OF DETAIL NECESSARY TO COMPLETE PERMIT APPLICATIONS**

*(Clarity and alignment between engineering terminology and natural resource and environmental standards information requirements; programmatic or general permit review standards)*

DEEP and CTDOT should engage in a program-specific “crosswalk” between the technical or detail information that is available and the percentage of CTDOT project design completed; this exercise should result in agreement(s) regarding the technical or detail information required for each permit type. CTDOT may consider whether its utilization of percent completion definitions can be made consistent between/among divisions.

DEEP and CTDOT should explore circumstances under which additional activities could be authorized without DEEP scrutiny and/or where certification by CTDOT engineers (internal CTDOT or consultant design) would be sufficient demonstration of environmental compliance. Stormwater may be such an area, where compliance with existing manuals sets the appropriate performance standard.

DEEP should determine and/or define which types or categories of qualified professional(s) operating at what levels would satisfy self-certification by CTDOT of its stormwater controls. To assist in this determination, CTDOT should identify for DEEP their internal staff and/or consultants that they might designate to certify that designs, operations and maintenance would satisfy environmental performance standards.

DEEP and CTDOT should establish a schedule for updating the manuals to be relied upon for establishing such performance standards.

DEEP and CTDOT should review at a granular level other states’ general permits or permits by rule (PBR) that have been identified in this report to determine whether similar practices would be acceptable and useful in Connecticut. In particular, the agencies should review: Maine’s presumption of need for projects to improve existing infrastructure; New Hampshire’s presumption of need for certain transportation projects; Maine and New Hampshire’s use of simplified forms and filings for transportation projects; Washington State’s programmatic permits for bridge structure repair, painting, and washing; channel, fishway, and culvert maintenance; and culvert replacement in non-fish bearing streams.

CTDOT and DEEP should continue discussions and formalize an approach to authorizing a maximum footprint of impact to wetlands. (This may require a legislative presumption of need for certain classes of transportation projects.) Also see the recommendation regarding mitigation programs that follows.

**ISSUE: SUBSTANTIVE ISSUES WITH RECURRING, MULTIPLE, SCHEDULE CHALLENGING ITERATIONS** (*Fisheries and wildlife impacts and mitigation; wetlands mitigation; emerging issues*)

With appropriate sensitivities built in to the agenda setting process, DEEP fisheries and wildlife staff should be asked, and at times be required, to attend monthly meetings.

DEEP should reevaluate its existing Stream Crossing Guidelines and update them as necessary. The guidelines should be sufficiently specific so that CTDOT can proactively incorporate such specifications or performance standards in its designs and/or design specifications or mitigation plans.

CTDOT should proactively incorporate fish passage and stream crossings or mitigation into its design plans to address impacts to these.

CTDOT should consider hiring fisheries biologist(s) or having such experts “on-call” to consult on specific projects. DEEP should consider the definition of “qualified professionals” who would certify reviews or designs.

DEEP and CTDOT, with the assistance of the Office of the Attorney General, should develop and seek a legislative amendment to provide for mitigation in-lieu fee and banking programs.

DEEP and CTDOT should design and develop a watershed-based habitat mitigation and banking program.

To the extent not already accomplished, the CTDOT/DEEP Working Group should be formally established. In addition to its current practice of addressing ongoing, identified issues, it should be used as necessary to update attendees on emerging issues and inform them of opportunities to participate in addressing such issues.

**ISSUE: ASSURING CONTINUOUS PROCESS IMPROVEMENT AND GEARING UP FOR A LARGER CAPITAL BUDGET AND MEGA PROJECTS** (*Staffing levels; metrics; Every Day Counts*)

CTDOT and DEEP should jointly work with OPM to refill vacant positions to assure the capacity needed to achieve the state’s transportation goals.<sup>2</sup>

CTDOT and DEEP should revisit CTDOT’s past proposals to fund positions at DEEP, identify needs within specific permitting programs and establish accountability and performance standards should positions be funded. The agencies should evaluate whether the current system of having CTDOT provide funds and the project codes for DEEP staff to utilize, as opposed to funding specific staff positions, is still viable. DEEP should evaluate with OPM whether it would be able to add specific FTEs on the basis of CTDOT funding, and reevaluate its current accounting and documentation system for utilization of CTDOT funds.

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<sup>2</sup> The authors fully recognize the state’s current budget circumstances. However, long-term transportation goals and interests will be challenged at best and jeopardized at worst should the staff necessary to develop and implement transportation projects not be available.

Management at the highest appropriate level at CTDOT and DEEP should jointly discuss with OPM any impediments to and mechanisms to overcome CTDOT payment for DEEP services and payment of overtime to bridge the 35- to 40-hour workday difference for DEEP employees.

To the extent that Conn. Gen. Stat. §4e-16 may restrict use of consultants by CTDOT for certain environmental review-related work efforts, CTDOT should clarify areas where use of consultants could enhance environmental review capacity and is not prevented by the statutory requirement to conduct cost-benefit analyses prior to such use, and explore a legislative amendment that might lessen this constraint.

CTDOT and DEEP should establish and institutionalize a SWAT team approach to mega projects. Appropriate staff from each agency should be designated and delegated necessary authorities to make commitments from project inception through construction.

CTDOT should establish and implement a system of performance metrics, ideally in conjunction and consistent with its project scheduling and plan sharing systems, that will provide the data necessary to identify opportunities for environmental review streamlining with greater precision.

CTDOT should, in consultation with DEEP, identify corridors likely to be impacted by transportation projects and review and address natural resource data gaps.

CTDOT should ensure that it is poised to take advantage of any and all FAST Act and EDC opportunities including new or modified programmatic agreements between or among federal and state highway, environmental, natural and cultural and social resource agencies. Also, OEP should establish regular status updates with the CTDOT EDC Coordinator to identify new initiatives that may enhance environmental review coordination and/or synchronization.

## INTRODUCTION

This study was conducted for the Connecticut Department of Transportation (CTDOT) by the Connecticut Academy of Science and Engineering (CASE) to identify practices for improving transportation project delivery performance for the various contracting methods used by CTDOT and other transportation agencies that are applicable for CTDOT's use.

Many factors influence a transportation agency's transportation project delivery performance. A 2009 National Cooperative Highway Research Program (NCHRP) report, "Best Practices in Project Deliverability Management" (NCHRP Project 20-68A, Scan 07-01), requested by the American Association of State Highway and Transportation Officials (AASHTO), highlights the issues and identifies several factors impacting project deliverability as a starting point for assessing practices and identifying strategies for CTDOT to consider for improving project deliverability performance:

*Transportation agencies are experiencing unprecedented pressure to deliver projects for constituents. Many factors contribute to this high-demand environment, including increasing congestion, reduced work periods for construction, workforce issues, intense public interest and involvement, and severe revenue pressures. Agencies are seeking ways to deliver projects in the most efficient and expeditious manner possible...*

*The Best Practices are divided into the four focus areas; however, assignment of these Best Practices to a specific area is not always easy due to the overlapping nature of their application. The following define the four focus areas: project management; performance measures; contracting practices; community involvement. (NCHRP Project 20-68A, Scan 07-01 2009)*

Practices reviewed to improve project deliverability included: organizational structure and staffing to support project delivery; project delivery method (PDM) selection to achieve project goals, such as timely completion and price certainty; contractor selection; performance measures; and streamlining environmental review processes and permitting to improve project deliverability, and for selecting a project-specific PDM.

The PDMs examined included alternative contracting methods (ACMs) in addition to the traditional design-bid-build (DBB) to identify practices most appropriate for CTDOT's consideration.

The report is structured in two parts. Part A covers overall project deliverability and Part B is focused on environmental review processes and permitting. Report chapters are as follows:

- Part A: Project Deliverability – Chapter 1: Literature Review; Chapter 2: Summary of State Practices from Interviews of Selected States; Chapter 3: Effective Practices – Found in the Literature; Chapter 4: Overview of CTDOT's Use of ACMs: Pilot Projects; Chapter 5: Engineering Pipeline and CTDOT Staffing; Chapter 6: Findings and Recommendations; Chapter 7: References; Appendices
- Part B: Effective Environmental Approvals and Permitting Streamlining Strategies – Chapter 1: Literature Review and Other States' Experiences; Chapter 2: Existing

Environmental Review Practices in Connecticut; Chapter 3: CTDOT Environmental Permitting Process; Chapter 4: Findings; Chapter 5: Recommendations; Appendices

A study committee was appointed by CASE to oversee and guide the study effort. A team was engaged by CASE to conduct the research for the study. The research effort included a literature review, interviews, and guest speaker presentations. Guest speaker presentation information is available electronically as noted in Appendix C.

## **PART A: PROJECT DELIVERABILITY**

This section of the report provides an overview of the current literature and other states' efforts to improve project deliverability for transportation projects. The section is organized as follows:

- Literature Review
  - Project Delivery Methods, including design-bid-build (DBB), design-build (D-B), construction manager-at-risk (CMAR), construction manager/general contractor (CM/GC), public private partnerships (P3), indefinite delivery/indefinite quality (IDIQ), and alternative technical concepts (ATCs)
  - Synthesis of the Project Deliverability Literature
- Summary of State Practices from Interviews of Selected States
  - Organizational Structure for ACMs
  - PDM Selection
  - Contractor Selection and Engagement
  - Hiring and Retention
  - Utilities and Rights-of-Way
  - Performance Measurement
- Effective Practices – From the Literature
- Overview of CTDOT's Use of ACMs: Pilot Projects
  - Design-Build
  - Construction Manager/General Contractor
  - Construction Manager-at-Risk
  - Performance Measures
- Engineering Pipeline and CTDOT Staffing
  - National and State Supply of Engineers: Bachelor Degrees Conferred
  - National and State Engineering Wages
  - DOT Outsourcing and Cost-Effectiveness
  - Engineering Career Paths and CTDOT Future Workforce Activities
- Findings and Recommendations
- References
- Appendices



## 1.0 LITERATURE REVIEW

The literature reviewed for this report consists of three categories of documents. The first category is those documents in the academic research literature and consists of peer-reviewed journal articles, conference proceedings papers, and related research reports. This category establishes the theoretical foundation for PDMs of interest. The second is the trade literature, which contains information published by trade associations like the Design-build Institute of America and the Associated General Contractors of America (AGC). This category furnishes regional/national level best practices in alternative project delivery and serves as a filter for identifying those practices identified in the academic literature that have been actually implemented and found to be effective. The third class of literature is public agency manuals, handbooks, and policy documents. These documents permit the researcher to put the information gleaned in the previous two categories into the statutory/regulatory context of a specific public agency. The information gleaned in this category will be useful in making comparisons between Connecticut and other states.

### 1.1 PROJECT DELIVERABILITY

A cursory search for the definition of “project deliverability” as a term of art came up empty. The dictionary defines deliverability as “something that can be done, especially something that is a realistic expectation” (Oxford 2016). A 2012 CASE report entitled *Benchmarking Connecticut’s Transportation Infrastructure Capital Program with Other States* (Lownes et al. 2012) used the term “project deliverability,” assuming it to be a commonly used term and as such, did not offer a formal definition. However, the report contained the following references, which provides some context related to this study:

*Deliverability concerns play a major role in project selection and capital programming...” and “...Project deliverability performance should be measured by monitoring the percentage of capital projects that are completed on time and on budget. (Lownes et al. 2012)*

The quotations from the report essentially speak to measuring the uncertainty associated with a DOT’s ability to achieve both budget and schedule estimates made during capital programming. This is an issue that plagues public works, providing the media with plenty of fodder with which to criticize public agencies and the officials charged with delivering desperately needed infrastructure replacement and renewal projects.

The benchmarking report also contains many references to the use of “innovative contracting methods” and “implementing innovative contracting techniques, like design-build.” The term “innovative” was used to refer to procurement methods that CTDOT did not employ at the time the report was written. The Federal Highway Administration (FHWA) initiated a program named *Every Day Counts* (EDC) in 2010, which encouraged states to adopt ACMs as one vehicle for accelerating highway project delivery (Mendez 2010). It is noted that the Brooklyn Bridge was delivered via design-build (D-B) project delivery in 1883 (Giroux 2009). Therefore, it is noted that while D-B project delivery may be a new contracting methodology that has been authorized for use by CTDOT, it is not a new method or idea in the US construction industry. Hence, the remainder of this report will refer to the implementation of procurement approaches that have not been used by a given agency using the FHWA term of ACMs.



The benchmarking report contained another salient point that is important to this study. The quotation is given below:

*All of the states surveyed are currently looking for ways to utilize their limited funding resources more efficiently. Most states are approaching this challenge by looking for new revenue sources, as well as implementing innovative contracting techniques to promote the efficient use of existing funds. (Lownes et al. 2012)*

The issue of stretching available funding has been around for decades (Lopez del Puerto et al. 2016). The traditional approach is to search for cost savings throughout the project's procurement life cycle. While that is certainly intuitively logical, research done for the Strategic Highway Research Program 2 (SHRP2) proposed that agencies delivering complex projects should focus on cost and schedule certainty rather than savings (Shane et al. 2011) because traditional and alternative project delivery methods tend to be either overly conservative or overly optimistic during the programming phase, resulting in cost and time underruns and overruns. The upshot is that rewards are given to those that tie up funding unnecessarily by over estimating and those that attempt to stretch the funding by optimistic estimates are punished when the projects finish late and over budget (Flyvbjerg et al. 2002). The FHWA Administrator made the following statement when he initiated the EDC program.

*EDC is designed to identify and deploy innovation aimed at shortening project delivery, enhancing the safety of our roadways, and protecting the environment. These goals are worth pursuing for their own sake. But in challenging times, it's imperative we pursue better, faster, and smarter ways of doing business. (Mendez 2010)*

ACMs are official EDC initiatives and constitute a smarter way of doing business by bringing the collective experience and creativity of all project stakeholders to bear on a given project at the earliest possible opportunity. It is interesting to note that Mendez substituted the word "smarter" for the word "cheaper" in the better-faster-cheaper cliché. This liberates DOTs from having to deliver the lowest cost solution and refocuses the project delivery decision from "minimize cost" to "maximize cost certainty" via thoughtful solutions to typical design and construction problems. Lopez del Puerto et al. (2016) articulated this issue in the following manner.

*Ultimately, the agency's first goal in controlling overall costs during project development and delivery is avoid reaching a point where it has to return to the funding source and ask for more money. That objective is literally achieved by increasing cost certainty from concept to ribbon-cutting. Therefore, the results of the [study's] analysis provide a clear argument for reviewing agency policy and changing the emphasis from striving to complete the project as cheaply as possible to investing in preconstruction activities that reduce risk and result in increased cost certainty. (Lopez del Puerto et al. 2016)*

This approach was validated by the SHRP2 R-10 project entitled Project Management Strategies for Complex Projects (Shane et al. 2011). The R-10 study expanded the traditional Cost-Schedule-Technical project management system by adding the two new dimensions of Finance and Context. The SHRP2 R-10 project's 5-Dimensional Project Management (5DPM) model provides a decent framework to organize the analysis of the literature for this study.

## 1.2 PROJECT DELIVERY METHODS

The AGC (2004) defines a PDM as “the comprehensive process of assigning the contractual responsibilities for designing and constructing a project...a delivery method identifies the primary parties taking contractual responsibility for the performance of the work”.

Each PDM is further defined by the structure of the various contracts between the owner, the designer, and the builder and the technical roles and responsibilities that are assigned to each party inside those contracts.

Highway/transportation projects are typically delivered using the Design-Bid-Build (DBB) delivery method where the owner first finalizes the design using either in-house or consultant design assets, which then produces a set of “biddable” construction documents upon which competing construction contractors will bid. The project is advertised by issuing an Invitation for Bids (IFB). Generally, the winner is chosen on a basis of the lowest, “responsive” and in some cases, “responsible” bid.<sup>3</sup> In DBB, there are no contractual obligations established between designer and contractor.

The DBB method has been in use for many years and has worked well for many projects. A study conducted for the California Department of Transportation (Caltrans) found that states using ACMs continued to deliver the bulk of their annual construction budget (>95%) using DBB (Gransberg and Molenaar 2008).

The literature is rife with discussions of the various issues found with the traditional DBB method. For example, the use of DBB gives no opportunity for contractor involvement in the design phase (Schierholz et al. 2012; Gambatese et al. 2002). The overall project schedule is linear, creating longer overall project durations (Venturato and Schroeder 2007). The use of DBB sometimes creates adversarial relationships between the parties involved. Finally, research has shown that DBB projects have a higher average cost growth than projects delivered using ACMs (FHWA 2006).

There are six PDMs used on highway projects, as follows:

1. Design-Bid-Build (DBB)
2. Design-Build (D-B)
3. Construction Manager/General Contractor (CM/GC)
4. Early Contractor Involvement (ECI)
5. Construction Manager-at-Risk (CMAR)
6. Public Private Partnerships (P3)

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<sup>3</sup> A responsive bid meets all the requirements of the advertisement and proposal, meaning all bid-related paperwork or electronic forms are completed and signed. A responsible bidder is physically organized and equipped with the financial means to undertake and complete the contract and is also not suspended or debarred, or whose business ethics have not been otherwise determined to be inadequate (*Project Development Required Approvals: Project Advertisement, Bid Review, and Request for Concurrence in Award*; USDOT, FHWA; August 2012).

Additionally, two contracting methods with applicable variations can be used in conjunction with the above PDMs:

1. Indefinite Delivery/Indefinite Quantity (IDIQ) contracts
2. Alternative Technical Concepts (ATCs)

For purposes of this report, the term ACM will conform to the FHWA definition which includes D-B, CMAR, CM/GC, ECI, P3, IDIQ, and ATCs (FHWA 2016). Therefore, there are 7 ACMs plus the DBB PDM discussed in the following sections.

In one study that compared three of the six delivery methods, the authors found that the impact of using an ACM reduced both cost and time growth during construction (Ibbs et al. 2003). The paper's main conclusion is that CM/GC and D-B projects tended to perform better in most measured criteria than traditional DBB projects. Some other major benefits associated with ACMs include shortening overall project delivery time, contractor input into the design, and early knowledge of costs. The following section will provide the necessary facts and definitions for each of the six PDMs.

### 1.2.1 Design-Bid-Build (DBB)

As previously stated, highway projects are traditionally delivered using the DBB project delivery method. Figure 1.1 shows that the owner is squarely situated between the designer and the builder in this project delivery process. In DBB, the owner "owns" the details of design during construction and, as a result, is financially liable for the cost of any errors or omissions encountered in construction. Public DBB projects are generally awarded on a low-bid basis, through an IFB process. There is no contractual incentive for the builder to minimize the cost growth in this delivery system. In fact, there can be an opposite effect. A builder who submits a low bid and is awarded a project contract may need to look to post-award changes as a means to make a profit on the project after bidding the lowest possible margin.

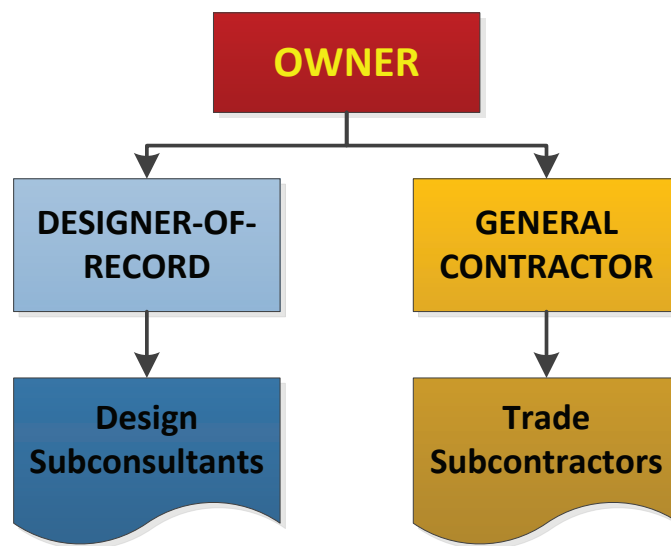


FIGURE 1.1. DESIGN-BID-BUILD (DBB)

It is worthy to note that the outsourcing of construction administration to a consultant, often called CM-as-Agent or Agency CM is merely a variation on the DBB theme and not a PDM in and of itself (Bearup et al. 2007).

### **1.2.2 Design Build (D-B)**

D-B is a project delivery method in which the owner procures both design and construction services in the same contract from a single, legal entity referred to as the design-builder. FHWA approved over 300 D-B transportation projects worth nearly \$14 billion in 32 states under the FHWA Special Experimental Projects program (SEP-14) (FHWA 2006). By 2002, the Florida Department of Transportation (FDOT) alone had awarded 49 D-B projects totaling nearly \$500 million and estimated that D-B reduced the traditional project delivery period by 30% (Peters 2003). To generate such growth in a short period vividly confirms that D-B must accrue tangible benefits to the public agencies that implement it. An early study by Songer and Molenaar (1996) found that the primary reason for selecting D-B project delivery was to accelerate the schedule. A later study for FHWA describes the motivation for implementing D-B when it states:

*The greatest motivation and realized benefit to a contracting agency of using design-build ... is the ability to reduce the overall duration of the project development process by eliminating a second procurement process for the construction contract, reducing the potential for design errors and omissions, and allowing for more concurrent processing of design and construction activities... (FHWA 2006)*

The D-B method typically uses request for qualifications (RFQ)/request for proposals (RFP) procedures rather than the DBB IFB procedures. There are a number of variations on the D-B process, but all involve three major components.

1. The owner develops an RFQ/RFP that describes essential project requirements in performance terms.
2. Proposals are then evaluated.
3. Finally, with the evaluation complete, the owner engages in some process that leads to contract award for both design and construction services.

The D-B entity is liable for all design and construction costs and normally, must provide a firm, fixed price in its proposal. Figure 1.2 shows that from the owner's standpoint, the project's chain of responsibility is considerably simplified. As the owner no longer owns the details of design, its relationship with the design-builder is based on a strong degree of mutual professional trust. Upon award, the design-builder literally controls this project delivery process with owner oversight.

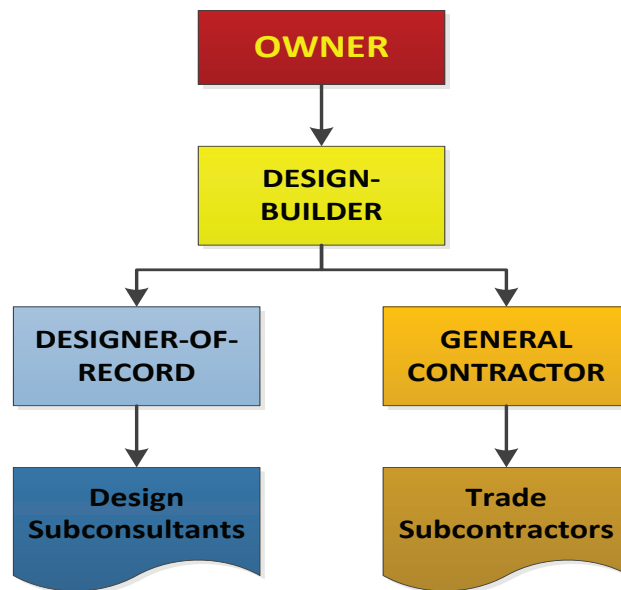


FIGURE 1.2. DESIGN-BUILD (D-B)

The issue of agency control over the details of design creates more problems on D-B projects than any other issue (Gransberg et al. 2008). Koch et al. (2010) describe the issue as a “culture shift.” The emotions associated with the culture shift required to implement it have run high. When D-B first emerged in the 1980s, its detractors consisted primarily of the professional societies associated with the design industry who argued that the use of D-B would inevitably degrade the ultimate quality of the constructed product by compromising the integrity of the design process. This fear was expressed in the National Society of Professional Engineers (NSPE) Position Statement #1726 which said:

*Design decisions may be determined or inappropriately influenced by team members other than the designer. This is more likely to occur when a non-designer is the lead on the design-build team. The leader may pressure designers to reduce self-imposed quality criteria or design standards to minimum levels in order to maximize profit. (NSPE 1995)*

This issue spawned a number of studies aimed at helping agencies determine an appropriate distribution of responsibility for quality management in a D-B transportation project, as well as how to effectively communicate roles and responsibilities for quality management in D-B solicitation documents. Transferring design liability to the design-builder requires the DOT to transfer many of the traditional quality assurance (QA) responsibilities as well (Loulakis et al. 2015). Detractors of D-B founded their opposition to change on the perception that the “fox may be guarding the hen house” so neatly captured in the NSPE statement above. A study by Ernzen and Feeney of the Arizona DOT’s D-B program (appropriately titled “Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?”) addressed this concern directly by comparing project QA test data on a D-B project where the design-builder had been assigned the responsibility for QA with data from a similar project delivered by traditional means. It found the following:

*Analysis of the data shows that despite a highly compressed schedule, the quality of the material on the project exceeded the project specifications and was similar to the quality of work completed for the state under traditional contracting methods with an Arizona DOT-operated quality assurance program.” (Ernzen and Feeny 2002)*

The Arizona DOT study and the growth in D-B across the nation effectively belie the theory that D-B project delivery results in decreased construction quality. It is hard to believe that sophisticated public owners, such as state DOTs, would propagate the spread of a delivery method that consistently resulted in a substandard or poor quality product regardless of its ability to expedite project delivery. Nevertheless, the fear continues to exist and DOTs new to D-B try to mitigate the possibility by creating over-prescriptive design requirements, which according to Loulakis et al. (2015) merely retain owner design liability after literally paying the design-builder to accept it. The FHWA Design-Build Effectiveness Study reports actual results that conclusively debunk the D-B quality myth, as summarized in the following quotation:

*On average, the managers of design-build projects surveyed in the study estimated that design-build project delivery reduced the overall duration of their projects by 14 percent, reduced the total cost of the projects by 3 percent, and maintained the same level of quality as compared to design-bid-build project delivery. (FHWA 2006)*

### **1.2.3 Construction Manager/General Contractor (CM/GC)**

CM/GC projects are defined via a contract between an owner and a construction manager/general contractor (“contractor”), who will ultimately be bound for the cost and schedule for construction of the project. In the CM/GC, the owner authorizes the contractor to contribute ideas during project design. The design effort will be satisfied by either in-house design personnel or outsourced to a design consultant. Generally, the contractor is chosen on a best-value basis through an RFP process, or qualifications-based selection (QBS) through a RFQ process. CM/GC ACM involves two contracts with the contractor. The first is for preconstruction services during design and the second is for the construction itself.

The project pricing structure in CM/GC contracts varies based on the needs of the owner. One common method uses a pricing provision in which the contractor stipulates a target price above which the owner is not liable for payment if the project’s scope does not change after the target price is established. If the owner chooses to incentivize the contract, a guaranteed maximum price (GMP) pricing provision is used and the owner and contractor split the savings if the final project price is less than the GMP. Other agencies merely utilize a standard lump sum or unit price contract pricing provision and rely on the contractor to furnish real-time pricing information during design development to keep the project’s as-designed cost below the owner’s authorized budget.



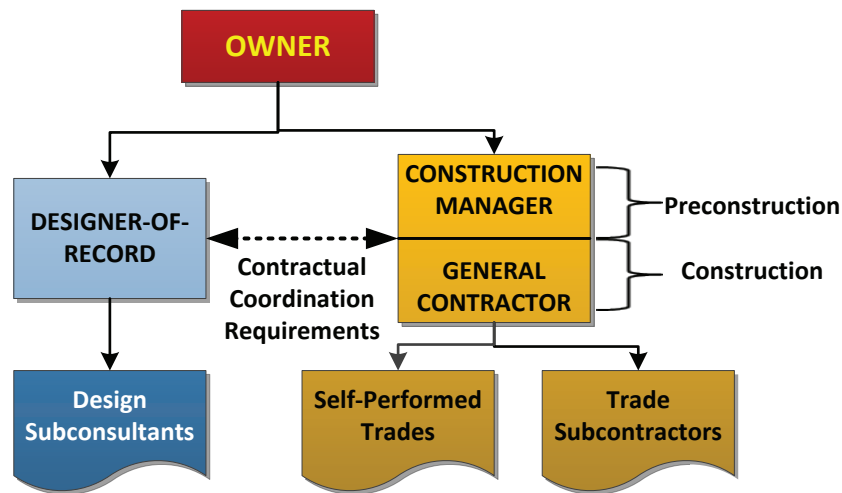


FIGURE 1.3. CONSTRUCTION MANAGER/GENERAL CONTRACTOR (CM/GC)

Figure 1.3 shows the contractual relationships between the three parties. There is a contractual coordination requirement between the contractor and the designer. This link differentiates CM/GC project delivery from DBB project delivery in that the design contract for CM/GC projects must be modified to require the designer to collaborate with the CM/GC contractor during design. One example is including a clause in the designer’s contract that the designer must respond to the CM/GC contractor’s comments on the design documents. If an agency chooses to utilize in-house design assets, it must develop an internal mechanism that holds agency design staff to a high level of responsibility for the design schedule as well as training to ensure that agency design staff understand the relationship they must maintain with the CM/GC contractor to permit the benefits potentially accrued in this project delivery method to actually be achieved.

### 1.2.3.1 EARLY CONTRACTOR INVOLVEMENT (ECI)

ECI projects are a variation of CM/GC project delivery that are characterized by a specific focus on cost control and constructability in preconstruction rather than the broader set of preconstruction services normally available in a state DOT CM/GC project. This approach was pioneered by the US Army Corps of Engineers (USACE) and used extensively and with great success during the Hurricane Katrina reconstruction program (Ruiz 2013). The Rhode Island DOT is currently implementing this ACM for the first time on the Park Avenue Railroad Bridge Replacement project in Providence.

In ECI (see Figure 1.4), the construction contractor is selected very early in the project development process, often at the same time as the design consultant, and provides a Constructability Review and Estimating (CRE) team during the design process to assist the owner and the designer in developing a high quality set of construction documents that have been designed within the target budget. The CRE team will participate in making key design decisions by furnishing priced options to the owner and consultant as well as schedule-related information for each potential option. The designer normally develops and provides the options to the CRE team. However, the CRE team is also empowered to point out additional alternatives that the consultant may have overlooked or of which the designer was unaware.

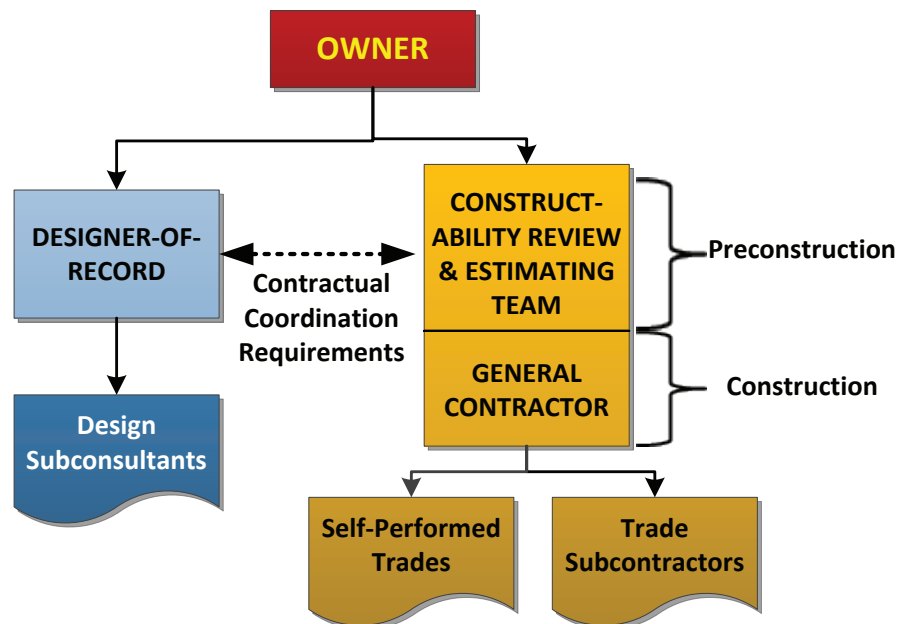


FIGURE 1.4. EARLY CONTRACTOR INVOLVEMENT (ECI)

The CRE team also assists in optimizing the design with the ECI contractor’s intended means and methods to maximize its constructability and minimize the required construction schedule. A common example of the optimization process is the contractor providing the structural designer with the load and reach limits of its mobile cranes, which will define the maximum weight of structural members that may be included in the final design.

USACE defines ECI as an integrated project delivery method that develops a holistic team consisting of the owner, designer, and contractor at the initiation of the project. Unlike CM/GC, which is priced using a negotiated GMP, an ECI contract is priced using the Federal Acquisition Regulation (FAR 16.403-2) process termed “Incentive Price Revision (Successive Targets).” This process is a best-value award process in which contractors’ qualifications and past performance are first evaluated on a Go/No Go basis against a set of evaluation criteria; those that are found to be qualified form a short list. The qualification criteria are generally kept to a minimum and a given contractor either meets or fails to meet a given criterion, eliminating the subjectivity found in qualifications-based award systems. For example, typical qualifications criteria for a bridge project might be as follows:

- The contractor will have successfully completed a minimum of four construction projects for the agency in the past five years.
- The contractor will have successfully completed at least one seismic retrofit of a major bridge (contract value exceeds \$X.X million) in the past five years.
- The contractor will have no unsatisfactory ratings in the USACE performance-based contractor evaluation database (CCAS) in the past three years.

Once the shortlist is formed, the price component is then developed. USACE announces the “Ceiling Price” which is the maximum amount of authorized funding for the project and



provides the technical documentation used by the USACE to reach that estimated cost. Instead of negotiating a GMP as in CM/GC, the competing contractors actually bid an “Initial Target Price” that consists of an “Initial Target Cost” (ITC) and an “Initial Target Profit” (ITP) as shown in Figure 1.6. These are compared to the “Ceiling Price” and the contract is awarded to the contractor that meets all the qualification requirements and has the lowest ITP. It must be understood that the operating term in the bid process is “TARGET” and that indicates that the price is expected to change as the design is fully developed.

An alternative award system for USACE ECI projects involves an interview process rather than the Go/No Go evaluation and is used when the project has a particularly complex design where contractor means and methods will drive the final design solution. In the interview, the contenders provide a formal presentation that includes the corporate qualifications and past projects, the qualifications and experience for key CRE personnel, project-specific issues, and preconstruction services components. During the interview, the contenders are asked to respond to a list of questions specific to the project as well as other standard questions that have been published in advance of the interview to all parties. Finally, the contenders are given a scenario exercise where they have five minutes to read the scenario, fifteen minutes to develop a solution that they present to the interview panel. The winner is identified using the FAR best-value award “Cost-Technical Trade-off” based on evaluation criteria published in the RFP. Price is provided in the same manner as Figure 1.5 and is normally assigned 50% of the weight.

ITEM NO	SUPPLIES/SERVICES	QTY	UNIT	UNIT PRICE	AMOUNT
0001 BASE	Preconstruction Services (Fixed Firm Price)	1	Lump Sum	\$ _____	\$ _____
0002 OPTION	Construction (Fixed Price Incentive)				
	Initial Target Cost (ITC)	1	Lump Sum	\$ _____	\$ _____
	Initial Target Profit (ITP)		%	_____ %	
	% Profit (between a% and b%)				
	(ITP = ITC x _____ %)	1	Lump Sum	\$ _____	\$ _____
					TOTAL (NET)
					\$ _____

*Initial Target Price* →

**Initial Target Price < Ceiling Price**

FIGURE 1.5. TYPICAL USACE ECI BID FORM

After the contract award, the winning contractor is required to submit a proposed general conditions fee. In the RFP, the USACE, as a minimum, includes the following:

- Description of scope of work
- Preliminary plans/specifications
- Construction testing matrix
- Quality management roles and responsibilities

USACE has no established process to identify at what percentage of project development the project delivery method selection decision is made; however, it normally requires the federal Project Development Team to develop a formal acquisition plan. Additionally, the design contract is modified to comply with ECI delivery in a FAR 16.403-2 Incentive Price Revision (Successive Targets) and typically includes:

- Design packages to be reviewed by the contractor's CRE team.
- Design milestones to facilitate preconstruction services packages.
- Requirements to incorporate/respond to CRE team constructability review comments.
- Coordination of design packages with construction contractor's self-performed work packages as well as the construction subcontractor bid packages.

The ECI contractor can declare the bid packages it wants to self-perform and is allowed to select its own subcontractors after prequalifying them; however, it must obtain three subcontractor quotes for all subcontractor work packages over \$100,000. The ECI contractor is also required to secure the government's approval (termed "Consent to Subcontract per FAR 44.2) prior to awarding subcontracts. The winning ECI contractor's "initial target price" is revised as design progresses to reflect both current quantities of work and market conditions. This procedure is consistent with a progressive GMP as defined by NCHRP Synthesis 402. The final lump sum target price is determined by an "incentive price revision" using successive targets as shown in Figure 1.6. The major components are the construction cost, including jobsite overhead, and the CRE team preconstruction services fee and profit, which includes home office overhead. The final project price is established at approximately 90% design. The lump sum can be changed if the scope changes (similar to DBB). The pricing system is fully "open books" where USACE is shown the contractor's actual costs to be able to determine the actual amount of profit that will be allowed under the incentive/disincentive scheme.

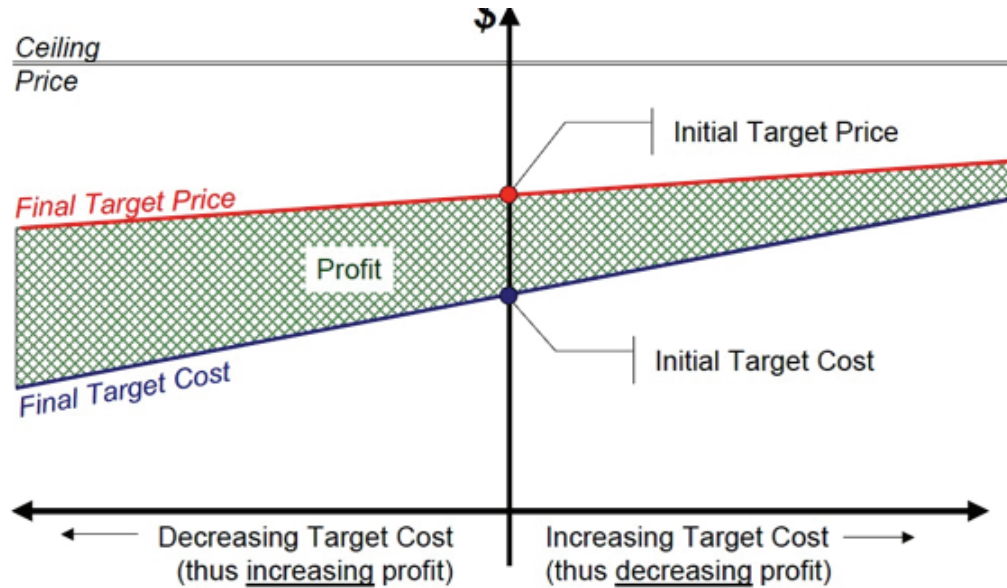


FIGURE 1.6. TYPICAL USACE ECI INCENTIVE/DISINCENTIVE SCHEME

#### 1.2.4 Construction Manager-at-Risk (CMAR)

CMAR is merely a version of CM/GC that permits the construction manager to subcontract out all the actual construction work, whereas in CM/GC the contractor is generally required to perform a minimum percentage with its own forces. CMAR is primarily used in the commercial construction industry. However, a number of states have implemented CM/GC without the need to amend their legislation by adopting the CMAR provisions in the public building sector. The Arizona, Florida, and Maryland DOTs are examples of agencies that are delivering CM/GC projects using their own state legislation that was originally enacted for public building construction.

The objective of CMAR project delivery is to furnish “professional management of all phases of a project’s life to an owner whose organization may not have those capabilities internally” (Strang 2002). CMAR project delivery typically involves two contracts. The first is for preconstruction services during design and the second is the construction contract itself. CMAR contracts usually include a payment provision where the CMAR stipulates a GMP above which the owner is not liable for payment if the project’s scope does not change. CMAR contracts may include incentives where the CMAR and owner split any cost savings realized below the GMP. Some states, like Oklahoma, convert the final negotiated GMP to a firm-fixed price contract, administering the construction as if it were a traditional DBB project thereafter. Most commonly, the owner retains the traditional design responsibility by awarding a separate design contract and furnishing the CMAR with a full set of plans and specifications upon which all construction subcontracts are based as seen in Figure 1.7.

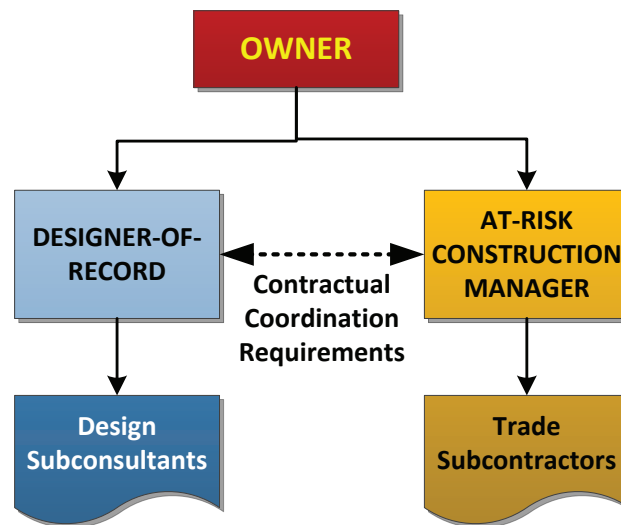


FIGURE 1.7. CONSTRUCTION MANAGER-AT-RISK (CMAR)

According to AGC (2004) the defining characteristics of the CMAR are the following:

- The designer and the CMAR hold separate contracts with the owner (as opposed to D-B)
- The CMAR is chosen based on criteria other than just the lowest construction cost (as opposed to DBB)

The CMAR can and is expected to provide realistic project cost estimates early in the project life cycle. After the design has reached a point where it adequately quantifies the project's scope of work and a final construction cost is established, the owner will enter into a contract with the CMAR to provide the necessary construction services. Many states reserve the right to go out for bid if they think that the CMAR's price is not competitive and are unable to negotiate a mutually determined construction cost (Minchin et al. 2007).

Enhanced constructability, real-time construction pricing capability, and speed of implementation are the major reasons selecting the CMAR method (Bearup et al. 2007). Additionally, some transportation agencies use CMAR to implement new and innovative technologies and to create an environment of rich collaboration in which to deliver complex projects (Alder 2007). Unlike DBB, CMAR brings the builder into the design process at a stage where definitive input can have a positive impact on the project. In CMAR, the construction manager essentially becomes the general contractor at the time the GMP is established.

### 1.2.5 Public Private Partnerships (P3)

According to Yescombe (2007), the term "public-private-partnership" (P3) was first used in the United States to describe the joint public and private sector funding of educational programs. P3 was also a term used to describe joint funding for utilities in the 1950s and enjoyed broader usage during the 1960s on public-private joint ventures to deliver urban renewal projects. Yescombe's definition of the current process is as follows:

*A P3 is thus an alternative to procurement of the facility by the public sector using funding from tax revenues or public borrowing. In a typical public sector procurement (also known as “design bid build”), the public authority sets out the specifications and design of the facility, calls for bids on the basis of this detailed design, and pays for construction of the facility by a private sector contractor. The Public Authority has to fund the full cost of construction, including any cost overruns, and operations and maintenance of the facility are entirely handled by the Public Authority, and the contractor takes no responsibility for long-term performance of the facility after the construction-warranty period has expired...In a P3, the Public authority specifies its requirements in terms of ‘outputs’, which set out the public services which the facility is intended to provide, but which do not specify how these are to be provided. (Yescombe 2007)*

As described above, one can see P3 project delivery diverges from the traditional prescriptive design found in DBB to an approach “where the public authority focuses more on the long-term outputs or performance of a facility and allows the private sector the ability to develop a plan to finance design build operate and maintain the facility to fulfill these desired outputs and performance requirements for an extended period of time” (Barutha 2016). Garvin (2009) stated that “transforming the role of Governments from service providers to overseers of service provision (i.e., ‘steering versus rowing’),” P3s are the contractual mechanism that permit government agencies to transition from ‘rowing to steering’. Also, the P3 method permits public agencies an opportunity to allow the private sector to perform the difficult task of ‘rowing’ allowing the agencies to “focus more on ‘steering’ in the direction needed to ensure services and infrastructure are in place to support local economy and other needs of the public they serve” (Barutha 2016).

The major aspect that distinguishes P3 project delivery from all other ACMs is the addition of private financing to the project. As one would expect, this change also demands a significant culture shift in public procurement processes. In other forms, the public treasury is providing the project funding and with that comes a fiduciary responsibility on the part of the agency to conduct due diligence and ensure that the final project is worth its price. With P3, the question is: where does the public agency’s responsibility end and where does the P3 concessionaire’s responsibilities begin? For projects on the national highway system, the DOT still has a duty to ensure that the final constructed product meets all standards and, in theory at least, should the concessionaire default, the facility’s operation and maintenance can be taken up by the agency without a need to make significant structural modifications to bring it up to standards (Loulakis et al. 2015). On the other hand, if the concessionaire is bound to provide post-construction operations and/or maintenance, then it is reasonable to presume that the need to strictly adhere to DOT standard design details and specifications has been removed. The literature does not authoritatively address this question and therefore it is assumed that it is still open to interpretation. Figure 1.8 shows a typical P3 contract structure upon which the variations discussed in the next section are based.

Figure 1.8 shows that there is a single contract between the public and the private sector concessionaire. Typically, the concessionaire is a developer with financial expertise who outsources the technical design and construction aspects of the P3 project to a D-B firm. In variations of P3 project delivery with post-construction operations and maintenance (O&M), the concessionaire also contracts directly with an operations and maintenance company for

a duration specified by the public authority. In addition to the technical components, there is also a finance component to the concession team, usually comprising equity partners and debt service providers. The equity partners are the long-term investors in the project for the overall contract duration with the public authority. Debt service providers are financial institutions that actually lend the concessionaire the funds to complete design and construction activities and receive incremental payments over the life of the project from the concessionaire. In most cases, the concessionaire is also a financial equity partner.

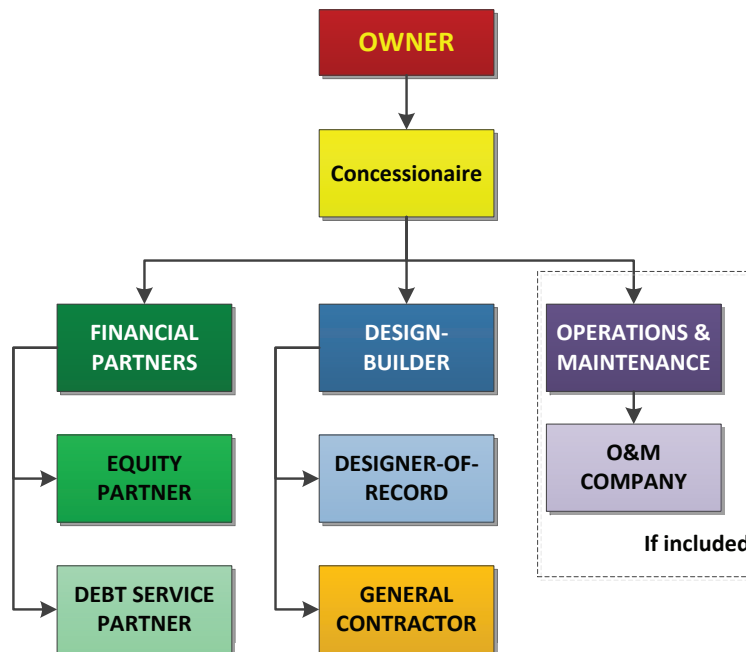


FIGURE 1.8. PUBLIC PRIVATE PARTNERSHIP (P3)

### 1.2.5.1 VARIATIONS OF P3

Like all ACMs, a number of distinct variations to P3 project delivery have evolved. The World Bank (2013) defines P3 agreements as “medium- to long-term arrangements between the public and private sectors whereby some of the service obligation of the public sector are provided by the private sector, with clear agreement on shared objectives for delivery of public infrastructure and/or public services.” Infrastructure Ontario (2014), further defines five different types of P3s shown in Table 1.1. In all five variations the private sector provides the financing for the contracted activities.

- Build and finance
- Design, build, and finance
- Build, finance, and maintain
- Design, build, finance, and maintain
- Design, build, finance, operate, and maintain



TABLE 1.1. VARIATIONS OF P3 PROJECT DELIVERY  
(ADAPTED FROM AUDITOR GENERAL OF ONTARIO 2014)

Design	Build	Finance	Operate	Maintain	Comments
	X	X			Smaller projects like renovations, additions or expansion of existing infrastructure.
X	X	X			Combine efficiencies of D-B with complete or partially deferment of finance.
	X	X		X	Provides long-term financing.
X	X	X		X	Large projects, new green field construction. Provides long-term financing.
X	X	X	X	X	Responsibilities for designing, building, financing and operating bundled and transferred to private sector. Partly or wholly financed by debt leveraging revenue streams.

Most P3 projects that involve maintenance are concluded with a contractually mandated transfer of the property developed during the concession. The agreement will contain what is commonly termed as “hand-back criteria.” These criteria define the physical condition that the facility must meet before it is transferred back to the public entity. It is common for toll roads and bridges to be restored to a given level of serviceability with major deficiencies being corrected and the tolling facilities removed. P3 is rightly being called the “wave of the future” with the condition of the nation’s transportation system getting worse and the ability to fund 100% of the requirements becoming less probable (ASCE 2013).

### 1.2.6 Indefinite Delivery/Indefinite Quantity (IDIQ)

IDIQ contracting is defined in the FAR as a contracting method that “provides for an indefinite quantity, within stated limits, of supplies or services during a fixed period” (FAR 2005). This definition applies specifically to federally funded projects. However, it can be used on a broader scale to identify IDIQ contracting practices in the transportation industry at the state level with one slight difference. The decision on whether or not to establish “stated limits” on the quantities of work to be ordered under a given IDIQ contract is optional at the state level, and depends on either constraints found in state regulations or on a given agency’s preferences. Hence, this report defines IDIQ contracts as those “contracting approaches that involve the procurement of an indefinite quantity of supplies and/or services on an as-needed basis using individual orders over a fixed period of time. An order may be termed as a work order, task order, delivery order, or job order” (Gransberg et al. 2015). IDIQ contracts are typically used to procure a series of “smaller” projects that are of a repetitive nature where the owner expects to benefit from cost and time savings because of the total number of units installed in a single work order is multiplied over many work orders.

The literature is rich with research on the federal IDIQ system, but despite the great variety of DOT IDIQ contracting approaches, very little formal research literature is available on state-



level IDIQs. Only one state DOT, Minnesota (MnDOT), had addressed IDIQ implementation via formal research (MnDOT 2014). The MnDOT study developed an IDIQ implementation guide for that state. The other resource is NCHRP Synthesis 473: Indefinite Delivery/Indefinite Quantity Contracting Practices (2015). Thus, the remainder of this section is based almost entirely on that synthesis and the MnDOT guide.

A PDM is a system used by owners to organize and coordinate planning, design, and construction activities. DBB, D-B, CM/GC, CMAR, and P3 are all commonly used delivery methods in highway construction projects (Gransberg and Shane 2010). On the other hand, contracting approaches are tools such as A+B (Cost+Time) bidding, lane rental, and guaranteed maximum price (GMP) that are used to support procurement procedures stated by the selected PDM (Walewski et al. 2001). In other words, delivery methods are intended to coordinate pre-construction, construction, and even post-construction (as required) activities, while contracting approaches are aimed at addressing more specific aspects or cycles within project life cycle.

Based on the definitions presented in the above paragraph, IDIQ contracting is often classified as a contracting approach (Walewski et al. 2001) since it is commonly restricted to design, construction, or maintenance activities in DBB contracts. However, Synthesis 473 survey information showed that at least five state DOTs are using Design-Build IDIQ (D-B-IDIQ) contracts, where the IDIQ contractor furnishes both design and construction services for each work/task order. Hence, D-B-IDIQ is merely an available contracting approach for D-B project delivery. D-B-IDIQ contracts deliver a group of similar types of D-B projects within a single IDIQ contract. Likewise, the synthesis survey data found that some agencies have also combined IDIQ contracting with CM/GC and CMAR project delivery (CM/GC-IDIQ or CMAR-IDIQ), where the agency has a contract with a CM/GC or CMAR contractor to provide input during the design phase and perform as the general construction contractor for each work/task order (West et al. 2012).

The fact that IDIQ transcends the PDMs of interest in this report makes it a candidate for improving project deliverability and as such, is worthy of inclusion in this study. It is noted that there is a plethora of terminology that has evolved in relation to this method as shown in Figure 1.9. Table 1.2 defines the prime differences and provides definitions for the remainder of this section.



FIGURE 1.9. IDIQ TERMINOLOGY. (GRANSBERG ET AL. 2015)


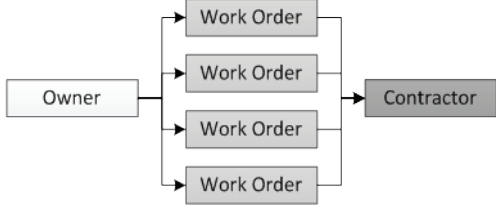
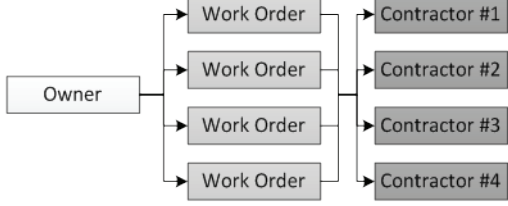
TABLE 1.2. IDIQ TERMINOLOGY – DEFINITIONS (GRANSBERG ET AL. 2015)

Term	Definition
<b>Delivery Order Contract</b>	Contract for supplies for which performance and delivery scheduling is determined by placing delivery orders with the contractor or contractors during a fixed period of time (FAR 2005)
<b>Task Order Contract</b>	Contract for services for which performance and delivery scheduling is determined by placing task orders with the contractor or contractors during a fixed period of time (FAR 2005)
<b>Job Order Contract</b>	Contracts for construction services (Farris 2002) for which performance and delivery scheduling is determined by placing work orders (task, delivery and/or job orders) with the contractor or contractors during a fixed period of time
<b>On-Call Contract</b>	Contract that involves a group of undetermined or predetermined small projects usually related to professional/engineering services, which are requested by issuing task orders (UDOT 2010). Some state DOTs also use this term to refer to construction and maintenance/repair contracts (Maine DOT 2011; TDOT 2010)
<b>Push-Button Contract</b>	Contract with a predetermined scope of work to be performed by the contractor pursuant to the agency’s issuance of work orders, which specify location, project description and amount of work required (FDOT 2012)
<b>Single Work Order IDIQ</b>	“A single contract is awarded to single contractor. Once the need to issue the work arises, the contractor then performs the desired services or furnishes the requisite supplies [a single work order issued during the contract period]” (Rueda and Gransberg 2013a).
<b>Single Award IDIQ</b>	“A single contract is advertised and awarded to a single contractor who then is awarded work orders based on the pricing furnished in the initial bid package” (Rueda and Gransberg 2013a).
<b>Multiple Award IDIQ</b>	“A single contract is advertised and a pool of qualified contractors is selected. Only those selected are subsequently allowed to bid on work orders. In most cases the work orders are awarded to the lowest bidder among the contractors in the pool” (Rueda and Gransberg 2013a).

A research study conducted by MnDOT (Rueda, et al. 2014) identified three different IDIQ contracting models (Table 1.3) based on the number of contractors selected to participate in the contract and the expected number of work orders to be issued (Rueda, et al. 2013). Table 1.3 also summarizes the structure of each IDIQ contracting model and provides the project characteristics that should be present to successfully implement each model. The FAR establishes a clear preference for multiple award IDIQ contracts, urging federal agencies to use this contract type to the maximum extent possible (FAR 2005). The preference for a competitive, multiple-award approach arises from the perception that single-award IDIQ contracts limit competition over the life of the IDIQ and a feeling that agencies will accrue cost savings from a competitive environment (GAO 1979; OFPP 1997). However, state DOTs appear to prefer the single-award approach, which “seems to better fit their procurement methods and limited resources, and even with less apparent benefits, DOTs have perceived an opportunity to improve their contracting practices” (Rueda 2013) by executing single-award IDIQ contracts (Gransberg et al. 2015). Four DOTs use multiple-award IDIQs, but these are used more for creating a larger pool of available “on-call” contractors than to increase price competition. In

three states, California, Delaware, and Maine, the competing contractors establish their unit prices for a standard set of pay items that will be applicable to all subsequent work/task orders. The scope of each work/task order is developed and each contractor’s bid price is calculated from the original award document. The contractor with the lowest price is awarded the work order. If the contractor is not able to perform the work by the specified work order completion date, the work order is assigned to the contractor with the next lowest price. Vermont was the fourth state and uses IDIQ for bridge and pavement preventive maintenance. They essentially advertise a request for letters of interest from the contractors that make up the IDIQ pool and negotiate the cost and period of performance, awarding the contract to the best value.

TABLE 1.3. IDIQ CONTRACTING MODELS STRUCTURE AND TYPICAL USE  
(ADAPTED FROM RUEDA, ET AL. 2014)

IDIQ Model	Diagram	Typical Contract Characteristics
<p><b>Single Work Order Contract</b></p>		<ul style="list-style-type: none"> <li>• When the agency foresees a future necessity which most likely will be fulfilled with one work order, but cannot fairly determine the total quantity of resources that will be ultimately required and/or the final delivery schedule.</li> <li>• Often used for emergency stand-by services, like hurricane debris removal.</li> </ul>
<p><b>Single Award Contract</b></p>		<ul style="list-style-type: none"> <li>• For repetitive tasks or services contained in a <b>narrow scope of work</b>, allowing a certain degree of uniformity among work orders;</li> <li>• When <b>only one contractor</b> has the capabilities to perform all work orders to be issued under the IDIQ contract; <b>or</b></li> <li>• When the agency considers that the ultimate number of work orders to be issued under the IDIQ contract <b>will not justify</b> award multiple contractors.</li> </ul>
<p><b>Multiple Award Contract</b></p>		<ul style="list-style-type: none"> <li>• For repetitive tasks or services contained in a <b>broad scope of work</b>, making it hard to determine a typical composition of work orders;</li> <li>• When <b>more than one contractor</b> has the capabilities to perform all work orders to be issued under the IDIQ contract; <b>and</b></li> <li>• When the agency considers that the number of work orders to be issued under the IDIQ contract will justify award multiple contractors.</li> </ul>

1.2.6.1 PROJECT DELIVERY METHODS IN IDIQ CONTRACTING

Figure 1.10 graphically illustrates that the use of IDIQ techniques with DBB, D-B, CM/GC or CMAR, does not change the conventional contractual structure of these delivery methods. Hence in DBB-IDIQ, the owner still furnishes a complete design before the contractor starts construction. In D-B-IDIQ a single entity is chosen to provide design and construction services for each work order, and in CM/GC-IDIQ and CMAR-IDIQ, a contractor is engaged to provide preconstruction services as well as perform as the general contractor during the construction phase. The selection of any of these contracting methods does not have a major impact on

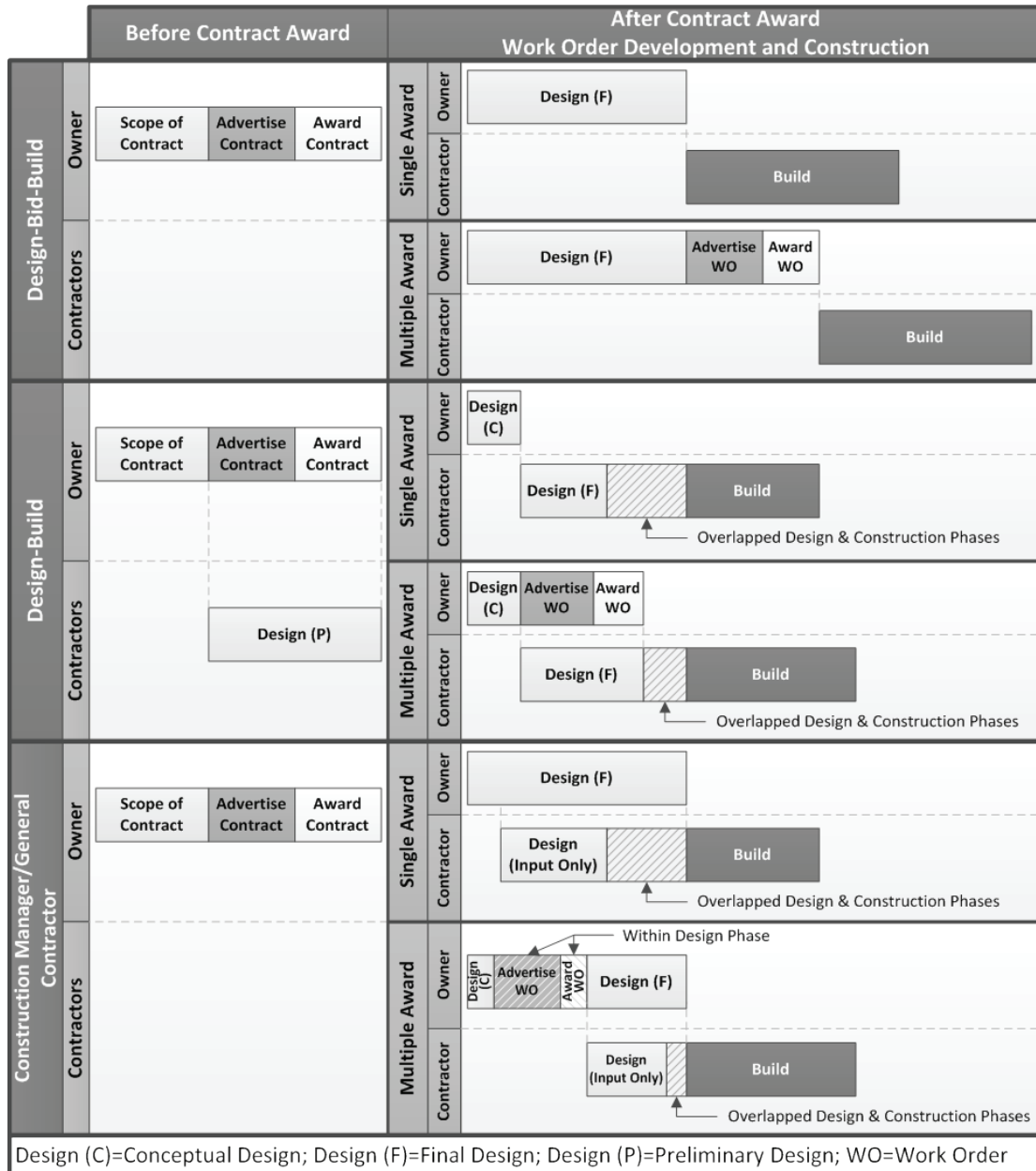


FIGURE 1.10. IDIQ PROJECT LIFE CYCLE FOR EACH DELIVERY METHOD  
 (ADAPTED FROM RUEDA ET AL. 2014)

the preconstruction activities performed before proceeding with construction. Therefore, the alternatives shown in Figure 1.10 may be properly understood as merely a group of individual DBB, D-B, or CM/GC and CMAR projects procured under a single IDIQ contract.

Regardless of the delivery method used and the number of awardees involved in an IDIQ contract, planning and design activities must be performed in two phases as shown in Figure 1.10. The owner must necessarily complete some initial design to develop the contract documents needed to advertise the IDIQ contract without knowing the specific details of each work order to be issued. The level of initial design completeness is given by the required content of bid packages to be submitted by interested contractors. NCHRP Synthesis 473 found that IDIQ contracts with straightforward scopes and uniform work orders (high similarity between work orders) tend to result in more initial design detail in the solicitation documents.

### 1.2.7 *Alternative Technical Concepts (ATCs)*

The FHWA defines an ATC as “a request by a proposer to modify a contract requirement, specifically for that proposer’s use in gaining competitive benefit during the bidding or proposal process... [and] must provide a solution that is equal to or better than the owner’s base design requirements in the invitation for bid (IFB for DBB) or request for proposal (RFP for D-B) document.” (FHWA 2012). ATCs were a prominent part of the first EDC program and the subject of NCHRP Synthesis 455 (Gransberg et al. 2014). Essentially, ATCs permit competing contractors on DBB, D-B, CM/GC and/or CMAR projects to alter the baseline design in a manner that both improves its final product and gives the contractors a competitive edge for their creative ideas. One author described ATCs as value engineering the project’s design during the procurement process with the owner getting 100% of the savings in the contract’s award price (Coblentz 2012).

ATCs have been associated with D-B projects virtually since the inception of D-B contracting and are specifically covered in the FHWA D-B rules (FHWA 2012). The application of ATCs in CMAR and CM/GC is less formal than in D-B and occurs in the pre-award selection of the contractor as part of the best value decision. The true innovation associated with ATCs occurred when the Missouri DOT applied ATCs to traditional low-bid highway projects. Missouri was followed by the Michigan DOT that restricted the ATC process to only contractor-proposed traffic control plans. The result was a savings of one full year of disruption on a freeway project that was scheduled to last two construction seasons (Gad et al. 2015).

ATCs furnish a mechanism to consider contractor design input prior to the award of a DBB, CM/GC, or D-B contract. “In the case of ATCs, the state [Missouri DOT] allows a contractor to submit ideas for innovative concepts on projects out for bid” (McMinimee, et al. 2009), and in doing so, the contractor is given the opportunity to enhance its competitiveness by being able to bid on its approved ATCs. Just as there are a number of different project delivery methods, there are a number of different methods by which ATCs can be included in each PDM.

Figure 1.11 is adapted from an unpublished presentation made as part of the FHWA *Every Day Counts* program (FHWA 2012), and the ATC submittal period has been added to show the differences in each PDM. The major difference in the figure is how early the agency gets ATC input when using CM/GC or CMAR project delivery. This is because the competing contractors can be evaluated on their potential for adding innovative alternatives to a given project without

the need for the agency to review and approve each ATC prior to making the selection of the winning contractor. In DBB, the baseline design is complete and must be altered to achieve benefits from an ATC. In D-B, the baseline design has been established through the preliminary design that is used to define the D-B project’s scope of work in the RFP. In this case, deviations from the baseline design and its associated criteria must be reviewed and approved before the D-B contract can be awarded.

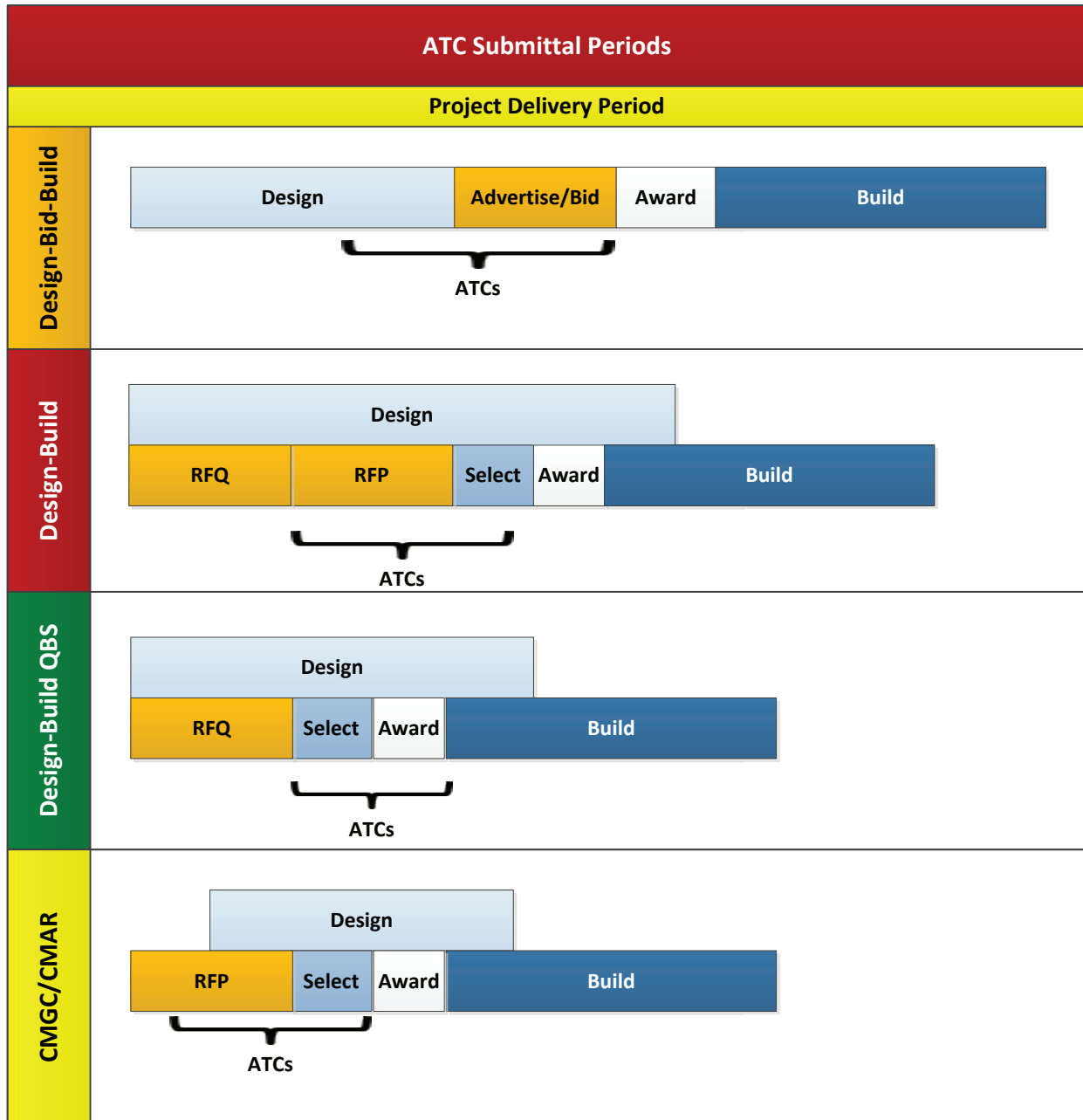


FIGURE 1.11. ATC SUBMITTAL PERIOD IN EACH PROJECT DELIVERY METHOD  
 (ADAPTED FROM FHWA 2012)



NCHRP Synthesis 455 reached a number of conclusions and effective practices regarding the application of ATCs. The conclusions are summarized, as follows:

1. "ATC usage has been successfully implemented in nearly all types of project delivery methods and is most commonly found in D-B projects.
2. ATC use is not constrained by an agency's project delivery selection decision, and agencies can implement ATCs without being constrained by technical or procurement issues on virtually all types of transportation projects.
3. ATCs create an opportunity to consider technical solutions that a DOT's engineers and consultants may not have contemplated." (Gransberg et al. 2014)

The following were found to be effective practices when implementing ATCs on all types of ACMs.

1. "The use of confidential one-on-one meetings to furnish an initial response to a potential ATC and permit competitors to decide whether to invest the time and effort in fully developing the ATC per the RFP.
2. Including some form of ATC submittal process was found to be an effective practice for D-B projects to furnish an opportunity to identify errors, omission, ambiguities and to provide clarifications that might not be raised when all RFIs are published.
3. Publishing a detailed ATC evaluation system in the project's solicitation permits competing contractors to better understand the ATC process.
4. ATCs can be used in conjunction with incentives for both early completion and quality products.
5. Because ATCs often revise the design to be more compatible with a given contractor's means, methods, and equipment, schedule and performance risk appear to be reduced." (Gransberg et al. 2014)

### **1.3 SYNTHESIS OF THE PROJECT DELIVERABILITY LITERATURE**

As previously mentioned, the SHRP2 R-10 5DPM model will be used to provide a logical framework upon which to synthesize the literature reviewed for this report. 5DPM maintains that the following dimensions must be managed to control complexity in transportation project delivery.

1. "Technical – All the typical engineering requirements including scope of design and construction, quality, need for integrated delivery, etc.
2. Schedule – The calendar-driven aspects of the project.
3. Cost – Quantifying the scope of work in monetary terms.
4. Context – External influences impacting project development and progress.
5. Financing – Not cost but the sources of the project's funding." (Gransberg et al. 2013)



Table 1.4 (see page 28) provides a synthesis of the impacts of each ACM in the five dimensions of complex project management. It also offers the literature's view of the impact each ACM has on cost and time certainty, the definition used in this report for "project deliverability." The conclusion shown in Table 1.4 is that all ACMs have a potential to enhance project deliverability. Obviously, the table simplifies the total picture. However, it does lead to one very important conclusion. In all cases, the methods create an opportunity to increase the level of integration and collaboration between the owner, the designer, and the construction contractor by giving the contractor a voice before the project's design is completed and it must be bound by a contract amount.

Thus, the literature review furnishes validation for the CASE capital program benchmarking study previously discussed (Lownes et al. 2012). To be effective, the Connecticut version of each ACM must be implemented with the following three objectives:

1. Increase the integration of the project team
2. Focus on maximizing cost and schedule certainty
3. Leverage the first two objectives to accomplish more with available capital

TABLE 1.4. SYNTHESIS OF THE IMPACT OF ALTERNATIVE CONTRACTING METHODS ON PROJECT DELIVERABILITY

ACM	Technical	Schedule	Cost	Context	Financing	Project Deliverability (Compared to DBB)	
						Cost Certainty	Schedule Certainty
<b>CMAR</b>	<ul style="list-style-type: none"> <li>- Alternate designs</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Overlap design &amp; construction</li> <li>- Early material work packages</li> </ul>	<ul style="list-style-type: none"> <li>- Real-time pricing</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Contractor coordination of utilities/ permits</li> <li>- Context sensitive means &amp; methods</li> </ul>	<ul style="list-style-type: none"> <li>- Cash flow planning during design</li> <li>- Phased financing possible</li> </ul>	Increased	Increased
<b>CM/GC</b>	<ul style="list-style-type: none"> <li>- Alternate designs</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Overlap design &amp; construction</li> <li>- Early material work packages</li> </ul>	<ul style="list-style-type: none"> <li>- Real-time pricing</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Contractor coordination of utilities/ permits</li> <li>- Context sensitive means &amp; methods</li> </ul>	<ul style="list-style-type: none"> <li>- Cash flow planning during design</li> <li>- Phased financing possible</li> </ul>	Increased	Increased
<b>D-B</b>	<ul style="list-style-type: none"> <li>- Alternate designs</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Overlap design &amp; construction</li> <li>- Early material work packages</li> </ul>	<ul style="list-style-type: none"> <li>- Early project pricing</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Contractor coordination of utilities/ permits</li> <li>- Context sensitive means &amp; methods</li> </ul>	<ul style="list-style-type: none"> <li>- Lump sum contract</li> <li>- Design to budget</li> </ul>	Increased	Increased
<b>P3</b>	<ul style="list-style-type: none"> <li>- Alternate designs</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Overlap design &amp; construction</li> <li>- Early material work packages</li> </ul>	<ul style="list-style-type: none"> <li>- Early project pricing</li> <li>- Design for lifecycle costs</li> </ul>	<ul style="list-style-type: none"> <li>- Contractor coordination of utilities/ permits</li> <li>- Context sensitive means &amp; methods</li> </ul>	<ul style="list-style-type: none"> <li>- Privately financed</li> <li>- Professional financial management</li> <li>- Financing of O&amp;M</li> </ul>	Increased	Increased
<b>IDIQ</b>	<ul style="list-style-type: none"> <li>- Repetitive designs</li> <li>- Constructability input possible</li> </ul>	<ul style="list-style-type: none"> <li>- Repetitive construction</li> <li>- Single procurement for multiple projects</li> </ul>	<ul style="list-style-type: none"> <li>- Fixed pricing for multiple projects</li> <li>- Economy of scale due unit pricing multiple projects</li> </ul>	<ul style="list-style-type: none"> <li>- Reduced need for submittals</li> <li>- Contractor coordination of utilities/ permits</li> </ul>	<ul style="list-style-type: none"> <li>- Ability to quickly obligate year-end funding.</li> <li>- Control total finance requirements via task order number</li> </ul>	Increased	Increased
<b>ATC</b>	<ul style="list-style-type: none"> <li>- Alternate designs</li> <li>- Constructability</li> </ul>	<ul style="list-style-type: none"> <li>- Alternate traffic control plans</li> <li>- Design for means &amp; methods</li> </ul>	<ul style="list-style-type: none"> <li>- Pre-award VE</li> <li>- Owner gets 100% of ATC savings in bid</li> </ul>	<ul style="list-style-type: none"> <li>- Alternate means &amp; methods</li> <li>- Emphasis on environmental</li> </ul>	<ul style="list-style-type: none"> <li>- Potential for reduction in need for financing.</li> </ul>	Increased	Increased

## 2.0 SUMMARY OF STATE PRACTICES FROM INTERVIEWS OF SELECTED STATES

Staff from ten state DOTs were interviewed to identify practices on a variety of project delivery issues. Additionally, some of these DOTs provided presentations to the CASE Study Committee. The Effective Practice section of the Literature Review chapter of this report references many of the states that were interviewed. Additionally, these interviews included some areas that were not covered in the Effective Practices section, but were selected based on information identified as of interest for this study.

The states that were interviewed included four New England states (Maine, Massachusetts, New Hampshire, and Vermont), as well as six additional states with well-developed ACM programs (Colorado, Georgia, Minnesota, North Carolina, Virginia, and Washington State). See Appendix A: State DOT Interview Guide/Questions that was used as a template for discussion.

It is noted that the four New England states as well as Colorado, Minnesota and Washington are forced-unionism states; Georgia, North Carolina and Virginia are right-to-work states (National Right to Work Legal Defense Foundation, Inc.).<sup>4</sup> The impact on project deliverability for DOTs that operate in a union environment is generally limited to internal staffing rules and regulations; in some states, the ability of DOTs to engage consultants for certain tasks may be more restrictive in union as compared to right-to-work states, which could impact project delivery in general.

This chapter is organized by interview topics, including general information, organizational structure, PDM selection, contractor engagement and selection, hiring/retention, performance measurement, rights-of-way and utilities.

### 2.1 GENERAL INFORMATION

In general, the capital project programs for the New England states are smaller in total dollars with fewer projects per year compared to the other states that were interviewed. Table 2.1 provides a summary of general information about the states that were interviewed. Except for Maine and New Hampshire, all eight states use ACMs on a regular basis, ranging from approximately three to more than 10 projects per year. All interviewed state DOTs use D-B, with five states indicating experience using CM/GC. Also, public private partnerships (P3) is allowed in four states that were interviewed. It is noted that Connecticut currently does not have legislation authorizing the use of P3.

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<sup>4</sup> MnDOT and WSDOT have unions for engineering and technical staff. CDOT does not appear to have an engineers' union (National Association of State Highway and Transportation Unions). However, CDOT staff are members of Colorado Workers for Innovative and New Solutions (WINS), a union representing Colorado state employees.

STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART A: SUMMARY OF STATE PRACTICES FROM INTERVIEWS OF SELECTED STATES

TABLE 2.1. GENERAL INFORMATION: INTERVIEWS OF SELECTED STATE  
DEPARTMENTS OF TRANSPORTATION

States Interviewed	Annual Capital Program (\$ Millions)	Number of Projects per Year	ACM Projects (as of Spring 2016)	ACMs Allowed
<b>NEW ENGLAND STATES</b>				
Maine (MaineDOT)	~\$250	175 – 200	11 D-B projects & 3 CM/GC projects	D-B, and CM/GC (with special permission from the legislature)
Massachusetts (MassDOT)	~\$1,200	~ 400	~ 20 projects	D-B (minimum \$5 million project value)
New Hampshire (NHDOT)	~ \$400	150 – 200	3 D-B projects	D-B (under \$25 million only, unless by special legislative approval)
Vermont (VTrans)	~\$250	80 – 90	~ 3 projects	D-B, CM/GC
<b>OTHER STATES</b>				
Colorado (CDOT)	\$700 – \$900	~ 200	~10 projects (40% – 50% of \$s)	D-B, CM/GC, P3
Georgia (GDOT)	~\$1,500	~ 500	3 – 5 projects (20% – 30% of \$s)	D-B, P3
Minnesota (MnDOT)	\$1,270	~ 200	4 – 5 projects (10% – 25% of \$s)	D-B, CM/GC
North Carolina (NCDOT)	~ \$1,800	~ 400	~10 projects (30% – 50% of \$s)	D-B, P3
Virginia (VDOT)	\$1,800 – 2,000	450 – 500	8 – 10 projects (~50% of \$s)	D-B, P3
Washington State (WSDOT)	\$2,500 – \$3,000	~ 400	20% – 30% of \$s	D-B, CM/GC (approval process required) P3 (authorized but not used to date)

## 2.2 ORGANIZATIONAL STRUCTURE – ALTERNATIVE CONTRACTING METHODS

It was found that there is no favored organizational structure used by DOTs for implementing and integrating ACMs into their departments. It is recognized that a DOT’s overall organizational structure and existing responsibilities for project development, design and construction may be considered in establishing the organizational structure for delivering projects using ACMs. Several options identified include:

- Centralized project development and execution
- Centralized project development and decentralized execution
- Decentralized project development and execution

Additionally, several departments identify a champion for ACMs. The champion may be the head of a department's ACM office or whoever is primarily responsible for ACM projects. The role of the champion may vary based on the organizational structure that is established.

Other identified effective practices that are used in conjunction with implementing and integrating the use of ACMs include:

- Using consultants for project document development and/or project management, such as assistance with developing procedure manuals for each of the ACMs, and for developing RFQs, RFPs, and contracts for services for specific projects.
- Training to familiarize DOT staff with ACMs. Additionally, a few states have provided training opportunities for the design and construction industry regarding the department's ACM program and practices.

## **2.3 PROJECT DELIVERY METHOD SELECTION**

State DOTs use a variety of approaches for selecting a PDM for projects. Typically, regardless of the complexity of the PDM selection process, most of the state DOTs interviewed use an internal team to make recommendations to the department's executive management (such as Chief Engineer, Bureau Chief, Executive Committee, and/or Commissioner) for PDM selection decisions. Different types of PDM selection tools are used, from checklists to more complex decision matrices.

The goal of the PDM selection process is to select a PDM best suited for a project based on factors determined to be of value for achieving overall project goals. Also, development of an objective formal process provides documentation that supports the justification for the selection of a specific PDM for a project. For several of the state DOTs interviewed, the PDM selection process is under development, with others revising the process based on their experience. Factors evaluated to determine the suitability of ACMs based on a project's description and goals include:

- delivery schedule
- complexity and innovation/ingenuity
- level of design
- price certainty
- risk management/assessment
- constructability and construction quality
- well-defined scope
- owner control, staff experience/availability
- competition and contractor experience

An overview of a PDM selection tool developed by the University of Colorado<sup>5</sup> and used by CDOT, and as customized by other interviewed states (MnDOT, WSDOT) follows. This multi-step process involves use of a series of evaluation forms and selection matrixes that help to objectively determine the optimal PDM for a project. Qualitative scoring, such as “most appropriate”, “appropriate”, “least appropriate”, and “fatal flaw” is used to assess opportunities and obstacles related to a series of factors for use in the analyses conducted in Step 2 and Step 3. The qualitative scores are compared and analyzed side-by-side for PDMs under consideration, and used in the decision making process for selection of the most appropriate PDM for a project.

1. Step 1: Involves identifying project attributes, goals and constraints including the PDMs to consider.
2. Step 2: Evaluation of primary selection factors including delivery schedule, complexity and innovation, level of design, cost, and if these factors indicate a preference for use of a specific PDM, then an initial project risk assessment should be conducted to ensure that risks can be allocated and managed as needed.
3. Step 3: Evaluation of secondary factors for the PDM identified in Step 2. This step is structured as a “pass/fail” analysis of the PDM identified in Step 2. These factors include: DOT staff experience and availability, level of oversight and control (owner control); and competition and contractor experience.
4. Finally, in Step 3, if an optimal PDM is not identified through this evaluation process, then the evaluation of the primary and secondary selection factors should be completed for remaining PDMs under consideration.

Several identified effective practices involved with PDM selection include the following:

- The PDM selection process should be formalized and institutionalized as a standard operating procedure and included in a department’s project development process documents.
- The PDM selection decision should be made as early as possible in the project development process to achieve the greatest benefits from using the selected PDM.
- The PDM selection process should include a formal risk analysis that is updated throughout the project delivery process.
- ACMs should be considered for large and smaller projects so that design firms and contractors of various sizes and capacities can gain experience.

## 2.4 CONTRACTOR SELECTION AND ENGAGEMENT

### 2.4.1 Contractor Selection Methods

In general, state DOTs use two broad types of contractor selection methods in conjunction with ACMs:

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<sup>5</sup> Project Delivery Selection Matrix; Transportation Construction Management, University of Colorado, Boulder; <http://www.colorado.edu/tcm/project-delivery-selection-matrix>

- Single-Phase contractor selection utilizes a Request for Proposal (RFP) process to select a project contractor. The single-phase, low-bid process is used by some states when project complexity and innovation opportunity are limited.
- Two-Phase: Most interviewed state DOTs typically use the two-phase process for contractor selection. This process consists of an initial RFQ including submittal by contractors of a Statement of Qualifications. This 1st phase in the process is used to short-list several contractors determined to be the best qualified for a project who are then invited to submit responses to the project RFP, the 2nd phase in the selection process. Submitted proposals are often evaluated and scored using a best value selection method.

The best value contractor selection process involves establishing a formula for proposal scoring based on technical qualifications/merit and price that may vary based on the ACM used as well as the complexity of a project. For a D-B project the technical evaluation of a proposal is typically based on its technical merit; and for CM/GC and CMAR projects it would be based on technical qualifications. Some state DOTs use set percentages for each, while others vary the percentages based on various factors such as project complexity or the need for innovation. Table 2.2 provides an overview of technical and price proposal scoring used by several states for D-B projects. The relative importance of technical merit and price based on the percentages set for a contract can have an impact on contractor interest in participating in the proposal process for a project.

TABLE 2.2. BEST VALUE CONTRACTOR SELECTION FOR ACMs: GENERAL SCORING OVERVIEW

	Technical Score Percent	Price Percent
<b>Georgia (GDOT)</b>	~25%	~75%
<b>Maine (MaineDOT)</b>	20% – 30%	70% – 80%
<b>Vermont (VTrans)</b>	30% – 50%	50% – 70%
<b>Virginia (VDOT)</b>	30%	70%

Typically, DOT staff serve on selection panels to evaluate proposals and select a project contractor. In some states, general engineering consultants with expertise in the use of ACMs provide technical assistance, but are not involved in proposal scoring.

### 2.4.2 Stipends

Development of a D-B technical and price proposal by a short-listed proposer in the 2nd phase of a two-phase contractor selection process typically involves significant work effort. Also, for D-B projects, many state DOTs may provide short-listed proposers an opportunity to include ATCs in their technical proposal to promote innovation and



flexibility. To encourage participation in the proposal process, stipends are typically offered to responsive but unsuccessful proposers, and as noted by GDOT, to all responsive proposers, especially where there is substantial opportunity for innovation and proposal development costs are significant. Terms and conditions for the awarding of stipends are typically included in project RFQs/RFPs, such as acceptance of a stipend by an unsuccessful proposer enabling the DOT at their sole discretion to use the proposer’s ATCs. The amount of a stipend may vary from project to project based on several factors including project complexity and the amount of information that a DOT requires to be included in a technical proposal. Table 2.3 provides an overview of stipends paid by interviewed states.

TABLE 2.3. DESIGN-BUILD BUDGETARY CONSIDERATIONS: STIPENDS

States Interviewed	Stipends Offered?	Sampling of Stipend Percentages Paid
<b>NEW ENGLAND STATES</b>		
<b>Maine (MaineDOT)</b>	Yes	0.12% – 0.47% of estimated construction cost
<b>Massachusetts (MassDOT)</b>	Yes	0.1% – 0.5% by type of project and estimated contract value, as well as ATCs and other deliverables requested
<b>New Hampshire (NHDOT)</b>	No	N/A
<b>Vermont (VTrans)</b>	Yes	0.17% of estimated construction cost
<b>OTHER STATES</b>		
<b>Colorado (CDOT)</b>	Yes	0.1% – 0.2% of estimated contract value
<b>Minnesota (MnDOT)</b>	Yes	0.2% – 0.4% of estimated contract value. Stipend guidelines set by legislation
<b>Washington State (WSDOT)</b>	Yes	0.2% – 0.4% of estimated contract value; the general philosophy has been to provide stipends that cover around 33% of the cost of developing the proposal; stipends are paid to all responsive proposers
<b>Georgia (GDOT)</b>	Yes	0.2% – 0.4% of estimated contract value
<b>North Carolina (NCDOT)</b>	Yes	Range of ~ 25% – 33% of estimated proposal preparation cost as determined by an Executive Committee. Stipends are limited to no greater than \$200,000
<b>Virginia (VDOT)</b>	Yes	Average of ~0.12% of total project cost for past 70 projects

### 2.4.3 Contractor Engagement

Some state DOTs reported various initiatives that they have used to involve the contractor community in their ACM programs. These include the following:

- Having contractors serve in an advisory capacity for development of a department’s ACM program and/or to provide recommendations related to innovative contracting (ACM) topics.
- Conducting meetings, workshops, webinars, and training to inform contractors about a department’s ACM program and projects, and to provide contractors with an opportunity to engage in discussion on contracting issues.
- Providing advance notice of projects to increase awareness and interest of potential proposers, and to increase the number of proposals submitted for projects.
- Selecting D-B for some smaller (lower cost) projects to attract a wider range of design-builders to provide smaller contractors with an opportunity to gain D-B experience.

## 2.5 HIRING AND RETENTION

In general, interviewed state DOTs indicated that a Bachelor’s degree is required for engineering positions, and a professional engineer (PE) license is necessary for promotion into senior staffing levels. The hiring and/or retention challenges noted are primarily due to higher salaries offered by private sector firms, as discussed in the “Engineering Pipeline and CTDOT Staffing” chapter of this report. Many DOTs indicated that their departments are able to provide attractive retirement, health benefits, and/or a family friendly working environment, which to some extent can offset the noted salary differential.

A strategy used by many DOTs to address hiring and retention challenges is to offer engineers “cross-training” to broaden their experience that can then lead to both engineering and project management career path opportunities.

The three right-to-work states that were interviewed – Georgia, North Carolina and Virginia – reported that they do not have gaps in staff experience. NCDOT competes with private sector firms by using retention offers and VDOT provides competitive salaries at all staff levels and often hires senior level staff from outside of the department.

The most common solution to staffing challenges for the unionized states that were interviewed is to hire consultants as needed. This practice is particularly helpful to CDOT where state legislation requires the department to maintain a 10% staffing vacancy.

Interviewed states reported that consultants are used for a variety of tasks for workload peaks and to fill in gaps due to staff attrition and retirements. Most DOTs are authorized to hire consultants without major restrictions. However, collective bargaining agreements limit some DOTs from using consultants for certain tasks. For example, MassDOT is not able to use consultants for field inspection (except for bridge painting and inspection). It is noted that NCDOT has a mandatory outsourcing requirement. If the required amount of outsourcing is not achieved, the department is required to terminate staff. Additionally, NCDOT’s required outsourcing has increased over the last four years, with almost 100% of highway design currently outsourced.

## 2.6 UTILITIES AND RIGHTS-OF-WAY (ROW)

All interviewed DOTs have separate offices that manage processes related to utilities and rights-of-way (ROW). Most interviewees indicated that utilities and ROW are significant issues for accelerating project delivery. The most common practice is coordination early in the project planning process to inform decision making and avoid conflicts for utility relocation/requirements and ROW property appraisal and acquisition.

Other practices identified by interviewees regarding utility and ROW challenges are as follows:

### *Utilities*

- Reimburse utilities for a percentage or all relocation costs
- Designate a staff member or a utility working group for utility-related issues and coordination with utility companies
- Delegate utility coordination/relocation to contractors

It is noted that this issue was reviewed and best practices were identified and evaluated in the Transportation Research Board's report, "Integrating the Priorities of Transportation Agencies and Utility Companies."<sup>6</sup> Among the best practices identified were

- advance relocation of utility work (evaluated as most valuable)
- early involvement of utilities in planning and design phase
- training of DOT designers on utility relocation processes
- development of a geographic information system (GIS) database
- preconstruction and progress meetings
- incentives for early relocation
- development of utility and ROW management systems
- inclusion of utility relocation work in DOT construction contracts
- subsurface utility engineering (SUE) to locate existing underground utilities and identify potential conflicts
- utility coordination meeting during design phase
- utility impact matrices
- SUE rating procedures and work site utility coordination supervisors for SUE (evaluated as least valuable)

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<sup>6</sup> Transportation Research Board Report S2-R15-RW, "Integrating the Priorities of Transportation Agencies and Utility Companies; <http://library.ctr.utexas.edu/hostedpdfs/txdot/psr/5475.pdf>

## ROW

- Utilize consultants for ROW acquisition (MassDOT)
- Delegate ROW appraisal and/or acquisition functions for D-B projects to design-builders with DOT oversight. This may involve initial property acquisitions by the DOT and additional acquisitions based on project design to be the responsibility of the design-builder, including the opportunity to design property acquisitions out of the project (GDOT, MaineDOT, MnDOT, VTrans, VDOT).
- Waive appraisal for properties with a value less than \$25,000 as authorized by legislation (VTrans)

## 2.7 PERFORMANCE MEASUREMENT

The interviewed state DOTs measure project success using various performance metrics. Some states periodically publish statewide performance data for the department's use and public access. The most common project delivery measures are schedule and budget. In general, project performance is compared against original contracts and schedules, with no distinction being made for the type of PDM used. Among the ten interviewed state DOTs, only CDOT and GDOT made efforts to compare ACM projects with DBB projects. It is noted that some states, other than those interviewed, have attempted to compare ACM and DBB projects, but this is complex due to the variables associated with different projects. Performance measures used by other interviewed DOTs are as follows:

- MaineDOT, NHDOT and VTrans publish an annual "Tri-State Performance Measures" report that includes project delivery performance measures based on each department's calendar year construction advertisement plan (CAP), such as: (1) percentage of projects advertised on-time, and (2) accuracy of project cost estimates in a department's original CAP and the value of projects added to the program in an ad hoc manner.<sup>7</sup>
- MassDOT publishes an annual on-line performance report, "MassDOT Tracker," that summarizes performance by modal division (e.g., Aeronautics, Highway, Rail and Transit, and Registry of Motor Vehicles).<sup>8</sup> For project deliverability, the measures include: (1) percentage of contracts trending on or under budget, (2) percentage of contracts trending on time, and (3) number of contracts completed in a year.
- WSDOT publishes a quarterly performance and accountability report, "The Gray Notebook," that includes detailed information on individual highway, rail and ferry projects.<sup>9</sup> The highway construction performance dashboard includes the percentage of projects: (1) completed early or on time, (2) completed under or on budget, (3) completed on time and on budget, and (4) advertised early or on time.

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<sup>7</sup> Tri-State Performance Measures: 2013 Annual Report; <http://vtrans.vermont.gov/sites/aot/files/highway/documents/publications/2013%20Tri-State%20Report.pdf>

<sup>8</sup> MassDOT's Annual Performance Report; <https://www.massdot.state.ma.us/InformationCenter/PerformanceManagementAccountability.aspx>

<sup>9</sup> WSDOT Gray Notebook; <http://www.wsdot.wa.gov/Accountability/GrayNotebook/navigateGNB.htm>

STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART A: SUMMARY OF STATE PRACTICES FROM INTERVIEWS OF SELECTED STATES

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- VDOT’s “Dashboard,” a performance reporting system for projects and programs, includes several project delivery measures: (1) on time, (2) on budget, and (3) environmental compliance.<sup>10</sup>
- NCDOT tracks three factors specific to project delivery: (1) project cost, (2) project completion, and (3) construction quality.<sup>11</sup>
- GDOT’s “Performance Management Dashboard” includes two measures for project delivery that identify the percentage of projects constructed: (1) on schedule and (2) on budget.<sup>12</sup> In addition, GDOT also tracks “ROW authorization on schedule” and “CST [construction] authorized on schedule.”

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<sup>10</sup> VDOT, Dashboard, Performance Reporting System for Projects and Programs; <http://dashboard.virginia-dot.org/>

<sup>11</sup> NCDOT Overview of construction performance measures; <https://connect.ncdot.gov/resources/Asset-Management/MSADocuments/Construction.pdf>

<sup>12</sup> GADOT, Performance Measurement Dashboard; <http://www.dot.ga.gov/BS/Performance>

### 3.0 EFFECTIVE PRACTICES — FOUND IN THE LITERATURE

The purpose of this section of the report is to consolidate effective practices found both in the literature and in the field. The section is organized according to the following categories found in the CASE “State DOT Interview Guide/Questions” (Appendix A) that was used to interview selected states, and consists of a series of tables that consolidate the practices.

- Organizational structure – Table 3.1
- Project delivery method selection process – Table 3.2
- Performance metrics – Table 3.3
- Budgetary considerations – Table 3.4
- Contractor engagement – Table 3.5
- Contracting techniques – Table 3.6

The information provided is intended to supplement the information gained through the project interview process conducted in conjunction with the research. The rubric used to identify an effective practice is that the practice has been discussed in the literature and can be found in a published public agency procurement document such as a standard procedure manual, a design manual, a policy letter, or a solicitation document like an RFP. Additionally, survey, case study, and interview information from eight NCHRP Syntheses, ten NCHRP/Airport Cooperative Research Program (ACRP)/Transit Cooperative Research Program (TCRP) projects and two SHRP2 projects on project delivery topics is also included.

Each table contains a summary of effective practices in this category as well as those state DOTs that use the practice. Key document and literature citations are also shown in the tables. The summary tables are not meant to be exhaustive or definitive. The information is as current as the documents from which it was drawn.



TABLE 3.1. ORGANIZATIONAL STRUCTURE

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Appoint a champion for alternative contracting practices	AZ, CA, CO, FL, GA, MA, MD, MN, MT, NC, NY, OR, UT, VA, WA	Blanchard 2007; Christensen and Meeker 2002; AAS-HTO 2001	CDOT 1997; Caltrans 2013; GDOT 2010; MnDOT 2003	Champion can be an individual for a given project or a special office in the DOT
Centralized ACM project development and execution	AK, GA, MD	Coblentz 2012	AKDOT 2005; GDOT 2010; MSHA 2013	There is no clear trend. However, one can infer that there is a need to have ACM expertise in the Central Office to identify and guide the development of projects that are good ACM candidates. This goes together with the champion practice
Centralized ACM project development and decentralized execution	FL, MA, MN, MT, NC, RI, UT, VA, WA	Blanchard 2007; Anderson and Damjanovic 2008; Alder 2007	MnDOT 2003; MDT 2008	
Decentralized ACM project development and execution	AZ, CA, CO ME, MO, NH, NM, TX, VT, WA	Carpenter 2012; Septalka and Goldblatt 2005	Caltrans 2013; CDOT 1997	
Outsource ACM project document development and/or program management	CO, GA, ME, MN, MO, NC, NH, NY, UT, VA, VT, WA	SAIC 2003; Schierholz et al. 2012; Alder 2007	AzDOT 2001; MnDOT 2008; NYSDOT 2007b; NCDOT 2000	Some DOTs like MN, MO, NC, UT and VA use general engineering consultants on IDIQ contracts
Over-the-shoulder reviews of design deliverables	CO, GA, MN, MO, NC, VA, WA	Koch et al. 2010; Loulakis et al. 2015	WSDOT 2004a; VDOT 2007; GDOT 2010	This approach reduces the demand on DOT design staff and expedites the design schedule
Provide formal ACM training for DOT staff	AZ, CA, CO, MN, NM, RI, UT, WA	McMinimee et al. 2009; Keston 2007	USDOT 2001; VDOT 2007; WS-DOT 2004a	Training creates a “neutral environment” where both internal staff and industry members can voice their concerns in a setting where there is no turf to defend and no perceived consequences for speaking out against the proposed changes.
Provide formal ACM training for design and construction industry partners	MN, RI, VT	Horn 2010; Hoffman et al. 2009	UTA 2003; VDOT 2007	



TABLE 3.2. PROJECT DELIVERY METHOD SELECTION PROCESS

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Formalize the ACM decision process and institutionalize it as a standard operating procedure within the agency project development process documents	AZ, CA, CO, FL, GA, MD, MN, UT, VA, VT, WA	Haddad et al. 2012; Hawkins 2009; Gibson 2007	CDOT 2006; Caltrans 2001; FDOT 2006	Normally involves the production of an ACM procedures manual or handbook.
Formal risk analysis and register as part of ACM selection process	CO, WA	Molenaar et al. 2000; Touran et al. 2008	VDOT 2006; WSDOT 2004	Risk register developed at the selection decision point is continuously updated throughout the remainder of the project delivery process.
Make ACM selection decision as early as practical in project development process	CA, CO, GA, MN, UT, VA, WA, WV	Trauner 2007; USACE 2006	VDOT 2006; WVDOH 2011	Many ACM failures point out that the decision to go ACM was made too late to be able to achieve the benefits.
Include ACM for small projects to permit local contractors to gain experience	MN, NC, RI, WA	Shane et al. 2011; Brinkman 2007	FTA 2003; Maine DOT 2011; MDOT 2011; MDT 2011	Self-explanatory
Select CM/GC for projects with large amount of utility issues and make CM/GC contractor responsible for utility coordination	AZ, CA, CO, FL, UT, WA	Lee 2008; Schierholz et al. 2012; Bearup et al. 2007; West et al. 2012; Gransberg & Shane 2010	Caltrans 2013c; AASHTO 2015	CM/GC preconstruction can include an early package to pothole and physically locate utilities so that the final design fully accounts for them.

TABLE 3.3. PERFORMANCE METRICS

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Establish quantitative performance measures	CA, CO, GA, UT, VA	Park 2012; Alder 2007	UDOT 2015	External stakeholders will want to know if a new method lived up to its potential. It is easier to start implementing ACMs with performance metrics and collect the necessary data to populate them than it is to reconstruct the data retroactively.

TABLE 3.4. BUDGETARY CONSIDERATIONS

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Offer stipends to responsive but unsuccessful proposers	AZ, CA, CO, FL, GA, MA, MD, ME, MN, MT, NC, NY, OR, SC, TN, UT, VA, VT, WA	Beard et al. 2001; Bearup et al. 2007; Christensen and Meecker 2002	Caltrans 2013b; VDOT 2006; WSDOT 2004; WVDOH 2011	Stipend amounts vary based on how much effort is required to produce the technical proposal.
Reduce bonding requirements to match annual amount that will be at risk of default to increase competition	MN	Kraft et al. 2014; Gransberg and Riemer 2009	MnDOT 2014	High bonding requirements often exclude local contractors from bidding ACMs.

TABLE 3.5. CONTRACTOR ENGAGEMENT

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Advance release of draft ACM RFP for industry comment	AZ, CO, FL, GA, MO, MT, UT, VA, WA	Blanchard 2007; Hitt 2012; Horn 2010; Koch et al. 2010	MoDOT 2010; MDT 2011; PennDOT 2011	Focus is on asking industry to identify those aspects of the RFP that add cost without adding value.
Early contractor involvement via DBB ATC process	MI, MO	Hitt 2012; Horn 2010; Gad et al. 2014	MDOT 2011; MoDOT 2010	Permits increased constructability by allowing each competitor to bid its preferred means and methods.
Formal industry outreach during development of ACM policy and procedures	CA, GA, MO, MN, MT, RI, VA, VT, WA	Hietpas 2012	MoDOT 2010; VDOT 2006; WSF 2005	Creates a forum to uncover previously unrecognized concerns at a point where they can be addressed before becoming locked in legislation or regulation.

TABLE 3.6. CONTRACTING TECHNIQUES

Effective Practice	States Where Found	Literature Citations	DOT Document Citations	Remarks
Use 2-step (phase) Best-value award procedures	AK, AR, AZ, CA, CO, FL, GA, MA, MD, ME, MN, MT, NC, NY, OR, SC, TN, UT, VA, VT, WA, plus others	Beard et al. 2001; Bearup et al. 2007	AASHTO 2008; ARDOT 2006; Caltrans 2011; FAR 1997	The consensus is that this approach should be the default option. This does not preclude the use of 1-step D-B and 1 or 2-step low bid award.
Use in-house design on CM/GC projects	CA, UT	Alder 2007; Gransberg & Shane 2010	Caltrans 2013b; Caltrans 2013c; UDOT 2011	States with unionized design staff and/or states that traditionally complete a signifi-cant portion of their design in-house find that this practice reduces the need to shift their business culture to implement CM/GC.
Use in-house design on small and/or emergency CM/GC projects	UT, MI	Gransberg & Shane 2010; Gransberg and Loulakis 2012	UDOT 2011; MDOT 2011	Eliminates the competition and liability issues of using either DBB or D-B.
Use in-house design with IDIQ contractor on emergency projects to achieve benefits from CM/GC.	FL, NY	Gransberg and Loulakis 2012; Gransberg 2013	FDOT 2011; NYSDOT 2007	IDIQ provides an on-call capacity to accomplish emergency work.
Confidential one-on-one meetings before submission of bid or proposal	AZ, CA, CO, FL, GA, MN, UT, VA, WA	Papernik and Far-kas 2011; Grans-berg et al. 2014	GDOT 2010; Mn-DOT 2003; FDOT 2011	State open records act may preclude these valuable meetings.

## 4.0 OVERVIEW OF CTDOT'S USE OF ALTERNATIVE CONTRACTING METHODS: PILOT PROJECTS

As previously noted, design-bid-build (DBB) is the traditional project delivery method used by CTDOT and is expected to be used in the future as the principal methodology for the department's projects. Statutory authorization and requirements for CTDOT's use of alternative contracting methods (ACMs) including design-build (D-B) and construction-manager-at-risk (CMAR), including construction manager/general contractor (CM/GC), was adopted in Public Act 12-70, amended in Public Act 15-5, and incorporated into the Connecticut General Statutes (See Appendix B).<sup>13</sup>

In preparation for conducting pilot projects using ACMs, CTDOT selected staff teams to plan, oversee and manage the projects. Their work effort included, with assistance from consultants, preparing policies, processes and management documents for each methodology. This planning effort resulted in CTDOT's selection of pilot projects to explore the benefits and gain lessons learned for each of the authorized ACMs. The pilot projects were selected from a review of projects in the early stages of development. The initial evaluation was based on project scope information and risk factors such as permitting, technical challenges, and stakeholder engagement. The criteria and or weighting of the criteria used for project selection for each of the ACMs were developed. It was intended that environmentally complex projects would not be included for consideration as a pilot D-B project.

A department bridge consultant reviewed a list of deficient bridges to identify several candidate projects from which CTDOT then selected the D-B pilot project. CTDOT senior management reviewed candidates and selected the CMAR project. Initially the CM/GC pilot project was selected utilizing an emergency declaration. Also, subsequent adoption of Public Act 15-5 provided statutory authorization for use of CM/GC by allowing construction manager self-performance. Final approval of the pilot projects was made by the Commissioner.

The selection of the design-builder for the D-B project, the construction manager for the CMAR project, and the construction manager/general contractor ("contractor") for the CM/GC project was conducted by a separate project team for each project using a two-phase selection process. An initial RFQ was issued, with CTDOT shortlisting several proposers for each project who were offered the opportunity to then respond to a RFP. A best value selection process that included a weighted criteria algorithm was used that considered both technical merit and price, with percentages for each based on factors specific to each project.

The following provides an overview of these projects currently in process with some preliminary lessons learned noted.

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<sup>13</sup> Connecticut General Statutes (Title 13a; Chapter 238: Highway Construction and Maintenance; §13a-95b: Designation of projects using construction-manager-at-risk or design-build contracts and §13a-95c: Commissioner's duties re construction-manager-at-risk and design-build contracts. Use of department employees and consultants)



## 4.1 DESIGN-BUILD

The D-B pilot project “involves the replacement of the superstructures (beams and concrete decks) of four bridges on Route 8/25 in Bridgeport approximately two miles north of I-95. Also included in the project is the rehabilitation of a large retaining wall supporting Route 8 and capacity improvements to two intersections on Lindley Street adjacent to Route 8 northbound.”<sup>14</sup> The bridges involved were nearing the end of their useful life.



BRIDGEPORT DESIGN-BUILD PROJECT UNDER CONSTRUCTION (PHOTO COURTESY OF CTDOT)

The project was originally intended to be a DBB project with internal CTDOT project design beginning in July 2012. Subsequently the project was selected as the D-B pilot project with all available design data used to develop a Base Technical Concept (BTC) for the D-B contractor proposal process. Development of the BTC, combined with the fact that the department was in the process of developing an entirely new procurement procedure for D-B contracts while also developing the request for proposals (RFP), contributed to the extended duration of the procurement process for this pilot project.

CTDOT indicated that this project was selected as the D-B pilot project for several reasons:

- The bridges are on the deficient bridges project list

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<sup>14</sup> CTDOT Website: <http://rt8bridgeport.com/about/>; Accessed 3/1/16



- It was a low risk project based on minimal expected environmental impacts, enabling CTDOT to gain experience
- Rights-of-way were not expected to be an issue
- There was potential for innovation
- An accelerated construction technique will be used. Prefabricated modular steel beam units fabricated off-site will be installed rapidly during a short road closure. Associated benefits include reducing impact on travel lanes from two years to two periods of approximately 14 days each.<sup>15</sup>

The following are selected project traits that summarize the suitability of the use of D-B for this project.

Project Traits	Expected Benefits Derived from Use of D-B for this Project
Risk Management	Enhanced based on assignment of risk to most appropriate party
Constructability	Greatly reduced risk to CTDOT
Collaboration	Enhanced through design and construction process
Owner Control	Reduced in return for benefits in other project traits
Innovation	Constructed wider deck units on-site as compared to transporting and using precast units, resulting in reduced work on existing structure and cost savings; raised retaining wall footings to reduce removal of contaminated soil with potential cost savings
Construction Quality	Expected to be similar to DBB project delivery method
Schedule Acceleration Completion	Reduced overall project duration; enabled start of construction tasks during design phase including construction of bridge sections and placement of fill onsite
Competitive Pricing	Used best value proposal selection process formula; project pricing considered in context of technical scoring
Price Certainty	Added some price certainty

The RFQ resulted in the submission of 11 proposals to CTDOT with six proposers selected for interviews. The interview process resulted in three proposers being shortlisted for the RFP process that required submittal of technical and price proposals. CTDOT encouraged design innovations by providing for inclusion of ATCs in proposals submitted by the shortlisted proposers. Shortlisted proposers that submitted responsive proposals were paid a stipend of \$90,000 that included CTDOT's right to use the ATCs submitted by the proposers. Proposals were rated using a best value selection method. Scoring was based on qualifications/technical merit and price using a weighted criteria algorithm – 1/3 technical proposal score (maximum of 100 points) and 2/3 price score (maximum of 200 points). The best value score was the sum of the technical proposal and price scores. The selected proposer was highly ranked for technical score and best (lowest) for price. The selected proposer was provided ATCs from

<sup>15</sup> Ibid.

unsuccessful proposals that CTDOT determined were acceptable for use on the project. One ATC was selected that offered the advantage of mitigating project risk. This involved raising the footings of a retaining wall to reduce removal of contaminated soil with potential cost savings as compared to pre-award.

A higher percentage of project design was completed by CTDOT staff than is typical for D-B projects. This decision was based on a risk assessment and the construction schedule, taking into account who was best suited to assume the risk, as well as a lack of experience of some CTDOT design units with D-B. Additionally, unanticipated environmental issues were identified after selecting the project as the pilot. Based on this development and, as current practice, CTDOT prepared and applied for the required flood management certification and a stormwater discharge permit for the project, including rehabilitation of the retaining wall. A constructability benefit from the use of D-B was the design-builder's design of the retaining wall that involved replacing a Bin-Wall using precast components.

CTDOT identified the following preliminary lessons learned from this project to implement and institutionalize D-B for use on other projects:

- Roles and responsibilities for CTDOT project management staff and a project design-builder are different for a D-B project than for a traditional DBB project. Staff involved in D-B projects should receive training on D-B project management responsibilities to ensure successful project outcomes. For example, there is a need for the design-builder and CTDOT staff to have a clear understanding of their responsibilities for quality assurance including quality control, independent assurance, and acceptance.<sup>16</sup>
- The careful development of the RFP and contract, including project scope of work, objectives, rules for innovation, roles and responsibilities for a D-B project, is critical to ensure that project outcomes meet intended project goals. This is due to the shift in control of project design and construction from the department to the design-builder.
- In general, all of the department's project-related manuals need to be updated and adapted for D-B projects. Additionally, a better performance-based specifications library and qualified products list is needed.

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<sup>16</sup> **Quality assurance (QA).** (1) All those planned and systematic actions necessary to provide confidence that a product or facility will perform satisfactorily in service; or (2) making sure the quality of a product is what it should be (Figure 1, page 11 [of cited reference]). [QA addresses the overall process of obtaining the quality of a service, product, or facility in the most efficient, economical, and satisfactory manner possible. Within this broad context, QA includes the elements of quality control (QC), independent assurance, acceptance, dispute resolution, laboratory accreditation, and personnel certification. The use of the term QA/QC or QC/QA is discouraged and the term QA should be used. QA involves continued evaluation of the activities of planning, design, development of plans and specifications, advertising and awarding of contracts, construction, maintenance, and the interactions of these activities.]

**Quality control (QC).** The system used by a contractor to monitor, assess and adjust their production or placement processes to ensure that the final product will meet the specified level of quality. QC includes sampling, testing, inspection, and corrective action (where required) to maintain continuous control of a production or placement process. [QC may or may not be specified by the agency. Even when it is, the specified QC requirements or activities may not be adequate to ensure the final product will meet the specified level of quality. Thus a contractor may elect to conduct activities in addition to specified QC activities to ensure the specified level of quality. These additional activities are referred to as Process Control (PC) activities. Quality control measurements (sampling, testing, and inspection results) may or may be used with other factors as a basis for acceptance or payment. PC measurements are not used by the agency in acceptance (Figure 1, page 11 [of cited reference]); Glossary of Transportation Construction Quality Assurance Terms, Sixth Edition, Transportation Research Circular, Number E-C173, Transportation Research Board of the National Academies; June 2013

- Environmental issues were identified during preliminary design that were not anticipated during project selection. This resulted in CTDOT completing the design and permitting for this aspect of the project due to the department's working relationship with DEEP. This experience shows that there is a need to consider permitting strategies that allow flexibility for early permitting of areas and allowed impacts followed by final definition of project design by the design-builder to provide opportunities for innovation and to broaden the use of D-B when beneficial.

The project was awarded to the selected proposer in April 2015 with construction starting in May 2015. As of March 2016, project cost was as projected at time of contracting. The project is scheduled for completion in September 2016 as planned.

## 4.2 CONSTRUCTION MANAGER/GENERAL CONTRACTOR

The Walk Bridge Project in Norwalk, a movable swing railroad bridge over the Norwalk River on the New Haven Rail Line constructed in 1896, was selected as the CM/GC pilot project. The site constraints, operational needs, the advantage of including the contractor in developing concepts, and the availability of specialized contractors made this project an ideal candidate for CM/GC. Approximately 175 Metro-North commuter rail, Amtrak, and freight trains utilize the bridge daily, carrying 125,000 commuters. The project scope involves the replacement of the four-track center pivot movable bridge with two independent bridges, with each bridge having independently operated movable spans (for redundancy). This project is very complex with significant site constraints (including adjacent electrical high towers, condominiums, a sewer treatment facility, the Norwalk Maritime Center, as well as commercial and recreational marine activity, and many stakeholders).



DIGITAL MODEL RENDERING OF THE CURRENT WALK BRIDGE, NORWALK (COURTESY OF CTDOT)



STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
 OVERVIEW OF CTDOT'S USE OF ALTERNATIVE CONTRACTING METHODS: PILOT PROJECTS

Project design started in July 2014. CTDOT completed 15% of the project design in preparation for issuance of an RFQ and a two-step proposal process for selection of the contractor.

CTDOT indicated that this project was selected as the CM/GC pilot project for the following reasons:

- Complexity, risk, and opportunity for innovation
- Need for a contractor with expertise and experience in various types of construction, including movable bridges, railroads, catenary systems, in-water deep foundations and high-tower electricity transmission structures/systems. Therefore, the CM/GC project delivery contracting methodology provided an opportunity to consider contractor qualifications as well as price in the selection process, compared to CTDOT's typical DBB contractor selection process that is based solely based on low bid.
- Opportunity for reduction in project timeline for design and construction

The following are selected project traits that summarize the suitability of the use of CM/GC for this project.

Project Traits	Expected Benefits Derived from Use of CM/GC for this Project
Risk Management	Very effective in identifying and addressing risk items
Constructability	Construction input during the design phase to be provided by the construction manager/general contractor
Collaboration	Co-location enhances the opportunity for communication
Owner Control	CTDOT maintains decision making authority
Innovation	Team approach captures design and construction innovation
Construction Quality	QA/QC procedures ensure a high quality project
Schedule Acceleration Completion	Allows for identification and prioritization of schedule critical activities
Competitive Pricing	Independent cost estimator (ICE) provides pricing expertise
Price Certainty	Guaranteed maximum price (GMP) provides price certainty

The CTDOT CM/GC Procurement Guidance Document is available on CTDOT's website.<sup>17</sup> Six proposals were submitted in response to the RFQ. CTDOT shortlisted four proposers who were then offered the opportunity to respond to an RFP. All four submitted proposals and were interviewed by CTDOT. The CM/GC selection scoring process was adapted from the procedures developed for the D-B pilot project. The weighting of technical proposal score and price was derived from an assessment of factors specific to this project at the time the RFP was published. The price component of the evaluation was based on the CM/GC's proposed "Construction Multiplier" – essentially the markup to compensate the contractor for profit and home office overhead, as further described in the RFP Section 1.6 Terminology: Construction

<sup>17</sup> CTDOT, CM/GC Procurement Guidance Document for the Walk Bridge Project, Project No. 0301-0092; [http://www.ct.gov/dot/lib/dot/documents/aec/ConnDOT\\_CMGC\\_Procurement\\_Guidance\\_Document.pdf](http://www.ct.gov/dot/lib/dot/documents/aec/ConnDOT_CMGC_Procurement_Guidance_Document.pdf)

Phase Multiplier and Section 6.10: Price Proposal.<sup>18</sup> The contractor was selected using a best value scoring method that was based on a technical proposal score (75% - maximum of 75 points) and price score (25% - maximum of 25 points). The best value score was the sum of the technical proposal and price scores. The selected proposer was highly ranked for technical score and best (lowest) for price.

The contractor's contract for pre-construction design phase services started in September 2015. The contractor is engaged on a time and materials basis to participate in and provide input during the pre-construction design phase of the project for the purpose of improving constructability, providing pricing feedback on design options, and identifying risks and mitigation strategies based on the contractor's means and methods. Price for the construction phase of the project will be based on successful negotiation of the contractor's cost proposal, with CTDOT's independent cost estimator (ICE) used as a basis for negotiations at each of the design milestones (30%, 60%, and 90%). If CTDOT and the contractor are not able to successfully negotiate a price for construction, CTDOT will solicit bids for construction following the standard DBB process.

For this project, the project team is physically co-located. Co-located team members include: CTDOT engineering and construction project managers; the contractor; design consultant; the ICE; and the project management consultant. The purpose of co-location is to encourage collaboration to address project-related items.

As of April 2016, design was approximately 30% complete. Advance projects, which are necessary to facilitate rail operations during the two-track outage, will begin in early 2017. It is expected that the construction of the main project will start in mid-2018 and will last approximately four to five years.

CTDOT identified the following preliminary lessons learned from this project to implement and institutionalize CM/GC for use on other projects:

- In general, the project delivery method selection process was time consuming. Looking beyond the pilot project, there is a need to identify dedicated staff resources for selecting project delivery methods for projects, and the selection of contractors.
- The CM/GC project delivery method is typically used for complex projects where the benefits of using this methodology are significant in achieving project goals. Consistent with effective practices for the CM/GC contracting methodology, the department assigned a CTDOT project manager dedicated to the project for design and

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<sup>18</sup> Definition from the CM/GC RFP: The Construction Phase Multiplier will be applied as the allowable Contractor markup for both self-performed and subcontracted work. The Construction Phase Multiplier will be used in the Contractor's estimates, its GMP proposals, and change order markup, as identified in the construction Terms and Conditions. The profit component of the construction phase multiplier is to include any bonuses, profit sharing, and employee performance incentives, but excludes all costs associated with direct Project construction activities, including but not limited to risk or contingency. Home office overhead is defined as all auditable costs that are allocated to all of the Contractor's ongoing projects, and all other corporate operation costs, including insurance that is maintained by the Contractor as a general cost of doing business. The Construction Phase Multiplier shall not include any field indirect costs or direct costs of the Project. The shortlisted Proposers shall provide its proposed Construction Phase Multiplier as its Price Proposal (See Form 1). The Proposers shall note that the CTDOT has established a minimum allowable multiplier of four percent (4.0%).

construction to facilitate collaboration and decision making, whereas this individual typically would have been working on a number of projects at the same time. Additionally, the benefits accruing through the use of CM/GC may also result in a reduction in staff effort in project support services. Therefore, dedication of staff resources in terms of impact on other projects and cost to achieve the benefits from use of the CM/GC need to be considered in the context of the project delivery contracting methodology selection process.

- The implementation of a new PDM requires the support, oversight, and involvement of senior leadership within the department. The CTDOT project manager needs to be provided with clear decision making authority guidance so that design and construction decisions can be made in an efficient and timely manner for effective management, project quality, schedule and cost.
- The co-location of project management staff has multiple benefits, but it is also a different dynamic and needs to be carefully managed to be effective and to create the desired outcomes.

### 4.3 CONSTRUCTION MANAGER-AT-RISK

The CMAR pilot project involves the construction of a new Maintenance of Way facility and an employee parking lot for the New Haven Rail Yard, and relocation of a street. All Metro-North departments (Track, Structures, Power and Communications & Signals, including Radio Maintainers) that maintain the yard and the New Haven main line infrastructure will be located in the facility.



MAINTENANCE OF WAY FACILITY RENDERING (PHOTO COURTESY OF CTDOT)

Special considerations for this project involved rail yard security requirements for the construction contractor if the facility was built on property within the rail yard. This was expected to increase project cost and construction time. Therefore, to reduce risk and project cost CTDOT



STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
 OVERVIEW OF CTDOT'S USE OF ALTERNATIVE CONTRACTING METHODS: PILOT PROJECTS

- Acquired property adjacent to the rail yard, but not within it, thus eliminating the need for rail yard security and providing the contractor with full control of the site.
- Secured necessary environmental permits.
- Demolished the building that was located on the property providing the contractor with a clean level site for construction of the new facility.

At the completion of the project, the facility and property it is located on, and the employee parking lot will be incorporated into the New Haven Rail Yard property.

CTDOT indicated that this project was selected as the CMAR pilot project for the following reasons:

- Vertical construction (facility) project as compared to horizontal (highway) project
- Provided for a GMP for the project
- Allowed for selection of construction manager based on qualifications and price as compared to low bid if conducted using DBB
- Provided flexibility to select specific building systems and components considering quality as compared to using a typical DBB process where general specifications are provided to the contractor, who then selects the specific system for the project

The following are selected project traits that summarize the suitability of the use of CMAR for this project.

Project Traits	Expected Benefits Derived from Use of CMAR for this Project
Risk Management	Managed, assigned or shared
Constructability	Construction manager provided input during the design phase
Collaboration	Construction manager collaborated on the design. Results were seen in roofing selection, pile design and wall construction.
Owner Control	Project specific to meeting the operational needs of Metro-North; owner control was an important consideration
Innovation	Incorporated innovation into design effort
Construction Quality	Important consideration based on expected service life of the building
Schedule Acceleration Completion	Defined schedule, ability to accelerate the pile driving contract and specified completion date were important factors derived from the CMAR process
Competitive Pricing	Not identified as a selection factor considering use of an Independent Cost Estimator (ICE), and Trades (subcontractors) to be awarded based on lowest responsible bidder
Price Certainty	Important consideration

The project involved separate contracts for design and construction with both entities reporting directly to CTDOT. The Construction Services Division (CSD) of the Connecticut Department

of Administrative Services has experience in conducting vertical construction projects using the CMAR delivery methodology. CTDOT used lessons learned from CSD in developing procedures for the pilot project, including the process used to select the construction manager. The construction manager was selected using a best value scoring method. The technical proposal/interview was scored on a 100-point scale with a quality incentive factor (QIF) applied to the score, resulting in an adjusted total average quality point score (technical score \* QIF). The proposal price was then divided by the adjusted average quality point score to determine the cost per unit of quality to determine proposal rankings.

Proposal price included three components:

1. Pre-construction Phase Services Cost: A fixed fee for pre-construction services during the design phase of the project. In accordance with the RFP, this fee was required to be not less than 0.25% and not greater than 0.75% of the estimated \$20M project work budget cost.
2. Construction Phase Services Cost: A lump sum fee for the construction services phase of the project based on the estimated project work budget cost. This fee is included in the construction manager's GMP proposal.
3. CMAR Fee: A fee based on a percentage of the CTDOT estimated project work budget cost. The resulting proposal CMAR Fee amount is included for determining the proposer's total proposal cost for use by CTDOT in the best value calculation that is used for selection of the construction manager. The actual CMAR Fee that is paid to the construction manager is the cost proposal percentage, which is then applied to the cost of work amount included in the construction manager's GMP as accepted by CTDOT.

A total of 10 construction manager proposals were received in response to the RFQ with five shortlisted and offered the opportunity to respond to a RFP. Interviews were conducted with the four companies that submitted proposals. The selected proposer was ranked best for technical proposal score and best (lowest) for price.

Similar to the pilot project employing the CM/GC project delivery contracting methodology, the selected construction manager was engaged for a fixed cost to participate in and provide input during the design phase of the project for the purpose of improving constructability, reducing change orders, and minimizing cost increases due to design changes. Price for the construction phase of the project was established at 90% of project design completion and was based on successful negotiation of the construction manager's cost proposal, including a GMP, with CTDOT's independent cost estimate used as a basis for negotiations. CTDOT had the option to solicit bids for construction, if CTDOT and the construction manager were not able to successfully negotiate a price for construction.

The selected design consultant started project design in July 2013. The construction manager started work in March 2014 during the design phase of the project; successful negotiation of a contract for project construction followed, with construction beginning in June 2015. The project is scheduled for completion in March 2017.

CTDOT identified the following preliminary lessons learned from this project to implement and institutionalize CMAR for use on other projects:

- CTDOT completed 30% of project design, a higher percentage of design typical for a CMAR project, before engaging the project design consultant and construction manager. The additional initial design effort was necessary due to changes in the maintenance requirements for shops to be included in the facility. The design consultant reviewed the project design work completed by CTDOT as a starting point for their design efforts, with input to be provided by the construction manager. For future consideration for CMAR projects, CTDOT will look to involve the design consultant and construction manager earlier in the design process in an effort to maximize collaborative benefits for project design and constructability.
- Construction manager involvement in the design process is expected to result in the contractor's "ownership" of the project design and outcomes.
- The CMAR methodology provided an opportunity for the construction manager to develop bid packages for subcontracting services and systems needed for project construction. For example, this process provides more flexibility in developing HVAC system requirements and control for selecting a system most appropriate for the building. By comparison, using the traditional DBB project delivery methodology, the contractor may select a system that only meets the minimum contract specification, which may not be best overall for the project when considering all life cycle factors.
- CTDOT senior management was involved in the selection of the PDM for the pilot project as well as selection of the design consultant and construction manager. CTDOT indicated that these processes were very time consuming and diverted senior staff involved from other responsibilities. As a result, CTDOT is interested in opportunities to streamline the processes involved for project, design consultant and contractor selection in the future.

#### 4.4 PERFORMANCE MEASURES

CTDOT has published a quarterly performance metrics report "On The Move" on its website since January 2009.<sup>19</sup> The performance measures that are used to monitor project progress provide CTDOT customers and the public with transparency and accountability information, and are used as a management tool by CTDOT to inform opportunities for project delivery improvements. Performance measures for construction included in the report are

- Percent of construction contracts completed within budget
- Percent of construction contracts completed on time
- Percent of construction contracts awarded within 60 days of bid opening

CTDOT maintains an internal breakdown of the twenty-one areas shown in the online report. Currently, construction quality, infrastructure longevity and staffing data performance measures are not included in the report.

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<sup>19</sup> CTDOT, On The Move – Performance Measures; <http://www.ct.gov/dot/cwp/view.asp?a=3815&q=448402>

In addition to these overall performance measures, CTDOT is considering conducting a lean review process<sup>20</sup> to identify key performance measures that should be monitored for the DBB project delivery contracting methodology process. It is noted that CTDOT has not started the process of identifying key project delivery performance measures for each ACM.

#### 4.5 SUMMARY

CTDOT developed policies, processes and management documents for each ACM to help guide pilot project selection, contractor selection, and project design and construction. Pilot project experience is expected to provide key lessons learned and insights into institutionalizing the department's use of alternative project delivery contracting methodologies and changes to related practices and procedures for the purpose of improving project delivery.

In addition to D-B, CM/GC and CMAR, the public private partnership (P3) contracting methodology is authorized by legislation (C.G.S. §4-255), but has not been used. No policies and/or procedures have been developed for P3s and this methodology is not part of this report.

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<sup>20</sup> LeanCT is the program within the [Office of Finance, Office of Policy and Management](#) that is responsible for the daily management and coordination of Connecticut's statewide process improvement initiative. The program assists agencies in using organizational, process and programmatic improvement techniques, such as Lean, to help create a sustainable, customer-focused, and more efficient future for Connecticut; Office of Policy and Management Website: [http://www.ct.gov/opm/cwp/view.asp?a=4595&q=538306&opmNav\\_GID=2162](http://www.ct.gov/opm/cwp/view.asp?a=4595&q=538306&opmNav_GID=2162)

## 5.0 ENGINEERING PIPELINE AND CTDOT STAFFING

Improving project deliverability requires an adequate workforce at a level of experience and skill to effectively and efficiently accomplish the work. However, as stated in a Connecticut General Assembly, Legislative Program review and Investigations Committee report, Department of Transportation Project Delivery Process: RBA Pilot Project Study 2010 and more recently noted by CTDOT Bureau of Engineering and Construction management in interviews conducted for this study, CTDOT has been challenged to maintain its workforce by a cyclical pattern of lay-offs, hiring freezes, open positions not filled, and state incentivized retirement initiatives. Maintaining an adequate workforce will become more acute as the state aims to build a best-in-class transportation system as outlined in *Let's GO CT!: Connecticut's 5 Year Transportation Ramp-Up Plan* and *Let's GO CT!: Connecticut's Bold Vision for a Transportation Future*.

This section includes

- Data on the supply of engineers and wages
- Use of Outsourcing
- Career Pathways and Outreach Activities

### 5.1 NATIONAL AND STATE SUPPLY OF ENGINEERS: BACHELORS DEGREES CONFERRED

Table 5.1 provides data on the number of bachelor's degrees conferred nationally for engineering, including engineering technologies, and civil engineering from 1985 – 2014; and Figure 5.1 presents the annual percentage of change in these degrees that were conferred for the same period. The data shows fluctuations in the number and percentage of annual change for these degrees. Of particular note is the nationwide decline in civil engineering degrees conferred for the periods from 1986 – 1992 and 1999 – 2004. This is significant as many of these graduates – now with 15 to 30 years of work experience and knowledge – are the backbone of today's transportation engineering workforce.

STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART A: ENGINEERING PIPELINE AND CTDOT STAFFING

TABLE 5.1. BACHELOR’S DEGREES CONFERRED BY US POSTSECONDARY INSTITUTIONS PARTICIPATING IN TITLE IV FINANCIAL AID PROGRAMS IN 1) ENGINEERING AND ENGINEERING TECHNOLOGIES AND 2) CIVIL ENGINEERING  
(SOURCE: US DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS)

Year	Number of Engineering and Engineering Technologies Degrees Conferred	Number of Civil Engineering Degrees Conferred
1985-86	97,122	8,679
1986-87	93,560	8,147
1987-88	89,406	7,488
1988-89	85,982	7,312
1989-90	82,480	7,252
1990-91	79,751	7,314
1991-92	78,036	8,034
1992-93	78,619	8,868
1993-94	78,580	9,479
1994-95	78,483	9,927
1995-96	77,997	10,607
1996-97	75,659	10,437
1997-98	74,557	9,926
1998-99	72,796	9,178
1999-00	73,323	8,136
2000-01	72,869	7,588
2001-02	74,588	7,665
2002-03	77,231	7,836
2003-04	78,079	7,827
2004-05	79,544	8,186
2005-06	81,406	9,090
2006-07	81,854	9,671
2007-08	83,608	10,455
2008-09	84,404	10,785
2009-10	88,735	11,335
2010-11	93,097	12,557
2011-12	98,654	12,808
2012-13	102,997	13,262
2013-14	108,969	12,993



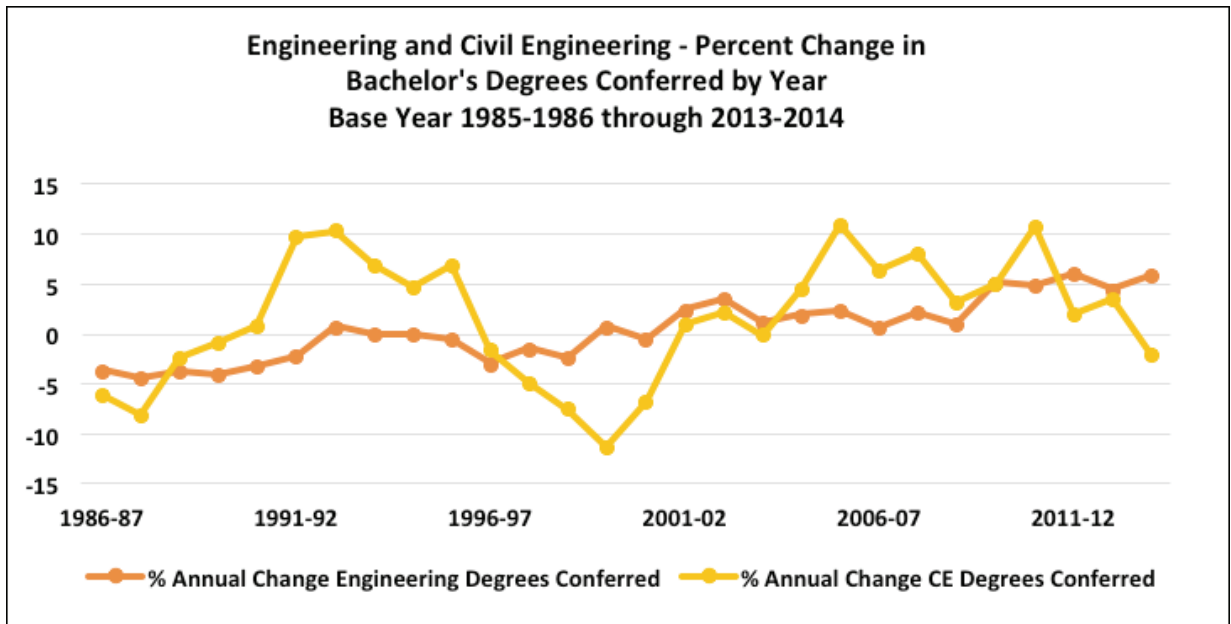


FIGURE 5.1: PERCENTAGE OF ANNUAL CHANGE IN BACHELOR’S DEGREES CONFERRED IN ENGINEERING AND CIVIL ENGINEERING IN THE US (DATA FROM THE US DEPARTMENT OF EDUCATION, NATIONAL CENTER FOR EDUCATION STATISTICS)

As shown in Figure 5.2, the number of civil engineering degrees conferred in Connecticut indicates a trend showing a decline from around 1986 – 2000 that is similar to that shown nationally. As reported in this study’s interviews with state DOTs, and by CTDOT, the nationwide and state-level declines may explain in part the current shortage and retention challenges for mid-level supervising engineers with 10 – 20 years of experience.

Another challenge for mid-level supervising engineers is found by examining the trend by gender in science and engineering degrees conferred from 2000 – 2011, as reported by the National Science Foundation<sup>21</sup>. Since 1982, women enrolled in undergraduate science and engineering programs have outnumbered men. In 2000, women earned 57.2% of the 1,254,618 degrees conferred in science and engineering, with virtually no change in 2011 at 57.2% of the 1,734,229 degrees. However, women earned only 24.2% of 9,571 civil engineering degrees conferred in 2000 and 22% of the 14,840 degrees in 2011. A larger percentage of women earning bachelor degrees, but significantly fewer women opting for careers in civil engineering, suggests a missed opportunity to increase the pool of future mid-level supervising engineers.

21 National Science Foundation, Science and Engineering Indicators 2014; <https://www.nsf.gov/statistics/seind14/index.cfm/overview>

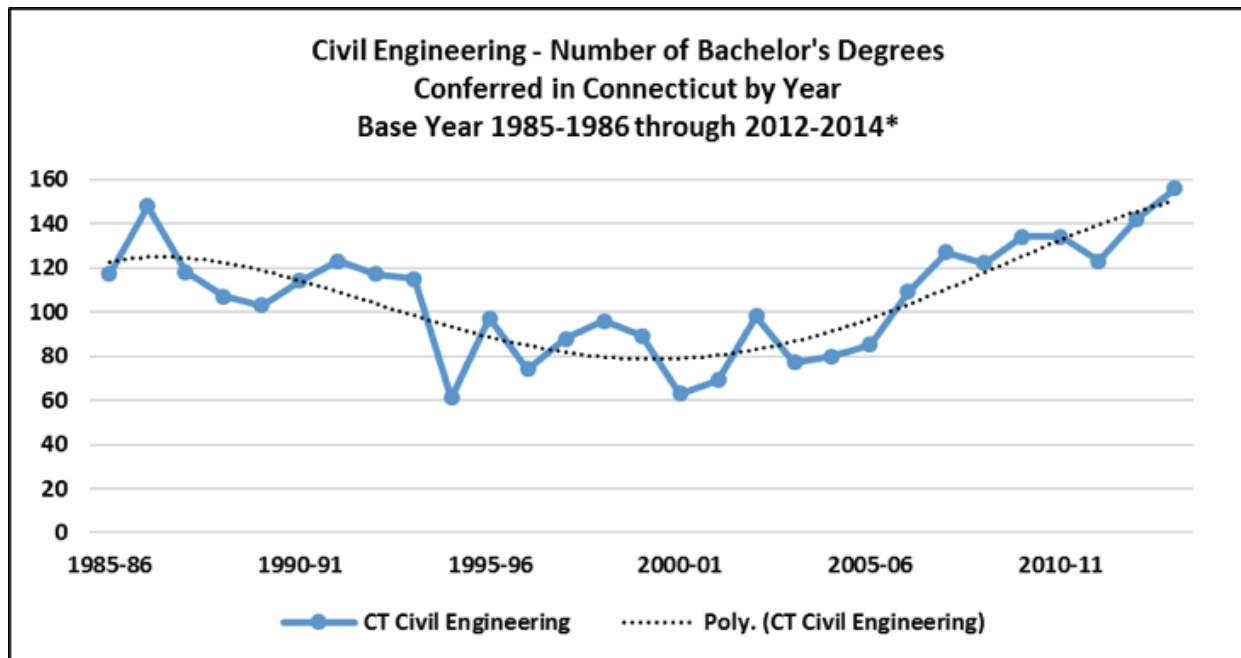


FIGURE 5.2: CIVIL ENGINEERING BACHELOR'S DEGREES CONFERRED IN CONNECTICUT (DATA SOURCE: CONNECTICUT OFFICE OF HIGHER EDUCATION) \*NOTE: THE POLYNOMIAL TRENDLINE WAS INCLUDED TO ASSIST IN ANALYZING THE FLUCTUATING DATA. THE NUMBER OF FLUCTUATIONS REQUIRED AN ORDER 4 POLYNOMIAL TRENDLINE.

## 5.2 NATIONAL AND STATE ENGINEERING WAGES

The ability of the public sector to offer a competitive salary may further explain the challenges of hiring and retaining mid-level supervising engineers for state DOTs as noted in interviews for this study with selected states and as reported by CTDOT.

The most comprehensive salary survey for engineering disciplines is conducted by the American Society of Civil Engineers (ASCE) and American Society of Mechanical Engineers (ASME) and published in "The Engineering Income and Salary Survey: Learn the Value of Engineers in Today's Market." According to publicly available data from this survey – with data collection between April 2011 – March 2012 – the median annual income was reported for the following categories, as shown in Table 5.2.<sup>22</sup>

<sup>22</sup> In this survey, income is defined as base salary from the primary employer, plus additional cash income, excluding over-time pay and income from secondary or part-time employment. The median annual income provides a measure of central tendency, and is not influenced by a few extreme data points.

TABLE 5.2. MEDIAN ANNUAL INCOME FOR ENGINEERING DISCIPLINES (SOURCE: AMERICAN SOCIETY OF CIVIL ENGINEERS AND AMERICAN SOCIETY OF MECHANICAL ENGINEERS, “THE ENGINEERING INCOME AND SALARY SURVEY: LEARN THE VALUE OF ENGINEERS IN TODAY’S MARKET (DATA COLLECTION PERIOD: APRIL 2011 – MARCH 2012)

CATEGORY	MEDIAN ANNUAL INCOME (highest to lowest per category)
Self-Reporting Data Points (n= 12,720)	\$94,117
<b>LEVEL OF GOVERNMENT</b>	
Federal government employees	\$101,000
Local government employees	\$93,120
State government employees	\$85,033
<b>US REGIONS</b>	
Pacific Southwest (CA, HI , NV)	\$104,814
South Central (AR, OK, LA TX)	\$102,000
Middle Atlantic (DE, MD, NJ, NY, PA)	\$95,000
Middle Southeast (DC, KY, NC, SC, TN, VA, WV)	\$94,422
Lower Southeast (AL, FL, GA, MS)	\$93,850
Lower Mountain (AZ, CO, NM, UT)	\$93,000
Pacific Northwest (AK, OR, WA)	\$93,000
<b>New England (CT, MA, ME,NH, RI, VT)</b>	<b>\$91,172</b>
Central Plains (IA, KS, MO, ND, NE, SD)	\$88,520
Great Lakes (IL, IN, MI, MN, OH, WI)	\$86,958
Upper Mountain (ID, MT, WY)	\$82,000

The difference between the median annual income for all respondents and state government employees is substantial. Additionally, the New England Region ranks eighth in median income compared to the other regions, with the Pacific Southwest Region the most competitive and the Upper Mountain Region the least competitive. A comparison of the median income of all respondents, by region and sector, suggests that the New England Region may be at a competitive disadvantage for hiring and retaining engineers. Given the higher cost of living in New England as compared with many other regions of the United States, engineers with high-demand skills and experience may opt for careers in other regions with a lower cost of living and/or more competitive wages.

CTDOT indicates that the department is currently competitive with wages and benefits for entry-level engineers, Transportation Engineer Trainees. CTDOT is generally able to hire entry-level engineers as positions become available once the positions are approved by the state’s Office of Policy and Management (OPM). Reportedly, the approval process for filling available positions with OPM can be lengthy and cumbersome. For example, from early May 2016 through the end of July 2016, CTDOT reported that requested approvals for vacant

Transportation Engineer Trainee positions had not been received, causing CTDOT to lose the opportunity to hire this past spring’s Connecticut college and university engineering graduates as trainees, except for a small number who committed prior to graduation.

CTDOT Transportation Engineer Trainees receive a salary increase after one year of service and are automatically promoted to Transportation Engineer 1 after two years, with promotion in less time if the trainee opts to take and successfully passes an exam. Promotion to Transportation Engineer 2 is automatic after one additional year of service. At this level, the employee is no longer considered to be in training. The process for promotion to Transportation Engineer 3 is competitive, not automatic, and not based on years of service, except that eligibility requires at least three years of experience; and is considered a mid-level career position. The CTDOT reports that in recent years, due to hiring gaps and lay-offs from past years, particularly state lay-offs in 2003, the department has had a candidate pool shortage for promotion to Transportation Engineer 3. As a result, the department has begun to promote staff who are only minimally qualified, rather than strongly qualified, and has left some Transportation Engineering 3 positions vacant.

CTDOT also reports that increasing the pool of Transportation Engineering 3 positions is negatively affected by the non-competitive starting salary the department is able to offer for outside hires at this level. An argument can be made based on the referenced ASCE/ASME survey that if Connecticut’s median annual income for engineers is low in comparison with those of selected US regions and nationally, and if CTDOT entry-level salaries are competitive, then the mid-level and/or high-level engineers must be affecting downward the annual income average.

As further evidence, Table 5.3 shows the starting salaries in 2016 by position for CTDOT engineering and construction engineering.

**TABLE 5.3: CTDOT ENGINEERING AND CONSTRUCTION ENGINEERING SALARIES BY POSITION (SOURCE: PROVIDED BY CTDOT OFFICE OF HUMAN RESOURCES)**

<b>Engineering and Construction Engineering Positions</b>	<b>Salary Grade and Step</b>	<b>Starting Salary</b>
Transportation Engineer Trainee	SG 18, Step 5	\$61,421
Transportation Engineer 1	SG 21, Step 4	\$68,541
Transportation Engineer 2	SG 23, Step 4	\$74,712
Transportation Engineer 3	SG 27, Step 1	\$81,531

For comparison, Table 5.4 shows a sample of median and average salaries for Connecticut employees by occupation. Additionally, CTDOT reported that average salary for the same skill level as a Transportation Engineer 3 was ~\$120,000 in the private sector. Other state DOTs interviewed indicated similar experiences with non-competitive salaries compared with the private sector, including MaineDOT, MnDOT, NHDOT, VTrans, and WSDOT.

TABLE 5.4: OCCUPATIONAL EMPLOYMENT AND WAGE DATA EXTRACTED FROM THE CONNECTICUT DEPARTMENT OF LABOR ([WWW1.CTDOL.STATE.CT.US/LMI/WAGES/NAICS2016.ASP](http://WWW1.CTDOL.STATE.CT.US/LMI/WAGES/NAICS2016.ASP))

Type of Industry	Position	Median Salary	Average Salary
Construction of Buildings	Civil Engineers	\$83,858	\$89,286
Heavy and Civil Engineering	Civil Engineers	\$91,791	\$93,638
Transportation Equipment Manufacturing	Architectural and Engineering Managers	\$152,223	\$160,441
Professional, Scientific, and Technical Services	Construction Managers	\$100,135	\$108,577
Professional, Scientific, and Technical Services	Architectural and Engineering Managers	\$129,454	\$139,268
Transportation Equipment Manufacturing	Engineers*	\$102,525	\$102,565
*All engineers except Aerospace, Electrical, Health and Safety, Industrial, Materials and Mechanical			

### 5.3 DOT OUTSOURCING AND COST-EFFECTIVENESS

CTDOT’s mid-level supervising engineer shortage may be further exacerbated as Connecticut expands transportation investment to achieve the goals of the state’s 5-year transportation plans. Even at the current level of transportation investment, the department may be challenged to fully staff to meet its needs due to the lengthy and cumbersome hiring process, and employee retention.

Several DOTs with similar challenges leverage their workforce through outsourcing. Decisions to outsource vary among DOTs and across activities, such as administration, planning, design, construction, maintenance, operations and rights-of-way. NCHRP Synthesis Report 246: Outsourcing of State Highway Facilities and Services (1997) found that staff constraints and specialty skills and equipment were the principal factors influencing the decisions of state DOTs to outsource. An updated study, NCHRP Synthesis 313: State DOT Outsourcing and Private-Sector Utilization (2003), drew the same conclusions.

Additionally, the NCHRP Synthesis Report 313 referenced a legislative audit performed on CTDOT in 1994 that determined that consultants were more expensive than in-house personnel for projects with less than \$5 million construction value. However, the NCHRP report further indicated that there was no defining statement on the cost-effectiveness of engineering services outsourcing and no indication of poor quality of work performed by private engineering firms. The report also cautioned that comparing staff versus outsourcing costs can be complicated by

*...utilization rates, how to account for non-project-related time for state employees in overhead, which management expenses can be distributed to projects by means of indirect overhead charges, proper accounting of insurance, utility and building expenses, and a variety of other factors. (NCHRP Synthesis 313, p. 8)*

Since January 2, 2010, state contracting agencies in Connecticut have been required to develop a cost-benefit analysis for consultant services in areas not previously contracted for by the agency, in accordance with the Connecticut General Statutes as follows:

- a) Prior to entering into any privatization contract for the privatization of a state service that is not currently privatized, the state contracting agency shall develop a cost-benefit analysis in accordance with the provisions of subsection (Conn. Gen. Stat. §4e-16)*

Given the inherent complexity of this type of analysis as noted in the referenced NCHRP report, conducting a cost-benefit analysis is a time-consuming process, with accuracy of the results not certain due to the nature of the analysis.

## **5.4 ENGINEERING CAREER PATHS AND CTDOT FUTURE WORKFORCE ACTIVITIES**

Several state DOTs interviewed for this study (NCDOT, NHDOT, VTrans) reported having multiple career paths for engineers, and MassDOT indicated its intent to create multiple paths for engineers in the near future. Providing multiple career paths offer engineers an opportunity to consider options that may be better suited for their interests and skills within the agency rather than having them explore opportunities in the private sector. CTDOT reported that it has a single career path for engineers and construction staff that leads career employees to project management, with no further options being considered at this time.

CTDOT is also engaged in outreach activities to support the development of a future transportation workforce. For example:

- AASHTO/Transportation and Civil Engineering Program (TRAC): This grant program funded by FHWA provides opportunities for state transportation agencies to use funds for activities that will help diversify the transportation workforce and ensure a well-qualified applicant pool. In Connecticut, TRAC focuses on real-world problems in the context of transportation. Practicing engineers serve as professional resources to secondary schools. Additionally, the program has funded activities such a Connecticut Construction Rodeo held at the Durham Fairgrounds for students who have in interest in construction, and a one-week summer introductory institute for high school students hosted by Central Connecticut State University.<sup>23</sup>
- College Internship Program: The department has an unpaid internship program for students who have completed their sophomore year of a bachelor's program or are pursuing a master's degree. The internship is intended "to provide hands-on work experience not typically available to students in the traditional academic setting." Opportunities include training in introductory professional engineering, construction, community planning, public transportation, agency administration, policy development, communications and outreach.

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23 CTDOT, Connecticut TRAC; <http://www.ct.gov/dot/cwp/view.asp?a=2362&Q=305582>



## 6.0 FINDINGS AND RECOMMENDATIONS

Generally, Connecticut's experience regarding the need to improve transportation project delivery is consistent with other states. This is evidenced by the multiple studies and efforts aimed at identifying effective practices and efficiencies for aspects of project delivery, including initiatives under the auspices of the federal *Every Day Counts* program. Among those aspects of project delivery identified as either impediments to certainty of cost or scheduling or opportunities for improving cost or scheduling certainty are contracting methodologies, integration of utility and rights-of-way operations and environmental reviews. Findings and recommendations regarding environmental reviews are addressed in Part B of this report.

Contracting practices have been identified as a focus area for transportation agencies seeking to deliver projects in the most efficient and expeditious manner possible. Alternative Contracting Methods (ACMs) constitute "a smarter way of doing business" by bringing the collective experience and creativity of all project stakeholders to bear on a given project at the earliest opportunity. This allows state transportation agencies to focus on maximizing cost and scheduling certainty via thoughtful solutions to typical design and construction problems. ACMs are not intended to, nor are they likely to, supplant traditional DBB as the main method of delivering transportation projects. States that have fully endorsed and implemented ACMs typically utilize them for a small percentage of their projects, but in many cases these projects are larger and consequently costlier, and thus represent a much greater percentage of a department's capital budget. It is important to identify the types of projects in which ACMs will improve scheduling and/or price certainty or solve complex or complicated issues.

A consistent lesson among all ACMs is that early contractor involvement is key to improved project delivery performance. It is also clear that certain techniques or mechanisms associated with ACMs may be incorporated for use in traditional DBB contracting and improve the performance of those projects. These may include, for example, use of an independent cost estimator (ICE) and alternative technical concepts (ATCs).

To be effective, CTDOT should consider the following three objectives in its implementation of ACMs:

1. Increase the integration of the project team
2. Focus on maximizing cost and schedule certainty
3. Leverage the first two objectives to accomplish more with available capital

Sufficient human capital in both quality and quantity must be available to implement transportation projects. Regardless of the contracting methodology, either staff or consultant services must be available and able to manage the complexities associated with projects from conception through completion.

Finally, specific performance measures or metrics and supporting data can help identify which aspects of project delivery provide the greatest opportunities for improvement. While development of a system of metrics may be resource consumptive, the data collection input

and report creation need not be. In addition to providing the information base for systematic, continuous assessment and improvements, metrics can be used to support specific budgetary, legislative or policy changes that might be otherwise difficult to achieve.

## **6.1 ORGANIZATIONAL STRUCTURE: POLICIES AND PRACTICES FOR IMPLEMENTING AND INSTITUTIONALIZING ALTERNATIVE CONTRACTING METHODOLOGIES**

### ***6.1.1 Findings***

A variety of organizational structures have been used successfully by DOTs to accommodate ACMs, including various combinations of centralized and decentralized project development and execution, as well as outsourcing project development and/or program management. The optimum ACM organizational structure depends on a DOT's existing organizational structure, the number of ACM projects per year to be implemented, and the experience the DOT has in implementing ACMs. Typically, the organizational structure evolves as the DOT staff gains experience with ACMs. Independent of the organizational structure, two critical common elements are having an ACM champion and having staff trained who are familiar with ACMs.

CTDOT's current organizational structure for project delivery is

- centralized through its headquarters office for project development. Project design is accomplished through its design office by either CTDOT staff or design consultants. Other project development functions such as procurement, finance, and rights-of-way are integrated into the responsibilities of each of the offices that provide these services.
- decentralized through its maintenance districts for project execution. CTDOT district staff are responsible for project construction for all projects within each district. Overall construction management leadership is centralized at CTDOT headquarters.

For its ACM pilot projects, CTDOT brought staff together from all related areas to create each ACM team; senior level staff led the projects.

Given the small number of ACM projects expected to be delivered initially by CTDOT, a centralized office with full-time dedicated staff for all aspects of ACMs (e.g., all engineering functions, plans and specifications, oversight of consultants, permit acquisition, procurement) is unnecessary; it would be very resource consumptive and inefficient. Instead, a central ACM office that coordinates and integrates existing CTDOT functions as currently structured can be used to provide effective, efficient leadership and coordination for ACM projects.

Implementing this latter approach will require creating an ACM office/unit that can interact with all centralized functional units as well as the district construction offices. The office's primary role would be to serve as department experts for implementing and guiding the use of ACMs with support from the department's leadership champion(s) in accessing resources throughout the agency. A key function of the ACM office involves integrating ACMs into the culture of the department by familiarizing staff with the methods, operations, and

responsibilities. Also, staff throughout the department assigned to specific ACM projects should serve as “mentors” for others and resources and advocates for the next projects.

Additionally, the significant experience and expertise of all CTDOT staff can be accessed and utilized on specific ACM projects as needed. The experience gained and lessons learned from specific ACM projects can then be integrated into policies and practices for use with the more traditional DBB methodology to improve overall project deliverability, as appropriate. Minnesota, Colorado, and Washington State are examples of models to emulate.

As a starting point, MnDOT's organizational structure is an approach that would enable CTDOT to efficiently implement up to about four projects per year. MnDOT's Design-Build (D-B) Office is led by the D-B Program Manager. Examples of tasks and responsibilities for this position are

- Leads, serves as champion, and maintains the ACM program
- Serves as the Assistant Program Manager on all D-B projects
- Develops RFP criteria
- Reviews RFPs and ATCs
- Leads one-on-one confidential meetings with contractors
- Leads the PDM selection process
- Leads the contractor selection process, including scoring meetings, but does not score proposals

MnDOT's D-B Project Manager has two dedicated staff members: a D-B Bridge Engineer; and a Metro “Alternative Delivery” Project Manager. A general engineering consultant provides support for all aspects of MnDOT's D-B program, including performing the bulk of engineering in preparation of RFPs.

In addition to D-B projects, CTDOT's ACM organizational structure will also need to lead CM/GC and CMAR projects. The management requirements for CM/GC and CMAR are different than for D-B projects, as CTDOT's technical involvement in the CM/GC and CMAR projects continues at a much greater level after selection of the construction manager.

ACM organizational structures in other states have evolved over time based on experience and need and it should be expected that this will occur in Connecticut. Other states have found that it can be efficient to have separate ACM units within the existing divisions. For example, Vermont has a separate unit in its finance and administration division dedicated to ACM projects. As CTDOT completes the ACM pilot projects and determines the methods for project and contractor selection, the department will be able to better identify areas where specific ongoing expertise is necessary and then determine whether separate units within existing divisions should be established.

### 6.1.1.1 ACM STAFFING/HUMAN RESOURCES

Among the common characteristics of effective ACM structures are the need for a departmental champion, staff familiarity – though not necessarily expertise – with ACMs, and a culture of adaptability and flexibility. Agency-wide training opportunities and communications will be imperative for instilling such culture.

Project Managers with appropriate skills need to assume certain responsibilities specific to the type of ACM used. To prepare for and assure these capabilities are available, an assessment of the different qualities/roles needed by managerial staff for the types of contracting methodologies used should be conducted.

States have varying numbers of staff assigned to ACMs; most use consultants in conjunction with their staff. Regardless of the size of the ACM program, it is important to build a team with members who have diverse backgrounds and an attitude of innovative problem solving.

Other state transportation agencies utilize consultants for ACM projects to varying degrees and across a full range of activities including, but not limited to

- developing ACM practices and documents;
- RFP/RFQ development;
- contract development;
- environmental reviews and document preparation;
- preliminary engineering design;
- project management;
- ACM method assessment and selection; and
- technical proposal assessments, but not decision making.

CTDOT has authority to engage consultants for training purposes in ACMs. For transitional purposes in progressing from no experience to operational experience, there is value in engaging a consultant to assist with procurement aspects of projects involving the use of ACMs. MnDOT has used a general engineering consultant with specific expertise for the procurement phase for ACM projects for many years and is just now considering bringing the work in-house.

It may be necessary to not only complete the pilot projects currently being undertaken by CTDOT, but also to concurrently determine the department's methods for project and contractor selection to inform the way CTDOT's ACM-related structure and staffing should evolve. A consultant with ACM experience will be needed.

### 6.1.2 Recommendations

CTDOT should establish a small, dedicated ACM office/unit conceptually based upon the MnDOT model, and others.

- The department should engage a general engineering consultant with ACM expertise to help accelerate the effectiveness of the ACM office and project success.
- To prepare for and assure that sufficient project management resources are available, the ACM office should conduct a needs assessment for the different qualities/roles required by managerial staff for utilizing the various ACMs.
  - As CTDOT completes the ACM pilot projects and determines the methods for project and contractor selection, the department will be able to better identify areas where specific ongoing expertise is necessary and then determine whether specialty groups within existing units should be established.
- The specific roles and responsibilities of department staff, consultants and contractors associated with various aspects of ACM development, specifications, selection and implementation should be identified and outlined in CTDOT ACM manuals.
- To institutionalize ACMs, junior level staff need to be trained and be involved in over-the-shoulder reviews with any general engineering consultants that are utilized so as to gain experience in RFQ and RFP preparation, contractor selection, and management of ACMs.

Led by the new ACM office, experienced CTDOT staff should be used to guide initial ACM program development (beyond the existing pilot projects) and subsequently for review, interviewing, responding to questions, and scoring of ACM proposals. As previously suggested, a general engineering consultant should be used to supplement existing staff and to provide expertise in ACM aspects with which CTDOT has limited experience. Consultant engagement for specific aspects of ACM projects should include a “training” component to prepare CTDOT staff to transition from using consulting services to assuming responsibility for tasks internally.

- Junior staff should be exposed to all available training to both build in-house capabilities and promote organizational culture change.
- Timing the transition from use of a consultant to use of in-house staff for the procurement function should take into consideration the volume of projects and preparedness of staff to assume these responsibilities. A determination of staffing needs specifically related to ACM program development and operation should similarly take into consideration the volume of projects likely to be procured through ACMs.

## **6.2 PROCESS FOR SELECTING A CONTRACTING METHODOLOGY**

### **6.2.1 Findings**

A systematized method of selecting projects whose delivery would benefit from ACMs must be established and implemented. The PDM should be determined early in the process so that the benefits of early contractor involvement can have the greatest opportunity to be realized, and to make the engineering design and contracting community aware of the selected PDM in order to provide adequate time for consideration of participating in the proposal process.



State DOTs have used a variety of qualitative and quantitative successful project selection methodologies ranging from checklists (MassDOT and VDOT) to selection matrices (CDOT, VTrans, MnDOT, WSDOT) to more sophisticated selection processes where consultants are involved in assessing the suitability of a project methodology (GDOT).

The selection matrix developed by the University of Colorado's Transportation Construction Management group has provided the basis for many of these methodologies. Using a three-stage process, the project team can complete the review in a three-hour workshop session if each team member has performed the assessment prior to the workshop.

- STAGE I - Project Attributes, Goals, and Constraints
  1. Delivery methods to consider (DBB, D-B, CM/GC)
  2. Project Description/Goals/Constraints
- STAGE II - Primary Factor Evaluation
  1. Delivery Schedule
  2. Complexity & Innovation
  3. Level of Design
  4. Cost
  5. Initial Project Risk Assessment
- STAGE III - Secondary Factor Evaluation
  1. Staff Experience/Availability (Agency)
  2. Level of Oversight and Control
  3. Competition and Contractor Experience

### **6.2.2 Recommendations**

While there is no "best" method for selecting an ACM for projects, it is recommended that CTDOT first develop a set of initial screening criteria for the types of projects that would or would not be considered for ACMs. For those projects that pass this initial threshold, a selection matrix process should be used for making the final decision. This could be the methodology developed by the University of Colorado or a modified version that best meets CTDOT requirements.

In general, for projects conducted using D-B, CTDOT will be accepting less control in exchange for the benefits of transfer of risk to the contractor, innovation, improving constructability, schedule, and price certainty. Also, the use of CM/GC or CMAR enables CTDOT to be at the table throughout the design process, has the benefit of early contractor involvement to improve project constructability, and can include innovative design and construction methods by having the designer, contractor, and owner working together to meet project goals and objectives. Given the importance of selecting the "best" contract methodology to achieve a project's goals



most efficiently, it is important for senior staff to be included on the selection process team. This is especially critical since ACMs will likely be considered for the most complex and highest cost projects where innovations can have the most impact.

## 6.3 CONTRACTOR SELECTION

### 6.3.1 Findings

The methodology for contractor selection depends on the ACM that is used. For D-B, the designer and contractor are engaged as a single entity (design-builder). For CM/GC and CMAR projects, the designer and the contractor – for CM/GC the construction manager/general contractor and for CMAR the construction manager – are engaged as separate entities under separate contracts.

#### 6.3.1.1 DESIGN-BUILD

Design-builder selection is conducted through either a single-phase RFP process or a two-phase process. The two-phase process begins with a screening process (RFQ) through which the most qualified contractors are identified and invited in phase 2 to submit proposals in response to an RFP, with selection based on either low bid or best value. For the two-phase process, a system needs to be developed to establish and evaluate qualifications in addition to a process for scoring the RFPs. Most DOTs use the two-phase process for the following benefits:

- Selected qualified design-builders are aware they are competing only with a limited number of proposers and therefore are more likely to spend the time to develop innovative designs and construction methods
- To further encourage participation in the proposal process and to increase the number of innovations submitted by design-builders, stipends are generally paid to the unsuccessful teams, and sometimes all proposers, to compensate them for some of their proposal preparation costs

Design-builder selection is resource-demanding. A selection team typically consists of five to seven members with a range of technical expertise. This team must conduct a detail review of the proposals, attend interviews and one-on-one confidential meetings, and analyze submitted ATCs for approval. The selection team should consist of both junior and senior DOT staff, regulatory agency staff, and other state agency stakeholders. The selection team can be aided by consultants who evaluate the technical merits of the submitted proposals, but only DOT and other state agency staff should formally score and rank the proposals. Because of the demanding process, formal training for reviewing D-B proposals is recommended.

To increase the likelihood of design-builders submitting high quality proposals with innovative ATCs, it is important that the selection process be based on best value and not just cost, and that proposers are made aware of the proposal scoring method in procurement solicitations. While the method for determining the best value (technical and price scores) can vary from project to project depending on the goals and constraints of the project, a contractor's interest in a project

can be significantly impacted if it is thought that the selection process is weighted heavily in favor of the low bid. Therefore, it is important to develop an RFP that scores innovation and cost in a manner that results in the selection of the best value proposal.

Offering stipends to responsive proposers is also important for receiving high quality proposals. Unlike traditional DBB projects where the designer's fee structure is based solely on qualifications and contractors are not compensated for preparing a bid package, competing design-builder proposers must complete a percentage of the project design to develop their proposed solution and to guarantee price and performance. In addition, the design-builders may need to develop more detailed designs (e.g., ATCs) in areas that the owner has deemed critical to meet specific project objectives. When used, ATCs are an important consideration for differentiating proposals in a value-driven selection process. Given that a stipend should be provided for a design worthy of consideration, a process for establishing stipend payments needs to be developed. This process can range from a simple percentage of a project's estimated construction cost or contract value to one based on the level of effort/design required to respond to the RFP that will vary depending on the level of detail required and the specific objectives of each project.

From a design-builder's perspective, early communication of a project prior to advertisement is important to provide sufficient time, reportedly three to 12 months, to form D-B designer/contractor teams to respond to a project RFQ. Once in the RFP phase of design-builder selection, owners need to maintain a predictable schedule so that shortlisted design-builders can allocate the appropriate time for proposal development. With regard to ATCs, the design-builders need time to prepare, and the owner should evaluate each design-builder's ATCs quickly and keep them confidential. Finally, one-on-one meetings between proposers and the owner enable open dialogue that helps to guide the RFP process and ultimately creates value to the owner.

As an example, a two-phase contractor selection process is used by MassDOT as outlined in their 15-step D-B Selection Process Manual. Based on qualifications and relevant experience, the proposers are first shortlisted and provided with a three-volume RFP that consists of the following:

- Volume I - Instruction to Proposers
- Volume II - Technical Provisions
- Volume III - Draft Contract (including conditional environmental permits)

The proposers are encouraged to submit ATCs and confidential meetings are held with each to discuss their ATCs. MassDOT makes an initial determination within three days with notice to the proposer – approval with conditions as necessary or disapproval with an explanation. Each proposer can then submit up to three ATCs by a specified date. The proposer may submit confidential clarifying questions regarding MassDOT's ATC determinations prior to final ATC submission. A final determination is then made within 7 days.

Throughout the RFP process, proposers are given the opportunity to ask questions and provide feedback related to the procurement documents. Each proposer is required to present their proposal to the Selection Committee. Each member of the Selection Committee scores the

technical aspects of the proposals. The best value proposal score is determined by dividing the price by the technical score. MassDOT provides stipends to the unsuccessful proposers to offset some proposal preparation costs.

### **6.3.1.2 CM/GC AND CMAR**

Unlike D-B projects, for CM/GC and CMAR the designer and contractor are selected separately. Project design can either be conducted in-house or using a design consultant selected through a RFQ process similar to selecting a designer for a DBB project. If a design consultant is selected, the designer's contract should include a requirement that they collaborate with the contractor during design. For example, the designer must respond to contractor design document comments. For in-house design, it is imperative that the design staff understand the close working relationship they must maintain with the contractor throughout design and construction to provide the best opportunity to achieve the benefits with use of these project delivery methods.

The contractor can be selected using a 2-phase process similar to that used for D-B projects – a RFQ for phase 1, followed in phase 2 with selected shortlisted proposers offered an opportunity to respond to a RFP requiring a technical proposal and a price proposal. Proposers are then interviewed by DOT and the contractor is selected using a best value process. Technical proposal requirements may include the proposer's management approach, a subcontracting plan, and approach to the pre-construction phase (e.g., plan for working cooperatively with the DOT and designer), and construction phase (e.g., innovative project approach and methods for minimizing impact) of the project. As an alternative if needed, a combined RFQ/RFP process can be used to accelerate the contractor selection process.

Since the contractor is engaged early in the design phase of the project, the price proposal is structured to provide for a fee for pre-construction services during the design phase, along with a separate fee for the construction phase, such as a construction multiplier (similar to that used by CTDOT in its CM/GC pilot project) that provides for contractor profit and overhead cost that is applied against the construction cost of the project. Also, during project design the contractor and the DOT negotiate a guaranteed maximum price (GMP) for construction. If agreed upon, then the contractor is engaged by separate contract for construction; if not, the project is let out for bid.

### **6.3.2 Recommendations**

It is recommended that CTDOT follow a two-phase contractor selection process for D-B, CM/GC and CMAR projects. This process should include the following:

- Sufficient time for potential D-B proposers to develop teams and respond to RFQs/RFPs
- Quick and confidential responses to ATCs when used
- Stipends paid to the responsive unsuccessful proposers for D-B
- Scoring of proposals based on best value – not solely on price. Scoring formula percentages for the technical proposal/qualifications and price should be flexible, and determined on a project-to-project basis, taking into consideration various factors such

as project complexity and innovation. Therefore, the greater the importance of the technical proposal/qualifications for a project, the higher the percentage assigned to the technical proposal/qualifications component of the best value score.

Stipends should be calculated based on the expected level of design work needed to provide a high-quality proposal that addresses specific project objectives instead of a simple percentage of a project's cost. The following is an example of one method for estimating the stipend payment.

$$\text{Stipend Payment} = (\#1) * (\#2) * (\#3) * (\#4)$$

Where:

*#1 = Estimated Project Cost (\$)*

*#2 = Average Percent Design Fee (%). (Shown as a percentage of project cost based on typical projects)*

*#3 = Percent of Design Required to Respond to RFP (%). This is an estimate of the percentage of the full design that the design-builder must complete to guarantee price and performance, including ATCs, if any, to meet specific project objectives*

*#4 = Percent of the calculated design fee [(#1)\*(#2)\*(#3)] not including profit to respond to the RFP . For example, if typical design profit is 20% then the calculated design fee is multiplied by 80%*

For CM/GC and CMAR projects, it is critical that the designer and contractor collaborate during the pre-construction phase to achieve the benefits of these project delivery methods. While it is recommended that this relationship be stipulated in contractual agreements, it is important that the owner play an active role in facilitating this relationship.

Early contractor involvement (ECI) in project design is integral in the use of ACMs. ATCs, an aspect of ECI, are mostly used in conjunction with D-B projects to provide an opportunity to increase innovation and may lead to higher-quality projects. ECI for CM/GC and CMAR projects is achieved through designer/contractor collaboration during the design phase of a project. Additionally, strategies to incorporate ECI into DBB should also be considered, such as use of ATCs as a component of contractor selection. CTDOT should monitor how ATCs are being incorporated into the best value selection process for CM/GC and CMAR projects, and DBB projects by other state DOTs.

## **6.4 HUMAN RESOURCES**

### **6.4.1 Findings**

Regardless of the contract methodology employed, experienced project managers are critical for the successful delivery of transportation projects. The past decade's cycle of early retirement offers, hiring freezes and hiring opportunities, coupled with the complexities and uncertainties associated with state hiring practices, has reduced CTDOT's stock of experienced project managers.

- Recruiting mid-level engineers is complicated by comparative salaries available in the private sector. While the salaries for CTDOT mid-level engineers begin at ~\$81K; the same skill level can earn an average salary of ~\$120K in the private sector.
- State hiring practices are cumbersome and unpredictable; restrictions, limitations on career paths and state budget uncertainties can be viewed negatively by prospective employees.

To build a best-in-class transportation system as outlined in *Let's GO CT!: Connecticut's 5 Year Transportation Ramp-Up Plan* and *Let's GO CT!: Connecticut's Bold Vision for a Transportation Future*, CTDOT is very likely to face significant challenges in staff constraints and specialty skills, and equipment. For example, the department's ROW Office has been reduced from 111 in 1990 to 66 staff in 2016, and over the past 14 years staffing was at a high of 86 and a low of 63 positions. While CTDOT can hire consultants for appraisal functions, it is likely limited in privatizing other related services by state statute (Conn. Gen. Stat. §4e-16, see below).

Two national studies (NCHRP Synthesis Report 246: Outsourcing of State Highway Facilities and Services, 1997 and NCHRP Synthesis 313: State DOT Outsourcing and Private-Sector Utilization, 2003) found that staff constraints, and specialty skills and equipment were the two principal factors influencing decisions by transportation agencies to outsource.

Consultants can be useful in absorbing the peaks and filling in the gaps when staff are leaving or retiring from the department. Many interviewed state DOTs are authorized to hire consultants without major restrictions.

- CTDOT indicates that the department's culture is not conducive to outsourcing to outside consultants those processes that typically have been the responsibility of the department.
  - CTDOT has in-house expertise on the most common types of transportation projects that will likely be completed using DBB (unless grouped into a large "bundle" where scaling can result in program savings). Therefore, in addition to particular non-routine skillsets, consultants may be most beneficial in the developing and implementing various ACM models and projects.
- It does not serve the department's long-term interests or capacity to rely on consultants for certain recurring tasks and needed skillsets.

CTDOT may be statutorily limited in its ability to use consultants to increase its productivity in certain areas. Conn. Gen. Stat. §4e-16 requires a cost-benefit analysis and business case to justify the "privatization" of a state service that is not presently privatized. CTDOT's use of consultants is reportedly limited to areas in which they typically use consultants unless they go through a time-consuming process with uncertain results.



### **6.4.2 Recommendations**

- CTDOT should work with OPM to fill new and refill vacant positions to assure the capacity needed to achieve the state's transportation goals.
- CTDOT should engage OPM in chartering a LEAN assessment specific to CTDOT hiring and retention, recognizing that CTDOT is in a somewhat unique position relative to the competitive nature of hiring engineers, and in particular, mid-level engineers capable of quickly becoming experienced project managers.
- To the extent that Conn. Gen. Stat. §4e-16 may restrict use of consultants by CTDOT for certain work efforts, CTDOT should
  - o Clarify areas where use of consultants could enhance its capacity and where such use is not prevented by the statutory requirement to conduct cost-benefit analyses.
  - o Explore with OPM proposing a legislative amendment that might lessen this constraint.

## **6.5 RIGHTS-OF-WAY (ROW)**

### **6.5.1 Findings**

Rights-of-way (ROW) acquisition is a complex, time-consuming and socially-sensitive process that is an integral component of the overall planning and implementation of transportation projects. The acquisitions of ROW can have a significant impact on schedule and cost.

As noted, CTDOT's ROW Office staffing has been reduced from 111 in 1990 to 66 in 2016. Therefore, there is concern about the department's capability to scale up for implementation of an increased transportation agenda and capital project budget. CTDOT is limited in its ability to hire consultants, except for appraisal functions, pursuant to Conn. Gen. Stat. §4e-16.

### **6.5.2 Recommendations**

CTDOT should

- Incorporate ROW appraisal and acquisition early in project planning processes.
- Investigate with FHWA and review any state limitations regarding the availability of appraisal waivers above currently authorized levels and the feasibility of having the same person conduct appraisals and acquisition negotiations under defined circumstances.
- Review its ability to hire consultants for aspects of ROW acquisition beyond appraisals.
- In consultation with the Office of the Attorney General, determine its authority to delegate ROW acquisition to design-build contractors, and if so develop protocols for such delegation.



- Through its EDC coordinator, continually monitor EDC newsletters and reports to identify innovations that enhance ROW professionals' ability to meet challenges associated with acquiring real property as may be applied to projects.

## 6.6 UTILITIES

### 6.6.1 Findings

CTDOT has indicated that utility relocation can be a significant delay factor in transportation project delivery.

Early identification of utility interests that may interfere with proposed highway projects is a critical process for the timely development of highway construction projects. Utility conflicts occur when a utility facility is in conflict with a proposed highway project or other utility installations, or is in noncompliance with the Utility Accommodation Rules. Effective management of utility conflicts is an important factor in delivering projects on schedule.

It is noted that this issue was reviewed and best practices were identified and evaluated in the Transportation Research Board's report, "Integrating the Priorities of Transportation Agencies and Utility Companies."<sup>24</sup>

CTDOT has staffed each district with a utility engineer; however, their efficacy is hampered and coordination with utilities remains challenging due to constantly changing company ownership and processes.

FHWA requires states to control utility use in rights-of-way on federal aid projects. States have the authority to develop their own policies and practices and operate under a utility accommodation policy approved by FHWA. Some states' accommodation policies provide guidance on timing requirements to meet certain schedule targets.

An FHWA *Every Day Counts* review of ACMs found that projects with ROW or utility issues that will impact the overall schedule are good candidates for the CM/GC process.<sup>25</sup>

### 6.6.2 Recommendations

CTDOT should

- Review its Utility Accommodation Policy, if it has not already done so, to identify opportunities to address issues underlying utility asset relocation delays.

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<sup>24</sup> "Integrating the Priorities of Transportation Agencies and Utility Companies"; Transportation Research Board report S2-R15-RW; <http://library.ctr.utexas.edu/hostedpdfs/txdot/psr/5475.pdf>

<sup>25</sup> FHWA, Center for Accelerating Innovation, Construction Manager/General Contractor, Every Day Counts; <http://www.fhwa.dot.gov/innovation/everydaycounts/edc-2/CM/GC.cfm>

- Review the best practices identified in the referenced TRB report and identify those that are implementable and valuable to its programs. Among the strategies that parallel best practices in other aspects of deliverability that should be considered are
  - conducting design as a team, including appropriate CTDOT staff and those involved in project design on behalf of CTDOT, and utility companies.
  - early communication with and involvement of utilities to inform decision making and avoid conflicts.
  - training designers, engineers and contractors on utility relocation processes.
- Meet with and enlist the assistance of the Connecticut Public Utility Regulatory Authority (PURA) to evaluate opportunities to utilize PURA's rate-setting and operational oversight of utilities as mechanisms to set expectations for utility responsiveness to transportation project requirements.
- In its development of ACM selection processes, recognize the value of CM/GC for projects with utility issues that can affect the overall project schedule.
- Through its EDC coordinator, continually monitor EDC newsletters and reports to identify innovations that enhance its ability to meet challenges associated with relocation of utilities and other utility coordination issues.

## 6.7 EVALUATING PROJECT AND PROGRAM PERFORMANCE

### 6.7.1 Findings

It is necessary to develop and use performance measures in order to identify areas that can improve all PDMs, including traditional DBB. Overall project criteria can include measures such as those related to delivery time, cost, quality, and stakeholder satisfaction. The more specific or detailed the identified project criteria measures, the more efforts for improvement can be focused. For example, knowing whether project delivery time is adversely affected by RFP development, contractor selection, permitting, or a combination of factors can inform system development and/or modifications. Also, performance measures could support specific budgetary, legislative, or policy changes – such as additional staffing, use of consultants, and self-certification of environmental compliance – that might be otherwise difficult to achieve. Furthermore, transparency of performance can enhance CTDOT's statewide support for achieving the goals of *Let's GO Connecticut!*

As noted in several sections throughout this study, CTDOT's development of a system for and implementation of ACMs will likely evolve. A relevant performance measurement system can help ensure that such evolution takes best advantage of lessons learned.

Utah DOT (UDOT) can serve as a model for establishment of a performance measurement system that is used to ensure continued improvement, innovation, teamwork and transparency. The performance of each division (Structures, ROW, Preconstruction, Environmental Services, Construction, Materials, Quality, and Utilities/Railroads) is evaluated based on accomplishments for the previous year compared to established performance goals. Description

of the division's function and responsibilities are presented along with graphs that show performance relative to the division's goals so that improvements in performance can be easily observed. The use of performance measures has extended beyond project delivery to include areas such as safety and preservation of infrastructure (pavement, bridges, and maintenance).

One methodology for quantifying the cost, schedule, and quality of DBB, D-B, and CM/GC projects was developed in FHWA's project entitled "Quantification of Cost, Benefits, and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications" that is pending publication. This study collected and analyzed data from 291 projects that included 134 DBB projects, 84 D-B Best Value projects, 39 D-B Low Bid projects, and 34 CM/GC projects.

### **6.7.2 Recommendations**

CTDOT should establish and implement a system of performance measures that will provide the data necessary to identify with greater precision opportunities for improving all PDMs. It is recommended that CTDOT review FHWA's project entitled "Quantification of Cost, Benefits, and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications" when it is published as guide for developing a methodology for quantifying performance measures across PDMs.

Pinpointing lessons learned with some level of accuracy and data integrity will support ongoing process improvement initiatives throughout the department and among its partners in the public and private sectors.

While development of a system of performance measures may be resource consumptive, the data collection input and report creation need not be. Performance measures could support not only improvements in project delivery, but also provide the legislative and statewide support needed to effectively achieve the goals of *Let's GO Connecticut!* Further, it is recommended that CTDOT review UDOT's Project Development Performance Management system. While it is expected that UDOT's system may be more extensive than that which CTDOT can or should undertake initially, a review of the system will identify those measures and approaches directly related to major areas included in this study – the effectiveness of ACMs and the impediments to timely project delivery.



## 7.0 REFERENCES

### 7.1 CHAPTER 1: LITERATURE REVIEW

Alder, R. (2007). "UDOT Construction Manager General Contract (CMGC) Annual Report." Utah Department of Transportation Project Development Group, Engineering Services and Bridge Design Section, Salt Lake City Utah, 39 pp.

American Society of Civil Engineers (ASCE) (2013). "Report card on America's infrastructure." ASCE, Reston, Virginia; 2013 <http://www.infrastructurereportcard.org/a/#p/home> [May 16, 2016].

Associated General Contractors of America (AGC). (2004). *Project Delivery Systems for Construction*, Associated General Contractors of America. Washington, D.C., 2004.

Auditor General of Ontario. (2014). "Infrastructure Ontario – Alternative Financing and Procurement." 2014 Annual Report of the Office of the Auditor General of Ontario.

Barutha, P.J. (2016). A Framework for Value for Money Assessment on Public Private Partnership Mega-Projects, Masters Thesis, Iowa State University, Ames, Iowa, 133 pp.

Bearup, W, Kenig, M., and O'Donnell, J. (2007). "Alternative Delivery Methods, a Primer." Proceedings, Airport Board Members and Commissioners Annual Conference, Airports Council International - North America, Chicago, IL.

Coblentz, M.A., (2012). "Alternative Technical Concepts Used on the ICC Project." 2012 Transportation Research Board, Paper # 12-6806, National Academies, Washington, D.C., 17 pp.

Ernzen, J. and T. Feeney, (2002). "Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?" Transportation Research Record 1813, Transportation Research Board, National Research Council, Washington, D.C., pp. 253-259.

Federal Acquisition Regulation (FAR), (2005), Volume I, Subpart 2.1, Government Printing Office, Washington, DC.

Federal Highway Administration (FHWA) (2006). "Design-Build Effectiveness Study." Final Report to Congress as Required by TEA-21, <http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm> (August 30, 2006).

Federal Highway Administration (FHWA) (2012), "Alternative Technical Concepts." Unpublished Presentation, Every Day Counts 2, US Department of Transportation, On-line, Available: <http://www.fhwa.dot.gov/accelerating/presentations/atc/> [April 21, 2013].

Federal Highway Administration (FHWA), "Alternative Contracting Methods (ACMs) Library." USDOT Federal Highway Administration, Washington, D.C., 2016. [Online]. Available: <http://www.fhwa.dot.gov/construction/contracts/acm/> [May 30, 2016].

Flyvbjerg, B., Skamris Holm, M. and Buhl, S. (2002) "Underestimating Costs in Public Works Projects: Error or Lie?" *Journal of the American Planning Association* 68:3, pp. 279-295.

Gad, G.M, Gransberg, D.D. and Loulakis, M.C. (2015). "Policies and Procedures for Successfully Implementing Alternative Technical Concepts." *Transportation Research Record: Journal of the Transportation Research Board* No. 2504, Transportation Research Board of the National Academies, Washington, D.C., pp. 78-86.

Gambatese, J., K. Dettwyler, D. Rogge and L. Schroeder. (2002). *Oregon Public Contracting Coalition Guide to CM/GC Contracting*. Oregon Public Contracting Coalition, Portland Oregon, p. 13.

Garvin, M. J. (2010). "Enabling development of the transportation public-private partnership market in the United States." *Journal of Construction Engineering and Management*, 136(4), pp. 402-411.

Giroux, R. P. (2009). "Relevance of Roebing." *Journal of Performance of Constructed Facilities* 23(1), pp. 2-4.

Government Accounting Office (GAO)(1991). *Using Structured Interviewing Techniques*, GAO/PEMD-10.1.5, Government Accounting Office, Washington, D.C., 191 pp.

Gransberg, D.D. and Molenaar, K.R. (2008). "Does Design-Build Project Delivery Affect the Future of the Public Engineer?" *Transportation Research Record 2081, Journal of the Transportation Research Board*, National Academies, pp. 3-8.

Gransberg D.D., M.C. Loulakis, and G.M. Gad. (2014). "Alternative Technical Concepts for Contract Delivery Methods." NCHRP Synthesis 455, Transportation Research Board, National Academies, Washington, D.C., 119pp.

Gransberg, D.D., Molenaar, K.R., and J.N. Datin. (2008) "Quality Assurance in Design-Build Projects." NCHRP Synthesis 376, Transportation Research Board National Academies, Washington, D.C., 139 pp.

Gransberg D.D., J.A. Rueda-Benavides, and M.C Loulakis. (2015). "Indefinite Delivery/ Indefinite Quantity Contracting Practices." NCHRP Synthesis 473, Transportation Research Board, National Academies, Washington, D.C., 619 pp.

Gransberg, D.D., J.S. Shane, K. Strong, and Lopez del Puerto, C. (2013). "Project Complexity Mapping in Five Dimensions for Complex Transport Projects." *Journal of Management in Engineering*. ASCE, Vol.29, (4), pp. 316-326.

Hitt, R., (2012). "Alternative Technical Concepts and Design-Bid-Build." Unpublished presentation, FHWA Every Day Counts Summit, Kansas City, Missouri, 22 pp.

Ibbs, C.W., Y. Kwak, and A. Odabasi (2003). "Project Delivery System and Project Change: A Quantitative Analysis." *Journal of Construction Engineering and Management*, 129(4), pp. 382-387.

Koch, J.E., Gransberg, D.D., and K.R. Molenaar (2010). *Project Administration for Design-Build: A Primer for Owners, Engineers, and Contractors*, ASCE Press, 286 pp.



- Lopez del Puerto, C., Craigie, E. and Gransberg, D.D. (2016). "Construction Cost Certainty Versus Construction Savings: Which is the Correct Approach?" Compendium, 2016 Transportation Research Board Annual Meeting, Paper 16-2754, Washington, D.C.
- Loulakis, M.C., Smith, N.C., Brady, D.L., Rayl, R.E., and Gransberg D.D. (2015). "Liability of Design-Builders for Design, Construction, and Acquisition Claims." NCHRP Legal Digest 68, Transportation Research Board, National Academies, Washington, D.C., 127 pp.
- Lownes, N., Jackson, E. and Bertolacciana, K. (2012). "Benchmarking Connecticut's Transportation Infrastructure Capital Program with Other States." Report No. CT-2276-F-12-6, Connecticut Academy of Science and Engineering, 78 pp.
- Mendez, V., (2010). "Every Day Counts: Innovation Initiative." Federal Highway Administration, Washington, DC, p. 1-2.
- Minchin, E., K. Thakkar, K., and R.Ellis, (2007). "Miami Intermodal Center-Introducing CM-At-Risk to Transportation Construction." in *Innovative Project Delivery Systems*, Molenaar, K.R. and Yakowenko, G. (Eds), ASCE Press, pp. 46-59.
- Minnesota Department of Transportation (MnDOT), (2014). Indefinite Delivery/Indefinite Quantity Implementation Guide. Office of Construction and Innovative Contracting (OCIC).
- Minnesota Department of Transportation, (2012). Design-Build Manual, MnDOT, St Paul, Minnesota, On-line Available at: [http://www.dot.state.mn.us/designbuild/documents/online/DBv12.htm#\\_Toc305159425](http://www.dot.state.mn.us/designbuild/documents/online/DBv12.htm#_Toc305159425) [May 15, 2016].
- National Society of Professional Engineers (1995). "Design/Build in the Public Sector "NSPE Board of Directors, Position Statement #1726, <http://www.nspe.org/govrel/gr2-ps1726.asp> (11-17-06)
- Office of Federal Procurement Policy (OFPP) (1997). Best Practices for Multiple Award Task and Delivery Order Contracting. Office of Management and Budget (OMB), Executive Office of the President, Interim Edition.
- Oxford Dictionary (2016). "Oxford Dictionaries: Language Matters." WWW Document, On-line Available at: <http://www.oxforddictionaries.com/>
- Peters, M. (2003). "An Important Project." Canal Road Intermodal Connector Meeting, Gulfport, Mississippi, <http://www.fhwa.dot.gov/pressroom/re031021.htm> [September 16, 2015]
- Rueda, J. A., (2013). Develop a Price Escalation Method for Minnesota Department of Transportation Indefinite Delivery/Indefinite Quantity: AxE Bidding, Master's Thesis, Iowa State University, Ames, 173 pp.
- Rueda-Benavides, J.A. and Gransberg, D.D., (2014). "Indefinite Delivery/Indefinite Quantity Contracting: A Case Study Analysis." Transportation Research Record, No. 2408, *Journal of the Transportation Research Board*, National Academies, pp. 17-25.
- Ruiz, L.A., (2013). "Early Contractor Involvement for Civil Works," Unpublished Presentation, Society of American Military Engineers, Meeting, August, 28, 2013.

- Scott, S., K. Molenaar, D. Gransberg, and N. Smith (2006). NCHRP Report 561: Best-Value Procurement Methods for Highway Construction Projects, Transportation Research Board of the National Academies, Washington, D.C., 167 pp.
- Schierholz, J. D.D. Gransberg, and J. McMinimee, (2012). "Benefits and Challenges of Implementing Construction Manager/General Contractor Project Delivery: The View from the Field." 2012 Transportation Research Board Paper #12-1206, National Academies.
- Shane, J., Strong, K., and Gransberg, D. (2011). Guidebook for Managing Complex Projects; Strategic Highway Research Program 2 Project R-10, Transportation Research Board, National Academies of Science, Washington, DC.
- Songer, A.D. and Molenaar, K.R. (1996). "Selecting design-build: private and public sector owner attitudes," *Journal of Management in Engineering*, ASCE, Vol. 12(6), 1996, pp. 47-53.
- Strang, W., (2002). "The Risk in CM at-Risk," *CM eJournal*, Construction Management Association of America, pp. 1-9.
- Thomsen, C., (2006). "Project Delivery Processes," Parsons Corporation, April 2, 2006, <http://www.3di.com/rnd/Files/Essays/Project%20Delivery%20Strategy.pdf> [November 22, 2015].
- Venturato, T. and J. Schroeder (2007). "Owner-Controlled Accelerated Project, Unique Project Delivery Method for Light Rail." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2006, Transportation Research Board of the National Academies, Washington, D.C., pp. 60-66.
- Walewski, J., E. Gibson, and J. Jasper (2001). "Project Delivery Methods and Contracting Approaches Available for Implementation by the Texas Department of Transportation." Center for Transportation Research, The University of Texas at Austin. FHWA/TX-0-2129-1, Oct. 2001.
- West, N.J.N., D.D. Gransberg, and J. McMinimee, (2012). "Effective Tools for Projects Delivered Using the Construction Manager/General Contractor." *Transportation Research Record No. 2268, Journal of the Transportation Research Board*, National Academies, pp. 33-42.
- Yescombe, E. (2007). *Public-Private Partnerships: Principles of Policy and Finance*. Elsevier Ltd. Butterworth-Heinemann, Burlington, MA.

## 7.2 CHAPTER 2: SUMMARY OF STATE PRACTICES FROM INTERVIEWS OF SELECTED STATES

National Right to Work Legal Defense Foundation, Inc.; <http://www.nrtw.org/rtws.htm>

National Association of State Highway and Transportation Unions; <http://nashtu.us/membership>

Colorado Workers for Innovative and New Solutions (WINS), <http://coloradowins.org>

MnDOT's "Design-Build Manual"; [http://www.dot.state.mn.us/designbuild/documents/online/DB\\_Manual.pdf](http://www.dot.state.mn.us/designbuild/documents/online/DB_Manual.pdf)

VDOT's "Design-Build Evaluation Guidelines"; [http://www.virginiadot.org/business/resources/DB\\_Evaluation\\_Guidelines\\_5-27-2014.pdf](http://www.virginiadot.org/business/resources/DB_Evaluation_Guidelines_5-27-2014.pdf)

GDOT's "Design-Build Suitability Assessment"; <http://www.dot.ga.gov/PartnerSmart/DesignManuals/DesignBuild/4-Design-Build%20Suitability%20Report%20and%20Risk%20Matrix%20Template.pdf>

VDOT's "Design-Build Procurement Manual"; [http://www.virginiadot.org/business/resources/ipd/DB\\_Manual\\_FinalCopy20111011.pdf](http://www.virginiadot.org/business/resources/ipd/DB_Manual_FinalCopy20111011.pdf)

## 7.3 CHAPTER 3: EFFECTIVE PRACTICES

### 7.3.1 Literature References

Abdelrahman, M., T. Zayed, and A. Elyamany. "Best-Value Model Based on Project Specific Characteristics." *Journal of Construction Engineering and Management*, ASCE, Vol. 134, No. 3, Mar. 1, 2008, pp. 179-188.

Actis, C., Unkefer, D., and Lewis J. "Alternative Contracting Methods: Alternative Technical Concepts." 2012 [Online]. Available: [http://www.fhwa.dot.gov/everydaycounts/edctwo/2012/pdfs/edc\\_atc.pdf](http://www.fhwa.dot.gov/everydaycounts/edctwo/2012/pdfs/edc_atc.pdf)

Alder, R. "UDOT Construction Manager General Contract (CMGC) Annual Report." Utah Department of Transportation Project Development Group, Engineering Services and Bridge Design Section, Salt Lake City Utah, 2007, 39 pp.

Allen, L.N., D.D. Gransberg, and K.R. Molenaar. "Partnering Successful Design-Build Contracts in the Naval Facilities Engineering Command Southwest Division." *The Military Engineer*, SAME, Vol., 94 (616), March, 2002, pp. 47-48.

American Association of State Highway and Transportation Officials (AASHTO), "Primer on Contracting for the Twenty-First Century." AASHTO Subcommittee on Construction - Contract Administration Task Force Report, Washington, DC, 2001.

American Association of State Highway and Transportation Officials (AASHTO) AASHTO Guide for Design-Build Procurement, American Association of State Highway and Transportation Officials, Washington, D.C., January 2008, p. 58.

Anderson, S.D. and Russell, J. S. Guidelines for Warranty, Multi-Parameter, and Best Value Contracting. NCHRP Report 451, Transportation Research Board, National Research Council, Washington, D.C. 2001, 101 pp.

Anderson, S. D., Molenaar, K. R., and Schexnayder, C. J. Right of Way Methods and Tools to Control Project Cost Escalation. National Cooperative Highway Research Program, Transportation Research Board of the National Academies. 2008,115 pp.

Anderson, S.D. and Damnjanovic, I. Selection and Evaluation of Alternative Contracting Methods to Accelerate Project Completion, NCHRP Synthesis 379, Transportation Research Board, Washington, D.C., 2008, 77 pp.

- Anderson, S. and M.I. Schneider. Design-Build Project Delivery. American Council of Engineering Companies, Washington, D.C. 2000, 77 pp.
- Arditi, D. and D. Lee. "Service quality performance of design/build contractors using quality function deployment," *Construction Management and Economics*. London: Vol. 22, Iss. 2, Feb. 2004, pp. 123-157.
- Australian Government, Department of Infrastructure and Transport, Infrastructure. Planning and Delivery: Best Practice Case Studies, 2010 [Online]. Available: [https://www.infrastructure.gov.au/infrastructure/publications/files/Best\\_Practice\\_Guide.pdf](https://www.infrastructure.gov.au/infrastructure/publications/files/Best_Practice_Guide.pdf)
- Beard, J. L., M.C. Loulakis, E.C. Wundram. *Design Build Planning Through Development*. McGraw-Hill, New York, 2001.
- Bearup, W, Kenig, M., and O'Donnell, J. (2007). "Alternative Delivery Methods, a Primer." Proceedings, Airport Board Members and Commissioners Annual Conference, Airports Council International - North America, Chicago, IL.
- Blakemore, F.P and T.F. Konda. "Design-Build Replacement of US-90 Bridge over Bay St. Louis, Mississippi." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2201. Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 106-112.
- Blanchard, B. "Design-Build Lessons Learned Florida DOT." Proceedings, Louisiana Transportation Engineering Conference, Baton Rouge, Louisiana, February, 2007, pp. 6-14.
- Blanding, J. "Quality Incentives: A Federal Perspective," Design-Build: A Quality Process Transportation Research E-Circular No. E-C090, Transportation Research Board, National Research Council, Washington, D.C., 2006, 9 pp.
- Bourne, J., S. DeWitt, and P. Drennon. "Ensuring Quality Is Built into the Request for Proposal Process." Design-Build: A Quality Process Transportation Research E-Circular No. E-C090, Transportation Research Board, National Research Council, Washington, D.C., 2006, p. 1.
- Brinkman G. "City of Phoenix Work Plan for SEP (Special Experimental Project) 14 Construction Manager at Risk Contract Historic Streetlight Restoration," July 3, 2007, <http://www.fhwa.dot.gov/programadmin/contracts/sep14azstreetlight> [May 15, 2009]
- Byrd, L. G. and A.A. Grant. "Prerequisites for a Successful Design/Build/Warranty Highway Construction Contract." A Report to the U.S. Department of Transportation, Federal Highway Administration, Washington, D. C., March 1993[Online]. Available: <http://www.fhwa.dot.gov/programadmin/contracts/byrd.cfm> [February 4, 2007].
- Capka, J. R. "Memo of Major Project Guidance" from FHWA Administrator to the Division Administrators dated January 19, 2007 [Online]. [ August 11, 2016] [http://www.fhwa.dot.gov/ipd/project\\_delivery/resources/general/mpg\\_memo.aspx](http://www.fhwa.dot.gov/ipd/project_delivery/resources/general/mpg_memo.aspx)
- Carlisle, J.B. Estimating "Costs of Pre-Construction Services for Construction Management-at-Risk." Master's Thesis, University of Oklahoma, Norman, Oklahoma, 2006, p. 52.

- Carpenter, J. "Annual Report on Alternate Technical Concept Programmatic Waiver, SEP-14 Progress Report," WSDOT, Olympia, WA, January 31, 2012, 6 pp.
- Carpenter, B., E. Fekpe, and D. Gopalakrishna. "Performance-Based Contracting for the Highway Construction Industry: An Evaluation of the Use of Innovative Contracting and Performance Specification in Highway Construction Final Report." Battelle, Columbus, Ohio, Feb. 2003, 49 pp.
- Christensen M.R. and Meeker, L.E. "Design/Build Projects - Lessons Learned from the Contractor's Perspective," Proceedings, American Railway Engineering and Maintenance-of-Way Association, Lanham, Maryland, 2002, p. 14.
- Coblentz, M.A., (2012). "Alternative Technical Concepts Used on the ICC Project." 2012 Transportation Research Board, Paper # 12-6806, National Academies, Washington, D.C., 17 pp.
- Collier, P., M. Corbett, and B. Lundrigan. "Quality performance in a design-build mega-project," Quality Congress. ASQ's Annual Quality Congress Proceedings, Milwaukee, 2001, pp. 17-26.
- Construction Industry Institute (CII). "Project Delivery Systems: CM at Risk, Design-Build, Design-Bid-Build." Research Summary RS 133-1, CII, Austin, Texas, 1997.
- Construction Industry Institute (CII). "Owner's Tool for Project Delivery and Contract Strategy Selection." Research Summary 165, Construction Industry Institute, Austin, Texas, 2003.
- Denzel, M. Sumitani, M., and Cohen, S. General Contractor/Construction Manager Form of Contracting: Issues and Recommendations. City of Seattle, Washington, Design-Build Institute of America (DBIA), Manual of Policy Statements. Design-Build Institute of America, Washington, D.C., 1998, p. 5.
- DeWitt, S. et al, "Construction Management Practices in Canada and Europe," Federal Highway Administration Report No. FHWA-PL-05-010, Washington DC, 2005.
- Drennon, P. W. "Utah's I-15, a transportation case study: Role of the owner's design professional in design/build and in the provisions for quality." Quality Congress. ASQ's ... Annual Quality Congress Proceedings, Milwaukee, 1998, p. 166. [http://www.cityofseattle.net/audit/report\\_files/2004-05\\_GCCM\\_Report.pdf](http://www.cityofseattle.net/audit/report_files/2004-05_GCCM_Report.pdf) [May 15, 2009], 2004, 26 pp.
- Ellicott, M.A. "Best-Value Contracting," Proceedings, Area Engineer's Conference, TransAtlantic Division, U. S. Army Corps of Engineers, Winchester, Virginia, 1994.
- Ellis, R. D., Herbsman, Z. and Kumar, A. "Evaluation of the FDOT design/build program." Final Report, Submitted to Florida Dept. of Transportation, State Project No. 99700-7543-010, Department of Civil Engineering, University of Florida, Gainesville, 1991.
- El Wardani, M., J. Messner, and M. Horman. "Comparing Procurement Methods for Design-Build Projects." *Journal of Construction Engineering and Management*, ASCE, Vol. 132, No. 3, 2006, pp. 230-238.
- Ernzen, J. and Feeney, T. "Contractor-Led Quality Control and Quality Assurance Plus Design-Build: Who Is Watching The Quality?" Transportation Research Record 1813, Transportation Research Board, National Research Council, Washington, D.C., 2002, pp. 253-259.



Ernzen, J., Murdough, G. and Drecksels, D. "Partnering on a Design-Build Project: Making the Three-Way Love Affair Work," *Transportation Research Record* 1712, Transportation Research Board, National Research Council, Washington, D.C., 2000, pp. 202-212.

Gad, G.M, Gransberg, D.D. and Loulakis, M.C. (2015). "Policies and Procedures for Successfully Implementing Alternative Technical Concepts." *Transportation Research Record: Journal of the Transportation Research Board* No. 2504, Transportation Research Board of the National Academies, Washington, D.C., pp. 78-86.

Gambatese, J., K. Dettwyler, D. Rogge and L. Schroeder. Oregon Public Contracting Coalition Guide to CM/GC Contracting, Oregon Public Contracting Coalition, Portland Oregon, 2002, p. 13.

Gharaibeh, N.G., J.W. Button, and P. Jalvi. Pavement Aspects in Design-Build Contracting for Highway Projects Synthesis of Highway Practice, Report No. TTI-2005-1, Texas Transportation Institute, Texas Department of Transportation, Austin, Texas, 2005, 96 pp.

Gibson, G.E., Migliaccio, G.C., and O'Connor, J.T. "Changing Project Procurement Strategy: An Implementation Framework," Sloan Industry Studies Working Paper Series, Sloan Foundation Industry Studies Annual Conference, April 26-27, Cambridge, Massachusetts., 2007, p. 20.

Gibson, G.E., C.I. McGinnis, W.S. Flanigan, and J.E. Wood, "Constructability in the Public Sector." *Journal of Construction Engineering and Management*, ASCE, Vol. 122 (3), 1996, pp. 274-280.

Gladke, J. "Incentives on Design-build Projects: Two Different Approaches." Design-Build: A Quality Process Transportation Research E-Circular No. E-C090, Transportation Research Board, National Research Council, Washington, D.C., 2006, p. 8.

Gonderinger, C., "TH 14/218 Design-Build Project Technical Memorandum Quality Management Plan (QC/QA Requirements)," Minnesota Department of Transportation Technical Memorandum, St. Paul, 2001, pp. 1-17.

Graham, P. Evaluation of Design-Build Practice in Colorado, Research Report IR(CX) 70-4(143), Colorado Department of Transportation, Denver, Colorado, 1997.

Gransberg, D.D. and Barton, R.F. "Analysis of Federal Design-Build Request for Proposal Evaluation Criteria," *Journal of Management in Engineering*, ASCE, Vol. 23 (2), April 2007, pp. 105-111.

Gransberg, D.D, J.E. Koch and K.R. Molenaar. Preparing for Design-Build Projects: A Primer for Owners, Engineers, and Contractors, ASCE Press, Reston, Virginia, 2006, 266 pp.

Gransberg, D.D., and K, R. Molenaar. The Impact of Design-Build on the Public Workforce. Keston Institute for Public Finance and Infrastructure Policy, University of Southern California, Los Angeles, California, 2007, pp. 20-26.

Gransberg, D.D. "Comparing Construction Manager/General Contractor (CMGC) and Federal Early Contractor Involvement (ECI) Project Delivery Methods." *Transportation Research Record*, No. 2573, *Journal of the Transportation Research Board*, National Academies, 2016, pp. 18-23.



Gransberg, D.D., "Case Studies of Early Contractor Design Involvement to Expedite the Delivery of Emergency Highway Projects." *Transportation Research Record No. 2347, Journal of the Transportation Research Board*. National Academies, 2013, pp. 19-26.

Gransberg, D.D. and K.R. Molenaar, "Analysis of Owner's Design and Construction Quality Management Approaches in Design-Build Projects." *Journal of Management in Engineering*. ASCE, Vol. 20 (4), 2004.

Gransberg D.D. and M.C. Loulakis. "Expedited Procurement Procedures for Emergency Construction Services." NCHRP Synthesis 438, Transportation Research Board, National Academies, Washington, D.C. 2012, 118 pp.

Gransberg D.D., M.C. Loulakis, and G.M. Gad. "Alternative Technical Concepts for Contract Delivery Methods." NCHRP Synthesis 455, Transportation Research Board, National Academies, Washington, D.C. 2014, 119 pp.

Gransberg, D.D. and Riemer, C. "Performance-Based Construction Contractor Prequalification." NCHRP Synthesis 390, Transportation Research Board National Academies, Washington, D.C., 2009, 101 pp.

Gransberg, D.D., and J.S. Shane. *Construction Manager-at-Risk Project Delivery for Highway Programs*, NCHRP Synthesis 402, 2010, 127 pp.

Haddad, N., Molenaar, K.R., and Schofield, M. "A Risk-Based Alternative Delivery Selection Process: the Colorado Experience." *Proceedings, DBIA, Design-build in Transportation Conference, Phoenix, Arizona, April 27, 2012*, p. 17.

Hawkins, B. "Managing the CM/GC Delivery Process: Avoiding Pitfalls That Can Take The 'Great' Out Of A Truly Great Delivery Method." Salem, Oregon, May 08, 2009. [Online] Available: [http://www.pnws-awwa.org/uploads/PDFs/conferences/2009/ENGR\\_FRI%20PM\\_HAWKINS\\_Managing%20CM-GC%20Process.pdf](http://www.pnws-awwa.org/uploads/PDFs/conferences/2009/ENGR_FRI%20PM_HAWKINS_Managing%20CM-GC%20Process.pdf) [August 11, 2016].

Hietpas, J. "Overcoming CMGC Legislative Hurdles." Presentation, 2012 CMGC Peer Exchange, Boston, Massachusetts, May 2012.

Hietpas, J. "I-35W St. Anthony Falls Bridge: Planning the Replacement." *Aspire*, Fall 2008, pp. 24-27.

Hitt, R. "Alternative Technical Concepts and Design-Bid-Build." Unpublished presentation, FHWA Every Day Counts Summit, Kansas City, Missouri, October 2012, 22 pp.

Hoffman, B., Dillon, J., Kreienheder, B., Manka, D., and Chirpich, A. "Early Contractor Involvement (ECI) for Civil Works." Presentation, Industry Workshop, US Army Corps of Engineers, New Orleans, Louisiana, January 28, 2009, p. 13.

Horn, G. "New Mississippi Bridge Project ATC Analysis." SEP-14 Report, March 25, 2010, 9 pp.

Keston Institute for Public Finance and Infrastructure Policy Research. "Impacts of Design-Build on the Public Workforce." Keston Institute for Public Finance and Infrastructure Policy Research Paper 07-01, April 2007, 48pp. [Online]. Available: <http://www.usc.edu/schools/sppd/keston/research/index.html> [June 1, 2011].

- Koch, J.E., D.D. Gransberg, and K.R. Molenaar. *Project Administration for Design-Build: A Primer for Owners, Engineers, and Contractors*, ASCE Press, Reston, Virginia, 2010, 286 pp.
- Kraft, E., H. Park, and Gransberg, D.D. "Performance Bond: Cost Benefit, and Paradox for Public Highway Agencies." *Transportation Research Record*, No. 2408, *Journal of the Transportation Research Board*, National Academies, 2014, pp. 3-9.
- Lee, J. "CM/GC at Oregon DOT." Presentation, WASHTO Conference, Portland Oregon 2008, 14 pp.
- Lopez del Puerto, C., D.D. Gransberg, and J. S. Shane. "Comparative analysis of owner goals for design/build projects." *Journal of Management in Engineering*, 24(1), 2008, pp. 32-29.
- Loulakis, M.C., Smith, N.C., Brady, D.L., Rayl, R.E., and Gransberg D.D. (2015). *Liability of Design-Builders for Design, Construction, and Acquisition Claims*, NCHRP Legal Digest 68, Transportation Research Board, National Academies, Washington, D.C., 127 pp.
- Loulakis, M.C., Wagner, B.P. and Splan, H.C. "Differing Site Conditions." Chapter 11 of *Construction Claims Deskbook*. Brams, R.S. and Lerner, C. Aspen Law and Business, New York, 1995, pp. 131-166.
- Loulakis, M.C. and Shean, O. J. "Risk Transference in Design-Build Contracting." *Construction Briefings*, 2nd series, Federal Publications, Washington, DC, 1996, *Construction Briefings*, 2nd series, Federal Publications, Washington, DC, 1996, 12 pp.
- Loulakis 2001 Cushman, R.F. and Loulakis, M.C. *Design-build Contracting Handbook, 2nd Edition*, Aspen Publishers, New York, 2001, 603 pp.
- Mahdi, I.M., Alreshaid, K. (2005). "Decision Support System for Selecting the Proper Project Delivery Method Using Analytical Hierarchy Process." *International Journal of Project Management*, 23, pp. 564-572.
- McMinimee, J.C. et al. *Best Practices In Project Delivery Management* NCHRP Project 20-68A, Scan 07-01, TRB, 2009, 137 pp.
- McLawhorn, N. "Implementing Design-Build." *Transportation Synthesis Report*, Wisconsin Department of Transportation RD&T Program, Madison, Wisconsin, 2003, 9 pp.
- McLain K., Gransberg, D.D., and Loulakis, M.A. "Design-build geotechnical risk mitigation tools." *Australasian Journal of Construction Economics and Building*, 14(12), 2014, pp. 1-19.
- Mendez, V. "Every Day Counts: Innovation Initiative." *Federal Highway Administration*, Washington, DC, 2010, pp. 1-2.
- Minchin, E., K. Thakkar, K., and R. Ellis. "Miami Intermodal Center-Introducing CM-At-Risk to Transportation Construction." in *Innovative Project Delivery Systems*, Molenaar, K.R. and Yakowenko, G. (Eds), ASCE Press, 2007, pp. 46-59.
- Molenaar, K., Vanegas, J., and Martinez, H. (2000). "Appropriate risk allocation in design-build RFPs," *Construction Congress VI: Building Together for a Better Tomorrow in an Increasingly Complex World*, Proceedings of the Congress, Florida, 2000, pp. 1083 - 1092.

Molenaar, K.R. A.D. Songer, and M. Barash. "Public-Sector Design/Build Evolution and Performance." *Journal of Management in Engineering*, ASCE, Vol. 15, No.2, 1999, pp. 54-63.

Molenaar, K.R., and D.D. Gransberg, "Design-builder Selection for Small Highway Projects." *Journal of Management in Engineering*. ASCE, Vol. 17, (4), 2001, pp. 214-223.

Molenaar, K., D. Gransberg, S. Scott, D. Downs, and R. Ellis. Recommended AASHTO Design-Build Procurement Guide: Final Report, Project No. 20-7/TASK 172, National Cooperative Highway Research Program Transportation Research Board National Research Council, Aug. 2005, 101 pp.

National Society of Professional Engineers (NSPE). "Design/Build in the Public Sector." NSPE Board of Directors, Position Statement #1726, 1995 [Online]. Available: <http://www.nspe.org/govrel/gr2-ps1726.asp> [November 17, 2006].

Papernik, B.G. and Farkas, D.J. "Using Alternative Technical Concepts to Improve Design-Build and PPP Procurements." Nossaman E-Alerts, [Online]. Available: <http://www.nossaman.com/using-alternative-technical-concepts-improve-designbuild-ppp>, [May 26, 2011].

Pappe, R.S. "ODOT's Design-build Program," Presentation, American Council of Engineering Companies Conference, Salem, Oregon, 2008. [Online]. Available: [http://www.oregon.gov/ODOT/HWY/MPB/docs/designbuild/Design\\_Build\\_Conversation\\_041508.pdf?ga=t](http://www.oregon.gov/ODOT/HWY/MPB/docs/designbuild/Design_Build_Conversation_041508.pdf?ga=t) [June 2, 2011]

Park, R.R. "CMGC Experience and Lessons Learned." Presentation at FHWA CMGC Peer Exchange, Boston, Massachusetts, May 2012.

Peters, M. "An Important Project." Canal Road Intermodal Connector Meeting, Gulfport, Mississippi, 2003 [Online]. Available: <http://www.fhwa.dot.gov/pressroom/re031021.htm> [September 16, 2006].

Phipps, A. R. "Maine Builds Longest-Span Precast Segmental Bridge with Unique Design-Build Selection Process." *Transportation Research Record: Journal of the Transportation Research Board*, No. 1696, TRB, National Research Council, Washington, D.C., 2000, pp. 71-76.

Postma, S.E., R. Cisneros, J. Roberts, R. Wilkison, J. Clevenger, A. Eastwood. I-15 Corridor Reconstruction Project Design/Build Evaluation 2001 Annual Report: Report No. UT-02.11. Utah Department of Transportation Research Division, Salt Lake City, UT, April 2002, 36 pp.

Potter, J.M., and D.K. McMahon. *Selecting a Quality Control/Quality Assurance Program for a Mega Design-Build Project*. Rummel, Klepper, and Kahl, LLP, Baltimore, Maryland, 2006, 12 pp.

Pulver, B. "Maine DOT Accelerated CMGC." Presentation, 2012 CMGC Peer Exchange, Boston, Massachusetts, May 2012.

Scheepbouwer, E. and Humphries, A.B. "Transition in Adopting Project Delivery Method with Early Contractor Involvement." *Transportation Research Record: Journal of the Transportation Research Board*, No. 2228, Transportation Research Board of the National Academies, Washington, D.C., 2011, pp. 44-50.

- Schierholz, J. D.D. Gransberg, and J. McMinimee. "Benefits and Challenges of Implementing Construction Manager/General Contractor Project Delivery: The View from the Field." 2012 *Transportation Research Record, Journal of the Transportation Research Board* Paper #12-1206, National Academies, January 2012.
- Schnell, B., Hillner, L., Jackson, W. and Leight, S. "I-270/Dorsett Road Interchange Design Options." Missouri DOT - St. Louis District, 2008, 27pp. [http://www.teamstl.org/Presentations/Meeting012208\\_DorsettDDI.pdf](http://www.teamstl.org/Presentations/Meeting012208_DorsettDDI.pdf) [May 26, 2011].
- Science Applications International Corporation (SAIC), Outsourcing of State DOT Capital Program Delivery Functions NCHRP Web Document 59 (Project 20-24[18]), Contractor's Final Report November 2003. [Online]. Available: [http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_w59.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w59.pdf), [April 9, 2012].
- Septelka, D. and S. Goldblatt. "Survey of General Contractor/Construction Management Projects in Washington State." State of Washington Joint Legislature Audit and Review Committee Report, Olympia, Washington, 2005, 117 pp.
- Scott, S, Molenaar, K.R., Gransberg, D.D., and Smith, N. Best Value Procurement for Highway Construction Projects, National Cooperative Highway Research Program Report 561, Transportation Research Board, National Academies, September 2006, p. 103.
- Shane, J.S., Strong, K., and Gransberg, D.D. Draft Guidebook for Managing Complex Projects, Transportation Research Board, National Academies, Washington, D.C. July 2011, 130 pp.
- Shane, J.S. Gransberg, D.D. and Strong, K. "Project Delivery Method Impact on Final Project Quality: Perceptions in the Transportation Industry." 2011 Transportation Research Board, Paper # 11-0937, National Academies, Washington, D.C. January 2011.
- Shane, J. and D.D. Gransberg. Coordination of the Design Contract with the Construction Manager-at-Risk Preconstruction Service Contract. In *Transportation Research Board: Journal of the Transportation Research Board*, No. 2151, Transportation Research Board of the National Academies, Washington, D.C., 2010, pp. 55-59.
- Shane, J.S., D.D. Gransberg, K.R. Molenaar, and J.R. Gladke. "Legal Challenge to a Best-Value Procurement System." *Journal of Leadership and Management in Engineering*, ASCE, Vol. 5, Iss. 1, January, 2006, pp. 1-6.
- Siebels, J.E. "Implementation of Design-Build Guidelines." Memo to Regional Transportation Directors Program Engineers, Colorado Department of Transportation, August 8, 1997, 2 pp.
- Songer, A.D. and Molenaar, K.R. "Selecting Design-Build: Private and Public Sector Owner Attitudes." *ASCE Journal of Engineering Management* Vol. 12, Iss. 6, 1996, pp. 47-53.
- Strong, K. Performance Effectiveness of Design-Build, Lane Rental, and A + B Contracting Techniques: Final Report, Report No. MN/RC-2006-09, Minnesota Department of Transportation, St. Paul, Minnesota, March 2006, 74 pp.
- Strong, K. C., J. Tometich and N. Raadt. "Cost Effectiveness of Design-Build, Lane Rental, and A + B Contracting Techniques." Proceedings of the 2005 Mid-Continent Transportation Research Symposium, Iowa State University, Ames Iowa, August 2005, 10 pp.



- Touran, A. "Owners Risk Reduction Techniques Using a CM," CMAA Research Report, Construction Management Association of America, Washington, DC, 2006, 55 pp.
- Touran, A. D.D. Gransberg, K.R. Molenaar, K. Ghavamifar, and P. Bakhshi. "A Guidebook for Airport Capital Project Delivery Methods." Airport Cooperative Research Program A01-05, Interim Report, Transportation Research Board, National Academies, Washington, D.C., 2008, pp. 17-19.
- Touran, A., D.D. Gransberg, K.R. Molenaar, K. Ghavamifar, D.J. Mason, and L.A. Fithian. A Guidebook for the Evaluation of Project Delivery Methods, TCRP Report 131, Transportation Research Board, National Academies, Washington, D.C., 240 pp.
- Transportation Research Board (TRB). "Innovative Contracting Practices." Transportation Research Circular 386, National Research Council, 1991, Washington, D.C., pp. 1-74
- Trauner Consulting Services. "Innovative Procurement Practices Alternative Procurement and Contracting Methods." California Department of Transportation Report No. 53A0104 Sacramento, California, 2007, pp. 10-12
- U.S. Army Corps of Engineers (USACE), MILCON Transformation Model RFP, Department of the Army, Washington, DC, 2006 [Online]. Available: <ftp://ftp.usace.army.mil/pub/hqusace/MILCON%20TRANSFORMATION/> [April 14, 2007].
- Warne et al. "Design-Build: A Quality Process." Transportation Research Circular E-C090, TRB, National Research Council, Washington, D.C., January 2006, 17 pp.
- West, N.J.N., D.D. Gransberg, and J. McMinimee. "Effective Tools for Projects Delivered Using the Construction Manager/General Contractor." *Transportation Research Record No. 2268, Journal of the Transportation Research Board*, National Academies, 2012, pp. 33-42.
- Wiss, R.A., R.T. Roberts, and S.D. Phraner. "Beyond Design-Build-Operate-Maintain New Partnership Approach Toward Fixed Guideway Transit Projects." *Transportation Research Record 1704, Paper No. 00-0675, Transportation Research Board*, National Research Council, Washington, D.C., 2002, pp. 13-18.
- Yakowenko, G. and Actis, C. "Alternative Technical Concepts." Every Day Counts 2, US Department of Transportation, Federal Highway Administration, 2012, On-line, Available: <http://www.fhwa.dot.gov/accelerating/presentations/atc/> [April 21, 2013].
- Yu, W., and K. Wang. (2012). "Best Value or Lowest Bid? A Quantitative Perspective." *Journal of Construction Engineering and Management*, ASCE, Vol. 138, No. 1, 2012, pp. 128-134.

### **7.3.2 Public Agency Document References**

American Association of State Highway and Transportation Officials (AASHTO) AASHTO Guide for Design-Build Procurement, American Association of State Highway and Transportation Officials, Washington, D.C., January 2008, p. 58.

American Association of State Highway and Transportation Officials (AASHTO) AASHTO Guide for CM/GC Contracting (Final Draft), American Association of State Highway and Transportation Officials, Washington, D.C., (2015), 82 pp.

Alaska Department of Transportation and Public Facilities (ADOT&PF). Guidebook for Design-Build Highway Project Development. December, 2005, 58 pp.

Arizona Department of Transportation Intermodal Transportation Division (Arizona DOT). Design-Build Procurement and Administration Guide, 2nd Edition, ADOT Construction Group, Phoenix, December 2001 [Online]. Available: <http://www.azdot.gov/Highways/ConstGrp/DesignBuildGuide.asp> [January 24, 2007].

Arizona Department of Transportation (Arizona DOT). Contracts and Specifications Section and Engineering Consultants Section Design Build Package Request for Statements of Qualifications and Requests for Proposals: Cortaro Road Interchange MP 245.8, Pima County, Arizona Department of Transportation, Phoenix, 1997.

Arizona Department of Transportation (ADOT) Valley Freeway Loop 303 Project Website, ADOT, Phoenix, Arizona, 2012, [Online]. Available: [http://www.azdot.gov/Highways/ValleyFreeways/Loop\\_303/North/PDF/Loop303\\_Map\\_printable.pdf](http://www.azdot.gov/Highways/ValleyFreeways/Loop_303/North/PDF/Loop303_Map_printable.pdf)

Arizona Procurement Code. "Emergency/Competition Impracticable Procurement." Chapter. 23, Article 3. Amended April 6, 2006. 152 pp.

Arkansas Department of Transportation (Arkansas DOT), Design-Build Guidelines and Procedures, Little Rock, April 2006.

California Department of Transportation (Caltrans) Construction Manual, Caltrans, Sacramento, California, 2013a, pp. 5-4.4-5-4.5, [Online] Available: <http://www.dot.ca.gov/hq/construc/manual2001/mct13-7.pdf>

California Department of Transportation (Caltrans). Request for Qualifications State Route 140 Ferguson Slide Restoration CMGC Projects. Division of Procurement and Contracts, Dec. 5, 2013b.

California Department of Transportation (Caltrans). Request for Qualifications State Route 99 Ferguson Slide Restoration CMGC Projects. Division of Procurement and Contracts, Oct. 1, 2013c.

California Department of Transportation (Caltrans), "Design-Build Demonstration Program." Web Document, Caltrans, Sacramento, California, 2011, [Online] Available: <http://www.dot.ca.gov/hq/oppd/designbuild/db.htm> [October 10, 2011]

California Department of Transportation (Caltrans). Invitation for Bid # 06A1964 Notice to Prospective Contractors. Division of Procurement and Contracts, Apr. 15, 2014.

Central Federal Lands Highway Division (CFLHD). Request for Proposals, Solicitation #: DTFH68-12-R-00004, Expedite Roadway Surfacing, Resurfacing, and Repair Contracts. FWHA, Mar. 3, 2012.

City and County of Honolulu (CCH). "Honolulu High-Capacity Transit Corridor Project Draft Environmental Impact Statement: Appendix C - Construction Process." City and County of Honolulu, Hawaii, 2008, pp. 2-9.

Colorado Department of Transportation (CDOT). Design-Build Manual. Denver, April 16, 2006, 46 pp.



STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART A: REFERENCES

---

Colorado Department of Transportation (CDOT). Request for Proposal, Book 1, Southeast Corridor Multi-modal Project, RFP No. 11584, Colorado Department of Transportation, Denver, Colorado, 2000.

Colorado Department of Transportation (CDOT). Design-Build Guidelines. Denver, August 1, 1997.

Delaware Department of Transportation (DelDOT). Special Experiment Project No. 14 (SEP-14) Alternative Contracting. DelDOT, Apr. 2013.

Delaware Department of Transportation (DelDOT). Indian River Inlet Bridge RFP. DelDOT, 2008.

Eastern Federal Lands Highway Division (EFLHD), Request for Proposals IBC-8888(012) Book 1, Federal-aid Project No. IBC-8888(012), District of Columbia Department of Public Work, 2001.

Federal Acquisition Regulation (FAR). "Two Phase Design Build Selection." *Federal Register* Vol. 62, No. 1, 62 FR 271, 1997.

Federal Highway Administration (FHWA), SEP-15 Program – Public Private Partnerships, USDOT Federal Highway Administration, Washington, D.C., 2007, [Online]. Available: <http://www.fhwa.dot.gov/PPP/sep15.htm> [June 3, 2007].

Federal Highway Administration (FHWA), Design-Build Effectiveness Study – As Required by TEA-21 Section 1307(f): Final Report, USDOT Federal Highway Administration, Washington, D.C., January 2006, 215pp. [Online]. Available: <http://www.fhwa.dot.gov/reports/designbuild/designbuild0.htm> [August 30, 2006].

Federal Highway Administration (FHWA). Construction Program Guide, Construction Management/General Contractor Project Delivery. FHWA, 2014, On-line, Available at: <http://www.fhwa.dot.gov/construction/cqit/cm.cfm> [May 20, 2014].

Federal Register. "Federal Highway Administration, Design-Build Contracting: Final Rule" December 10, 2002, Volume 67, No. 237, pp. 75902 – 75935.

Federal Transit Administration "Tri-Met's Construction Manager/General Contractor Approach Lessons Learned 44." Publication 1363, Washington D.C., 2003 [Online]. Available: [http://www.fta.dot.gov/printer\\_friendly/publications\\_1363.html](http://www.fta.dot.gov/printer_friendly/publications_1363.html) [accessed June 1, 2010].

Florida Department of Transportation (FDOT). Request for Proposal for Districtwide Traffic Operations Design-Build Push Button Contract. FDOT, Jun. 1, 2009.

Florida Department of Transportation (FDOT). District 7 Design-Build Push Button Contract. Unpublished presentation, May 12, 2011, P. 31, On-line, Available at: [http://modot.org/business/outdoor\\_advertising/documents/AASHTO%20Presentations%202011/Florida\\_Design%20Build%20Push.pdf](http://modot.org/business/outdoor_advertising/documents/AASHTO%20Presentations%202011/Florida_Design%20Build%20Push.pdf) [June 1, 2014]

Florida Department of Transportation (FDOT). Design-Build Guidelines. Tallahassee, February 8, 2006.

Florida Department of Transportation (FDOT). "Alternative Technical Concepts Reviews." FDOT Design-build Guidelines, Vol. 2, February 4, 2011, WWW document available at <http://www.dot.state.fl.us/construction/designbuild/DBDocuments/RFPDocs/AlternativeTechnicalConcepts.pdf> [May 26, 2011]

Florida Department of Transportation (FDOT). Request for Proposal, Milling and Resurfacing of Interstate 95, Financial Projects NO. 409846-1-52-01; Federal-aid Project NO. 0953 102 I; Contract NO. E-5F84, District 5, Florida Department of Transportation, Tallahassee, 2003.

Florida Department of Transportation and Federal Highway Administration, State of the Practice Review in Design-Build, 2002 [Online]. Available: <http://www.dot.state.fl.us/construction/Design%20Build/DB%20General/State%20of%20Practice%20D-B.doc> [August 26, 2006].

Florida Department of Transportation (FDOT). Interstate 75 over the Peace River Bridges Design/Build Deck Replacement and Widening Project Design and Construction Criteria, Description: I-75, Peace River Bridge Charlotte County Financial Project ID #: 404697 1 52 01, Charlotte County, Florida Department of Transportation, Tallahassee, Florida, 2001.

Georgia Department of Transportation (GDOT). Design-Build Manual. GDOT, 2010.

Idaho Transportation Department (ITD). Request for Qualifications for Term Agreement for Consultant Services. ITD, Nov. 2013.

Indiana Department of Transportation (INDOT). Fiber Optics Shared Resources Project, Request for Proposals. INDOT, 2000.

Iowa Department of Transportation (Iowa DOT). 3 Year On-Call Contract – Threatened and Endangered Species Services, Request for Proposals. Iowa DOT, 2011.

Kansas Department of Transportation (KDOT). Design-Build Policy Guide. KDOT, 2003.

Kentucky Transportation Cabinet (KYTC), Request for Proposals, Wilson Road DB Project, KYTC, 2006.

Maine Department of Transportation, (Maine DOT). Request for Proposals, Caribou Connector New Highway and Bridge Construction Design-build Project, Project No. HPP-STP-6462-500; Maine Department of Transportation, Augusta, Maine October 13, 2010.

Maine Department of Transportation, (Maine DOT). Request for Proposals, I-295 Commercial Street Connector, FHWA Project No. IMD-7589(300); MDOT Project No. 7589.30, Maine Department of Transportation, Augusta, 2003.

Maine Department of Transportation (Maine DOT). Request for Proposals, Design-Build Services for Memorial Bridge Replacement Project, Maine DOT, Montpelier, Maine, 2011, p. 57.

Maine Department of Transportation (MaineDOT). On Call Paving Services (No Pin Project) Statewide. Maintenance and Operations, Nov. 2011.

Maryland State Highway Administration (MSHA). Request for Proposals, MD-24 CMAR Project, MSHA, 2013, 126 pp.

Mass Transit Administration (MTA) of the Maryland Department of Transportation. “Lesson 27: Quality Assurance and Quality Control on A Design/Build Transit Project.” Project Management Oversight Lessons Learned References in Guidelines FTA Pub 1380, 1997 [Online]. Available: [http://www.fta.dot.gov/printer\\_friendly/publications\\_1380.html](http://www.fta.dot.gov/printer_friendly/publications_1380.html) 8-22-06 [September 14, 2006].

- Massachusetts Highway Department (Mass Highway). Design Build Procurement Guide. Massachusetts Highway Department, Boston, Massachusetts, January 19, 2006.
- Massachusetts Department of Transportation (MassDOT). Longfellow Bridge Rehabilitation Phase II Request for Proposals. Boston, Massachusetts, 2012, p. 2.
- Michigan Department of Transportation (MDOT), SEP-14 Work Plan: M-222 Slope Stability CMGC Project, MDOT, Lansing, MI 2011, p. 7.
- Michigan Department of Transportation (MDOT), SEP-14 Work Plan: Zilwaukee Bridge Bearing Replacement CMGC Project, MDOT, Lansing, MI, 2011, p. 11.
- Minnesota Department of Transportation (MnDOT), "MnDOT's Response to National Transportation Safety Board Recommendations." I-35W Bridge in Minneapolis, November 2008, <http://www.dot.state.mn.us/i35wbridge/> [December 22, 2008]
- Minnesota Department of Transportation (MnDOT). "Approach to Alternative Technical Concepts." MnDOT Design-Build Program White Paper No. MN-11, St. Paul, Minnesota, August 12, 2003, p. 1.
- Minnesota DOT (Mn/DOT), Request for Proposals, Book 1 - TH 61 Hastings Bridge Design-Build Project S.P. 1913-64, Minnesota DOT, Metro District, St. Paul, Minnesota, January 13, 2010, p. 7.
- Minnesota Department of Transportation (Minnesota DOT). Addendum 5 Project Management Book 2B, Trunk Highway 52 Oronoco Design-Build Project, St. Paul, Minnesota 2005.
- Minnesota Department of Transportation (Minnesota DOT). T.H. 52 (Rochester) Design-Build Request for Proposals S.P. 5502-85 Part 1: Scope of Work, District Six - Rochester, Minnesota Department of Transportation, Rochester, 2002.
- Minnesota Department of Transportation (Minnesota DOT). Request for Qualifications T.H. 52 Design-Build Project S.P. 5502-67, 5507-45, 5508-78; HPPMN45(101), NH014(308), District Six - Rochester, Minnesota Department of Transportation, Rochester, 2001a.
- Minnesota Department of Transportation (Minnesota DOT). Part I: Scope of Work T.H. 100-Duluth St. S.P. 2735-172, Design-Build Request for Proposals, Minnesota Department of Transportation, St. Paul, Minnesota, 2001b.
- Minnesota Department of Transportation (MnDOT). Indefinite Delivery/Indefinite Quantity Implementation Guide. Office of Construction and Innovative Contracting (OCIC), 2014.
- Mississippi Department of Transportation (Mississippi DOT). Request for Proposals, Addendum 1, A Design-Build Project Bridge Replacement on US 90 Biloxi to Ocean Springs Bridge Jackson and Harrison Counties, Mississippi, Contract No. ER/BR-0003-01(099) 104556/301000 -Biloxi/Ocean Springs Bridge, Mississippi Department of Transportation, Jackson, 2005a.
- Mississippi Department of Transportation (Mississippi DOT). Request for Proposals, Addendum 1, A Design-Build Project Bridge Replacement on US 90 Over St. Louis Bay Hancock and Harrison Counties, Mississippi, Project No. ER/BR-0003-01(098) 104555/301000 - US 90 St. Louis Bay Bridge Replacement, Mississippi Department of Transportation, Jackson, Mississippi, 2005b.

Missouri Department of Transportation (Missouri DOT). Final Request for Proposals, for The New I-64 Design-Build Project, Project Number J6I0978, Book 1, Missouri Department of Transportation, Chesterfield, Missouri, 2006.

Missouri Department of Transportation. (MoDOT). The Bridge Improvement Project Request for Proposals, Instructions to Proposers: Design Build Contract Draft - October 29, 2008 32pp.

Missouri DOT (MoDOT). "Hurricane Deck Bridge Replacement Project, ATC Meeting." February 10, 2011. On-line: Available at: [http://www.modot.org/central/major\\_projects/camden.htm](http://www.modot.org/central/major_projects/camden.htm)

Missouri DOT (MoDOT). Alternate Technical Concept (ATC) Process for the MRB Missouri I-70 Interchange Project J6U1086," August 27, 2010. On-line: Available at: <http://www.newriverbridge.org/documents/MRBMoInterchangeATCConcept9-27-10.pdf>

Missouri Department of Transportation (MoDOT). Job Number: J2I2165T, Various Counties. Missouri Highways and Transportation Commission, 2010.

Montana Department of Transportation (MDT). Design-Build Guidelines, MDT, Helena, Montana, April 14, 2008, p. 34.

Montana Department of Transportation (MDT). Design-Build Request for Proposal US 2 – Rockfall Mitigation, Flathead County, Project # SFCN 1-2(169)154, Montana Department of Transportation, Helena, Montana, March 25, 2011, 39 pp.

Nevada DOT (NDOT). Request for Proposal SR 28 CM-at-Risk Project, NDOT, 2016, 187pp.

New Mexico State Highway and Transportation Department (NMSHTD). Request for Proposals, US70 Hondo Valley, AC-MIP-070-41(35) 264, New Mexico State Highway and Transportation Department, Santa Fe, 2001.

New York City Department of Transportation (NYCDOT). Design, Construction and Construction Support Services for the Rehabilitation of the Northbound and Southbound Bruckner Expressway Bridges over CSX and Amtrak, Request for Proposal, Contract No. HBX1123, PIN 84107BXHR171, NYCDOT, New York, November 20, 2007, p. 26.

New York State Department of Transportation (NYSDOT). Design-Build Procedures Manual, Volume 1, Albany, September 2005, 141 pp.

New York State Department of Transportation (NYSDOT). Work Plan for Utilizing Job Order Contracting for Bridge Preservation and Maintenance. NYSDOT, Nov. 26, 2007a.

New York State Department of Transportation (NYSDOT). Statewide Emergency Bridge Contract: Guidance, NYSDOT Engineering Instruction EI 07-012. NYSDOT, Albany, 2007b, pp. 1-3.

New York State Department of Transportation (NYSDOT). Proposal D261160. NYSDOT, May 21, 2009.

New York State Department of Transportation (NYSDOT). NYSDOT/FHWA SEP 14 Pilot Program, Job Order Contracts for Bridge Maintenance. NYSDOT, March, 2012.

STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART A: REFERENCES

---

North Carolina Department of Transportation (NCDOT). Design-Build Package: I-77 South of SR 1225 to US 21, Contract ID: C 201269, Yadkin County, North Carolina Department of Transportation, Raleigh, 2006a.

North Carolina Department of Transportation (NCDOT). Design-Build Package: NC 43 Connector, TIP R-4463B, Craven County, North Carolina Department of Transportation, Raleigh, 2006b.

North Carolina Department of Transportation (NCDOT). Design-Build Package: I-40 from West of SR 1224 (Monte Vista Road) To I-240 in Asheville, Contract ID: C 201277, Buncombe County, North Carolina Department of Transportation, Raleigh, 2005a.

North Carolina Department of Transportation (NCDOT). Design-Build Package: I-77 from I-485 to SR 2136 (Gilead Road) Exit 23, Contract ID: C 201288, Mecklenberg County, North Carolina Department of Transportation, Raleigh, 2005b.

North Carolina Department of Transportation (NCDOT). Design-Build Package: US64 Knightdale Bypass, Project No. 8.14021002; Federal-aid No. NHF-64(73), North Carolina Department of Transportation, Raleigh, 2002.

North Carolina Department of Transportation (NCDOT). Reconstruction of I-85 from North of NC 150 to Just North of I-85 Business, Request for Proposal, TIP I-2304AD, November 10, 2010, p. 12.

North Carolina Department of Transportation (NCDOT). Design-Build Policy & Procedures, Raleigh, January 6, 2000.

Ohio Department of Transportation (Ohio DOT). Request for Proposals, SR11, Project No. 3000-01; MAH-SR11-16.040; PID 18722, District 4, Ohio Department of Transportation, Ravenna, Ohio, 2001a.

Ohio Department of Transportation (Ohio DOT). Final Report: Six-State Survey of Construction Administration Practices and Procedures, Ohio Department of Transportation, Columbus, 2001b.

Oregon Department of Transportation (ORDOT). Request for Proposals, I-84 Quarry Bridges Section DB Project, ORDOT, 2002.

Pennsylvania Department of Transportation (PennDOT). Innovative Bidding Toolkit, PennDOT Publication 448, Bureau of Project Delivery, Harrisburg, Pennsylvania, 2011, 197 pp.

San Joaquin Hills Transportation Corridor Agency, Design/Build Services: San Joaquin Hills Transportation Corridor Entire Corridor IFB, No. S90-19, Transportation Corridor Agency, Costa Mesa, California, 1991.

South Carolina Department of Transportation (SCDOT). Procedures For Design-Build Procurement Of Department Of Transportation Highway Construction Projects (Best Value Process), Bureau of Administration, SCDOT, Columbia, SC, 2012, 6pp. <http://www.scdot.org/doing/designbuild.shtml>

South Carolina Department of Transportation (SCDOT). Design-Build Contract for the Replacement of the SC 700 Bridge Over the Stono River, Work Plan for SEP-14, South Carolina Department of Transportation, Columbia, South Carolina, 1996.



South Dakota Department of Transportation (SDDOT). Request for Proposals, Interstate 229, Project No. IM229-2(50)2; PCEMS No. 1231, South Dakota Department of Transportation, Pierre, South Dakota, 2000.

Tennessee Department of Transportation (TDOT). Design-Build Standard Guidance TDOT, 2009, 165 pp.

Texas Department of Transportation (TxDOT). Request For Proposals To Develop, Design, Construct, Finance, Operate And Maintain The North Tarrant Express, TxDOT, Austin, TX May 5, 2008, 80 pp.

Texas Turnpike Authority (TTA). Request for Proposals to Construct, Maintain and Repair the SH 130 Turnpike Through an Exclusive Development Agreement, Texas Turnpike Authority, Texas Department of Transportation, Austin, Texas, 2001.

Texas Turnpike Authority (TTA). SH 130 Turnpike Project Exclusive Development Agreement, Texas Turnpike Authority, Texas Department of Transportation, Austin, Texas, 2002.

U.S. Department of Transportation (USDOT). Request for Proposals, Natchez Trace Parkway (PRA-NPS 3P13), RFP NO. DTFH71-00-B-00008, U.S. Department of Transportation, Sterling, Virginia, 2001.

Utah Department of Transportation (UDOT). Request for Streamlined Proposal Construction Management/General Contractor (CMGC) Services, Project No. F-0014(34)6, SR-14; Landslide Emergency Repair, UDOT Salt Lake City, Utah, November 21, 2011, 32 pp.

Utah Department of Transportation (UDOT). Request for Proposals, SR-92; East of I-15 in Lehi, Utah County, Project No. STP-0092(5)1, Utah Department of Transportation, Orem, Utah, 2005.

Utah Department of Transportation (UDOT). Request for Proposals SR-201 Design-Build Project, Project No. SP-0201(5)13, Addendum #3, Utah Department of Transportation, Orem, Utah, 2004a.

Utah Department of Transportation (UDOT). Request for Proposals SR-265 – University Parkway at UVSC Project No. NH-0265(5)2, Utah Department of Transportation, Orem, Utah, 2004b.

Utah Department of Transportation (UDOT). Parley’s Crossing Tunnel @I-215 Project STP-LC35(123) Request for Proposal, Utah Department of Transportation, Orem, Utah, 2004c.

Utah Department of Transportation (UDOT). Request for Proposals, I-15 Corridor Reconstruction Project, Project No. \*SP-15-7(135)296, Utah Department of Transportation, Orem, Utah, 1997.

Utah Department of Transportation (UDOT). UDOT Project Development Performance Management, UDOT, 2015.

Utah Transit Authority (UTA). “CM/GC Peer Review Meeting,” Memorandum, Utah Transit Authority, Salt Lake City Utah, August 12, 2003, 34 pp.

Vermont Agency of Transportation (VTTrans). “Design-Build Contracting,” Montpelier, Vermont, 2010a, [Online] Available: <http://www.aot.state.vt.us/conadmin/DesignBuild.htm> [March 20, 2011].



Vermont Agency of Transportation (VTrans). Request for Qualifications, US Route Bridge Improvement, Bridge No. 24, Town of Richmond Vermont, VTrans Project No. Richmond STP-RS 0284(11), VTrans, Montpelier, Vermont, 2010b, 46 pp.

Virginia Department of Transportation (VDOT). "General Conditions of Contract Between Department and Design-Builder." Design-Build Standard Template Documents, VDOT, Richmond, Virginia, 2010, 187pp. [Online]. Available: [http://www.virginiadot.org/business/resources/ipd/2010\\_TemplateDocuments\\_100511.pdf](http://www.virginiadot.org/business/resources/ipd/2010_TemplateDocuments_100511.pdf); [July 8, 2011]

Virginia Department of Transportation (VDOT). Quality Control, Quality Assurance, Independent Assurance and Independent Verification Guide for use on Public-Private Transportation Act & Design Build Projects. Richmond, Virginia, March 28, 2007, 30 pp.

Virginia Department of Transportation (VDOT). Request for Proposals, A Design-Build Project Approaches and Bridge over Garden Creek Canal (Route 609) Mathews County, Virginia, Project No. 0609-057-140, P106, M501, B601, R201, Mathews County, Virginia Department of Transportation, Richmond, 2006a.

Virginia Department of Transportation Innovative Project Delivery Division (VDOT). Design-Build Procurement Manual (In Draft Format), Richmond, November 12, 2004 Revised June 30, 2006b.

Virginia Department of Transportation (VDOT). Request for Proposals, A Design-Build Project Design and Construction of a Safety Rest and Information Center on I-64 Eastbound in New Kent County, State Project #: 0064-063-F08, PE102, L802, New Kent County, Virginia Department of Transportation, Richmond Virginia, 2002.

Washington State Department of Transportation (WSDOT). Guidebook for Design-Build Highway Project Development, Olympia, June 20, 2004a, 85 pp.

Washington Department of Transportation (WSDOT). Request for Proposals, Everett HOV Design-build Project, Washington Department of Transportation, Olympia, Washington, 2004b.

Washington State Department of Transportation (WSDOT). Request for Proposals, Thurston Way Interchange, SR500 MP3.15 to MP 4.73, Clark County, Washington Department of Transportation, Kelso, Washington, 2000.

Washington State Ferries (WSF). "Request For Proposals General Contractor/Construction Manager (GC/CM) Anacortes Multimodal Terminal, Washington State Ferries Project No. XL 1714, Washington State Ferries, Terminal Engineering, Seattle, Washington, February 2005, 11 pp.

West Virginia Division of Highways (WVDOH). Policies and Procedures Concerning Design-Build Projects, West Virginia DOT, Charleston, WV, 2011, p. 3.

Wisconsin Department of Transportation (WiDOT). Asphaltic Pavement Warranties: Three-Year Progress Report, Wisconsin Department of Transportation, Madison, Wisconsin, 1998.

#### **7.4 CHAPTER 5: STAFFING AND ENGINEERING PIPELINE**

NCHRP Synthesis Report 246: Outsourcing of State Highway Facilities and Services (1997).

NCHRP Synthesis 313: State DOT Outsourcing and Private-Sector Utilization (2003).

## APPENDIX A

### STATE DOT INTERVIEW GUIDE/QUESTIONS

#### INTRODUCTION

The Connecticut Academy of Science and Engineering is conducting a study on behalf of the Connecticut Department of Transportation on Strategies for Improving Transportation Project Delivery Performance.

Research for the study includes identifying effective practices of other states and regions and the tools and methods other states and regions use to assess their progress in achieving project deliverability performance. Of particular interest are

- Effective organizational strategies used by state DOTs to build their capacity to use various project contracting methodologies
- Effective practices for selecting a project contracting methodology
- Performance metrics used to identify progress in improving project delivery to aid the department in continually improving its project delivery performance

CASE appreciates your willingness to speak with the Research Team about your department's practices. For your consideration in preparation for the interview, see below the STATE DOT INTERVIEW GUIDE/QUESTIONS.

See the following for more information about the study:

- Study Scope of Work
- List of Study Committee Members, CTDOT and Connecticut Department of Energy and Environmental Protection Study Contacts, and Interested Parties

#### STATE DOT INTERVIEW GUIDE/QUESTIONS

- *General Information*
  - On average over the past five years, what is the value of your Capital Program and what are the future projections?
  - How does the dollar value translate into total projects per year and what percent of the total projects use alternative project delivery contracting methods?
  - What does your state's legislation allow with regard to alternative project delivery contracting methods?
- *Organizational Structure*

- o Does the department have a special office(s) for procurement, design, oversight, and/or inspection for alternative project delivery?
- o Does the department have a special office(s) that manages processes related to utilities, rights of way and environmental issues or is this process imbedded in the design or construction office?
  - ◇ Are utilities and rights of way significant issues in your capital program?
  - ◇ Have you tried non-traditional strategies to assure that rights of way and utilities do not delay project schedules?
- o Does the department have any problems hiring and retaining staff?
  - ◇ Does the department have multiple career paths for engineers?
  - ◇ Are there specific educational requirements for any positions?
  - ◇ Does the department have any specific shortage areas?
  - ◇ Does the department have the authority to hire “consultants” to cover shortages or gaps in staffing?
  - ◇ Are consultants utilized for the development or implementation of alternative project delivery contracting methodologies?
  - ◇ Is there a cap or other restrictions placed on the use of consultants?
- ***Project Delivery Contracting Method Selection Process***
  - o Are all projects reviewed for suitability of alternative project delivery contracting methods or just certain types of projects?
    - ◇ At what point in the project development timeline are projects reviewed for suitability?
    - ◇ Is there a standard process, with standard rubrics, used in the evaluation process?
  - o Who determines which projects will use an alternative project delivery contracting methodology?
- ***Performance Metrics***
  - o How does your department measure project success?
  - o Are projects measured against a standard or each other?
  - o Is any effort made to compare alternative delivery method projects to standard projects?
- ***Budgetary Considerations***
  - o Do you pay stipends for contractors that submit proposals for DB or CMGC/CMAR?
  - o If so, how do you determine the stipend?

- o What is the average percent of stipend based on the total project cost?
- *Contractor Engagement*
  - o Is there a pool of contractors that you work with on a regular basis, particularly regarding alternative project delivery contracting methods?
  - o How are potential contractors solicited and selected?
  - o What strategies have you utilized to increase contractor participation in the department's alternative project delivery contracting program?

## APPENDIX B

### Connecticut General Statutes

#### Title 13a; Chapter 238: Highway Construction and Maintenance

*(2016 Supplement to the General Statutes of Connecticut; Revised to January 1, 2016)*

**Sec. 13a-95b. Designation of projects using construction-manager-at-risk or design-build contracts.** (a) The Commissioner of Transportation may, as an alternative to using a design-bid-build contract, designate specific projects to be completed using a (1) construction-manager-at-risk contract with a guaranteed maximum price, or (2) design-build contract.

(b) If the commissioner designates a project to use a construction-manager-at-risk contract with a guaranteed maximum price, the commissioner may have the project designed by department personnel or enter into a contract with an architect or engineer for the project design, and may also enter into a contract with a construction-manager-at-risk contractor who will provide input during the design process and may be responsible for the construction of the project. The commissioner may permit the contractor to self-perform a portion of the construction work if the commissioner determines that the construction manager general contractor can perform the work more cost-effectively than a subcontractor. All work not performed by the construction manager general contractor shall be performed by trade subcontractors selected by a process approved by the commissioner. The construction-manager-at-risk contract shall have an established guaranteed maximum price. In the event that a guaranteed maximum price cannot be agreed upon, the commissioner may elect to call for bids on the project as provided for pursuant to section 13a-95. The commissioner may select the architect, engineer or contractor from among the contractors selected and recommended by a selection panel. Any such contract for such project shall be based upon competitive proposals received by the commissioner, who shall give notice of the project, by advertising at least once, in a newspaper having a substantial circulation in the area in which the project is located, and may give notice on the Department of Administrative Services State Contracting Portal, or use other advertising methods likely to reach qualified construction manager general contractors. Award of any such contract shall be based upon the general conditions and staff costs plus qualitative criteria. The commissioner shall establish all criteria, requirements and conditions of such proposals and award and shall have sole responsibility for all other aspects of the project. Any contract shall clearly state the responsibilities of the contractor to deliver a completed and acceptable project on a date certain, the maximum cost of the project, and, if applicable, as a separate item, the cost of property acquisition.

(c) If the commissioner designates a project to use a design-build contract, the commissioner may enter into a single contract with the design-builder, who the commissioner may select from among the design-builders selected and recommended by a selection panel. The contract shall (1) include, but not be limited to, such project elements as site acquisition, permitting, engineering design and construction, and (2) be based on competitive proposals received by the commissioner, who shall give notice of the project and specifications for the project, by advertising, at least once, in a newspaper having a substantial circulation in the area in which the project is located, and, at the commissioner's discretion, on the Department of Administrative Services State Contracting Portal, and may use other advertising methods



likely to reach qualified design-build contractors. Award of the design-build contract shall be based on a predetermined metric provided to proposers in advance of technical proposal development. This metric may be unique to each project, but shall consist of a combined score of qualifications and past performance of the proposer, technical merit of the proposal and cost. The commissioner shall establish a selection panel for each project to score the qualifications and past performance and technical portion of the proposal using the predefined scoring metric. The sealed cost portion of the proposal shall be opened in a public ceremony only after the qualifications and past performance and technical portions of the proposals have been scored. The commissioner shall determine all criteria, requirements and conditions for such proposals and award and shall have sole responsibility for all other aspects of the contract. Such contract shall state clearly the responsibilities of the design-builder to deliver a completed and acceptable project on a date certain, the maximum cost of the project, and, if applicable, as a separate item, the cost of property acquisition.

*(P.A. 12-70, S. 1; P.A. 13-277, S. 14; June Sp. Sess. P.A. 15-5, S. 159.)*

*History: P.A. 12-70 effective June 6, 2012; P.A. 13-277 amended Subsec. (a) to delete "pursuant to this chapter", effective July 1, 2013; June Sp. Sess. P.A. 15-5 amended Subsec. (b) to allow project to be designed by department personnel, to permit the contractor to self-perform a portion of the work and to allow for bids where a guaranteed maximum price cannot be agreed upon and amended Subsecs. (b) and (c) to allow notice of projects to be posted on Department of Administrative Services State Contracting Portal or through other advertising methods, effective June 30, 2015.*

**Sec. 13a-95c. Commissioner's duties re construction-manager-at-risk and design-build contracts. Use of department employees and consultants.** (a) For any contract entered into pursuant to section 13a-95b, the Commissioner of Transportation shall: (1) Perform project development services. Such services may include, but need not be limited to, the size, type and desired design character of the project, performance specifications, quality of materials, equipment, workmanship, preliminary plans or any other information necessary for the department to issue a request for proposals, and (2) perform oversight of projects and provide inspection services, which shall include, but need not be limited to, inspection of construction, surveying, testing, monitoring of environmental compliance, quality control inspection and quality assurance audits.

(b) (1) After the first two projects performed with contracts authorized pursuant to section 13a-95b, the Commissioner of Transportation shall perform all development and inspection work, as described in subsection (a) of this section, using department employees. The commissioner may utilize consultants to perform the design of the project, if the commissioner determines, after conducting an assessment of project delivery schedule, staffing capacity and the technical expertise required, that the department lacks the capacity and technical expertise required to perform the design of a project designated to be constructed by a construction-manager-at-risk. For projects designated to be constructed using the design-build contracting method, the responsibility to perform detailed design work shall remain with the contractor. The Commissioner of Administrative Services shall place the positions required for this work on continuous recruitment pursuant to the provisions of section 5-216. In addition, employees may be appointed to durational positions to reduce the need for inspection or development work to be performed by consultants. Such employees may be appointed as engineers if they

have met the education, knowledge and training requirements required by the Department of Administrative Services job classification to durational positions without examination to reduce the need for inspection or development work to be performed by consultants. Any contract entered into with a consultant for the initial project bid in accordance with section 13a-95b shall contain a provision that provides for training the employees of the Department of Transportation in the process for bidding and managing projects entered into in accordance with section 13a-95b.

(2) Notwithstanding the provisions of subdivision (1) of this subsection, there shall be a transition period during which the Commissioner of Transportation may authorize the continued use of consultants if necessary to complete contracts authorized pursuant to section 13a-95b. During this period, the commissioner shall make all reasonable efforts to perform development and inspection work as described in subsection (a) of this section using, where such employees are available, department employees and reducing, and where possible eliminating, the dependency on outside consultants. The commissioner shall establish a program to train department employees to support alternative project delivery methods. Such training program may be provided in projects utilizing consultants, as provided for in this section. The commissioner shall report, on or before October first annually, to the Governor of the progress made in training employees in alternative project delivery methods, improving the diversity of technical expertise of employees and building internal project delivery capacity. The authority granted by this subdivision to use consultants on contracts entered into pursuant to section 13a-95b shall be subject to a termination date which shall be January 1, 2022, unless the Governor certifies that the use of consultants is necessary to complete projects authorized pursuant to section 13a-95b, which shall extend such termination date to a date not later than January 1, 2025.

*(P.A. 12-70, S. 2; June Sp. Sess. P.A. 15-5, S. 160.)*

*History: P.A. 12-70 effective June 6, 2012; June Sp. Sess. P.A. 15-5 amended Subsec. (b)(1) to allow use of consultants for design in certain circumstances, amended Subsec. (b)(2) to require a program to train department employees to support alternative project delivery methods and change deadline for use of consultants from the earlier of the date the Governor certifies consultants are no longer needed or January 1, 2019, to January 1, 2022, unless the Governor certifies that the use of consultants is necessary, which shall extend the deadline to January 1, 2025, and made technical changes, effective June 30, 2015.*

## APPENDIX C

### STUDY COMMITTEE MEETINGS AND GUEST SPEAKERS

The following is a list of study committee meetings, including presentations to the CASE study committee by guest speakers and the CASE Research Team. In the electronic version of this report, links to meeting proceedings are highlighted in blue.

#### OCTOBER 2, 2015 – MEETING 1

- **Welcome and Introductions:** Richard H. Strauss, Executive Director, CASE
- **CTDOT Speaker**  
Scott Hill, Engineering Administrator, Office of Engineering, CTDOT
- **Study Committee Member Presentation – [Presentation Materials](#)**  
Ken Robie, Project Delivery Bureau Director, Highway Division, VTrans  
*Topic: VTrans Bureau of Project Deliverability*
- **Guest Speaker – [Presentation Materials](#)**  
Michael Ruth, Ecologist, FHWA Office of Project Development & Environmental Review  
*Topic: Red Book: Synchronizing Environmental Reviews*
- **Research Team Presentation – [Presentation Materials](#)**
- **Committee Discussion and Next Steps**

#### NOVEMBER 13, 2015 – MEETING 2

- **Research Team Update – [Presentation Materials](#)**
- **Guest Speaker – [Presentation Materials](#)**  
Kenneth J. Hess, AICP, P.P., Principal Environmental Project Manager, Parsons  
*Topic: Environmental Permits on Design-Build Projects*
- **Guest Speaker – [Presentation Materials](#)**  
Keith R. Molenaar, PhD, K. Stanton Lewis Professor, Construction Engineering Management Program., Dept. of Civil, Environmental and Architectural Engineering, University of Colorado at Boulder  
*Topic: Project Deliverability Research*
- **Committee Discussion and Next Steps**

#### DECEMBER 11, 2015 – MEETING 3

- **Research Team Update – [Presentation Materials](#)**
- **Study Committee Member Presentation – [Presentation Materials](#)**  
MassDOT: Patricia Leavenworth, PE, Chief Engineer, Highway Division with Mike McGrath, PE, Deputy Chief Engineer for Construction  
*Topic: Alternative Contracting Methodologies - Successes and Challenges*

- **Guest Speakers – Presentation Materials**  
CDOT: Nabil Haddad, PE, Innovative Contracting Program Manager,  
Project Development and Jordan Rudel, Environmental Program Manager  
*Topic: Colorado's Experience Using Alternative Contracting Methodologies*
- **Committee Discussion and Next Steps**

#### JANUARY 29, 2016 – MEETING 4

- **Study Consultant Presentation – Presentation Materials**  
Douglas Gransberg, PhD, Donald F. and Sharon A. Greenwood Professor,  
Department of Civil, Construction and Environmental Engineering, Iowa  
State University  
*Topic: Best Practices in Project Deliverability*
- **Guest Speaker – Presentation Materials**  
Kenneth Avery, Water Resources Segment Leader, Bergmann Associates  
*Topic: Challenges, Techniques, and Results for Environmental Performance  
Using Design-Build and Implications for Other Alternative Delivery  
Pathways on Large Projects*
- **Guest Speakers**  
*Topic: Contractor Perspectives on Use of Alternative Project Delivery Contracting  
Methodologies*  
Kiewit Corporation: Michael Fischer, Business Development Manager –  
Presentation Materials  
Middlesex Corporation: Jim Reardon, Alternative Delivery Manager, and  
Dave Socci, Sr., Sr. Vice President Preconstruction – Presentation Materials
- **Research Team Update – Presentation Materials**
- **Committee Discussion and Next Steps**

#### FEBRUARY 26, 2016 – MEETING 5

- **Guest Speakers – Presentation Materials**  
MnDOT: Peter Davich, PE, Design-Build Program Manager and Hafiz  
Munir, Research Management Engineer  
*Topic: Experience in Achieving Enhanced Environmental Benefits Using  
Design-Build*
- **Guest Speaker – Presentation Materials**  
Chuck Parish, Project Manager, The Walsh Group  
*Topic: Contractor Perspective on Use of Alternative Project Delivery  
Contracting Methodologies*
- **Research Team Update – Presentation Materials**
- **Committee Discussion and Next Steps**

**MARCH 23, 2016 – MEETING 6**

- **Research Team Presentations**
  - Engineering Pipeline and Staffing/Outsourcing – [Presentation Materials](#)
  - Environmental Permitting Streamlining Activities and Environmental Permitting for Alternative Project Delivery Methods – [Presentation Materials](#)
- **Committee Discussion and Next Steps**

**APRIL 15, 2016 – MEETING 7**

- **Research Team Presentations**
  - State Interviews on Effective Practices – [Presentation Materials](#)
- **CTDOT Speaker**
  - Jim Fallon – [Presentation Materials](#)  
*Topic: Update on CM/GC Pilot Project*
- **Committee Discussion to Develop Findings and Concepts for Recommendations, and Next Steps**

**MAY 9, 2016 – MEETING 8**

- **CTDOT Speakers**
  - Andrew Cardinali and Christopher Angelotti  
*Topic: Update on Design-Build Pilot Project*
  - Bruce Olmstead and Mike Mendick – [Presentation Materials](#)  
*Topic: Update on CMAR Pilot Project*
- **Guest Presenter**
  - Fred Doehring, Deputy Pre-Construction Engineer, UDOT  
*Topic: UDOT Project Development Performance Management –*  
[Presentation Materials](#)
- **Study Committee Discussion to Brainstorm Findings and Recommendations, and Next Steps**

**JUNE 6, 2016 – MEETING 9**

- **Study Consultant Presentation**
  - Douglas Gransberg – [Presentation Materials](#)  
*Topic - Project Deliverability: Literature Review and Effective Practices*
- **Study Committee Discussion on Findings and Recommendations, and Next Steps**





## **PART B: EFFECTIVE ENVIRONMENTAL APPROVALS AND PERMITTING STREAMLINING STRATEGIES**

This section of the report provides an overview of the current literature and efforts by other states to streamline environmental reviews for transportation projects. To provide a context to consider effective practices implemented by other states, Connecticut's current environmental review process is described as well.<sup>26</sup> The section is organized as follows:

- Literature Review and Other States' Experiences
  - Environmental Permitting: State Environmental Permitting Streamlining Activities; Federal Environmental Permitting Streamlining Initiatives; Environmental Permitting for Design-Build Projects
  - Permit Streamlining Activities in Selected New England States: Permitting Stage; Federal Permitting
  - State Programs: Vermont; Maine; New Hampshire; Massachusetts
- Existing Environmental Review Practices in Connecticut
  - Connecticut Environmental Review Processes: Concept/Planning Stage; Effective Practices for Gaining Efficiencies in the National Environmental Protection Act (NEPA) Process; Federal Permitting; Summary of Connecticut Environmental Permitting
  - Effective practices for NEPA efficiencies
  - Federal Permitting
- CTDOT Environmental Permitting Process
  - Environmental Review Workflow
  - Coordination Between CTDOT, DEEP, and Federal Regulatory Agencies
- Findings
- Recommendations
- Appendices

### **1.0 LITERATURE REVIEW AND OTHER STATES' EXPERIENCES**

Environmental review has been identified as a challenge for CTDOT for improving project deliverability. CTDOT reports that it misses established project schedule dates because

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<sup>26</sup> While recognizing that cultural and historic resource impacts, and related consultations required by §106 of the National Historic Preservation Act of 1966 (NHPA) are often implicated as challenges to project permitting, these areas are not studied herein. Monitoring of and readiness to employ effective strategies to address this area as identified by *Every Day Counts* initiatives is recommended.

environmental permits<sup>27</sup> have not be acquired within their scheduled time frame. No metrics are currently available to indicate specifically which aspects or steps of environmental review are the “bottlenecks” to delivery. However, significant anecdotal evidence provided by both CTDOT and the Connecticut Department of Energy and Environmental Protection (DEEP) has guided this study approach.

## 1.1 ENVIRONMENTAL PERMITTING

### 1.1.1 *State Environmental Permitting Streamlining Activities*

Environmental permitting is often identified as one of the impediments for delivering projects, especially routine projects, in a timely manner. To address this issue, state and federal transportation and regulatory agencies have implemented environmental permitting streamlining processes and procedures that attempt to reduce the time and cost associated with the permitting process while also improving environmental and community outcomes.

One of the first studies to assess the effectiveness of the streamlining efforts and to develop a list of best practices was conducted by Washington State (State of Washington – Overview of Environmental Permitting for Transportation Projects, January 2005). As a basis for benchmarking the effectiveness of the streamlining efforts, it was found that the time required for completing the environmental permitting process can vary significantly between projects. For completing the environmental documentation phase (i.e., NEPA process), about two projects per year require an Environmental Impact Statement (EIS) and take an average of 42 months to complete; about four projects per year require an Environmental Assessment (EA) and take an average of 26 months to complete; and the majority of the projects (approximately 195 per year) are completed using Categorical Exclusions or Documented Categorical Exclusions and take on average 15 hours to complete (see Figure 1.1).

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<sup>27</sup> The term permit is used broadly and can include other forms of environmental approvals and regulatory authorizations like general permits, or certifications each of which has different application and review process requirements (i.e., some are self-implementing requiring only a registration, some a registration and approval, some a full adjudicatory process).

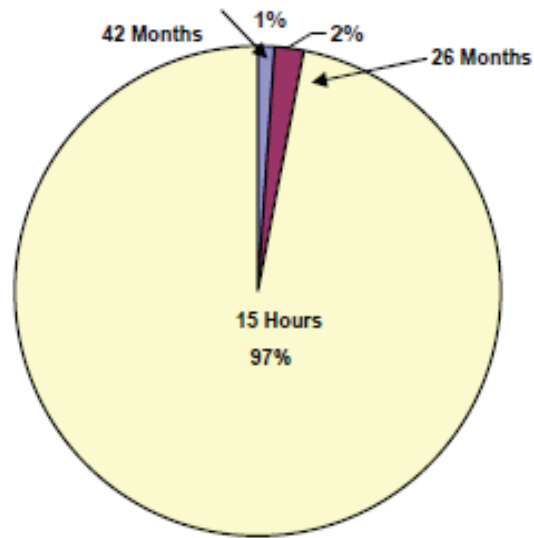


FIGURE 1.1. DISTRIBUTION OF PROJECTS BY AVERAGE ENVIRONMENTAL DOCUMENTATION COMPLETION TIME (SOURCE: STATE OF WASHINGTON – OVERVIEW OF ENVIRONMENTAL PERMITTING FOR TRANSPORTATION PROJECTS, JANUARY 2005)

Likewise, the permitting time frame varies significantly between projects, with the permitting time frame for most construction projects taking from four to six months. Some complex projects can require extensive permitting that can take up to two years to complete, while some construction projects can be completed without environmental permits (see Figure 1.2).

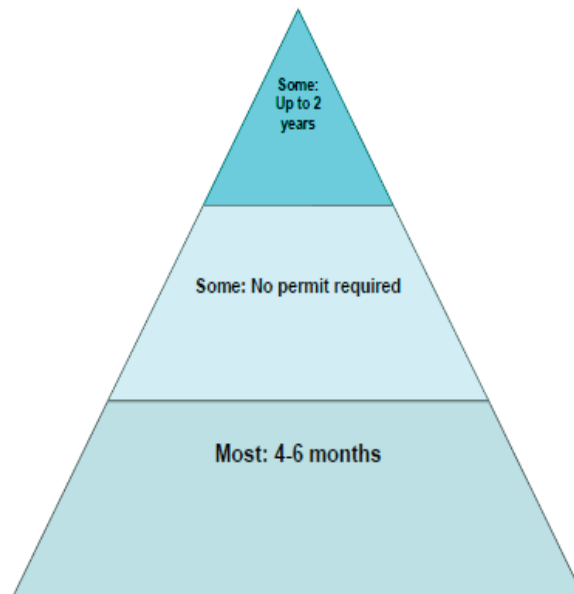


FIGURE 1.2. TIME TO COMPLETE ENVIRONMENTAL PERMITTING FOR TRANSPORTATION PROJECTS (SOURCE: STATE OF WASHINGTON – OVERVIEW OF ENVIRONMENTAL PERMITTING FOR TRANSPORTATION PROJECTS, JANUARY 2005)

It is noted that while not explicitly stated in the Washington State report, it is a reasonable hypothesis that permitting completed in less than six months was completed under a general permit and projects taking longer required individual permits.

Washington's environmental permitting streamlining efforts began with the creation of the Blue Ribbon Commission on Transportation in 1998 and the Transportation Permit Efficiency and Accountability Committee (TPEAC) in 2001. TPEAC was mandated to "optimize limited resources available for transportation improvements and environmental protection." The streamlining efforts initiated fall under one of the following three themes:

- **People-Oriented Initiatives:** Emphasize the collaboration, communication, and coordination between WSDOT and federal, state, and local regulatory agencies. Examples included coordination of project schedules across agencies, development of multi-agency teams, and dispute resolution methods.
- **Policy-Oriented Initiatives:** Focus on changes to existing policies to increase permit efficiency and timeliness. Examples included more flexible approaches to mitigate the environmental impacts of transportation projects, improve environmental compliance training and monitoring, and increase public involvement.
- **Permit Innovations:** Focus on improving the efficiency of permit development and review. Examples included the creation of programmatic or general permits for routine maintenance activities and the development of on-line permitting applications that are easier and faster to access and submit.

The four criteria used to assess and compare streamlining efforts were: (1) reduced program delivery time; (2) reduced program delivery costs; (3) environmental performance; and (4) customer/stakeholder satisfaction.

The first two criteria, reduced program time and costs, are project delivery goals. It appears that these were measured qualitatively as part of this study given that one of the recommendations for a follow-in study was to "identify the data and information systems needs to produce performance measures such as length of time to complete project permitting, costs of permitting efforts, and costs of mitigation" (i.e., identified as Audit/Study Topic 3).

The third criterion, environmental performance, is an indicator of environmental protection and improvement, where any damage to the environment caused by a transportation project should be mitigated and the environment should be improved beyond its pre-construction state when possible. As with delivery time and cost, it appears that this criterion was qualitatively measured as one of the study recommendations was to "assess the progress and effectiveness of the implementation of the WSDOT environmental management system, including environmental stewardship and sustainability" (i.e., identified as Audit/Study Topic 1).

The fourth criterion, customer/stakeholder satisfaction, is an indicator of the success of the streamlining initiative in the eyes of the various stakeholders. Interviews of stakeholder's observations and perspectives were used to assess this criterion.

The streamlining activities that had substantial success in meeting the four criteria were

- Improvement of agency coordination and permitting speed through formation of multi-agency permitting teams
- Development of on-line applications for multi-agency aquatic permits
- Replacement of project-specific permits with broad multi-year (“programmatic”) permits for many routine and maintenance and operation activities
  - o Examples of successful Washington State programmatic permits include bridge structure repair, painting, and washing; channel, fishway, and culvert maintenance; and culvert replacement in non-fish bearing streams
  - o In contrast, programmatic permits were determined to be unsuitable for bridge replacement, bridge scour mitigation, and bank stabilization since these activities have a high environmental impact and specific impact varies from project to project
- Creation of a liaison program to fund natural resource agency staff dedicated to processing permits for transportation projects

Based on the success of these streamlining initiatives, it was recommended that a Transportation Permitting Efficiency and Accountability Committee be formed in Washington State to encourage agencies to start additional streamlining initiatives.

Appendix A provides a summary table, divided into people-oriented initiatives, policy-oriented initiatives, and permit innovations, that Washington State developed for all project-specific streamlining activities. Each streamlining activity is evaluated with respect to the criteria of reduced time, cost reduction, environmental performance, and stakeholder satisfaction. Many of the streamlining activities were still under development, so the Washington State study was not able to fully assess the type or degree of their success.

Areas that were identified where further improvement is desirable or where more effort may be needed to build on initial successes included workload forecasting and inconsistent funding. For workload forecasting, regulatory agencies need information on state DOT project timelines to better align staff and resources with permitting needs of transportation projects. Examples of where inconsistent funding was a barrier include the following:

- Start-and-stop funding that leads to the “shelving” of transportation projects and their associated environmental documents resulting in outdated impact analyses and mitigation plans, as well as a loss of institutional knowledge when there is turnover in transportation and resource agency staff
- Low resource agency salaries that create employee turnover when salaries are higher for similar positions in the transportation agency or federal resource agencies
- Failure to fund proposed streamlining pilot projects

After reviewing Washington State's current environmental permitting processes and streamlining efforts, the research team investigated streamlining activities in other states. Extensive interviews were conducted with 10 state DOTs that were identified to have advanced permit streamlining efforts; 14 additional states completed an abbreviated survey. Based on these interviews and surveys, the following two themes emerged for successful streamlining strategies:

- Importance of cultural change to encourage creativity and non-traditional methods for efficiently solving permit issues
- Value of information technology to create efficiencies through databases and geographic information systems (GIS)

Several topics were also identified for further study that play an important role in project deliverability and the environmental permitting process:

- Assess the effect of resource agency employee turnover on the environmental permitting process and develop strategies for improving employee retention if retention is shown to be an important factor
- Identify performance measures such as length of time to complete project permitting, cost of permitting efforts, and costs of mitigation to better assess proposed mechanisms for reducing the time and cost of environmental permitting while maintaining desired environmental standards

### ***1.1.2 Federal Environmental Permitting Streamlining Initiatives***

The 2015 Red Book was developed by a federal agency workgroup<sup>28</sup> to assist state and local agencies that fund or develop transportation projects as well as the federal agencies that review permit applications (Synchronizing Environmental Reviews for Transportation and Other Infrastructure Projects, 2015). The 2015 Red Book is an update of the original 1998 Red Book (Applying the §404 Permit Process to Federal-Aid Highway Projects, 1998) and is intended to be a "how-to" handbook focused on a concurrent review or synchronization process for transportation, resource, and regulatory agency staff at the federal, state and local level. A concurrent, or synchronized, review process refers to performing the various environmental reviews and permitting processes at the same time. Ideally, this will lead to one environmental analysis that satisfies the needs of all agencies involved in the proposing, funding, or approving of a project. However, it is also recognized that there is a diverse set of agencies involved in the review process, each with statutorily defined responsibilities, that may have differing missions and available resources. The handbook also includes lessons learned from 1998 such as programmatic approaches, transportation liaisons, innovative mitigation practices, and communication technology that can also improve review synchronization.

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<sup>28</sup> 2015 Red Book: Synchronizing Environmental Reviews for Transportation and Other Infrastructure Projects, FHWA Pub.# FHWA-HEP-15-047, 09 2015; and 1998 Red Book: Applying the §404 Permit Process to Federal-Aid Highway Projects, FHWA, 1998. Workgroup comprised of the USACE, US Coast Guard, Federal Highway Administration, Federal Railroad Administration, Federal Transit Administration, US Environmental Protection Agency, US Fish and Wildlife Service, and National Oceanic and Atmospheric Administration.



One of the major accomplishments of the 1998 Red Book was the emphasis on synchronization of NEPA and §404 review processes. Given that many transportation projects require a number of mandatory reviews that would also benefit from early and open communication, the 2015 Red Book extends the concept of synchronization to these types of environmental permit activities. However, it is also recognized that the vast majority of projects proposed by a transportation agency qualify for a categorical exclusion (CE) under NEPA because they are not large capital projects and have generally predictable minor impacts to aquatic and other resources. Thus, the in-depth coordination of a synchronized review may require more effort than would be beneficial. In these cases, programmatic approaches can accomplish compliance in a more expeditious manner. For example, frequent transportation activities such as culvert replacement or road resurfacing generally follow the same procedures and share similar levels of impact across similar eco-regions. Programmatic approaches allow regulatory agencies to set thresholds for these types of activities that result in abbreviated review processes. Advantages to programmatic reviews include the following:

- Reviewing agencies can explore and seek resolution of broad issues that could benefit a large number of actions, thus saving time by eliminating the need to address the same issue repeatedly. Also, this provides more predictability in transportation planning.
- Issues can be discussed and resolved before they cause disagreement on a specific project
- An adaptive approach can be applied to the project development process of a transportation agency if shortcomings in the project development process are identified through a programmatic approach

Next, transportation liaisons have been found to improve the environmental permitting process. Transportation liaisons are those positions funded by transportation agencies within federal or state resource and regulatory agencies to expedite the environmental review process. Benefits of transportation liaisons include:

- A dedicated point of contact within a resource or regulatory agency that provides for improved communication and coordination leading to more predictable environmental reviews and helping to advance a project even when typical points of contention are encountered
- Environmental and regulatory expertise to help plan and design projects to avoid the most environmentally sensitive areas
- Prioritization of a large quantity of permit applications
- Early (pre-application) coordination and participation from a resource or regulatory agency
- Sole focus on a highly controversial or complex project

The 2015 Red Book recommends that state transportation agencies conduct a self-assessment to determine whether funding is permitted by law and whether such a position would meet the agency's needs.

Throughout the handbook, the concepts of early communication and information sharing are stressed as a key to successful implementation of NEPA review synchronization. While technology provides for excellent opportunities for sharing information, agencies should still attempt to meet face-to-face when feasible to resolve issues that arise during the design process, with electronic tools being used to support these face to face meetings. Electronic tools include document sharing and comment-tracking capabilities, facilitation of more thorough documents by prompting users to include specific information, and geospatial tools (e.g., US Fish and Wildlife Service [USFWS], Information for Planning and Conservation Web tool, NEPAassist, Essential Fish Habitat [EFH] Mapper, and Endangered Species Act [ESA] Web tool).

### ***1.1.3 Environmental Permitting for Design-Build Projects***

The design-build (D-B) alternative contracting method (ACM) provides additional challenges to the environmental permitting process beyond the traditional design-bid-build (DBB) delivery system. To provide D-B teams the most flexibility to meet the project goals, only 15% to 30% of the design is typically completed before the project is awarded to a design-builder. At this point, final permits cannot be approved and issued because the specific environmental impacts are not known. Two other ACMs (CM/GC and CMAR) are very similar to the traditional DBB delivery system where final permits are usually approved at the 70% to 100% design level.

To assess the challenge of environmental permitting of D-B projects, the National Cooperative Highway Research Program (NCHRP) funded a 2005 study by the Louis Berger Group entitled, *Design-Build Environmental Compliance Process and Level of Detail: Eight Case Studies*, that examined the practices utilized by state transportation agencies in preparation of permits and the level of design detail in advance of selecting a design-build contractor. It was found that state agencies took a wide range of approaches in the acquisition of permits and advancing the project to the design-build phase. In general, the three environmental permitting practices were:

1. State transportation agency secures conditional permits<sup>29</sup> and the design-builder is responsible for modifying and/or complying with the permits
2. State transportation agency secures some conditional high-risk permits such as §404 wetland permits and §401 water quality certifications and the design-builder is responsible for modifying and complying with those permits as well as obtaining the more construction-specific approvals such as soil erosion and sediment control permits
3. Design-builder is responsible for obtaining and complying with all permits

In most cases, the state transportation agency decided to obtain the key project-wide permits as conditional permits. These required permit conditions and mitigation measures were then included in the D-B RFP, with the design-builder being responsible for compliance and implementation. In 2014, a study by Hannon et al.<sup>30</sup> in which they interviewed seven state DOTs (Colorado, Florida, Michigan, North Carolina, Utah, Virginia, and Washington) found

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<sup>29</sup> The 2005 Berger Study used the terminology "early action permit" for permits that were obtained at 15% to 30% design and included conditions and mitigation measures that were required to be met before a final permit was approved by the regulatory agency. For this report, the terminology "early action permit" was replaced by "conditional permit" to highlight that these are not final permits.

<sup>30</sup> Hannon, David, K. Mostaan and B. Ashuri (2014). "Challenges and Opportunities for Expediting Environmental Analysis in Transportation Design-Build Projects", ASCE Construction Research Congress.

that this remains the primary environmental D-B permitting practice; the state DOT acquires most non-construction related permits in advance to reduce the risk to D-B teams and to expedite the D-B team's ability to start construction.

The case studies showed that the D-B permitting and approval process can flow at an expedited rate for a variety of project types and project settings. Examples of the common successful practices found among the projects included the following:

- Specific, well-written RFP that provides enough detail about environmental conditions and commitments in relation to the finished project without being too rigid to preclude innovation on the part of the design-builder
- Involvement of the review and regulating agencies early in the design process for their approval and coordination
- Provision for incentive payments to the design-builder for reducing impacts to environmentally sensitive areas below a level that was approved by the regulatory agencies
- Preliminary 15% to 30% level of highway design to provide enough detail to obtain conditional permits, demonstrate constructability, identify impacts, and minimize project risks
- Acquisition of the most critical permits by the state transportation agency for the highest-risk activities prior to issuance of the RFP, with design-builder responsible for any amendments that must be approved by the sponsoring and regulatory agencies
- Provision for a qualified on-site construction engineer or manager who is responsible for reporting to the state transportation agency on management plans and environmental issues in order to minimize violations
- Stipulation in the RFP that environmental violation costs are the responsibility of the design-builder
- Co-location of state DOT and regulatory agency staff to improve responsiveness, coordination, and interaction

A follow-on study was also conducted by the Louis Berger Group (Modification and Amendment of Environmental Permits on Design-Build Projects, August 2007) that focused in more detail on the permitting process for D-B projects. For each of the eight case studies investigated in the 2005 report, a more detailed analysis was conducted that included a review of the permits and modifications pertaining to the project, and interviews with representatives from the state DOT, state and federal permitting agencies, and the design-builder. Separate questionnaires were developed for each of the entities focusing on their individual roles, experience, and opinions of the permitting process as related to the D-B project.

The following lessons learned are also summarized in Table 1.1.

- **Working Relationships:** All parties (i.e., transportation agency, design-builder, and regulatory agencies) involved in the permitting process must be dedicated to the success of the project. To facilitate communication, one suggestion was to establish a single point of contact within all involved agencies and the design-builder. This seems to work especially well for those regulatory agencies that have designated staff working solely on state DOT projects.

Several states held frequent meetings with the agencies and design-build teams where questions could be answered directly by the permitting agency or the design-builders. In general, the states that were able to maintain open lines of communication had the most successful experiences with the D-B project delivery process.

One concern of regulatory agencies was the use of out-of-state design-builders that were not familiar with local/regional issues and permitting practices. Furthermore, the design-builders may not have a vested interest in maintaining a good relationship with the regulatory agencies if they are not locally based.

- ***Initial Permitting Responsibility and Compliance:*** Most state DOTs surveyed indicated that from their perspective, the most efficient process was to acquire the initial permits with the D-B team handling the modifications. Most D-B teams were content with this arrangement; they were not overly anxious to assume responsibility for initial permitting and agreed that completing the modifications themselves was the most efficient method. The main concern of design-builders was being able to start work immediately and not being held up by permitting. In general, they also preferred to have the conditions of the initial permits included in their contract documents.

The regulatory agencies had some reservations about the permitting process. Several regulatory agency participants expressed a strong belief that contractors were cutting corners in complying with the conditions of the permit. Some of this concern was alleviated if an independent environmental monitor was assigned to the project. Also, US Army Corps of Engineers (USACE) participants noted that they were uncomfortable issuing permits based on worst-case-scenario estimates of impacts or when given very general locations for work platforms or outfalls. These worst-case-scenario estimates affect the environmental incentives written into contracts. In some cases, when impacts are adjusted according to the final design, the design-builder appeared to have met the incentives while in actuality the impacts were overestimated from the beginning.

- ***Permit Modification and Amendment Responsibility:*** Oversight of permit amendments and modifications by state DOTs varied considerably, with some DOTs providing a high level of oversight and others very little. Design-builders indicated that they wanted control and that having the DOT as the "middleman" sometimes slowed down the process. The regulating agencies did not have a problem with processing modifications nor did they think that the D-B process led to an excessive amount of modifications as compared to traditional DBB projects.

From the case studies investigated, most plans were at about a 30% level of design or less at the time initial permit applications were completed. The D-B teams prefer this lower level of design because it provides them maximum flexibility in the development of the project design. However, regulatory agencies prefer plans submitted at a greater level of detail so permits are based on real impacts.

Most modifications appear to be unrelated to the D-B methodology, but were specific to the geotechnical, hydrological, or other issues in the project's geographical area. No patterns were found among the case studies except that it appears that the more complicated projects that span many years or were done in many phases had the most modifications.

TABLE 1.1. EFFECTIVE ENVIRONMENTAL PERMITTING PRACTICES IDENTIFIED BY STATE DOTs, DESIGN-BUILD CONTRACTORS, AND REGULATORY AGENCIES FOR DESIGN-BUILD PROJECTS (FROM THE LOUIS BERGER GROUP, 2007)

Lessons Learned	State DOTs	Design-Builders	Regulatory Agencies
<b>Working Relationships and Communication</b>	<p>Maintaining good relationships with permitting agencies is essential</p> <p>Regulatory agencies and local and regional governing bodies should be properly informed of design-build project delivery method</p>	<p>Dedicated points of contact help streamline the permitting and modification / amendment process</p> <p>Contractors should have more direct access to permitting agencies</p>	<p>Points of contact should be established with the state DOTs, contractor, and agency</p> <p>There should be early coordination and frequent and regular meetings throughout the project</p> <p>There should be open communication</p>
<b>Initial Permitting Responsibility and Compliance</b>	<p>State DOTs should generally acquire initial permits because they are familiar with regulatory agency requirements</p>	<p>Approval of permits based on a lesser level of design provides increased flexibility for contractors</p> <p>There should be an expedited review for D-B projects</p>	<p>Permit application packages should be submitted with more detailed plans and exact locations of project impacts to avoid needing to base permits on hypothetical or estimated parameters</p> <p>Permit and all conditions should be incorporated into the design-build contract</p> <p>Contractors should be monitored to ensure that they do not cut corners</p>
<b>Permit Modification and Amendment Responsibility</b>	<p>Involvement varied considerably between state DOTs</p>	<p>Contractors preparing modifications are considered to be most efficient</p>	<p>Preference to work with the state DOTs because of established relationships</p>

As shown in Table 1.1, the effective practices identified differ by the specific group making the recommendation, and perspectives and preferences between different groups may conflict. For example, the design-builder wants a lesser level of design prepared, but with permits still being approved at this lesser design level. In contrast, regulatory agencies identified that approving initial permits with lesser level of design has been problematic, and prefer that more detailed plans be used for initial permit submittals.



After evaluating the eight D-B projects and taking into consideration the differing perspectives of state DOTs, the design-builders, and the regulatory agencies, the permitting process that is thought to be the most successful is depicted in Figure 1.3. The major points are that (1) initial permitting is prepared and submitted by the state DOT; (2) any required modifications are prepared by the design-builder and submitted to the state DOT; and (3) that regular meetings be held with the regulatory agencies throughout the permitting process.

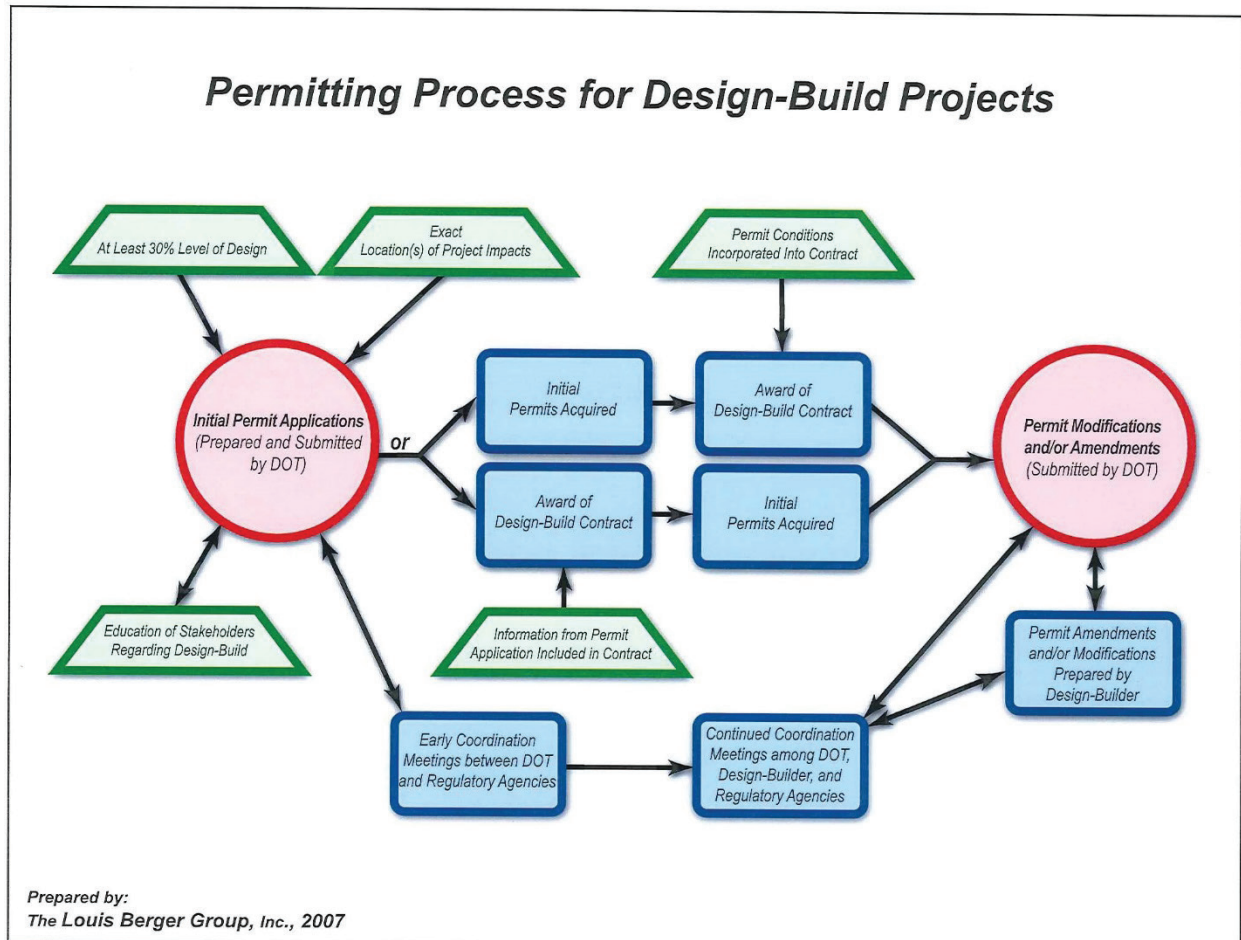


FIGURE 1.3. SUGGESTED PERMITTING PROCESS FOR DESIGN-BUILD PROJECTS (MODIFICATION AND AMENDMENT OF ENVIRONMENTAL PERMITS ON DESIGN-BUILD PROJECTS, THE LOUIS BERGER GROUP INC., 2007)

## 1.2 PERMIT STREAMLINING ACTIVITIES IN FOUR NEW ENGLAND STATES

Among the many environmental permitting programs potentially applicable to DOT projects, the programs identified as having the most impact on project deliverability are those addressing wetlands and watercourses, flood management and stormwater management. Natural resource issues (e.g., fisheries, wildlife) as well as cultural and historic resource issues, are addressed through federal and state regulatory programs. This study has investigated other states, primarily



in New England, to identify potential streamlining opportunities in the environmental and natural resource regulatory areas. While recognizing that cultural and historic resource impacts are often implicated as challenges to project permitting, these areas are not studied herein.

### **1.2.1 Permitting Stage**

This study investigated four New England states (Maine, Massachusetts, New Hampshire, and Vermont) to identify potential streamlining opportunities in the environmental and natural resource regulatory areas. The focus on the New England states was based on the shared federal regulatory and resource agency regional administrations, environmental issues and cultural ethic.

Additionally, the study included a summary review of the USACE interactions with those states as its wetlands and watercourses regulatory responsibilities are to a great extent coincident with the state regulatory programs and similarly affect transportation project deliverability.

It is instructive to note the federal promotion of programmatic permits and agreements as a mechanism to streamline environmental review of transportation projects.

“There are two basic kinds of programmatic agreements (PA):

- A PA that describes the actions that will be taken by the parties in order to meet their environmental compliance responsibilities for a specific transportation project, called here a project-specific PA
- A PA that establishes a process through which the parties will meet their compliance responsibilities for an agency program, a category of projects, or a particular type of resource, called here a procedural PA”<sup>31</sup>

PAs have been used to streamline reviews under Endangered Species Act (ESA) §7, National Historic Preservation Act (NHPA) §106, and National Environmental Policy Act (NEPA)/Clean Water Act (CWA) §404 merger processes.

Two of the four states, Vermont and Massachusetts, have established alternative contracting programs; other states have had some alternative contracting experiences. To the extent available, specific applicability to ACMs were identified.

The noted 2005 Washington State report that collected and assessed other states' efforts toward similar goals was used as a guide to categories of and attempts at streamlining activities.

### **1.2.2 Federal Permitting**

#### **1.2.2.1 USACE WETLANDS AND WATERCOURSES REGULATION (§404 CWA)**

As noted, states in the New England region are within the same USACE District.<sup>32</sup> The oversight, interpretation and application of wetlands and watercourse regulatory programs bear an element of consistency across these states. Similarly, the federal resource agencies

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<sup>31</sup> What is a Programmatic Agreement?, Center for Environmental Excellence by AASHTO; [http://environment.transportation.org/documents/programmatic\\_agreement\\_toolkit/WhatIsPA.html](http://environment.transportation.org/documents/programmatic_agreement_toolkit/WhatIsPA.html)

<sup>32</sup> Within the region there are three separate permitting groups: (1) CT, (2) NH, ME, VT, RI, (3) MA.

([USFWS], National Marine Fisheries Service [NMFS], US Environmental Protection Agency [EPA]) with jurisdiction and expertise applied through USACE's regulatory actions are regionally discrete and consistent. However, the requisite Endangered Species Act (§7) USFWS or NMFS consultations, their underlying investigations, and potential project conditions may be very varied depending on the species of concern. (It should be noted that while the USACE permit(s) are the most commonly used vehicle for addressing environmental and natural resource issues pursuant to federal law, there may be instances where no permit is required yet the federal standards apply. In those instances, the agency under whose jurisdiction the substantive issue resides will take a lead regulatory role.)

Each of the New England states has a state-specific **programmatic general permit** (PGP) that identifies actions for which less than a full individual permit from USACE is required. The categories of activities covered by state-specific PGP vary from state-to-state based on various factors including, but not limited to, the coincident coverage of the activity and/or resource delineation, agreement by the coincident state regulatory authority and acceptance by non-government organizations (NGOs) and the general public. The conditions and process of approval (i.e., reporting or non-reporting) are specified for each activity covered within a given PGP.

USACE convenes or attends **monthly interagency meetings** with the federal agencies (sometimes called joint processing meetings) to discuss upcoming projects, including transportation projects. This provides an opportunity for the agencies to concur or disagree with a project's PGP status and identify specific issues of concern, and solutions and/or regulatory approaches. Projects may be raised first as a concept and may or may not be raised again at subsequent meetings. Participation by resource agencies varies from state-to-state and project-to-project.

The identification and implementation of mitigation for unavoidable wetlands losses has historically been an impediment to USACE permitting. In-lieu fee programs have been developed as a mechanism to provide for appropriate and meaningful wetland mitigation. The utilization of such programs has been described as very useful in Maine and New Hampshire; very limited in Massachusetts because of state regulatory requirements; and not significant for transportation projects in Vermont because the VTrans projects have such small scale impacts. The USACE has developed an In-Lieu fee program in Connecticut which CTDOT has used to mitigate impacts for the §404 permits. (A Connecticut court decision regarding state statutory authority to accept such mitigation on the state level has limited its utility.)

Additional state-specific insights regarding USACE interactions and efficiencies follow.

#### 1.2.2.2 ENVIRONMENTAL PROTECTION AGENCY/STORMWATER REGULATION

EPA has established national standards through which the federal Clean Water Act NPDES, including its stormwater management programs, can be delegated to and implemented by states. In New England, only New Hampshire and Massachusetts do not have delegated programs; EPA administers the program. Separate stormwater management areas include construction, industrial, municipal, and transportation. The combination of delegation and general permit development has been seen as a mechanism for both efficiency and effectiveness in stormwater management.

State-specific insights regarding stormwater management efficiencies are included in the State Programs Section.

## 1.3 STATE PROGRAMS

As previously noted, research on the four New England states (Vermont, New Hampshire, Maine and Massachusetts) focused on wetlands, watercourse, flood management and stormwater management regulatory programs and included a summary review of the USACE interactions with those states. The information learned from the New England states was then reviewed against parallel programs and interactions in Connecticut (See Section 2.0: Existing Environmental Review Process in Connecticut). State and federal information was largely derived from interviews with key staff in state environmental regulatory agencies, environmental sections of the states' transportation agencies, and the USACE. The model questionnaire that guided preliminary interviews with the state regulatory agencies and a table of contacts are included in Appendix C. Following the preliminary interviews, selected individual agency websites, statutes, regulations and rules, permitting and other documents were reviewed. Documents and/or citations or links of particular relevance are provided in Appendix B.

### 1.3.1 *Vermont*

#### 1.3.1.1 RIVER CORRIDORS/FLOODPLAIN PROTECTION

The 2011 Tropical Storm Irene changed both the physical and regulatory landscape in Vermont. Irene created the impetus for a new framework for the state's River Corridors and Floodplain Protection programs. The Stream alteration program addresses activities in-channel (e.g., sliplining, culverts, etc.). Under this new statutory construct, VTrans must comply with program standards but is not required to obtain a permit from the Vermont Department of Environmental Conservation (DEC). Rather, VTrans and DEC engage in a formal consultation process.<sup>33</sup> Projects are posted at the 25% design stage on Microsoft SharePoint. DEC wants to see delineations of cuts and fills and storage offsets on plans. The consultation continues iteratively until program standards are met. (The legislation that created the new construct also provided for additional positions and an education and awareness component regarding rivers and roads best management practices [BMPs]). Technical assistance and support is not exclusively for VTrans but does specifically include VTrans staff training, particularly regarding maintenance and emergency repairs.

Vermont's Floodplain Management Rules are implemented through both general and individual permits. The existing general permit covers, among other activities, repair, maintenance, replacement, or reconstruction of transportation and utility networks provided that they are of approximately the same vertical and horizontal dimension. The regulatory standards include by reference Federal Emergency Management Agency (FEMA) hydraulics and hydrology requirements.

#### 1.3.1.2 WETLANDS

VTrans project applications are typically submitted during preliminary design phase when the project footprint has been determined<sup>34</sup> and the wetland impacts estimated.<sup>35</sup> VTrans

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<sup>33</sup> The consultation process was the product of Vermont's 1<sup>st</sup> interagency LEAN process.

<sup>34</sup> But see Section 1.3.1.4 regarding D-B and lack of a nimble way to modify permits when contractors identify additional (often access-related) needs.

<sup>35</sup> See above in-lieu fee program comment re: small scale of VTrans wetlands impacts.

environmental staff work directly with DEC regional ecologists (there are six regional ecologists) and are in the field evaluating sites at the preliminary design stage. DEC feedback is brought to VTrans engineers and environmental permitting staff. Wetlands program management noted that the pace of VTrans projects (including for example land acquisition) allows for early environmental involvement. DEC and VTrans staff work together to develop realistic regulatory schedules.

Additionally, the Vermont wetlands program includes a series of both regulatory "allowed" (i.e., no permit needed) uses which are implemented through a memorandum of understanding (MOU) between VTrans and the Vermont Agency of Natural Resources (ANR), including self-certification of those activities by VTrans, and general permit activities for which the linear project threshold has been increased (see Appendix B).

### **1.3.1.3 STORMWATER**

Vermont has a delegated NPDES program; its stormwater component comprises construction permits, operational permits and a state post-construction permit. Most of the state's stormwater regulation is through general permits. Construction general permit applicability is "risk based" according to a matrix that includes the area of disturbance, slope, etc. For "low risk" projects, the application does not require any detail. Rather, the applicant stipulates to site conditions (e.g., limit on concurrent disturbance, proximity to receiving water, etc.) as part of the application. For "moderate risk" projects, site plans are required. No specific percent of design completion is required, but it is effectively 100%, with the recognition that these are not typically construction plans. The subsequent operational permits require and are based upon "construction level" design. In Vermont, VTrans has the largest number of permits and a disproportionate share of individual permits. The latter is attributed to the unique requirements for linear projects.

There is no preferential treatment of VTrans projects, nor formal upfront interagency coordination. Project review is conducted by DEC district staff that currently includes approximately 12 technical staff; DEC is moving toward dedicated transportation project staff.

VTrans' specific general permit (TS-4), consolidating existing requirements under Vermont's Municipal Separate Storm Sewer System (MS4) program, and commercial and industrial stormwater requirements, is in development.

### **1.3.1.4 VTRANS D-B PROCESS VIS-A-VIS ENVIRONMENTAL PERMITTING**

VTrans uses Conceptual Plans, analogous to other states' 25% or 30% plans, to obtain NEPA clearance for projects. At this stage the design has progressed far enough to demonstrate the intent of the project and its overall footprint. For D-B projects, the base technical concept (BTC) is the design concept that is included in the Conceptual Plans for the purpose of NEPA and provided with the RFP. During the development of the BTC, prior to the issuance of the project RFP, VTrans meets with the permitting agencies to review the expected project impacts and identify any potential issues that may put at risk or delay obtaining permits once the design has advanced. If possible, VTrans resolves those issues up front and includes any necessary restrictions or other language in the RFP so as to minimize issues to the extent possible for D-B teams submitting project proposals. The D-B teams then have the option during the proposal process to work with the BTC or submit an alternative technical concept (ATC) for consideration.

When a D-B team submits a detailed ATC to VTrans for review, they are required to identify potential permit impacts as part of their submittal. This includes NEPA. If VTrans approves the ATC, the expectation is the D-B Team is responsible for doing the legwork for re-evaluating the NEPA if they are awarded the project. The D-B team would perform any additional fieldwork and assessment that may be required for the NEPA re-evaluation and submittal to VTrans. This information is reviewed for completeness and accuracy by the VTrans Environmental Section before being forwarded to FHWA. There is language in the RFP that supports this expectation.

All state and federal permits are acquired by the D-B team, with VTrans listed as the owner or co-permittee; D-B teams are required to provide an Environmental Commitments Officer within the key personnel in their proposal. This person is responsible for all permits and coordination with VTrans and the resource agencies. VTrans reports that to date they haven't had any significant issues that they don't also experience in traditional DBB projects. DEC program managers report that (1) design-builder firms would benefit from training in the river corridors and floodplain protection programs, and (2) DEC wetlands regulators do not have a nimble way to deal with permit updates or changes.

### **1.3.2 Maine**

Maine's environmental regulatory programs as applied to the Maine Department of Transportation (MaineDOT) are somewhat nested and often deferential to the expertise of MaineDOT Environmental Office (Maine DEP) staff. A Maine DEP land resources program director comments that the enhancement of MaineDOT's environmental group and its early engagement with engineers set the stage for the legislature's acceptance of several MaineDOT-specific environmental program exemptions/exceptions (see Appendix B).

Because of the significance in the kind and extent of Maine's fisheries and wildlife habitat(s), MaineDOT project reviews are often defined and driven by the biological review and consultation that is required under the federal Endangered Species Act (§7) as a prerequisite to USACE permit application submission. Consultation must be completed before federal permits can be issued. Though the state's programs are summarized herein, they appear to be integrated within (or subservient to) their federal counterparts.

#### **1.3.2.1 SITE LOCATION DEVELOPMENT ACT**

Maine's Site Location Development Act regulates large developments that create three acres or more of impervious surface in a manner like a mini/state NEPA review. MaineDOT and the Maine Turnpike Authority (MTA) are subject to a general permit specific to these agencies that significantly streamlines many procedural requirements of the Act while requiring them to

- review and assess their natural resource encroachments and impacts (wetlands, vernal pools, streams, significant wildlife habitats, rare, threatened, and endangered species and unusual natural areas);
- apply for Maine's Natural Resource Protection Act permits or exemptions as well as all federally required resource related permits; and
- comply with and operate to their BMPs or design manual provisions regarding stormwater, wildlife and fisheries, historic structures, etc.



Notification, as opposed to application, to Maine DEP with documentation of plans, natural resource location, and stormwater management is required.

### **1.3.2.2 NATURAL RESOURCE PROTECTION ACT**

A Natural Resource Protection Act permit is required when an activity<sup>36</sup> will be located in, on or over any protected natural resource, or located adjacent to a coastal wetland, great pond, river, stream or brook or significant wildlife habitat contained within a freshwater wetland, or certain freshwater wetlands.<sup>37</sup> A streamlined process is available for MaineDOT and MTA projects. Unlike other activities where natural resource impact avoidance is the goal and inability to avoid must be demonstrated, there is an assumption that MaineDOT/MTA projects to improve existing infrastructure are unavoidable. That process is embodied within the Natural Resource Protection Act's Permit By Rule (PBR). Minimization of and mitigation for unavoidable impacts occur routinely as part of transportation project design and internal review.

PBR applies to the maintenance, repair, reconstruction, rehabilitation, replacement or minor construction of a state transportation facility carried out by, or under the authority of, MaineDOT or the MTA, including any testing or pre-construction engineering and associated technical support services. While the performance standards are the same as for other projects, the PBR requires a more simplified form to be filed with Maine DEP; if no response is generated by Maine DEP within 14 days, the activity may proceed. Resource compensation is required if the impact exceeds certain amounts within certain miles of road.

### **1.3.2.3 STORMWATER CONSTRUCTION PERMIT AND STATE PROGRAM**

Similar to Vermont and Connecticut, Maine has a delegated NPDES program (see Appendix B). Its federally approved general permit includes a provision for an MOU with MaineDOT and MTA that accomplishes the purposes of the stormwater program (see Appendix B). The MOU specifies that regardless of the project, MaineDOT and MTA will follow Maine DEP standards. However, there is recognition of constraints that often arise with larger projects, so while the state's transportation agencies must meet general standards, if MaineDOT or MTA identifies that specific standards cannot be met, Maine DEP will accept alternative performance. MaineDOT and MTA are not required to secure permits from Maine DEP; rather, they submit annual reports to Maine DEP.

### **1.3.2.4 DEP/DOT COORDINATION PROCESSES**

Conversations between MaineDOT and Maine DEP begin upfront and continue throughout project design and permitting. MaineDOT's Environmental Office instituted internal production meetings with production schedules and a project database that displays automatic reminders as components of process improvements. The Office uses a project and portfolio management software system. This tool is not yet shared with resource agencies. MaineDOT interacts directly with Maine DEP regional offices; and Maine DEP does not have MaineDOT-dedicated staff.

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<sup>36</sup> An "activity" is (A) dredging, bulldozing, removing or displacing soil, sand, vegetation or other materials; (B) draining or otherwise dewatering; (C) filling, including adding sand or other material to a sand dune; or (D) any construction, repair or alteration of any permanent structure.

<sup>37</sup> In all, this Act covers a range of activities and resources akin to the combination of Connecticut's tidal wetlands, coastal structures, dredging and fill, and inland wetlands and watercourses statutes.



As a means to proactively address Maine DEP and Maine Inland Fisheries and Wildlife concerns, the MaineDOT Environmental Office and Maine DEP have, among other things, established a fish passage and stream crossing review procedure, and an engineering design goal to the 100-year storm to provide connectivity between the agencies (see Appendix B).

#### **1.3.2.5 DEP/MAINEDOT/FEDERAL AGENCIES' COORDINATION PROCESSES**

MaineDOT brings its calendar year workplan of candidate projects to state and federal resource agencies to begin interagency discussions; general project scopes, rather than plans, are presented. The goal is to identify and standardize a means to address "avoidance" and "minimization" before applications are submitted.

MaineDOT projects are discussed at monthly interagency (federal and state) meetings. Because of the significance of the state's fisheries, the process is often driven by the federal NMFS and geared toward demonstrating that a project will not impact endangered species. In order to bring predictability and certainty to §7 consultations, MaineDOT is

- seeking a programmatic biological opinion with USFWS specific to Atlantic Salmon.
- funding the establishment of a salmon-specific in-lieu fee mitigation program for use when performance standards related to full accessibility of crossing structures cannot be met in high habitat priority areas.

MaineDOT has formally established and funded two liaison positions with USFWS.

#### **1.3.2.6 DESIGN-BUILD**

MaineDOT acquires its permits before issuing a project RFP. Permitted design is "worst case," i.e., largest expected, acceptable footprint following avoidance and minimization, on the basis of a project's NEPA review. Then as necessary, MaineDOT returns to the regulatory agency(ies) with plans created for preliminary design review. MaineDOT provides a "menu" of options to meet performance standards (e.g., seasonal restriction, in-water work windows, fish passage, habitat connectivity) in its bid documents. MaineDOT maintains control and sets permitting and performance standards for both standard contract specifications and special provisions.

### ***1.3.3 New Hampshire***

The New Hampshire Department of Environmental Services (DES) has dedicated staff to address New Hampshire Department of Transportation Department (NHDOT) projects. In addition, NHDOT is authorized by statute to provide funding for DES staff or consultative services in lieu of payment of otherwise required state permit application fees.

#### **1.3.3.1 ALTERATION OF TERRAIN PROGRAM**

New Hampshire Alteration of Terrain permits are required whenever a project proposes to disturb more than 100,000 square feet of contiguous terrain (50,000 square feet if any portion of the project is within the protected "shoreland"), or disturbs an area having a grade of 25% or greater within 50 feet of any surface water. This program addresses and controls soil erosion and stormwater runoff.

Pursuant to a MOU, NHDOT does not file for permits under this program (see Appendix B); rather DOT projects must be substantially equivalent to stormwater, and soil and erosion control requirements. (See Section 1.3.3.3: Stormwater.)

### **1.3.3.2 WETLANDS MANAGEMENT PROGRAM**

DES meets monthly with NHDOT at which conceptual plans are discussed; they then meet again, including federal agencies, at the early design phase. These Natural Resources meetings are usually attended by USACE, EPA, NH Fish and Game, NH Heritage Bureau and FHWA. The intent is to identify items of concern. Noting that it can be years from design to permitting, DES and NHDOT coordinate with the federal agencies on an ongoing basis so that approvals occur smoothly.

New Hampshire has taken programmatic steps to address the wetland review trinity – avoid, minimize, mitigate – for transportation projects. Several years ago, the legislature created a presumption of need for transportation projects, thereby eliminating an early hurdle of demonstrating wetland impact acceptability. Regarding minimization, while affording contractors some flexibility, NHDOT adds and DES accepts an additional 10 to 15 feet of “temporary impact.” Mitigation or compensation is required for project impacts. (New Hampshire notes that its in-lieu fee program has worked well.)

Applications are generally submitted at a fairly detailed design stage (DES estimates at 80%-90% design). However, permits can be issued where the submission of less than the required information results in additional permit conditions and may require additional approvals before or during construction.

In accordance with administrative rule, permits are not required for routine roadway and railway maintenance activities, including, but not limited to, existing culvert replacements, extensions, or orientations; headwall construction, repair, replacement, or stabilization; and roadside ditch maintenance, conducted in accordance with “Best Management Practices for Routine Roadway Maintenance Activities in New Hampshire” (2001), published by NHDOT.

### **1.3.3.3 STORMWATER**

New Hampshire does not have a delegated NPDES program; EPA is the permitting authority for NPDES activities for New Hampshire. Therefore, in addition to, or coincident with, the functional equivalence requirement of the Alteration of Terrain MOU, NHDOT is subject to the Construction General Permit (CGP) and Municipal Separate Storm Sewer System (MS-4) permit.

The CGP permitting process requires NHDOT and/or its contractors to submit the following:

- Notice of Intent (NOI) to identify all receiving water bodies of any construction runoff as well as indicate the presence of any threatened, endangered species or critical habitats present within the project area
- Stormwater Pollution Prevention Plan (SWPPP) identifying the proposed erosion and sediment control techniques to be used on the project, including the appropriate BMPs used to minimize the discharge of pollutants from the construction site.

#### **1.3.3.4 DES/DOT COORDINATION**

In addition to NHDOT/DES continual communication and coordination, NHDOT utilizes its DES single point of contact to set and coordinate a priority list for its standard wetlands, dredge and fill permits. Also, NHDOT participates in all DES rulemaking revision processes. NHDOT and DES are engaged in LEAN process reviews to identify streamlining opportunities in the planning and permit application processes; and NHDOT is focusing on level of information expectations.

Within NHDOT, the Bureau of Environment works with the project design engineers to understand and address the requirements of the environmental regulatory programs. All design and engineering staff are centralized, as compared to being de-centralized in districts across the state, and operate as partners in production.

#### **1.3.3.5 DES/DOT/FEDERAL AGENCIES COORDINATION**

As previously noted, NHDOT meets monthly with DES. These "Natural Resources" meetings are usually attended by USACE, EPA, NH Fish and Game, NH Heritage Bureau and FHWA.

Five to 10 projects at various stages of development are reviewed. Through this iterative process design, mitigation, and conditions of work decisions are made prior to formal permit application submission.

#### **1.3.3.6 DESIGN-BUILD**

NHDOT has statutory authority for D-B but no other ACMs. NHDOT's experience with its I-93 reconstruction project was unique. NHDOT acquired its overall project permit at the 30% design stage. The overall project was comprised of six construction projects; additional submissions were required for each specific project. In all, the additional submissions and oversight of the permitting for each specific project were very burdensome, and it is unlikely that NHDOT would pursue such an approach for permitting for this type of project again.

### ***1.3.4 Massachusetts***

Massachusetts has several unique staffing and environmental regulatory accommodations for Massachusetts Department of Transportation (MassDOT) transportation projects. MassDOT funds a dedicated project manager at the USACE, another at MassDEP as a project liaison and a third in the Natural Heritage & Endangered Species Program (NHESP), part of the Massachusetts Division of Fisheries and Wildlife, Department of Fish and Game.

MassDOT's Environment group is responsible for all permit applications. Pre-application meetings occur informally on an approximate quarterly or as needed basis. MassDOT contacts state resource groups (e.g., fisheries) directly and early in the project planning and design process.

The Massachusetts programs that parallel the Connecticut state environmental programs of focus include: Massachusetts Environmental Protection Act (MEPA) which is the state's comprehensive development environmental review law; Ch. 91, its Tidelands, Great Ponds, Navigable Rivers and Streams program; and, Ch. 131, its wetlands and watercourses protection program.

A table of Massachusetts regulatory thresholds and time frames can be found at [http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Permit\\_Table.pdf](http://www.massdot.state.ma.us/Portals/8/docs/environmental/wetlands/Permit_Table.pdf)

#### **1.3.4.1 BRIDGES**

Through its Bond Bill, the repair, reconstruction, replacement or demolition of existing MassDOT (see Appendix B), Massachusetts Turnpike Authority and municipally-owned bridges—including the immediate approaches necessary to connect the bridges to the existing adjacent highway and rail system—in which the design is substantially the functional equivalent of, and in similar alignment to, the structure to be reconstructed or replaced, are exempt from the above noted laws. Exceptions to the exemption exist where specific MEPA thresholds for review are exceeded. All work must comply with MassDOT's Stormwater Handbook.

Therefore, Water Quality Certifications (WQCs) are the key state authorizations for most bridge projects. The WQC liaison receives applications at the 50% – 70% design level. Within the context of these redevelopment projects, hydraulics and drainage performance are generally improved to meet USACE stream crossing standards.

WQC reviews are expedited; publication in the State Environmental Monitor triggers other resource groups, natural heritage and historic commission sign-offs.

#### **1.3.4.2 HIGHWAYS**

MassDOT highway projects are generally subject to review under the state's MEPA, and its Wetlands Protection and Tidelands Laws. Each of these laws has regulatory thresholds on the basis of some combination of land/water square footage of impact, specific resources affected, and/or type of activity.

The Wetlands Protection Act has provision for a class of "limited projects" that allows some flexibility to exceed filling thresholds while requiring mitigation and stormwater management. Among those allowed projects are maintenance and improvement of existing public roadways, but limited to widening less than a single lane; adding shoulders; correcting substandard intersections; and improving inadequate drainage systems.

#### **1.3.4.3 STORMWATER**

Massachusetts does not have a delegated NPDES program. Therefore, stormwater management is subject to direct EPA authority and is implemented through its Construction Stormwater General Permit and the state's yet-to-be-approved MS-4 program. In addition, the state stormwater program is implemented through local conservation commissions with an appeals process to MassDEP.

#### **1.3.4.4 MASSDOT/DEP/FEDERAL AGENCY COORDINATION**

FHWA and MassDOT fund a dedicated USACE project manager position. The funding agreement includes performance standards (e.g., time frames within which to respond to applications) and requires quarterly reporting based on the standards.

The USACE liaison annually receives a list of projects with advertising dates. There are occasional pre-application meetings at approximately the 25% design stage to which various resource agency members are invited. Generally, two joint processing meetings are held each month.

### 1.3.4.5 DESIGN-BUILD

There is a distinction between the environmental regulatory response to D-B bridges as compared to highways (or other) transportation projects. Since the regulatory regime for bridges generally relies solely on WQCs, amendments as may be needed are relatively straightforward. For other than bridge work, state wetlands authorizations (i.e., orders of conditions) are often based upon the “worst case” footprint or extent of impact. If the project footprint and/or impact changes occur, the wetlands authorization regulatory process must be repeated.

### 1.3.5 Summary Multi-State Effective Practices

Utilizing the Washington State study as a base, four activities emerge as effective streamlining practices: improvement of agency coordination; development of on-line applications (and as expressed here, other web-based information, data layers and data sharing); programmatic permits (expanded here to encompass general permits, permits by rule); and liaison programs to fund natural resource agency staff (limited here to federal liaison programs, DOT-funded staff or other dedication of staff that is captured within agency coordination.) Table 1.2 represents a summary of the application of these practices in the above reviewed New England states.

TABLE 1.2. EFFECTIVE STREAMLINING PRACTICES IN SELECTED STATES

Activity	MA	ME	NH	VT
<b>Improvement of Agency Coordination</b>	USACE/MassDOT/ MassDEP  - Monthly meetings/formal and informal	MaineDOT/ MaineDEP  - Monthly meetings/formal and informal  MaineDOT/ MaineDEP/federal agencies  - Monthly meetings/formal and informal	NHDOT/NHDES  - Dedicated staff  NHDOT/NHDES/ federal agencies  - Monthly meetings/formal and informal  - Project prioritization coordination	VTrans/VTDEC  - Monthly meetings/formal and informal  VTrans/VTDEC/ federal agencies  - Monthly meetings/formal and informal
<b>Development of On-Line Applications</b>	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing
<b>Programmatic Permits [and other permitting efficiencies]</b>	General permits Statutory exemptions Admin. expedited reviews USACE PGP	General permits Streamlined processes USACE PGP Programmatic agreement with USFWS in development	General permits Statutory rules/exemptions NHDOT/NHDES MOU (substantial equivalence in lieu of permits) USACE PGP	General permits VTrans self-certifications Statutory exemptions USACE PGP
<b>Liaison Program to Fund Natural Resource Agency Staff</b>	MassDEP/USACE Natural Heritage MassDOT/USACE	MaineDOT/USFWS	No formal federal liaison program	No formal federal liaison program



## 2.0 EXISTING ENVIRONMENTAL REVIEW PRACTICES IN CONNECTICUT

### 2.1 CONNECTICUT ENVIRONMENTAL REVIEW PROCESSES

The following is a summary of only some of the environmental regulatory processes applicable to transportation project delivery in Connecticut and includes permit streamlining and other effective practices implemented to date. This overview is intended to provide background for and relevance to an evaluation of opportunities to enhance project deliverability. Complete and specific regulatory jurisdictions and procedures are available at websites for the state and federal agencies of cognizance.

#### 2.1.1 *Concept/Planning Stage*

Though potentially resource and time intensive and extensive, the federal NEPA and coincident Connecticut Environmental Protection Act (CEPA) process has not been identified as the type of impediment of concern to CTDOT project delivery at this time. This is largely because the NEPA process is well defined and established and does not vary significantly from state to state; the CEPA process takes precedence to the extent that differences between the state and federal requirements are accommodated. Moreover, NEPA/CEPA streamlining efforts have occurred and continue to evolve through efforts noted below.

For any given project, the benefit of the NEPA/CEPA review to the subsequent permit streamlining efforts derives from defining a major project's purpose and need, and identifying broad stroke alternatives to address them. In the concept/planning stage of the environmental review, two specific useful determinations can be made: (1) whether the project is unlikely to have significant environmental impacts and falls within a Categorical Exclusion (CE) under NEPA and therefore is not required to go through a lengthy Environmental Assessment (EA) or Environmental Impact Statement (EIS) process, and (2) what the explicit or de facto "least environmentally damaging preferred alternative" (LEDPA) is. Identification of the LEDPA begins to circumscribe further, future regulatory reviews by eliminating the reexamination of whether the project approach has avoided, minimized and mitigated project impacts and establishing a project "footprint." (This trinity can be the iterative review component that extends individual permit or natural resource authorizations.) Through a complete Final EIS, a Record of Decision can include environmental commitments (i.e., mitigation measures, performance standards) for reference in future/further regulatory processes or incorporation in state and/or federal permits.

#### 2.1.2 *Effective Practices for Gaining Efficiencies in the NEPA Processes*

The 2015 Fixing America's Surface Transportation (FAST) Act includes a number of changes to federal law intended to streamline the environmental review process for many transportation projects across the federal government. The initiatives authorized by or embodied in this legislation may be further institutionalized and would be available to the states either programmatically or as applied to specific projects. For example, among the efficiencies that will be available to Connecticut projects in the future are concurrent or synchronized, rather



than iterative, NEPA and USACE permitting reviews, and more flexible use of funding prior to NEPA completion. FAST Act provisions are also further refining allowable progress in project design prior to NEPA completion to accommodate and facilitate D-B projects.

Specifically, the FAST Act<sup>38</sup>:

- ***Extends the environmental review process that applies to highways and public transportation to railroad and multimodal projects.*** The Act provides the Secretary with the authority to extend the highway environmental review provisions (23 U.S.C. 139) to some rail and multimodal projects.
- ***Codifies the Every Day Counts initiative.*** The FAST Act codifies FHWA's *Every Day Counts* initiative that helps identify, accelerate, and deploy proven innovations that shorten the project delivery process and improve environmental sustainability.
- ***Allows greater use of funds for permitting improvements.*** The FAST Act enables any public entity receiving surface transportation funding to make funds available to federal agencies, State agencies, and Indian tribes to support activities that improve the permitting and review processes.
- ***Improves early and substantive engagement among agencies during the environmental review process.*** The Act clarifies the roles and responsibilities of the different federal agencies involved in the environmental review process and sets up a checklist to help project sponsors identify the environmental issues in the project area and the agencies with jurisdiction for affected natural, cultural and historic resources. ([Click to access the Checklist of Environmental Requirements and Resources](#))
- ***Expands a public Dashboard to provide transparency to the review of transportation projects.*** The Act requires an online platform to make publicly available the status and progress of a broader variety of projects undergoing environmental review, including projects receiving innovative financing.
- ***Reduces duplicative reviews and adds additional optional process.*** The Act extends an exemption under which environmental review of post-1950 concrete bridges can be addressed as a group instead of requiring individual review.
- ***Expedites environmental review for reconstruction in the aftermath of an emergency.*** The Act emphasizes the use of exemptions and expedited processes for environmental review and consultation for the reconstruction of road, highway, railway, bridge, or transit facilities damaged by an emergency if the reconstruction is in the same location with the same capacity, dimensions, and design as before the emergency.
- ***State Pilot Project on NEPA.*** The Act establishes a pilot program to allow up to five states that have assumed federal responsibility for the NEPA review process to use their state laws and regulations to conduct environmental reviews and approve projects.

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<sup>38</sup> The Fast Act: Accelerating Project Delivery, Transportation.gov, USDOT; <https://www.transportation.gov/fastact/project-delivery-factsheet>

Connecticut is engaged in available mechanisms to streamline review pursuant to NEPA. FHWA and the CTDOT have a programmatic agreement in place that allows CTDOT to process certain categorical exclusions internally, provided they meet the provisions within the programmatic agreement.<sup>39</sup> This reduces the overall time required for NEPA approvals. FHWA, CTDOT and the Connecticut State Historic Preservation Officer (SHPO) also have a current programmatic agreement to cover National Historic Preservation Act, §106, responsibilities for certain minor projects and projects involving the Merritt Parkway, which is listed on the National Register of Historic Places. Implementation of these agreements will reduce the volume of projects requiring SHPO review by excluding routine projects that have minimal or no impact on historic properties.

### 2.1.3 Federal Permitting

#### 2.1.3.1 USACE WETLANDS AND WATERCOURSES REGULATION (404/401WQC)

The federal CWA, §404, establishes a program to regulate the discharge of dredged or fill material into water of the United States, including wetlands. USACE is the regulatory agency of cognizance; EPA, USFWS and NMFS each have a role in reviewing permit applications.<sup>40</sup> Under the CWA, an applicant for a federal license or permit to conduct any activity that may result in a discharge to **waters** of the United States, i.e., a §404 permit, must provide the federal agency with a **§401** certification (WQC) that the discharge is consistent with water quality standards. Under EPA's overall aegis, states have the authority to issue water quality certifications; in Connecticut, WQC is within DEEP's jurisdiction.

The USACE Connecticut PGP has two components: one for tidal wetlands, and tidal, coastal and navigable waters, as defined and regulated by Connecticut, and one for inland water resources. The PGPs allow for either no or a reduced level of review by USACE and federal resource agencies. Inclusion of activities, both by type and/or size and extent, within the PGP is predicated on the generally expected degree and acceptability of impacts on natural resources' values and the review of the otherwise regulated activity by state regulators either through a state's regulatory programs and/or the requisite §401 WQC. The current PGP is due to expire in July 2016. A new PGP has been published for public comment and the USACE is evaluating and responding to comments, including those from CTDOT and DEEP.

USACE and EPA, and as necessary or desired, USFWS and NMFS, attend **monthly interagency meetings** to discuss upcoming transportation projects, among others. USACE and EPA also attend meetings that occur as part of the CTDOT/DEEP/USACE monthly Project Managers Meetings; applications on the meeting agenda are usually close to completion (i.e., ready to be submitted). Agencies can concur or disagree with a project's PGP status, identify specific issues of concern and potentially set application requirements and/or project expectations and performance standards. (See Section 3.0: CTDOT Environmental Permitting Process).

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<sup>39</sup> Environmental Review Toolkit, Program Overview, Environmental Streamlining and NEPA: A History; FHWA, USDOT; <https://www.environment.fhwa.dot.gov/strmlng/index.asp#history>

<sup>40</sup> Connecticut State Historic Preservation Officer (SHPO) and the two federally recognized tribes THPOs also have a role in reviewing permit applications, in order to satisfy §106 of the National Historic Preservation Act of 1966 (NHPA). Even if there is no 404 or 401 permit required, there may still be a "federal nexus" under other federal law that may result in a different federal agency being the lead federal agency.

Separate meetings are convened for new, large projects. These may be raised first as a concept and may or may not be raised again at subsequent meetings. Participation by resource agencies varies.

The identification and implementation of mitigation for unavoidable wetlands losses has historically been an impediment to USACE permitting. In-lieu fee programs have been developed as a mechanism to provide for appropriate and meaningful wetland mitigation. The USACE has developed an in-lieu fee program in Connecticut which CTDOT has used to mitigate impacts for the §404 permits. A Connecticut court decision regarding state statutory authority to accept such mitigation on the state level has limited its utility.

### ***2.1.4 Summary of Connecticut Environmental Permitting<sup>41</sup>***

With some exceptions, environmental permitting of state transportation projects is no different than permitting for private projects: it is the activity (e.g., placement of structures or fill, creation of impervious surfaces) or potential natural resource impact (e.g., inland or tidal wetlands, stream channels or floodplains) that defines the regulatory requirements for proposed work. Defining the activities and impacts associated with a given transportation project (including construction access and methodologies as well as post construction compliance) governs the identification of environmental regulatory requirements.<sup>42</sup> Within the regulatory jurisdiction(s), various mechanisms may be available for review and approval (e.g., individual permits, general permits)<sup>43</sup>. Regulatory jurisdiction is established by state statute, or as delegated by federal law, while the regulatory processes are statutorily authorized but established through departmental discretion (programmatically, as opposed to case-by-case.)<sup>44</sup> *[For the most part in Connecticut, in cases where state regulatory jurisdiction and federal regulatory jurisdiction are coincident, the state process will drive the federal process.]*

#### **2.1.4.1 APPLICATION REQUIREMENTS/PERFORMANCE STANDARDS**

The extent of information required in any application is that which is necessary for the commissioner of DEEP to make findings that the regulated activity will not have any unacceptable impacts on protected resources or their essential functions and will otherwise achieve all appropriate regulatory standards. Requirements may vary on a case-by-case basis

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41 Environmental permitting includes air, waste and water resource management, all of which may be *im-plicated* in transportation project deliverability. However, this work will focus on the water resource related programs as they have the greatest potential to *effect* deliverability.

42 This process is operationalized by CTDOT through its internal “Environmental Review Request” and “Permit Need Determination” form.

43 “DEEP has the authority to issue general permits in most major program areas including the air, water, and waste programs. This authority allows the Commissioner to develop and issue a single permit to cover similar minor activities throughout a prescribed geographic area. A general permit sets terms and conditions for conducting an activity that, when complied with, are protective of the environment. There are three basic types of general permits or ways of authorizing activities using a general permit. Under the first type, a person conducting an activity described in a general permit may initiate the activity without prior registration (some of these permits may require later registration). A second type of general permit requires registration prior to initiation of the activity (this registration frequently requires certification of a professional engineer). The third type of general permit requires *DEEP approval prior to initiation* of the activity. In some cases, this approval will contain site-specific conditions in addition to those already contained in the general permit. In almost every case, general permits are a quicker and more cost effective way to permit minor activities for both the Department and the applicant. For a list of activities covered by general permits, see the *List of General Permits* (DEP-FS-004) fact sheet.”

44 The descriptions below are limited summaries of regulatory jurisdictions and statutory authorities and requirements. Links to the appropriate DEEP forms and requirements are provided and should be consulted for specific details.

depending on complexity of a project and the types and extent of resources potentially affected. Individual permits usually require more detailed and specific information. General permits are issued based upon the commissioner's determination that the eligible class of activities will, if conducted in accordance with all established conditions, be consistent with applicable standards. Therefore, less information or degree of detail may be sufficient.

In addition to the individual regulatory programs, several other environmental or natural resource programs are implemented through those regulatory programs. These programs include the Connecticut Coastal Management Act, which is applicable within a prescribed boundary, and the Endangered Species Act. All other DEEP permits must be consistent with these two acts. Once the regulatory jurisdictions applicable to a given project are established, and natural resource (fisheries, wildlife, natural diversity database [NDDDB]) implications identified, those specific resource divisions within DEEP may become involved in assessing the project and providing performance guidance. Staffing of DEEP's natural resource divisions has historically been a challenge and is continuing, and potentially worsening, to date.

Performance standards are primarily embodied in the statutes and regulations for the specific regulatory programs; however, other sources are recognized as the criteria or standards to which projects must be designed and with which they must comply. Of particular relevance, these include the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control (DEP Bulletin 34); the 2004 Connecticut Stormwater Quality Manual; and the 2000 CTDOT Drainage Manual.

#### **2.1.4.2 THE KEY REGULATORY PROGRAMS**

##### ***Inland Water Resources (inland waters and wetlands, floodplain management)***

Individual permits are required for activities that occur in or are likely to affect inland wetlands or watercourses or their essential functions unless they are statutorily exempt or covered by one of the expedited permitting processes identified below. Flood Management Certifications are required for state actions that occur in floodplains or floodways and/or will affect the flood water retention or carrying capacity of those lands. In addition to individual permits, the following regulatory approaches are currently in effect:

- General Permit for Minor Activities Inland Wetlands and Watercourses
  - o Infrastructure Repairs: Repair or replacement of a bridge; placement, repair, or replacement of cables, conduits or pipelines; placement of fill or disturbance to wetlands, watercourses or flood plains for roadway reconstruction provided that such repairs do not impact more than 0.10 acres of wetlands, watercourses or floodplains (Section 3(a)(5))
  - o Activities Authorized Under a Department of Army (USACE) General Permit, and Activities Authorized Under a General Section 401 Water Quality Certification Issue by the Department: Any activity for which an authorization has been granted under a Department of Army (USACE) General Permit provided
    1. the commissioner has granted a §401 WQC for such Department of the Army General Permit.



2. the activity is consistent with the §401 WQC granted by the commissioner for such Department of the Army General Permit (Section 3(a)(8)).

Eligibility under the general permit includes some reliance on other state regulatory program sign offs (i.e., endangered species, coastal management, aquifer protection, etc.), but is not otherwise apparently performance based.

- General Flood Management Certification for CTDOT
  - o Specific to 12 minor CTDOT activities: 1) Minor Safety Improvements, Streetscape, and Transportation Facility and Enhancement Projects; 2) Roadway Repair, Repaving, Maintenance & Underground Utilities; 3) Minor Stormwater Drainage Improvements; 4) Removal of Sediment or Debris from a Floodplain; 5) Wetland Restoration, Creation, or Enhancement; 6) Scour Repairs at Structures; 7) Guide Rail Installation; 8) Deck and Superstructure Replacement; 9) Minor Culvert and Bridge Repairs including proper containment; 10) Fisheries Enhancements; 11) Surveying and Testing; and 12) Bicycle I Pedestrian, Multi-Use Trails and Enhancement Projects
  - o Includes performance standards directly or through reference to CTDOT or DEEP manuals

The Inland Water Resources Division (IWRD) has a total of nine (9) staff to meet all of its statewide responsibilities. IWRD estimates that CTDOT accounts for 60% to 70% of its workload. IWRD has two individuals assigned to the Monthly Project Managers meeting but does not otherwise have staff dedicated to transportation projects. IWRD has conducted and/or participated in several LEAN process improvement exercises through which reductions in application review steps and overall time frames were identified and have been achieved.

#### *Tidal, Coastal, Navigable Waters and Tidal Wetlands*

Individual permits are required for activities that occur in tidal wetlands, and tidal, coastal or navigable waters of the state unless the activity is statutorily exempt or covered by one of the expedited permitting processes identified below.

- Certificates of Permission (COPs)
  - o Maintenance and minor modification/alteration of either previously authorized activities or activities conducted prior to the establishment of state jurisdiction; other specific enumerated activities. Generally, less detailed supporting documentation required in applications; statutorily established timelines for DEEP action.
- General Permits
  - o General Permit for Coastal Maintenance (DEEP-OLISP-GP-2015-02): CTDOT maintenance activities meaning rehabilitation, repair, replacement of state-owned and maintained transportation infrastructure and appurtenances such as highways, roadways, bridges, and railways, and associated supporting and protective structures integral to the use and functionality of such infrastructure

including, but not limited to, temporary accessways, stormwater-related structures, bridge piers, decks and abutments, mechanical, electrical or operational structures or workhouses.

The DEEP Office of Long Island Sound Programs (OLISP) has a single staff person dedicated to CTDOT projects who is contemporaneously working on other OLISP efforts. OLISP currently, and in the recent past, has a low number of CTDOT permit applications and is involved on an ongoing basis with a number of major projects, including large bridge replacement projects. This arrangement has reportedly worked well for both agencies. However, an increase in application levels and/or CTDOT activities in coastal areas may challenge the single point of contact approach.

OLISP identifies the CTDOT/DEEP Environmental Review Monthly meetings<sup>45</sup> as being very effective in identifying and addressing issues upfront. For example, based on the parameters of OLISP's regulatory programs, these meetings are helpful in identifying at the outset generally known site limitations of specific CTDOT projects. OLISP further notes that its process experiences some delay waiting for NDDDB reviews and points to the staffing constraints within that program.

#### *Stormwater Management*

EPA has established national standards through which NPDES, including its stormwater management programs, can be delegated to and implemented by states. Connecticut has a delegated stormwater management program that it implements largely through separate general permits in the following areas: construction, industrial, commercial, municipal and transportation. Transportation projects will fall within one and may fall within more than one of these regulatory areas. Several stormwater general permit requirements allow for, or require certification by, third party qualified professionals. At the time of this writing, DEEP has completed its public comment period for a general permit specific to CTDOT operations (General Permit for the Discharge of Stormwater from the Department of Transportation Separate Storm Sewer Systems).

Additionally, DEEP has instituted an on-line system for **stormwater construction and industrial general permit registration(s) filings**. Reviews of technically complete portal filings for CTDOT projects can be completed within two to four business days. Reportedly, delays in review times are typically associated with consultants for CTDOT who do not provide technically complete documentation in the filing for DEEP review.

Current Stormwater Program staff includes six full-time equivalents (FTEs). Current staffing levels represent historically the highest levels compared to prior years. It is anecdotally reported that about 67% of one FTE is devoted to DOT project reviews.

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<sup>45</sup> See E.2.2.1 CTDOT Environmental Workflow for a description on the CTDOT/DEEP Environmental Review Monthly meetings.



### 3.0 CTDOT ENVIRONMENTAL PERMITTING PROCESS

Obtaining all required environmental approvals and permits requires coordination between the CTDOT Bureau of Engineering and Construction and Bureau of Policy and Planning. The Office of Environmental Planning (OEP) within the Bureau of Policy and Planning is the central point of contact between the transportation design engineers (CTDOT engineers and design consultants and DEEP and the federal permitting agencies).

#### 3.1 CTDOT ENVIRONMENTAL WORKFLOW

The environmental review process is initiated by the Design Engineer submitting an Environmental Review Request Form to OEP (see Appendix D). The request form includes:

- Project Description including Site Location Map, Purpose and Need Statement, and Concept / Sketch Plans
- Original or Resubmittal of Environmental Review Request Form
- Project Facts regarding cultural resources, air and noise issues, and wetland impacts
- Rights-of-Way Status (Highway and Railroad)
- Coordination with CT State Historic Preservation Officer
- Coordination with Office of Environmental Compliance
- Public Outreach
- Funding
- Final Design Plan Date and Advertising Date
- Socio-Economic
- Parks/Wildlife Refuges/Scenic Roads/Bikeways
- Historic and Archaeological Resources (including tribal coordination)
- Water Resources
- Natural Resources – Threatened or Endangered Species
- Air Quality
- Noise
- Consistency with the state’s Conservation and Development Plan

Currently, the design engineer submits a Permit Need Determination Form (PNDF)<sup>46</sup> to OEP at the same time as the Environmental Review Request Form. The PNDF was developed as a tool to help determine what permits are needed early in the design process, but has become over time a more involved process that is not working as intended.

To meet CTDOT's goal of submitting permits at the end of semi-final design, the PNDF process is being improved to better align with the preliminary design process. The two-step process is initiated by the design engineer when basic project information is submitted to OEP. This starts the environmental information gathering (e.g., endangered species, aquifer protection) and coordination (e.g., fisheries) process. The second part of the PNDF is conducted at approximately 25% design before the designer prepares the preliminary design report. Staff from OEP and the designer meet to review project plans, discuss resulting proposed impacts and to identify the permits that will be needed. The designer's plans should show flagged wetlands, flood plain limits, and expected impacts. The PNDF form is then reviewed at a face-to-face meeting with OEP and Environmental Permit Coordination Unit (EPC) staff, and Hydraulics and Drainage (H&D) staff if there are complex FEMA/flood plain issues. The goal of the face-to-face meeting is to come to agreement on the PNDF, or shortly thereafter with limited follow-up. The PNDF is not required for "curb-to-curb" projects such as pavement markings, LED re-lamping, channel post signing (i.e., wrong way, multi-way stop, school warning signs), traffic control signals, and pavement preservation. The updated Part 1 and Part 2 PNDF are shown in Figure 3.1.

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<sup>46</sup> As previously noted, the term permit is used broadly and can include other forms of regulatory authorization like general permits, or certifications each of which has different application and review process requirements (i.e., some are self-implementing requiring only a registration, some a registration and approval, some a full adjudicatory process.



**CONNECTICUT DEPARTMENT OF TRANSPORTATION  
PERMIT NEED DETERMINATION FORM**

*A location map and detailed project description must accompany Part 1 of this request. Submittals are to be sent to the OEP.*

- |   |   |
|---|---|
| Town (s): <a href="#">Click here to enter text.</a>                         | FDP Date: <a href="#">Click here to enter a date.</a>   |
| State Project #: <a href="#">Click here to enter text.</a>                  | Anticipated Construction Start Date: <a href="#">Click here to enter a date.</a>              |
| CORE Project #: <a href="#">Click here to enter text.</a>                   | Bridge Number: <a href="#">Click here to enter text.</a>                                      |
| Funding Source (if Municipal): <a href="#">Click here to enter text.</a>    | Town or State Initiated: <a href="#">Choose an item.</a>                                      |
| Federal Funding in any phase (ROW/ PE/ CN): <a href="#">Choose an item.</a> | Waterway(s): <a href="#">Click here to enter text.</a>  |
| -Funding Agency: <a href="#">Click here to enter text.</a>                  | Construction Oversight: <a href="#">Choose an item.</a>                                       |
| DOT Design contact: <a href="#">Click here to enter text.</a>               | Target Part 2 Meeting Date (4-6 weeks before PD): <a href="#">Click here to enter a date.</a> |
| Phone: <a href="#">Click here to enter text.</a>                            |   |
| Project Description: <a href="#">Click here to enter text.</a>              |   |

**PART 1** (To be completed by OEP based on project location map and project description provided.)

**Section 1: Department Coordination Requirements / BMP's**

**Water Resources**

- No Concerns Noted Choose an item.
- DEEP Boating Concerns Choose an item.
- Impaired Waterbody Choose an item.
- Watershed/Water Co. Land/Reservoir Choose an item.
- Public Wells Choose an item.
- Aquifer Protection Area Choose an item.
- Sole Source Aquifer Protection Area\* Choose an item.
- Coast Guard Coordination needed Choose an item.
- Potential LEAN candidate Choose an item.
- Potential FEMA Floodplain Involvement\*\*\* Choose an item.

**Natural Resources**

- No Concerns Noted Choose an item.
- DEEP Property Acquisition Required Choose an item.
- Wild and Scenic River Designation Choose an item.
- Prime Farmland Choose an item.
- DEEP Fisheries Coordination Choose an item.
- NDDB Coordination Choose an item.
- NDDB Coord. (for Stormwater Permit)\*\* Choose an item.
- Federally Listed Species Coordination Choose an item.

\*EPA Coordination to be made in conjunction with FHWA.

\*\*If a stormwater permit is required, NDDB coordination must occur if species are located within 1/4mile of the project site.

\*\*\* Coordination with the DOT Hydraulic and Drainage Unit will be required to finalize Flood Management permitting requirements. Use attached review request form to initiate H&D review.

**Section 2: Permit and Department Coordination Requirements / BMPs for Municipal Projects**

*This is the only section that will be responded by OEP for Municipal Projects. State and Federal Permit Requirements are to be determined by the Municipality. Flood Management permitting will need to be approved prior to submission of any State and/or Federal Permits required for a municipal project.*

**Flood Management Certification**

- Not Required Choose an item.
- Additional Information Required Choose an item.
- Flood Management General (H&D) Choose an item.
- Flood Management MOU (H&D, OEP &Town) Choose an item.
- Individual Flood Management (DEEP-IWRD) Choose an item.
- Ind. Flood Management Exemption (DEEP-IWRD) Choose an item.

**Natural Resources**

- No Concerns Noted Choose an item.
- DEEP Fisheries Coordination Choose an item.
- NDDB Coordination Choose an item.
- Federally Listed Species Coordination Choose an item.
- Sole Source Aquifer Protection Area Choose an item.
- Potential LEAN candidate Choose an item.

**Comment:**

[Click here to enter text.](#)

## **PART 2** (EPC will work with the Designer to set up a PNDF Part 2 meeting, prior to 30% design progress.)

The designer should plan to bring the following to the meeting, at a minimum:

- Latest design plans
- Estimated tree clearing area ( [Click here to enter text.](#) acres)
- Estimated overall erodible surface area disturbance ( [Click here to enter text.](#) acres)
- Approximate wetland and watercourse impact totals ( [Click here to enter text.](#) sq. feet)
- Approximate floodplain impact totals ( [Click here to enter text.](#) sq. feet)
- Drainage area (for bridge/cross culvert work only); drainage area to the structure ( [Click here to enter text.](#) sq. miles)
- Site photographs
- If the project is coastal and the consultant completed a tidal wetland delineation, please bring a copy of the consultant's wetland delineation report which will include a list of identified tidal wetland vegetation.

Please see PNDF Instruction Guide on OEP's Water & Natural Resources website.

The following will be completed by OEP at the time of the meeting or immediately following.

### **Section 3: State Permitting Requirements**

#### **Flood Management Certification**

- Not Required Choose an item.
- Additional Information Required Choose an item.
- Flood Management General (H&D) Choose an item.
- Individual Flood Management (DEEP-IWRD) Choose an item.
- Ind. Flood Management Exemption (DEEP-IWRD) Choose an item.

#### **401 Water Quality Certification**

- Not Required Choose an item.
- 401 - Self-Verification Form (SV) Choose an item.
- 401 - Pre-Construction Notification (PCN) Choose an item.
- 401 - Individual (DEEP-IWRD) Choose an item.
- 401 - Individual (DEEP-OLISP) Choose an item.

#### **Inland Wetlands/Watercourses Permits**

- Not Required Choose an item.
- DMP Activity (*Maintenance Activities only*) Choose an item.
- DMP Activity (*Rails Maintenance Activities only*) Choose an item.
- General Water Resource Construction Activities (DEEP-IWRD) Choose an item.
- Individual Inland Wetlands & Watercourses (DEEP-IWRD) Choose an item.
- Temporary Authorization (DEEP-IWRD) Choose an item.
- Emergency Authorization (DEEP-IWRD) Choose an item.

#### **Stormwater Permits**

- Not Required Choose an item.
- General Stormwater and Dewatering from Construction Activities (DEEP-WPED) Choose an item.
- General Stormwater Associated with Industrial Activities (DEEP-WPED) Choose an item.

#### **Coastal Permits**

- Not Required Choose an item.
- Additional Information Required Choose an item.
- Coastal Consistency Review (OEP Internal Sign-off) Choose an item.
- Coastal Consistency Review (DEEP-OLISP) Choose an item.
- Certificate of Permission (DEEP-OLISP) Choose an item.
- General Coastal Maintenance (DEEP-OLISP) Choose an item.
- Structures, Dredging & Fill (DEEP-OLISP) Choose an item.
- Structures, Dredging, Fill and Tidal Wetlands (DEEP-OLISP) Choose an item.
- Temporary Authorization (DEEP-OLISP) Choose an item.
- Emergency Authorization (DEEP-OLISP) Choose an item.

#### **Dam Permits**

- Not Required Choose an item.
- Gen. Dam Safety Repair (DEEP-IWRD) Choose an item.
- Ind. Dam Construction (DEEP-IWRD) Choose an item.

#### **Department of Public Health (DPH) Permits**

- Not Required Choose an item.
- Water Company Land General Permit Choose an item.
- Water Company Land Change in Use Choose an item.



## **PART 2 (con't)**

### **Section 4: Federal Permitting Requirements**

#### **Section 404/Section 10 Permits (USACE)**

- Not Required Choose an item.
- Additional Information Required Choose an item.
- Self-Verification Form (SV) Choose an item.
- Pre-Construction Notification (PCN) - Eng. Form 4345 Choose an item.
- Individual Permit - Eng. Form 4345 Choose an item.
- Emergency Authorization Choose an item.

#### **United States Coast Guard (USCG)\***

(If identified in Section 1)

- Not Required Choose an item.
- Construction Letter Choose an item.
- Coast Guard Bridge Permit Choose an item.
- Exempt from Permit under STURRA by FHWA Choose an item.

\*Coordination with FHWA will be required to determine USCG permitting requirements.

#### **Comment:**

Click here to enter text.

Reviewed By: Choose an item.

Date: Click here to enter a date.

Concurrence By: Choose an item.  
OEP Transportation Supervising Planner

Date: Click here to enter a date.

Review based on project plans dated: Click here to enter a date.

***NOTE: If project scope or project limits change, permit needs may change and must be coordinated with the OEP.***

Revised 7/25/2016

Office of Environmental Planning

FIGURE 3.1. CTDOT PERMIT NEED DETERMINATION FORM (OEP, 7/25/16)

Preliminary hydraulic reports and a conceptual layout of the drainage system that may include channels, ditches, swales, and stormwater quality treatment requirements are prepared by the design engineer for the preliminary design (i.e., 30% design) phase. After consultation with engineering, OEP determines if a project at this point should be presented at a CTDOT/DEEP Environmental Review monthly meeting (See Section 3.2: Coordination Between CTDOT, DEEP, and Federal Regulatory Agencies).

In the 30% to 60% design phase, engineering finalizes the footprint of all impacts; the drainage system design and hydraulic analyses are finalized and final reports are drafted; and OEP continues to coordinate and finalize agreements with the resource agencies. Once completed, the draft permit applications are prepared by engineering and reviewed by OEP. While the goal is to complete draft permit applications at 60% design, the submission of the permit applications to OEP for some projects is occurring closer to 90% design. The time it takes OEP to review some permit applications and iterative internal reviews can further delay the submittal of final permit applications by OEP to DEEP and federal regulatory agencies.

As designs are being finalized and permit applications are being prepared, OEP determines if the design engineer should present their design at the monthly Project Managers Meeting that is attended by DEEP, USACE, EPA, and OEP. This is a regulatory meeting where the stakes are much higher than when presenting at the CTDOT/DEEP Environmental Review monthly meeting. Environmental issues are more easily addressed if identified and discussed at the CTDOT/DEEP Environmental Review monthly meetings as designs are still being refined at this early design stage. Changes identified and required at the Project Managers Meeting stage will likely lead to a delay in the construction of the project.

Previously established, but not current, average review and processing times for environmental permits are displayed in Figure 3.2 to illustrate the multi-step, iterative processes associated with a given permit review. To help facilitate the review of projects that are of greatest importance, OEP and engineering management meet monthly (i.e., called Permit Priorities Meeting) to prioritize CTDOT permit applications for DEEP's review. All environmental permits must be approved by DEEP and federal agencies before the project can be advertised for construction unless a waiver is granted by the Chief Engineer.



### Average Review and Processing Times for Environmental Permits

Permit (Issuing Agency/Office)	Average OEP Review Time Per Submission <sup>1,2</sup>		Estimated Processing Time by the Reviewing Agency/Office <sup>3</sup>	Public Notice Period
	Multiple reviews usually required	2 Weeks		
IW Individual /FMC/401 WQC (IWRD)*	2 months	180 Days**	Registered upon submission to DEEP	30 day public notice period
IW General (IWRD)	1 month			No Public Notice
FMC (IWRD)*	1 month	60 days**		No Public Notice
FMC with Exemption (IWRD)*	1 month	4 months		30 day public notice period
FM-MOU	1 month	OEP signoff follows H&D		No Public Notice
FM-General		OEP does not review		No Public Notice
401 WQC (IWRD)*	1 month	180 Days**		30 day public notice period
401 WQC (OLISP)	1 month	180 Days**		Public notice runs concurrently with IW, SDF or TWSDF
401 WQC via RFP Addendum (IWRD)*	1 month	180 Days**		No Public Notice
Tidal Wetlands Structures Dredge and Fill (OLISP)**	2 months	180 Days**		40 day public notice period
Tidal Wetlands (OLISP)**	2 months	180 Days**		40 day public notice period
Structures Dredge and Fill (OLISP)	2 months	180 Days**		30 day public notice period
Certificate of Permission (OLISP)	1 month	45 days**		No Public Notice
Coastal Area Management Consistency Review (OLISP)	1 month	90 days**		No Public Notice
Coastal Area Management Consistency Review (OEP)	1 month	1 month once determined to qualify		No Public Notice
ACOE Cat. 1	3 weeks	1 month		No Public Notice
ACOE Cat. 2 ***	2 months	4 months from issuance of DEEP 401 WQC		No Public Notice
ACOE Individual***	2 months	5 months		30 day public notice period
Dam Construction (IWRD)	1 month	120 Days**		30 day public notice period

H&D Prepares Approval Letter to Municipality.  
May Contain Special Conditions.

\* If permits are submitted concurrently, will be processed jointly by DEEP  
\*\* Per DEEP Factsheets reporting average processing times  
\*\*\* Due to extent of review involved (mitigation plan concurrence, mitigation checklist, etc., extensive pre-application coordination may be required)

Notes:  
1. The total time a project requires for review is based on the completeness of the package received and the responsiveness to comments made by OEP during the previous review. OEP is not responsible for project timelines when comments are provided and there is a significant lag time until the next draft permit is submitted for our review.  
2. Review times do not include the amount of time required for OEP staff to conduct wetlands delineations, prepare ACOE field data sheets and related field work, or to prepare environmental write-ups in support of permit applications.  
3. Timeframes above do not include estimates of time a permit may spend in an Agency's signature loop following approval.

Permit Need Determination Forms (PNDF)  
PNDF is to be submitted at the scoping stage (or at the time the Environmental Review is submitted). Initial reviews generally are completed within 3 months. Final PNDP will not be completed until the footprint of all impacts is finalized, coordination with resource agencies (Fisheries, NDDB, Water Companies, etc) has reached satisfactory level, and if/when a project needs to be reviewed at LEAN or PMM meetings. Time of issuance is related to the rate of the project design, but will generally be issued between the completion of PD and the 60% design phase.

- IWRD - DEEP Inland Water Resources Division
- OLISP - DEEP Office of Long Island Sound Programs
- ACOE - Army Corp of Engineers
- OEP - DOT Office of Environmental Planning
- H&D - DOT Hydraulics and Drainage Unit

FIGURE 3.2. CTDOT AVERAGE REVIEW AND PROCESSING TIMES FOR ENVIRONMENTAL PERMITS (ILLUSTRATIVE - NOT CURRENT)

### 3.2 COORDINATION BETWEEN CTDOT, DEEP, AND FEDERAL REGULATORY AGENCIES

Obtaining all required environmental permits requires coordination between the CTDOT Bureaus of Engineering & Construction and Policy & Planning as well as the applicable state and federal regulatory agencies as illustrated in Figure 3.3. OEP is the central point of contact between the transportation design engineers (CTDOT engineers and design consultants) and DEEP and the federal permitting agencies. Within this framework, OEP provides consistency in the submission of the completed permit applications and enables a single point of contact for the regulatory agencies (e.g., DEEP, USACE, EPA). State and private consulting design engineers submit to OEP the permit applications and support documentation for review as shown by the solid line in Figure 3.3. Arrows are included in both directions because the permit applications may be reviewed and revised multiple times as the design evolves before the permit application is finalized. The dashed lines between the EPC unit and engineering design and OEP represents the unit's liaison role in quickly resolving issues that might arise between engineering and OEP.

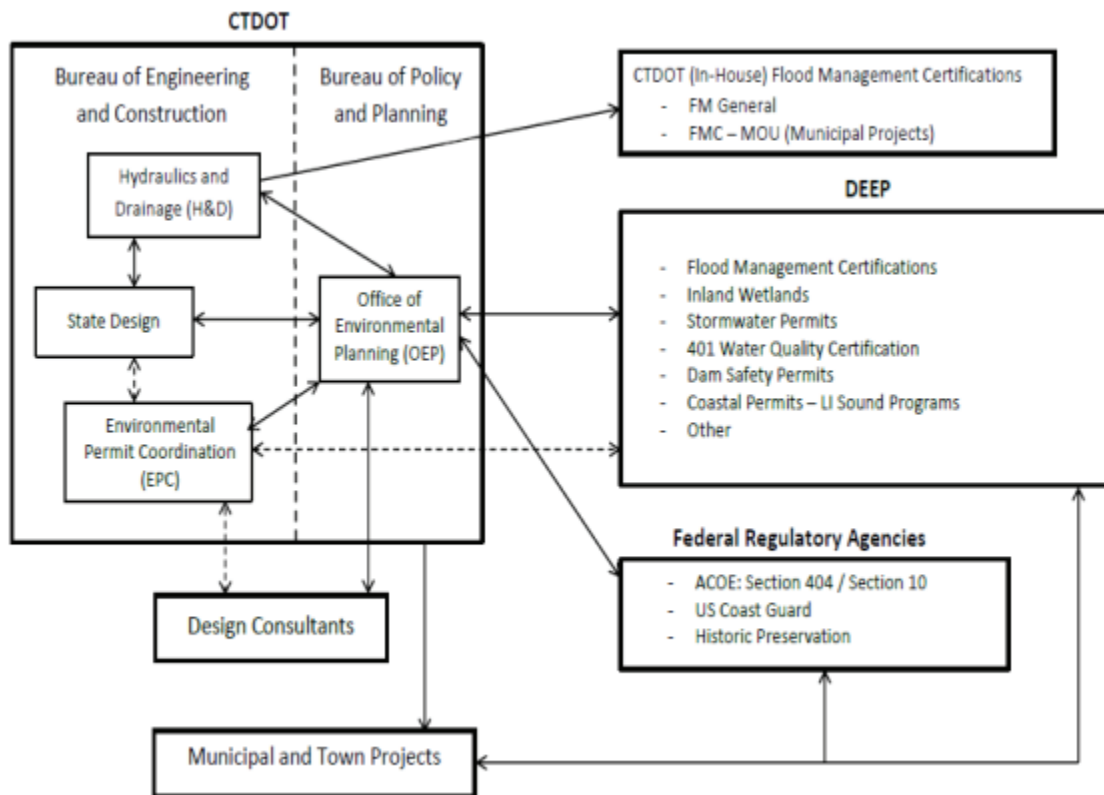


FIGURE 3.3. COORDINATION BETWEEN CTDOT, DEEP, AND FEDERAL REGULATORY AGENCIES

OEP is responsible for submitting the permit application to the state and federal regulatory agencies. To coordinate CTDOT's design efforts with the regulatory and resource agencies

permitting requirements, two monthly meetings are currently taking place. These are the CTDOT/DEEP Environmental Review meeting and the Project Managers Meeting that take place one after the other. The CTDOT/DEEP Environmental Review monthly meetings are organized by OEP to discuss the environmental impact on state permitting for specific projects. Design engineers present their project-specific environmental issues early in the design process (approximately 30% stage) with the goal of getting early guidance from DEEP so that there are not any last minute environmental issues that could delay a project. This is designed to be an iterative process where the project can be discussed in more than one monthly meeting, as needed. Agreements made at these meetings that include best management practices, alternative approaches, mitigation practices, and resolution of technical issues such as flood certification requirements, are documented and distributed to DEEP, OEP and the design engineers and accompany the permit application. After the CTDOT/DEEP Environmental Review monthly meetings are completed, the Project Managers Meeting is held that includes the USACE and EPA. Design engineers are involved in the meeting and provide presentations to the regulatory agencies. The agenda for this meeting includes projects further along in the process, i.e., almost ready to submit to regulatory review (approximately 90% stage).

Additionally, CTDOT and DEEP meet on a bi-weekly basis to discuss larger non-project specific issues that may impact the permit application and approval process (e.g., new USACE Connecticut General Permit, new DEEP General Permits, FEMA Letter of Map Revision(LOMR)/Conditional Letter of Map Revision (CLOMR) procedure, DEEP Fisheries Sign-off procedures, and additional changes to improve or streamline the permitting process). This meeting is referred to as the CTDOT/DEEP Permit Working Group.

The Bureau of Engineering and Construction includes an EPC. EPC has a number of roles. Primarily, the unit acts as a liaison between engineering units and OEP. Engineers or OEP can bring in EPC if they are having problems understanding one another or are at an impasse. EPC is copied on correspondence between the offices. If acute issues arise, EPC reacts quickly to get involved and resolve them before they become larger issues. Another goal of EPC is to develop good examples and guidance for design engineers who may only be required to complete environmental permit applications on an infrequent basis. EPC also prepares Engineering Directives/Bulletins for environmental processes for engineers.

EPC is available to help OEP staff when requested and tries to provide an engineering perspective where possible for project design and schedules. The unit also examines and makes suggestions to improve processes; when it is decided by CTDOT management that a process should change, the EPC is responsible for documenting and helping to implement the change. A good example of this is doing the legwork to obtain permits earlier in the design process. EPC also reviews and coordinates department comments on proposed federal/state regulations. Additionally, EPC looks over OEP review comments that are provided back to engineers to make sure the comments are clear and understandable, lessen inconsistencies between reviews, and reduce comment/response iterations, wherever possible.

H&D also plays a critical role in the environmental permitting process. The typical practice is that H&D prepares hydraulic analyses and reports for State Design (“in-house”) projects, while design consultants (DEs) prepare the hydraulic analyses and reports for consultant-designed projects. H&D reviews and approves the analyses and reports prepared by DEs. In regard to drainage design, highway designers (State Design) prepare the drainage design for “in-house”

projects while DEs prepare drainage designs for consultant-designed projects. H&D reviews the drainage designs prepared by DEs while the drainage designs by State Design are only reviewed by H&D upon the request of the project engineer. Preliminary hydraulic reports and a conceptual layout of the drainage system that may also include channels, ditches, swales, and stormwater quality treatment requirements, are submitted for the 30% design review. After the design engineer has finalized the highway alignment and/or the bridge type and alignment, the drainage system design, hydraulic analyses and associated reports can be finalized. Final reports are completed and approved subsequent to the 60% design review. The hydraulic and drainage design, and the supporting analyses and reports, are key elements in many of the permit applications. Given their long-standing relationship with DEEP, H&D self-certifies the Flood Management Certification (FMC) for certain activities pursuant to a General Permit and the FMC for eligible municipal projects that are administered by the CTDOT. Analyses and reports prepared by or reviewed and approved by H&D are not re-checked and reviewed in detail by DEEP.

The ability of DEEP to review environmental permit applications in a timely manner is influenced not only by the number and complexity of CTDOT projects, but also by private and municipal/town projects. Municipal/town infrastructure projects (bridges and roads) can adversely affect DEEP's response time because these environmental permit applications do not go through the same type of thorough review by CTDOT prior to submittal to DEEP as CTDOT projects. In some cases, the time required by DEEP to review the municipal/town applications is significantly greater than other permit applications. The responsibility of the state and federal regulatory agencies to review the municipal/town projects is also shown in Figure 3.3.

## 4.0 FINDINGS

Generally, Connecticut's experience regarding the effect of environmental reviews on transportation project delivery is consistent with other states. This is evidenced by the multiple studies and efforts aimed at identifying efficiencies for those processes, including recent federal legislation seeking to integrate environmental reviews with transportation planning and implementation processes.

Connecticut's experience, like that of other states, reflects a healthy tension between two state agencies with critical public welfare missions. While they are not mutually exclusive, regulators with an environmental and natural resource protection mission and a regulated entity with a safe and effective transportation system mission will have different perspectives and priorities. But all indications are that staff and management in each agency have a healthy respect for the other's missions, roles, and competencies, which is key to the collaborative efforts they must engage in for mutual success.

Returning to the categories identified in the seminal study of effective streamlining practices undertaken by the State of Washington, Connecticut is in line with other New England states in many of environmental streamlining efforts to date as shown in Table 4.1.



TABLE 4.1. EFFECTIVE STREAMLINING PRACTICES IN SELECTED STATES,  
INCLUDING CONNECTICUT

Activity	MA	ME	NH	VT	CT
<b>Improvement of Agency Coordination</b>	USACE/ MassDOT/ MassDEP  - Monthly meetings/ formal and informal	MaineDOT/ MaineDEP  - Monthly meetings/ formal and informal  MaineDOT/ MaineDEP/ federal agencies  - Monthly meetings/ formal and informal	NHDOT/ NHDES  - Dedicated staff  NHDOT/ NHDES/fed- eral agencies  - Monthly meetings/ formal and informal  - Project prioritization coordination	VTrans/VT- DEC  - Monthly meetings/ formal and informal  VTrans/VT- DEC/federal agencies  - Monthly meetings/ formal and informal	DEEP-OLISP  - Dedicated CTDOT staff  CTDOT/DEEP  - Monthly Meetings  CTDOT/ DEEP/federal agencies  - Monthly meetings
<b>Development of On-Line Applications</b>	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing	Various degrees across programs; web-based information and data sharing
<b>Programmatic Permits [and other permitting efficiencies]</b>	General permits  Statutory exemptions  Administrative expedited reviews  USACE PGP	General permits  Streamlined processes  USACE PGP  Programmatic agreement with USFWS in development	General permits  Statutory rules/exemptions  NHDOT/ NHDES MOU (substantial equivalence in lieu of permits)  USACE PGP	General permits  VTrans self-certifications  Statutory exemptions  USACE PGP	Several program area general permits/expedited processes  - Coastal COP process  - FMC MOU  USACE PGP's
<b>Liaison Program to Fund Natural Resource Agency Staff</b>	MassDEP/ USACE  Natural Heritage  MassDOT/ USACE	MaineDOT/ USFWS	No formal federal liaison program	No formal federal liaison program	No formal federal liaison program

However, the lack of specific performance measures or metrics makes it difficult to identify with any precision continuing opportunities for improving aspects of environmental review that are impediments to deliverability. Data provided and assessed through such established measures



are necessary for continued improvement. For example, prior to engaging in the development of a new programmatic agreement, which is in itself a time and resource consuming process, it would be important to know how many projects are likely to benefit from such agreement, and what percentage of review time might be reduced by the transportation and environmental agencies. While development of a system of metrics may be resource consumptive, the data collection input and report creation need not be. Metrics could support specific budgetary, legislative or policy changes that might be otherwise difficult to achieve (e.g., additional staffing, use of consultants, allowance of self-certification of environmental compliance, public notice requirements).

- A. Transportation project deliverability is affected by the time involved in acquiring environmental permits. CTDOT reports that it misses established project schedule dates because permits have not been acquired within their scheduled time frame. As in many large bureaucracies, the silo-ing of both tasks and information within CTDOT has contributed to permit acquisition and therefore project scheduling difficulties. The recent establishment of EPC within CTDOT's Bureau of Engineering and Construction is serving as a useful intra-agency liaison.
- Among the contributing factors to the permit acquisition time difficulty is that CTDOT's OEP, which serves as support to the engineering services, relies on CTDOT's project designers to initiate the evaluation process for a project's environmental requirements – both substantive and procedural. The literature review and investigation of processes in other states indicates that the involvement of OEP and potentially the resource agencies in a project at the earliest stage possible would jumpstart the review and application preparation process, including:
    - a. Identification of necessary permits
    - b. Outreach to and inclusion of the regulatory and natural resource support agencies to identify issues in application preparation, project design, and compliance (including resource mitigation planning)
    - c. Development of realistic schedules for permit acquisition and therefore deadline (bids/proposals, etc.) dates
  - The recently established (December 2015) CTDOT/DEEP Permit Working Group, comprising representatives from DEEP's regulatory and natural resource offices and CTDOT's OEP, EPC and Engineering offices, has identified several process and performance issues and has begun to systematically address them. Specific items are identified as appropriate below. (See Findings, Item B)
  - Other state DOTs have addressed some of the issues identified in Item A:
    - a. Using the transportation agency's annual capital plan as the conceptual project list that is shared within DOT, as well as with the regulatory agencies (Maine, Massachusetts). This very early involvement has been identified as keeping project schedules realistic and on track as well as providing early identification of potential issues.

The MaineDOT, for example, has a three-year rolling work plan. Its environmental office first screens out the scopes that do not typically concern the resource agencies (e.g., surface treatment, crack seal, bridge painting). They then

use an internally created GIS layer that shows potential projects and overlays the different types of habitats the fisheries agencies are concerned about. Following the winnowing of the list, MaineDOT meets with USFWS, NMFS, state IFW and Marine Resources departments and a few non-government organizations, looks at each project that has been added (i.e., the new year's projects), and asks for additional input on projects they may have seen before. During these discussions, MaineDOT is specifically looking at whether fish passage/habitat connectivity is critical for a species in a specific location and to understand expectations, not comments on a specific design.

- b. Establishing and using shared project scheduling software/databases (Maine, Vermont - Microsoft SharePoint). This enables all parties to stay informed of the status of a project's progress and schedule; use that information to revisit, become updated or provide new or additional input at appropriate stages; call for additional meetings; and receive pop-up reminders of key steps and deadlines.
- There is an opportunity for more uniformity in permit application development through over-the-shoulder work by OEP with designers. Overall reduction of time to develop the application at CTDOT prior to sending the application to DEEP would be expected.
  - DOT and DEEP conduct monthly CTDOT/DEEP Environmental Review Monthly Meetings and Project Managers Meetings, which also include federal regulatory agencies, at which projects are discussed, before the permit application stage. The projects presented at the CTDOT/DEEP Environmental Review Monthly Meetings are generally at an earlier stage of development than those presented at the Project Managers Meetings. The meetings are designed to be either iterative or "once and done." They provide an opportunity to determine the permits or authorizations that will be required, the best management practices that apply and should be incorporated into a project, potential mitigation requirements and any other issues or concerns. The intent is that notes from these meetings become part of the application record providing guidance, commitments and closure on decided issues.
    - a. OEP, with input from engineering, determines the agendas for these meetings. OEP is not always aware of what stage project designers are at for any given project; design units will bring projects to OEP's attention at different stages of design.
    - b. While there are between 120 and 150 projects in design at any given time, only seven or eight are presented at the monthly Project Managers Meetings and another three or four at the CTDOT/DEEP Environmental Review Meetings.
    - c. Given the above numbers, there is a significant gap between the total number of projects and the number that benefit from these meetings.
    - d. The project designer is responsible for the presentation at these meetings. The quality of presentations is reportedly uneven among in-house and consultant designers. Some leeway is to be expected based upon the stage of development at which the project is being presented (i.e., anywhere from concept to final design). However, some consistency in presentation quality can be gained through a better understanding of expectations at such meetings and training for in-house and consultant presenters as needed.

- e. parties agree that the CTDOT/DEEP Environmental Review Monthly meetings and the monthly Project Managers Meetings are extremely useful.

B. The level of detail necessary to “complete” permit applications has in certain circumstances been both varied and unclear: until recently, there was no agreement among designers, OEP, and/or DEEP regarding how much information is necessary to demonstrate for regulatory purposes that projects will meet environmental standards. There was neither clarity nor alignment between engineering terminology used by DOT regarding “% completion” and the specific information necessary to address natural resource and environmental standards.

This issue transcends the type of permit being sought (i.e., individual versus general or programmatic) even though general permits are intended to be less cumbersome to both the regulated entity and regulators. Connecticut has many programmatic and/or general permits, especially for numerous routine maintenance and operations activities. Several of those, however, still require submission of substantial information to DEEP for their consideration prior to authorization under those permits.

Sufficiency of information and level of detail necessary for application completion has been a major focus of the CTDOT/DEEP Permit Working Group. The Group’s meetings are designed make improvements to permit processes so that applications can be prepared and submitted earlier in the design. The meetings have already made several improvements in both application clarity and construction-related issues. Specifically, the Group has:

- Developed several sample Permit Plan Sets that allow for less detail to be included in permit applications from CTDOT to DEEP.
- Agreed upon an interpretation of time of year work restrictions for coffer dam installation that is protective of the fisheries of concern while allowing greater construction time frames.

The Group’s work is ongoing. Among the items in process at the time of this writing are

- Development of application checklists.
- Development of hydraulics report requirements.
- Working to reduce “Permit Determination of Need” and Fisheries database backlogs.
- Improving coordination with and earlier involvement of DEEP fisheries staff.

Another aspect of this issue is the extent to which DEEP may, as the statutorily designated regulator, rely upon determinations made by CTDOT engineers/design consultants.

Other states have identified environmental permitting areas where that state’s DOT does not have to file an application with its environmental agency. Rather, the transportation agency can rely on its design meeting certain published and accepted standards in what might be considered a self-certification approach to assuring environmental regulatory compliance. These published and accepted standards generally include those that also exist and are relied upon in Connecticut, (i.e., Stormwater, Soil and Erosion Control, and Drainage manuals.) These approaches

have been variously authorized by statute (Massachusetts - bridge project exemptions contained in its Bond Bill) and/or authorized by statute and implemented through Memoranda of Understanding (New Hampshire - Alteration of Terrain MOU, Maine - Stormwater Construction General Permit and MOU). Similarly, DEEP has recognized that materials and models approved by the CTDOT Hydraulics and Drainage unit do not generally need further detailed review.

Particularly within wetlands protection programs, other states and their respective USACE counterparts, use a “worst case” footprint for establishing acceptable wetlands impacts and the requisite mitigation requirements. “Worst case” still involves a demonstration that the design, including anticipated construction methods, has avoided and minimized resource encroachment, but does not require final design details that may further modify the footprint. This enables less detail regarding final design to be accepted at the permit application stage. (Maine, New Hampshire, Vermont)

CTDOT and DEEP have recognized and have been discussing the use of the referenced approach to natural resource-based permits and have taken steps to move forward with this approach. As referenced above, CTDOT and DEEP have developed permit plan sets that have less detail; these may include or be extended to the “footprint” or “worst case” approaches.

- C. Certain substantive issues appear to recur as requiring multiple, and often schedule busting, iterations between CTDOT and DEEP.
- Fisheries and wildlife impacts and mitigation.
    - a. OEP has only recently had access to DEEP fisheries data. DEEP does not have a database for all locations and/or species. The CTDOT/DEEP Permit Working Group is collaborating with DEEP’s fisheries to have staff involved earlier to identify potential impacts or mitigation for unavoidable impacts. Delayed involvement can result in the late identification of the specific issue and/or habitat restoration or impact mitigation approach. DEEP fisheries staff indicate that they might be able to conduct earlier screenings; however, staff resource issues are cited as a significant concern. DEEP Fisheries Stream Crossing Guidelines were first published in 2008 to identify basic principles for fisheries mitigation; these do not appear to have provided sufficient guidance to ameliorate or eliminate this issue. Other states have established fish passage and stream crossing review procedures (Maine, New Hampshire); and an engineering design goal to the 100-year storm to provide connectivity and resilience (Maine).
    - b. DEEP Wildlife Division is undergoing some restructuring to provide better regulatory liaison services.
    - c. Fisheries enhancements will be accepted as mitigation by DEEP and the USACE for Bridge and Culvert projects.

- d. DEEP Fisheries and Wildlife staff identify a need for a DOT/DEEP mitigation banking system, noting that there is and needs to be a difference between terrestrial and aquatic resource mitigation systems.
- Wetlands mitigation issues are less a matter of late identification and more a matter of finding, designing, and implementing acceptable mitigation projects. In an attempt to address these challenges, the USACE has developed in-lieu fee programs for federally defined wetlands; one such program has been established for Connecticut. However, fee payment in-lieu of mitigation under Connecticut's statutes has been limited because a state court decision determined that such payments were not consistent with state law. Other states have identified mixed utility of the in-lieu fee program ranging from quite useful (New Hampshire) to not "bought into" because of state and local requirements (Massachusetts).

It is unclear whether existing wetlands mitigation opportunities will be (a) meaningful, (b) available in sufficient quantity, quality, and/or (c) affordable to accommodate a significant increase in statewide transportation improvement projects without banking and/or in-lieu fee programs.

- Emerging environmental issues are a concern within CTDOT.
  - a. For example, USFWS concern and subsequent rulemaking regarding bats created uncertainty for transportation project planning and implementation. The rollout of information created some tension between CTDOT and USFWS based in part on lack of early communication both between USFWS and CTDOT and within CTDOT.
  - b. Resilience and climate adaptation may lead to increased flood hazard mitigation standards for transportation projects.

#### D. Staffing and Funding

DEEP land use and natural resource programs have historically been understaffed for the array of programs and responsibilities they are required to handle. They are largely state general funded (as opposed to receiving significant federal grants) and subject to the dynamics of state budgeting. To assist DEEP and assure that CTDOT's program needs would not be jeopardized for lack of DEEP staff, CTDOT has for about the last two decades provided funding for DEEP staff. Rather than hiring or assigning specific staff to CTDOT projects, DEEP has had staff who work on CTDOT environmental reviews "code" to a CTDOT fund. In other words, there are not five (the approximate number equated to the dollars provided) staff at DEEP who work on CTDOT projects; rather, the equivalent of five Full-time Equivalents (FTE) of funding is available. This arrangement provides DEEP with the flexibility to manage its staff resources and have staff with appropriate expertise work on CTDOT projects as necessary and appropriate.

It is unclear whether all associated DEEP staff (e.g., permit analysts, resource specialists, supervisors, managers) utilize the appropriate CTDOT project coding provided to account for and document DEEP's use of available funding. DEEP staff may be utilizing generic task codes (i.e., permit review, supervision) and therefore under accounting for the costs associated with CTDOT project reviews.



Both CTDOT and DEEP (1) indicate that additional DEEP staff would help expedite the review and issuance of CTDOT environmental permits/authorizations, and (2) are concerned about their capability to provide the necessary services should vacant positions remain unfilled and/or to meet project delivery expectations with a significant increase in the level of the CTDOT capital project program.

- Table 4.2 indicates the current number of staff per the relevant DEEP regulatory and natural resource support programs. As noted above, this staff is not dedicated to CTDOT projects. Rather, they are responsible for all statewide flood management, inland wetlands, water diversion, tidal wetlands, coastal structures and fill policy, planning and compliance efforts; construction, industrial, municipal stormwater management programs; and fisheries and wildlife monitoring and management. As an example, the timely availability of fisheries and wildlife staff expertise and involvement in CTDOT projects has been identified as a schedule impediment. It is reported that these staff spend at least 50% of their time on natural resource management tasks other than permit application reviews for CTDOT or other regulated projects.

TABLE 4.2. DEEP CURRENT STAFFING —  
RELEVANT REGULATORY AND NATURAL RESOURCE SUPPORT PROGRAMS (2016)

Reviewers (includes supervisors)	Current (2016)
Inland Water Resources Division (IWRD)	9
Office Long Island Sound Programs	9
Stormwater Management	6 (no supervisor)
Inland Fisheries	4
Marine Fisheries	1
Wildlife	5 (no supervisor)

In the case of IWRD authorization, the time frames for review have improved through various streamlining initiatives and allowed the limited staff to keep pace with the current level of applications even though the normal processing time is lengthy due to a backlog of applications.

- DEEP technical staff is on a 35-hour workweek schedule. CTDOT staff is almost exclusively on a 40-hour workweek schedule and many units are working overtime. The difference in available hours has been raised as a possible detriment to DEEP's accommodation of CTDOT's application review and processing needs. As noted above, CTDOT is currently providing funding for DEEP staff that work on CTDOT projects; it is unclear whether administrative approval has been given to utilize those funds to support additional workweek hours as well as overtime as a means to ameliorate this issue.



- CTDOT may be statutorily limited in its ability to use consultants to increase its productivity in certain areas. Conn. Gen. Stat. §4e-16 requires a cost-benefit analysis and business case to justify the “privatization” of a state service that is not presently privatized. CTDOT is apparently limited to the use of consultants only in areas in which they typically use consultants unless they go through a costly process with uncertain results.
- E. Mega Projects are likely to tax existing processes of transportation project environmental permitting and compliance.
- Federal FAST ACT/*Every Day Counts* provides opportunities for funding and expedited processes for identified projects.
- F. With the exception of D-B, environmental reviews and permitting for ACMs are the same as those for traditional DBB projects and would benefit from streamlining practices for individual reviews and synchronization of multiple reviews.
- Both the literature and other states’ experiences indicate that in order to gain the benefits of D-B, some level of environmental permitting may be warranted prior to initiating a project’s procurement process (i.e., RFQ/RFP). The challenge is to find the balance between the level of detail required for environmental review and approval and that which undermines the flexibility of responders for submittal of their proposals.
  - It appears that environmental review and permit streamlining strategies for D-B projects are often negotiated among the state DOTs as project owners and state and federal regulators on a project-specific rather than programmatic basis.
  - There have been many anecdotal examples of state and/or federal permits being issued on the basis of “30%” of preliminary design. To the extent verified, those circumstances were specifically negotiated and the ensuing permits or authorizations heavily conditioned to assure environmental compliance and natural resource protection.
  - Some states make clear in their D-B RFPs and subsequent contracts that all environmental approvals are the responsibility of the successful proposer. Other states have specified that where the transportation agency has acquired permits (preliminary or final), any modifications are the responsibility of the design builder.
  - In recognition and support of the states’ interest in utilizing D-B to improve project deliverability, FHWA has attempted to address the balancing challenge identified above. This includes clarification of what is included in preliminary and final designs, how they intersect with NEPA requirements, and states’ ability to use federal funds at various stages through the review process. (<http://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/prelimdesign.cfm>)

## 5.0 RECOMMENDATIONS

The following recommendations are applicable to all project delivery methodologies. As an overarching recommendation, each agency must rethink and change its current view of the transportation-environmental compliance relationship. For its part, CTDOT must ensure its environmental compliance paradigm incorporates environmental compliance and natural resource protection and enhancement as an integral part of design. This will require additional training and vetting of both staff and consultant engineers. It will additionally require significant integration of and communication between environmental and transportation experts, on an inter- and intra-agency basis. For DEEP's part, its management must assess its streamlining paradigms to consider its clients' (i.e., CTDOT and other major development entities) processes. In other words, DEEP needs to understand and accommodate the development sector's need for some level of authorization certainty prior to achieving the level of certainty DEEP desires and/or is required to find as a matter of final authorization.

The following recommendations offer some vehicles for implementing the above cultural and paradigm shifts, in addition to others currently being developed in detail through ongoing inter-and intra-agency efforts. In summary fashion, the recommendations all speak to (1) close and continual communication between the environmental and natural resource professionals and transportation professionals; (2) increased use of technology to assist in coordinating schedules, sharing technical information and deployment of resources; and (3) the need to establish meaningful and implementable metrics to assist in both outward public messaging and inward data collection to support maintaining or changing programs and processes.

### 5.1 ISSUE: PERMIT ACQUISITION WITHIN SCHEDULED TIME FRAME TO MAINTAIN ESTABLISHED PROPOSAL/BID DATES *(Initiation of multi-agency involvement; shared scheduling/project management databases; iterative feedback/input loops)*

- CTDOT Engineering and OEP, in consultation with DEEP, should identify categories of projects for which OEP will provide contemporaneous, ongoing, collaborative participation with design engineers from project inception through final design. Other states and the literature have described this as “over-the-shoulder” reviews. It seems, for example, that culvert replacements are often both logistically complex from a construction perspective and an opportunity for either improving fisheries passage, maintaining the status quo, or providing meaningful mitigation. It would therefore appear that as a category, these projects (or some subset of same) would benefit from such over-the-shoulder reviews so that realistic options regarding natural resources could be incorporated at an early design stage.
- CTDOT should use its annual capital project plan to begin early multi-agency involvement. As in Maine, CTDOT OEP should establish and implement a preliminary screening process to identify types of projects unlikely to raise environmental or natural resource concerns (historic and cultural issues should be screened for at this level as well). Appropriate designated representatives from CTDOT Engineering/OEP and

DEEP should begin discussions at project inception. Based upon an initial assessment, CTDOT Engineering and OEP should identify projects (in addition to those identified categorically per above) for which OEP will provide contemporaneous, ongoing, collaborative participation with design engineers from project inception through permit application preparation and final design. Ideally, a specific OEP staff person would be assigned to each identified project from its inception through permit acquisition. Such partnered, over-the-shoulder participation is intended to replace sequential, iterative reviews between or among CTDOT engineers, OEP staff and DEEP. DEEP involvement should be sought and provided at any stage.

- CTDOT should use shared project scheduling software so that all divisions are aware of project status/deadlines. The scheduling software should be used by DEEP as well so that they can assure involvement at appropriate times.
- Beyond scheduling, CTDOT and DEEP should be able to share planning files. Electronic access to project plans and data could identify issues earlier in the design process, obviate the need for certain issues to await placement on meeting agendas, and potentially reduce the staff time involved in iterative requests and responses for information.
- Agendas for both the CTDOT/DEEP Environmental Review meeting and Project Manager monthly meeting should be developed to discuss projects in which at least one representative believes there will be technical and/or scheduling challenges in acquiring environmental approvals. Criteria should be established to determine which projects are brought forth at monthly meetings. Sensitivity should be built in to the attendance lists based upon the specific project(s) challenges.
  - o To the extent that over-the-shoulder reviews and/or partnering between designers and OEP staff as well as shared project files are instituted, input from environmental and natural resource representatives should be sought and received as needed. Agenda items could then be reserved for more complex issues or sophisticated discussions. Similarly, projects that would still benefit from collaborative interagency review should be placed on an agenda so that project schedules can be maintained.
  - o Preparation of agendas should, to the extent known at the time, identify the purpose for the item's inclusion, i.e., issue(s) or questions of concern.
  - o For items that have been presented at prior meetings or been the subject of prior inter- or intra-agency discussions, preparation for the meeting should, as appropriate, include follow-up or documentation of resolved issues.
  - o Staff from OEP and EPC should work together with in-house and consultant designers to present projects to the regulatory agencies from both the engineering and environmental perspectives.
- Any of the appropriate parties should be able to request additional items or iterative sessions.
- Given the almost universal agreement regarding the value of both the CTDOT/DEEP Environmental Review Monthly meeting and Project Manager Meetings held monthly, there should be more time or additional sessions made available so that more projects can benefit.

- o Implementation of several of the above recommendations should provide efficiencies for the individual meetings such that staff resources are not unduly affected.
- Consider establishing routine training modules regarding environmental application requirements and permit authorization compliance for engineering staff, and make them available to consultants. Depending on an individual consultant's experience and/or track record, participation in training sessions may be mandated.
- CTDOT project managers need to take an active role in preparation and review of presentations by consultants at monthly meetings.
- Maximize utilization of monthly meetings. Assure documentation of agreements and commitments arrived at; incorporate documentation in permit application/documents.

## **5.2 ISSUE: LEVEL OF DETAIL NECESSARY TO COMPLETE PERMIT APPLICATIONS** *(Clarity and alignment between engineering terminology and natural resource and environmental standards information requirements; programmatic or general permit review standards)*

- DEEP and CTDOT should engage in a program-specific "crosswalk" between the technical or detail information that is available and the percentage of CTDOT project design completed; this exercise should result in agreement(s) regarding the technical or detail information required for each permit type. CTDOT may consider whether its utilization of percent completion definitions can be made consistent between/among divisions.
- DEEP and CTDOT should explore circumstances under which additional activities could be authorized without DEEP scrutiny and/or where certification by CTDOT engineers (internal CTDOT or consultant design) would be sufficient demonstration of environmental compliance. Stormwater may be such an area, where compliance with existing manuals sets the appropriate performance standard.
- DEEP should determine and/or define which types or categories of qualified professional(s) operating at what levels would satisfy self-certification by CTDOT of its stormwater controls. To assist in this determination, CTDOT should identify for DEEP their internal staff and/or consultants that they might designate to certify that designs, operations and maintenance would satisfy environmental performance standards.
- DEEP and CTDOT should establish a schedule for updating the manuals to be relied upon for establishing such performance standards.
- DEEP and CTDOT should review at a granular level other states' general permits or permits by rule that have been identified in this report to determine whether similar practices would be acceptable and useful in Connecticut. In particular, the agencies should review
  - o Maine's presumption of need for projects to improve existing infrastructure.
  - o New Hampshire's presumption of need for certain transportation projects.

- o Maine and New Hampshire’s use of simplified forms and filings for transportation projects.
- o Washington State’s programmatic permits for bridge structure repair, painting, and washing; channel, fishway, and culvert maintenance; and culvert replacement in non-fish bearing streams.
- CTDOT and DEEP should continue discussions and formalize an approach to authorizing a maximum footprint of impact to wetlands. (This may require a legislative presumption of need for certain classes of transportation projects.) Also see the recommendation regarding mitigation programs that follows.

### **5.3 ISSUE: SUBSTANTIVE ISSUES WITH RECURRING, MULTIPLE, SCHEDULE CHALLENGING ITERATIONS** (*Fisheries and wildlife impacts and mitigation; wetlands mitigation; emerging issues*)

- With appropriate sensitivities built in to the agenda setting process, DEEP fisheries and wildlife staff should be asked and at times be required to attend monthly meetings.
- DEEP should reevaluate its existing Stream Crossing Guidelines and update them as necessary. The guidelines should be sufficiently specific so that CTDOT can proactively incorporate such specifications or performance standards in its designs and/or design specifications or mitigation plans.
- CTDOT should proactively incorporate fish passage and stream crossings or mitigation into its design plans to address impacts to these.
- CTDOT should consider hiring fisheries biologist(s) or having such experts “on-call” to consult on specific projects. DEEP should consider the definition of “qualified professionals” who would certify reviews or designs.
- DEEP and CTDOT, with the assistance of the Office of the Attorney General, should develop and seek a legislative amendment to provide for mitigation in-lieu fee and banking programs.
- DEEP and CTDOT should design and develop a watershed-based habitat mitigation and banking program.
- To the extent not already accomplished, the CTDOT/DEEP Working Group should be formally established. In addition to its current practice of addressing ongoing, identified issues, it should be used as necessary to update attendees on emerging issues and inform them of opportunities to participate in addressing such issues.



#### 5.4 ISSUE: ASSURING CONTINUOUS PROCESS IMPROVEMENT AND GEARING UP FOR A LARGER CAPITAL BUDGET AND MEGA PROJECTS

*(Staffing levels; metrics; Every Day Counts)*

- CTDOT and DEEP should jointly work with OPM to refill vacant positions to assure the capacity needed to achieve the state's transportation goals.<sup>47</sup>
- CTDOT and DEEP should revisit CTDOT's past proposals to fund positions at DEEP, identify needs within specific permitting programs and establish accountability and performance standards should positions be funded. The agencies should evaluate whether the current system of having CTDOT provide funds and the project codes for DEEP staff to utilize, as opposed to funding specific staff positions, is still viable.
  - DEEP should evaluate with OPM whether it would be able to add specific FTEs on the basis of CTDOT funding.
  - DEEP should reevaluate its current accounting and documentation system for utilization of CTDOT funds.
- Management at the highest appropriate level at CTDOT and DEEP should jointly discuss with OPM any impediments to and mechanisms to overcome CTDOT payment for DEEP services and payment of overtime to bridge the 35- to 40-hour workday difference for DEEP employees.
- To the extent that Conn. Gen. Stat. §4e-16 may restrict use of consultants by CTDOT for certain environmental review-related work efforts, CTDOT should
  - clarify areas where use of consultants could enhance environmental review capacity and is not prevented by the statutory requirement to conduct cost-benefit analyses prior to such use.
  - explore legislative amendment that might lessen this constraint.
- CTDOT and DEEP should establish and institutionalize a SWAT team approach to mega projects. Appropriate staff from each agency should be designated and delegated necessary authorities to make commitments from project inception through construction.
- CTDOT should establish and implement a system of performance metrics, ideally in conjunction and consistent with its project scheduling and plan sharing systems, that will provide the data necessary to identify opportunities for environmental review streamlining with greater precision.
- CTDOT should, in consultation with DEEP, identify corridors likely to be impacted by transportation projects and review and address natural resource data gaps.
- CTDOT should ensure that it is poised to take advantage of any and all FAST Act and *Every Day Counts* (EDC) opportunities, including new or modified programmatic

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<sup>47</sup> The authors fully recognize the state's current budget circumstances. However, long-term transportation goals and interests will be challenged at best and jeopardized at worst should the staff necessary to develop and implement transportation projects not be available.

- agreements between or among federal and state highway, environmental, natural and cultural and social resource agencies.
- OEP should establish regular status updates with the CTDOT EDC Coordinator to identify new initiatives that may enhance environmental review coordination and/or synchronization.

## APPENDIX A

### ASSESSMENT OF STREAMLINING SUCCESS STATE OF WASHINGTON

*(State of Washington – Overview of Environmental Permitting  
for Transportation Projects, January 2005; Figure 5)*

Streamlining Activity	Reduced Time	Reduced Cost	Environmental Performance	Stakeholder Satisfaction	Comment
<i>People-oriented Initiatives</i>					
MAP Team is a co-located team of WSDOT and resource agency personnel working cooperatively to review permit applications and process permits for WSDOT transportation projects.	+	+	+	+	Very successful streamlining activity. Expansion of MAP Team program should be considered.
Workload of the Northwest Region MAP Team is set by priorities and tracked by a WSDOT manager/facilitator.	+	+	+	+	Manager is on temporary assignment to the MAP Team. Successor should be carefully chosen for facilitation and relationship-building skills.
Pilot Project: Hood Canal Bridge with Port Angeles Graving Facility.	+	*	+	+	Complex permitting process completed on time.
Pilot Project: I-405 Intersection with Highway 167.	-	-	-	-	No progress due to funding delays.
Pilot Project: SR 24 at I-82 to Keys Road.	-	-	-	-	Delayed progress due to funding impacts.
WSDOT/Ecology: Water Quality Implementing Agreement enhances coordination regarding compliance with water quality regulations.	*	*	+	+	Addresses Clean Water Act, including National Pollutant Discharge Elimination System.
Four Corners Process provides a multi-agency process for conflict resolution, which evolved into a multi-layered management process.	+	*	+	+	"Four Corners-Next Steps" agreement allows WSDOT to coordinate directly with USFW and NOAA Fisheries.
WSDOT/WDFW: Memorandum of Agreement enhances coordination of State Hydraulic Code Rules.	*	*	+	+	Addresses coordination regarding compliance for hydraulic projects.
Signatory Agency Committee integrates aquatic resource permit requirements (Clean Water Act, Section 404) with NEPA and SEPA requirements.	+	*	*	±	Promotes early decisions. NEPA reviewers want the Committee to consider all NEPA documents, not just EIS. The SAC Agreement has three concurrence points associated with NEPA; however, some NEPA reviewers indicated that their involvement prior to the triggering of NEPA (by federal funding or actions) may be helpful to avoid redesign issues.
FHWA/Federal Transit Administration: "Linking Planning and NEPA" workshop.	NA	NA	NA	NA	There are trained non-federal planners in NEPA concepts. However, there is no NEPA connection to local land-use planning, which will require a federally legislated solution.
WSDOT/COE/Ecology coordination meetings regarding CWA compliance for proposed and current projects.	*	*	+	+	Interagency communication.
WSDOT/FHWA/USFW/NOAA Fisheries hold pre-biological assessment meetings for agency feedback regarding project impacts to listed species.	+	*	+	+	Interagency communication.
WSDOT and Ecology hold monthly coordination meetings regarding projects and policy issues.	*	*	+	+	Interagency communication.

- 12 + Successful implementation is ongoing or completed.  
 - Delayed or incomplete implementation.  
 ± Successful implementation is ongoing or completed, but further improvements or efforts needed.  
 \* Under development or too soon to assess.  
 NA Activity was found to be Not Applicable to streamlining of Washington transportation projects.

STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART B: APPENDICES

Streamlining Activity	Reduced Time	Reduced Cost	Environmental Performance	Stakeholder Satisfaction	Comment
WSDOT and Ecology hold monthly stormwater meetings to coordinate and define the transportation stormwater/runoff management program.	*	*	+	+	Interagency communication.
Annual Tribal Conference to identify, discuss, and resolve mutual concerns regarding transportation.	*	*	+	+	Interagency communication.
WSDOT/COE Memorandum of Understanding (MOU) to address regulatory overlap with the three COE districts making decisions in Washington.	*	*	*	+	Interagency communication.
<i>Policy-oriented Initiatives</i>					
Develop a watershed approach to environmental mitigation.	*	*	+	+	Project-specific success. Initiative development is ongoing. Likely to have positive affects on all success criteria.
Develop models and strategies to maximize the impact of funds on environmental issues and mitigation, on a watershed-wide basis.	*	*	+	*	Project-specific success. Initiative development and field-testing continue.
Develop consistent methodology for submittal and evaluation of completed plans that impact environmental resources, as well as proposed mitigation measures.	*	*	+	*	Integrated mitigation guidance continues under development and field-testing.
WSDOT Environmental Geographic Information System (GIS) Workbench provides a consistent database for natural resource and infrastructure information.	+	+	+	+	Ongoing updates, including new data layers and ortho-photos. WSDOT has data usage agreements with Washington Depts. of Fish and Wildlife and Natural Resources.
Salmon and Steelhead Habitat Inventory and Assessment Program is an interactive GIS database.	+	*	+	*	Best available database for aquatic resource information, but populating the data system is dependent on funding.
Design-Build Initiative requires significant early coordination with resource agencies to present sufficient background for permit and consultation approvals.	+	*	*	*	Ongoing development. Agencies prefer to review design in a permit application or consultation package.
WSDOT <i>Environmental Compliance Assurance Procedure for Construction Projects and Activities</i> .	*	*	+	+	Ongoing implementation. Joint effort with resource agencies to increase environmental awareness and reduce violations.
TPEAC-funded environmental training program is a component of the WSDOT environmental management system.	*	*	+	+	TPEAC has identified 5 training gaps to be filled and has funded 2,000+ staff trainings.
Environmental performance measurements are presented quarterly in WSDOT's <i>Measures, Markers and Mileposts</i> , also called the "Gray Notebook." <sup>13</sup>	*	*	+	*	Topics in Gray Notebook are not always assessed as metrics. A formal metrics baseline should be established for assessment at a regular frequency.
Develop and prioritize streamlining opportunities.	+	+	+	+	Ongoing process. This activity appears to drive the development of streamlining projects.
WSDOT and FHWA initiatives to prepare reader-friendly documents.	*	*	*	±	Mixed stakeholder satisfaction: reader-friendly to the layperson, but agency reviewers preferred the former EIS format.

<sup>13</sup> The "Gray Notebook" is WSDOT's quarterly performance measure report and is available at <http://www.wsdot.wa.gov/accountability/>.



STRATEGIES FOR IMPROVING TRANSPORTATION PROJECT DELIVERY PERFORMANCE  
PART B: APPENDICES

Streamlining Activity	Reduced Time	Reduced Cost	Environmental Performance	Stakeholder Satisfaction	Comment
<i>WSDOT Highway Runoff Manual.</i>	*	*	±	±	Provides consistent runoff management on transportation projects, but it cannot be fully implemented until it is deemed equivalent to Ecology's current Stormwater Management Manuals.
Seek federal delegation of permitting authorities for streamlining benefits.	NA	NA	NA	NA	Federal government has already delegated management and enforcement of applicable federal environmental regulations.
Wetlands banking program.	*	*	*	*	Consistent commitment to program has not been demonstrated. Delayed progress since early 2001 due to funding impacts. Specialist hired in July 2004, but funding expires in June 2005. Ecology has requested continued funding. WSDOT has moved forward on wetland banking since the early 1990s and obtained legislation to develop a revolving fund to finance advanced mitigation projects. WSDOT is providing funding for three wetland banks.
<i>Permit Innovations</i>					
On-line Joint Aquatic Resource Permit Application (JARPA) provides a cross-cutting permit application for a variety of natural resource permits, including hydraulic project approvals (HPAs), which require multi-agency review and permitting approval.	+	+	+	+	On-line JARPA likely to increase efficiency of permit processing even further and have positive impacts on all success criteria.
Programmatic Permits with Ecology and WDFW.	+	+	+	+	Highest priority permits issued; significant savings in time and costs for maintenance activities.
WSDOT and resource agencies: additional programmatic permits.	+	+	+	+	Saves both staff time and project funding and reduces liability risks.
Notice to local government regarding transportation projects.	*	*	*	*	Insufficient survey time to assess success.
Consolidated local permit process.	*	*	*	*	Limited implementation; development is ongoing.
Hydraulic project approval program requires approval/denial of permit within 45 days of WDFW receipt of a complete JARPA.	+	+	+	+	Project-specific success due to statutory requirement.
WSDOT liaison program provides 22 dedicated staff to the resource agencies, including the MAP Team.	+	+	+	+	Very successful streamlining activity. The development of performance measures is expected to help WSDOT better weigh the costs and benefits of liaison positions.



## APPENDIX B

### SELECT REFERENCED STATE DOCUMENTS

See links or text sections from the documents or legislation from other states' referenced in this report (access the links through the electronic version of this report, with the links highlighted in blue text).

#### 1. MAINE

- **MAINE STORMWATER MOA (2007 UPDATE)**: Memorandum of Agreement for Stormwater Management Between the Maine Department of Transportation, Maine Turnpike Authority and Maine Department of Environmental Protection. The MOA was originally signed in 1998, with updates in 2003 and 2007. As part of the MOA, MaineDOT prepares an annual report, with the most recent report as follows: **MaineDOT STORMWATER MOA 2015 ANNUAL REPORT**
- **MaineDEP PERMIT-BY-RULE CHAPTER 305** and **MaineDEP PERMIT-BY-RULE CHAPTER 310**: Maine DEP Permit-by-Rule Chapter 305 regulations apply to certain activities covered under the Natural Resources Protection Act (NRPA). The regulations identify activities taking place in or adjacent to wetlands and waterbodies that should not significantly affect the environment if carried out according to the standards contained in the regulations. A person proposing to do work that qualifies for Permit-by-Rule is required to file notice with the Department of Environmental Protection (DEP) instead of preparing an individual permit application. See Chapter 305, Section 11(B) (7) for language stating that MDOT or Maine Turnpike Authority do not have to meet certain standards in overarching rule for wetland and waterbodies permitting (Chapter 310). Those Chapter 310 standards that do not have to be met are avoidance and the submission of an alternatives analysis, site characteristics report, and activity description.

#### 2. MASSACHUSETTS

- **MASSACHUSETTS BOND BILL FOR FISCAL YEAR 2015-2019**: The bond bill includes reference to certain transportation projects that are exempted from environmental review. See the following text from relevant sections of the bond bill signed by Massachusetts Governor Deval Patrick on April 19, 2014.

**SECTION 24.** Notwithstanding any general or special law to the contrary, section 61 and sections 62A to 62L, inclusive, of chapter 30 of the General Laws, chapter 91 of the General Laws and section 40 of chapter 131 of the General Laws shall not apply to bridge projects of the Massachusetts Department of Transportation and the Massachusetts Bay Transportation Authority for the repair, reconstruction, replacement or demolition of existing state highway, authority and municipally-owned bridges, including the immediate approaches necessary to connect the bridges to the existing adjacent highway and rail system, in which the design is substantially the functional equivalent of, and in similar alignment to, the structure to be reconstructed or replaced; provided,

however, that said section 61 and said sections 62A to 62I, inclusive, of said chapter 30 shall apply to the repair, reconstruction, replacement or demolition project where the project requires a mandatory environmental impact report pursuant to 301 CMR 11.00, and all work shall be subject to the requirements of the then current edition of the Massachusetts Department of Transportation's Stormwater Handbook as approved by the department of environmental protection under applicable law. Notice of any application to the department of environmental protection for a water quality certification shall be published in the Environmental Monitor and the work shall be subject to performance standards prescribed by the department of environmental protection pursuant to section 401 of the Federal Clean Water Act if applicable to the project. Notwithstanding any other provision of this section, said section 61 and said sections 62A to 62I, inclusive, of said chapter 30, said chapter 91 and said section 40 of said chapter 131 shall apply to any portions of the bridge and roadway approaches to the crossing of the Charles River for the Central Artery and Tunnel Project. If any state highway, authority or municipal bridge crosses over a railroad right-of-way or railroad tracks, the department, authority or municipality, as applicable, shall seek the opinion of a railroad company, railway company or its assigns operating on the track of a necessary clearance between the track and the bridge, but department, authority or municipality and their agents or contractors may enter upon any right of-way, land or premises of a railroad company or railway company or its assigns for purposes that the department, authority or municipality may consider necessary or convenient to carry out this section. If a flagman is needed to carry out this section, the railroad company, railway company or their assigns shall provide the flagman, the cost of which shall be borne by the bridge project, except in the case of a bridge transferred pursuant to chapter 634 of the acts of 1971. For the purposes of this section, "bridge" shall include any structure spanning and providing passage over water, railroad right-of-way, public or private way, other vehicular facility or other area. Any project exempted from any law pursuant to this section shall be subject to the public consultation process required by the then current version of the Massachusetts Department of Transportation's Project Development and Design Guidebook.

### 3. NEW HAMPSHIRE

- **NHDOT TERRAIN ALTERATION PERMIT EXEMPTION (2011):** NHDOT and the New Hampshire Department of Environmental Services signed a Memorandum of Understanding under which NHDOT does not need to file for permits under the Alteration of Terrain Program but does need to perform in a manner substantially equivalent to that program's requirements.
- **NEW HAMPSHIRE CODE OF ADMINISTRATIVE RULES:** See below for text from relevant sections referenced in the NHDOT Terrain Alteration Permit Exemption: Chapter 300 Criteria and Conditions for Permits, Section 303.05 **Projects That Do Not Require a Permit**. The following activities shall not require a permit or, unless explicitly stated, a notification to the department:

(q) Routine roadway and railway maintenance activities, including, but not limited to, existing culvert replacements, extensions, or orientations; headwall construction, repair, replacement, or stabilization; and roadside ditch maintenance, conducted in accordance with "Best Management Practices for Routine Roadway Maintenance Activities in New

Hampshire”, published by the New Hampshire department of transportation, dated August 2001 (“BMPs for Routine Roadway Maintenance”), provided:

1. The activity sponsor shall
  - a. Obtain a “Notification of Routine Roadway and Railway Maintenance Activities” form from the department by calling (603)271-2147 or by downloading a copy from <http://www.des.nh.gov/wetlands>;
  - b. File a properly completed notification form with the department, indicating that the proposed project meets the criteria for exemption from the permitting process, which completed form shall include:
    1. The name and mailing address of the activity sponsor;
    2. The name and daytime telephone number of an authorized representative of the activity sponsor;
    3. The location of the proposed activity;
    4. A description of the proposed activity;
    5. Reference to the applicable BMP section which applies to the activity;
    6. A copy of the USGS topographical map identifying the location of the proposed project;
    7. Sketches of the proposed construction design;
    8. Color photographs of the proposed work site showing existing structures, surrounding land, and the subject water body; and
    9. A signed certification that the information provided above is accurate and correct;
  - c. Provide a copy of the completed notification form to the local governing body and to the municipal conservation commission, if any, at least 5 calendar days prior to commencement of work;
2. No work shall occur on property not owned by the activity sponsor without the activity sponsor, in addition to the requirements in (1) above, providing:
  - a. A written release from all owners of the property on which the work will be done; or
  - b. A completed notification form, at least 5 calendar days prior to start of work, to each owner of property that will be impacted by the work;
3. No work shall be done in excess of the activities outlined in the “BMPs for Routine Roadway Maintenance”;
4. Siltation, erosion, and turbidity controls shall be:
  - a. Installed in accordance with the “BMPs for Routine Roadway Maintenance”;
  - b. Maintained so as to maximize their effectiveness; and
  - c. Left in place until disturbed areas are fully stabilized; [End of Relevant Section]

#### **4. VERMONT**

- VERMONT STORMWATER MOU (2015): This Memorandum of Understanding between VTrans and the Vermont Agency of Natural Resources (ANR) includes allowed uses and an example of a self-certification document for activities by VTrans.

## APPENDIX C

### PRELIMINARY QUESTIONNAIRE/INTERVIEW GUIDE MODEL INTRODUCTORY MESSAGE/REQUEST FOR INFORMATION

Connecticut is undertaking a study of Transportation Project Deliverability with a goal of identifying best management practices, specifically including ACMs, used in other states to improve project deliverability. My specific area within the study is with regard to environmental permitting as it is addressed (substantively and procedurally) when alternative contracting methods are used and more generally to identify any best management practices used by other states to assist their DOT's in project deliverability. I have attached an overview of our Study description for your information.

As such my study partner Dave Pines and I are looking for contacts within either or both [INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY] to get their take on [INSERT STATE] DOT's use of ACMs (D-B in particular). Among the types of questions or lines of inquiry we would want to pursue with your environmental regulatory folks are

- Whether INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY have modified their regulatory procedures to accommodate transportation projects
- Have they established general permits, MOUs, etc. and if so can they provide details/copies
- Have INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY dedicated staff to review such projects
- At what stage of DOT project planning do INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY get involved
  - Do INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY provide input to D-B Firms as to what design and construction methods may or may not be acceptable during Design Build RFQ process
- Are all permit applications submitted by DOT (i.e., or office within DOT) or are they submitted directly by the design consultant?
- Are INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY involved and if so how involved are INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY before the permit application is submitted (one meeting or ongoing basis?)
- To what level of design do DOT projects progress before applications are submitted to INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY under traditional DBB? Does that differ under D-B or other ACMs?



- Do INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY have sufficient information under varying contracting methods to issue permits
- If applications are submitted at an early(ier) phase of design, are there more conditions or iterative reviews
- Who is responsible for changes or modifications to a permit (as necessary)?
- Are INSERT STATE ENVIRONMENTAL AND/OR NATURAL RESOURCE REGULATORY AGENCY seeing any difference in compliance and/or environmental performance attributed to ACMs?
  - How is compliance monitored on D-B projects? Is this any different than DBB projects?
- Are there types of projects and/or categories of impacts that especially do or do not lend themselves to expedited processes?

## STATE AND FEDERAL CONTACTS

### MAINE

- DEP Land Division Director
- DOT Environmental Office Director

### MASSACHUSETTS

- DEP MassDOT Project Manager

### NEW HAMPSHIRE

- DES Wetlands Bureau, Public Works Supervisor
- DOT Environmental Services Director
- DOT Wetlands program manager

### VERMONT

- DEP Stormwater Program Manager
- DEP Floodplain Manager
- DEP Wetlands Program Manager
- VTrans
- VTrans Highway Division

### USACE

- Chief, Permits and Enforcement Branch C (NH, ME & VT)
- Chief Permits and Enforcement Branch B (CT & RI)
- CTDOT Project Manager
- MA Project Manager
- Environmental Scientist/Project Manager MassDOT Liaison

## APPENDIX D

### CTDOT ENVIRONMENTAL REVIEW FORMS

To access the following forms, click on the hyperlink:

- [CTDOT Environmental Review Request Form \(Revised April 2010\)](#)
- [CTDOT Environmental Review Form \(Revised April 2016\)](#)

## MAJOR STUDIES OF THE ACADEMY

### 2016

- Early Childhood Regression Discontinuity Study
- Connecticut Disparity Study: Phase 3

### 2015

- Addressing Family Violence in Connecticut: Strategies, Tactics and Policies
- Shared Clean Energy Facilities
- Methods to Measure Phosphorus and Make Future Predictions

### 2014

- Energy Efficiency and Reliability Solutions for Rail Operations and Facilities
- Connecticut Biomedical Research Program: Analysis of Key Accomplishments
- Peer Review of a CL&P/UConn Report Concerning Emergency Preparedness and Response at Selective Critical Facilities
- Connecticut Disparity Study: Phase 2

### 2013

- Analyzing the Economic Impact of Transportation Projects
- Health Impact Assessments Study
- Connecticut Disparity Study: Phase I
- Connecticut Stem Cell Research Program Accomplishments

### 2012

- Strategies for Evaluating the Effectiveness of Programs and Resources for Assuring Connecticut's Skilled Workforce Meets the Needs of Business and Industry Today and in the Future
- Benchmarking Connecticut's Transportation Infrastructure Capital Program with Other States
- Alternative Methods for Safety Analysis and Intervention for Contracting Commercial Vehicles and Drivers in Connecticut

### 2011

- Advances in Nuclear Power Technology

- Guidelines for the Development of a Strategic Plan for Accessibility to and Adoption of Broadband Services in Connecticut

### 2010

- Environmental Mitigation Alternatives for Transportation Projects in Connecticut
- The Design-Build Contracting Methodology for Transportation Projects: A Review of Practice and Evaluation for Connecticut Applications
- Peer Review of an Evaluation of the Health and Environmental Impacts Associated with Synthetic Turf Playing Fields

### 2009

- A Study of the Feasibility of Utilizing Waste Heat from Central Electric Power Generating Stations and Potential Applications
- Independent Monitor Report: Implementation of the UCHC Study Recommendations

### 2008

- Preparing for Connecticut's Energy Future
- Applying Transportation Asset Management in Connecticut
- A Study of Weigh and Inspection Station Technologies
- A Needs-Based Analysis of the University of Connecticut Health Center Facilities Plan

### 2007

- A Study of the Feasibility of Utilizing Fuel Cells to Generate Power for the New Haven Rail Line
- Guidelines for Developing a Strategic Plan for Connecticut's Stem Cell Research Program

### 2006

- Energy Alternatives and Conservation
- Evaluating the Impact of Supplementary Science, Technology, Engineering and Mathematics Educational Programs
- Advanced Communications Technologies

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**805 Brook Street, Building 4-CERC, Rocky Hill, CT 06067-3405**  
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**web: [www.ctcase.org](http://www.ctcase.org)**

## **CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING**

The Connecticut Academy is a non-profit institution patterned after the National Academy of Sciences to identify and study issues and technological advancements that are or should be of concern to the state of Connecticut. It was founded in 1976 by Special Act of the Connecticut General Assembly.

### **VISION**

The Connecticut Academy will foster an environment in Connecticut where scientific and technological creativity can thrive and contribute to Connecticut becoming a leading place in the country to live, work and produce for all its citizens, who will continue to enjoy economic well-being and a high quality of life.

### **MISSION STATEMENT**

The Connecticut Academy will provide expert guidance on science and technology to the people and to the State of Connecticut, and promote its application to human welfare and economic well-being.

### **GOALS**

- Provide information and advice on science and technology to the government, industry and people of Connecticut.
- Initiate activities that foster science and engineering education of the highest quality, and promote interest in science and engineering on the part of the public, especially young people.
- Provide opportunities for both specialized and interdisciplinary discourse among its own members, members of the broader technical community, and the community at large.

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