I-70 TWIN TUNNELS RISK ASSESSMENT AND PROJECT DELIVERY SELECTION

Colorado Department of Transportation
Innovative Contracting Advisory Committee

I-70 Twin Tunnels Project Delivery Selection Approach/Evaluation
November 2nd, 2011 9am to 4pm @ Region 1 HQ Aurora - Plains Conference Room

Overview

This document provides a formal approach for CDOT highway project delivery selection. The document provides generic forms for use by CDOT staff and project team members. By using these forms, a brief project delivery selection report can be generated for each individual project. The primary objectives of this document are:

- Present a structured approach to assist CDOT in making project delivery decisions;
- Assist CDOT in determining if there is a dominant or obvious choice of project delivery methods; and
- Provide documentation of the project delivery decision in the form of a Project Delivery Decision Report.

Background

The project delivery method is the process by which a construction project is comprehensively designed and constructed including project scope definition, organization of designers, constructors and various consultants, sequencing of design and construction operations, execution of design and construction, and closeout and start-up. Thus, the different project delivery methods are distinguished by the manner in which contracts between the agency, designers and builders are formed and the technical relationships that evolve between each party inside those contracts. Currently, there are several types of project delivery systems available for publicly funded transportation projects in the Colorado. The most common systems are Design-Bid-Build (DBB), Design-Build (DB), and Construction Manager/General Contractor (CM/GC). No single project delivery method is appropriate for every project. Each project must be examined individually to determine how it aligns with the attributes of each available delivery method.

- DBB is the traditional project delivery method in which an agency designs, or retains a designer to furnish complete design services, and then advertises and awards a separate construction contract based on the designer's completed construction documents. In DBB, the agency "owns" the details of design during construction and as a result, is responsible for the cost of any errors or omissions encountered in construction.

- DB is a project delivery method in which the agency procures both design and construction services in the same contract from a single, legal entity referred to as the design-builder. The method typically uses request for qualifications (RFQ)/request for proposal (RFP) procedures rather than the DBB invitation for bids procedures. The design-builder controls the details of design and is responsible for the cost of any errors or omissions encountered in construction.

- CM/GC (CMR) is a project delivery method in which the agency contracts separately with a designer and a construction manager. The agency can perform design or contract with an engineering firm to provide a facility design. The agency selects a construction manager to perform construction management services and construction works. The significant characteristic of this delivery method is a contract between an agency and a construction manager who will be at risk for the final cost and time of construction. Construction industry/Contractor input into the design development and constructability of complex and innovative projects are the major reasons an agency would select the CM/GC method. Unlike DBB, CM/GC brings the builder into the design process at a stage where definitive input can have a positive impact on the project. CM/GC is particularly valuable for new non-standard types of designs where it is difficult for the owner to develop the technical requirements that would be necessary for a DB procurement without industry input.

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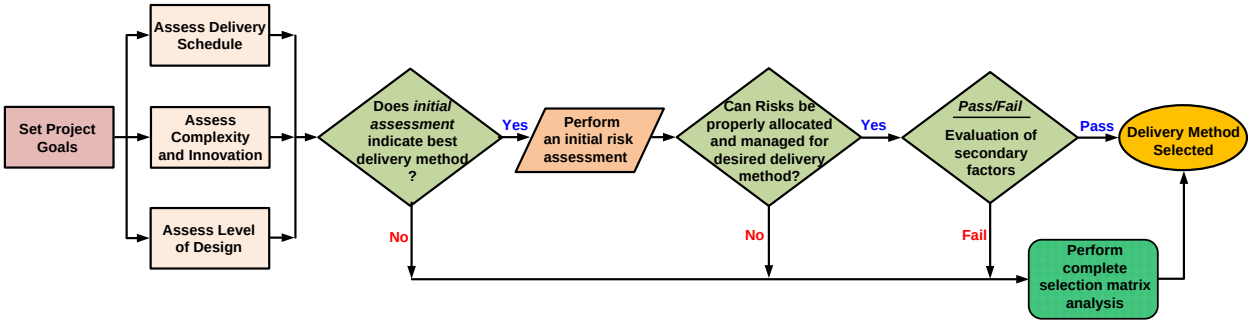
Project Delivery Selection Approach

This document provides generic forms for use by CDOT staff. By using these forms, a brief project delivery selection report can be generated for each individual project. The process is divided into the following sections.

- Project Description Checklist
- Project Goals
- Evaluation of the four primary factors
    1. Delivery Schedule
    2. Complexity & Innovation
    3. Level of Design
    4. Initial Project Risk Assessment

    Note: The evaluation of the delivery method can end here if there is a clear choice, with a brief pass/fail type of analysis of the remaining factors. If there is not a clear choice then evaluation should continue to include the following secondary factors.
    5. Cost
    6. Staff Experience/Availability (Owner)
    7. Level of Oversight and Control
    8. Competition and Contractor Experience

The flowchart below summarizes this process.



CDOT Project Delivery Selection Flowchart

The following forms and appendices are included to facilitate this process.

Forms

- Project description checklist
- Project goal guidance
- Project delivery method opportunity/obstacle summary form
- Project delivery method opportunity/obstacle notes forms

Appendix

- Project delivery method opportunity/obstacle checklists with project risk assessment discussion and checklists.

Project Description Checklist

The following items should be considered in the project description as applicable. Other items can be added if they influence the project delivery decision. Relevant documents can be added as appendices.

- ❒ Project Name: I-70 Twin Tunnels
- ❒ Project Limits: Interstate 70 between Mileposts 241 and 244.
- ❒ Project Budget: The Estimated Design and Construction Budget for this project is $60 million.
- ❒ Project Est. Date: The Estimated Delivery Date is October 31st, 2013.
- ❒ The Req. Date: The Required Delivery Date for three lanes open in the eastbound direction is October 31st, 2013.
- ❒ Project Funding: The Sources of Funding for this project are Federal and FASTER dollars.
- ❒ Project Location: The project is located in the I-70 Corridor east of Idaho Springs.
- ❒ Major Features of Work include:
    - o Widening the Eastbound bore of the Twin Tunnels to between 51' and 61' feet;
    - o Adding a third lane to eastbound from MP 241 to MP 244 (Floyd Hill);
    - o Flattening the curves eastbound as much as possible between the Twin Tunnels and the bottom of Floyd Hill at 244;
    - o Rebuilding structure F-15-BH over I-70;
    - o Retrofitting or reinforcing structure CLR314-W0.7 over Clear Creek east of the old Game Check area south of the Twin Tunnels;
    - o Constructing permanent BMP facilities for water quality;
    - o Constructing transitions to the old US40 roadway and CR 314 for detouring I-70 Traffic off and onto I-70;
    - o Reconstructing CR314, rock excavation, and walls for area affecting by I-70 realignment.
    - o Employ and construct recommended mitigation for SWEEP, ALIVE, 106, and SCAP committees;
    - o Restore the frontage road, trailhead, and trail on CR314 after detour is no longer in use; and
    - o Implementing a possible managed lane in the inside lane eastbound for Peak Period Pricing during congested periods.
- ❒ Major Schedule Milestones
    - o Goal Setting Meeting – October 27th, 2011
    - o Risk Assessment/Delivery Method Evaluation – Nov 2nd, 2011
    - o RFP for CM/GC – December 1st, 2011
    - o RFP for Design – December 1st, 2011
    - o Selection Process – December 2011 to February 2012

- Team Scoping Workshop – March 2012
- Preconstruction Phase – March 2013 to Summer 2013
- Construction Phases – March 2013 to October 2013
- 3 EB lanes on I-70 Open to Traffic October 31st, 2013

- The major project stakeholders are:
  - City of Idaho Springs
  - Traveling public (State and out of State)
  - CDOT
  - FHWA
  - SWEEP Committee
  - ALIVE Committee
  - 106 Committee
  - DRCOG
  - Summit, Jefferson, and Clear Creek Counties

- Major Challenges
  - Meeting project goals and objectives within the schedule, scope, and budget;
  - Minimizing throw away work for future I-70 Realignment;
  - Keeping PEIS/ROD, Corridor CSS, and Tunnel Visioning Commitments;
  - Protecting Clear Creek, minimizing impacts to environmental resources;
  - CDOT has limited experience with geotechnical tunnel work; and
  - Schedule and ROW risks.

- Main Identified Sources of Risk:

HIGH RISK - <75%

Construction and Constructability

- Uncertainty in construction unit costs (e.g., earthwork)
- Uncertainty in construction quantities (e.g., bridges, walls, tunnels)
- Issues related to tunnel construction procedures (see also tunneling under Geotech)
- Issues related to other construction procedures
- Problems with or uncertainty in construction sequencing / staging / phasing / construction duration
- Condition of existing structures (repair required?)
- Maintenance of Traffic (MOT) / Work Zone Traffic Control (WZTC) Issues
  - Issues related to detours

Design

- Construction staging/phasing
  - Uncertainty in retaining walls
- Tunneling-specific issues
- Project delivery method
- Global Right of Way
- Replace structures instead of retrofit existing (or vice-versa)
- Tolling facilities
- Managed lanes
- ROW and Parcel Acquisitions

Safety Issues:

- Reduced Speed Detour;
- 24/7 Construction work;
- Safety Critical Work; and
- Construction Traffic Control;
- Possible Bike and Pedestrian Access to CR314 during detour traffic;

MEDIUM RISK – 25 % < X < 75%

Uncertainty in "Soft" Costs and / or Schedule

- Construction management and construction inspection
- Unable to reach GMP

Construction and Constructability

- Additional geometry re-alignment
- Difficult or multiple contractor interfaces
- Accidents/incidents during construction (traffic/collapse/slope failure/vandalism)
- Critical equipment failure
- Other difficult or specialized construction issues
- Construction under high water or flood conditions.

Design

- Consider the uncertainty, the risk or opportunity related to the "base" design elements. Consider risks such as early design or changing project definition. Consider the type, size, and location of design elements, the unit prices and the quantities. Example elements include:
  - horizontal alignment (e.g., geometry / grade)
  - bridges
  - retaining walls
  - storm water collection and treatment
  - erosion control methods and BMPS
  - maintenance of traffic / traffic control
- Design deviations (e.g., design speeds, vertical clearances, turn radii)
- Additional aesthetics / context-sensitive solutions (CSS)
- Additional project elements that increase project footprint (e.g., wider shoulders)

Environmental

- Uncertainty related to changes in design, ROW, or other circumstances and the subsequent need for re-evaluated environmental documentation.
- Dewatering Issues – during construction and sustainable dewatering of tunnel.
- Location not identified for disposal of waste rock
- Encounter unanticipated contaminated or hazardous materials
- Challenge to final decision document including documentation (e.g., resulting in delay in issuance of the final decision document. Southwest Energy Efficiency Project comments or allegations of segmentation could be risks.
- Delay in review and/or approval of environmental documentation (does not meet CDOT or FHWA expectations and delays or lengthens reviews and delays decision document)
- Supplemental environmental documentation or Re-evaluation required that is time consuming
- Additional mitigation required, on- or off-site (e.g. solid waste disposal, wetlands, hazardous materials disposal)
- Unanticipated Section 106 issues (archaeological, cultural, or historical finds)
- AQ conformity determination
- ALIVE and SWEEP recommendation implementation.
- 4(f) issues different than anticipated – particularly those related to the CCC Greenway Plan.
  - Timing in obtaining a Section 404 permit
  - Delay in agreement on wildlife crossing mitigation
  - Delay in SWEEP impacts/mitigation agreement (permanent BMPs, SCAP measures)

- Other Regulatory/Permitting Issues (CDPHE fugitive dust, CDPHE solid waste disposal, CDPHE groundwater disposal, CDPHE hazardous materials, etc.)

External Influences (e.g., Political, Regulatory, Municipalities, Economic)

- Public opposition (Managed Lanes/Tolling/Peak Period Pricing)
- Political opposition (Managed Lanes/Tolling/Peak Period Pricing)
- Funding shortfall (and related delay or increased financing cost)
- Funding amount
- Intergovernmental agreements and jurisdiction

Geotechnical and Structural

- Uncertainty in bridges or culverts (including type/size/location– foundations and superstructure)
- Uncertainty in retaining walls (including type, length, height – foundations and superstructure)
- Tunneling-specific issues
  - Uncertain or early design
  - TBM problems (e.g., Tunnel Boring Machine operator issues / inexperience; machine procurement; machine maintenance; drive rate; other problems)
  - Drill and Shoot Experience, schedule, waste disposal

Permitting

- Difficulty or delay in obtaining permit approval (by permit type; e.g., 401, 404, NPDES)
- Impractical or onerous permit conditions (current and in the future)
- Challenges to permits once issued (e.g., 401, 404)
- Challenges to keep general contractor following permits

Project Delivery and Procurement

- Project delivery method - CM/GC – Management of, CDOT and Public Understanding of Method

Right-of-Way / Real Estate

- Right of Way (ROW) problems (for widening, drainage, pipelines, detention, staging, etc.)
- Process delays (e.g., ROW plan development by team; plan approval process)
- Right of Way (ROW) relocation of renters, required 90days notice.

Scope Issues

- Replace structures instead of retrofit existing (or vice-versa)
- Additional local improvements and for detour route required (e.g., additional paving)
- Tolling facilities and Managed lanes – facilities, approval, agreements, buffer zone, infrastructure

LOW RISK - <25% - All others risks are either low or very low. These risks will be assessed during the design phase.

Project Goals, Core Values, and Context Statement

An understanding of project goals is essential to appropriate project delivery selection. Typically, the project goals can be defined in three to five items. Examples are provided below,1 but the report should include project-specific goals. These goals should remain consistent over the life of the project.

PROJECT PURPOSE AND CORE VALUES

The purpose of the Twin Tunnels project is to improve eastbound highway safety, operations and travel time reliability in the Twin Tunnels area of the I-70 Mountain Corridor east of Idaho Springs.

Stakeholder Core Values
Safe travel for people and goods. **Safety** for emergency responders and maintenance workers. A s**afe** crossing for wildlife.
Mobility through safe and reliable transportation facilities.
A primary access and visual **gateway** to the Mountain Mineral Belt, historic Idaho Springs and Front Range communities.
Wildlife, wildlife habitat, migration routes and access to Clear Creek.
Clear Creek, as a clean, high-quality water resource, a recreational asset, an aquatic resource with sustainable fisheries' habitat, a drinking water source, and a defining natural feature of the corridor.
Tourist destinations and community facilities, including the Scott Lancaster Trail and Bridge, the waste-water treatment plant, the planned Clear Creek Greenway, the frontage road, and Clear Creek.
History as a defining element of Clear Creek County. Celebrating the cultural resources associated with mining and mining towns, and the first successful tunneling operation as part of the construction of I-70 west through Colorado's mountains.

PROJECT GOALS

1. SAFETY, MOBILITY, AND OPERATIONAL CHARACTERISTICS
    a. Improve safety, mobility, and operational characteristics in the project limits.
    b. Improve travel time reliability along the I-70 corridor.

2. QUALITY
    a. Design and construct a quality project that is consistent with the overall vision and commitments approved by the PEIS

3. SCHEDULE and BUDGET
    a. Meet the project schedule and budget to have three east bound lanes fully operational from approximately mile post 241.5 west of the Twin Tunnels to mile post 244 at the bottom of Floyd Hill by October 31, 2013 without sacrificing quality.

4. ENVIRONMENTAL
    a. Adhere to all environmental compliance requirements, including those documented in the Twin Tunnels final decision document, permitting stipulations and I-70 Mountain Corridor PEIS/ROD commitments.
    b. Implement innovative methods for environmental stewardship and community supported enhancements within the project scope, schedule, and budget.

5. STAKEHOLDER INVOLVEMENT
    a. Provide meaningful stakeholder involvement as prescribed in the I-70 Mountain Corridor CSS.
    b. Facilitate and foster collaboration, communication, and partnerships among all members of the project team.

6. PUBLIC COMMUNICATION
    a. Provide accurate, meaningful, and timely communication.

7. CONSTRUCTION
    a. Maintain mobility through the project during construction.
    b. Provide safe conditions for workers and the traveling public.

Project Delivery Selection Matrix Summary

Determine the factors that should be considered in the project delivery selection, discuss the opportunities and obstacles related to each factor, and document the discussion on the following pages. Then complete the summary below.

PROJECT DELIVERY METHOD OPPORTUNITY/OBSTACLE SUMMARY			
	DBB	**DB**	**CM/GC**
Primary Evaluation Factors			
1. Delivery Schedule	+	X	++
2. Project Complexity & Innovation	-	N/A	++
3. Level of Design	+	N/A	+
4. Initial Project Risk Assessment	+	X	++
Secondary Evaluation Factors			
5. Cost	+	N/A	+
6. Staff Experience/Availability (Owner)	++	N/A	+
7.Level of Oversight and Control	+	N/A	+
8. Competition and Contractor Experience	+	N/A	+

Key:
- **+ +** Most appropriate delivery method
- **+** Appropriate delivery method
- **–** Least appropriate delivery method
- **X** Fatal Flaw (discontinue evaluation of this method)
- **NA** Factor not applicable or not relevant to the selection of project delivery

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CONCLUSIONS AND COMMENTS:

On November 2nd, 2011 CDOT, the FHWA, and specialty units for Region 1 met and conducted a review for the Twin Tunnels Widening Project. Risks were identified, categorized, assessed, and listed. Design Bid Build, Design Build, and Construction Manager/General Contractor delivery methods were discussed in references to the goals and risks for the Twin Tunnels to determine the best project delivery method.

The merits of each delivery method were discussed and each method was evaluated under the four primary factors of Delivery Schedule, Complexity & Innovation, Level of Design, and Initial Project Risk Assessment. The secondary factors of Cost, Staff Experience/Availability(owner), Level of Oversight & Control, and Competition & Contractor Experience were also discussed and evaluated.

RESULTS AND RECOMMENDATIONS

The Design-Build delivery method was eliminated during evaluation under the primary factors with regards to delivery schedule and initial project risk assessment. It was determined that Region 1 had **high** schedule risk if it utilized design-build delivery with regards to developing the contract, technical specifications, and having a conceptual design ready. The initial risk assessment also identified that several of the high risk areas had unknown risks at the present time and it would be hard to determine those risks for the technical specifications for any design build procurement book 2. After identifying these two areas as Fatal Flaws, the team did not evaluate Design-Build further.

The remaining Design-Bid-Build and CM/GC delivery methods were fully evaluated under all eight factors. Design-Bid-Build was evaluated as appropriate under method under the primary factors of Delivery Schedule, Project Complexity & Innovation, and Initial Risk Assessment. It was evaluated as no an appropriate delivery method under Level of Design. For the three secondary factors of Cost, Level of Oversight & Control, and Competition & Contractor Experience it was evaluated as appropriate and for Staff Experience/Availability(owner) it was evaluated as most Appropriate.

CM/GC was identified as most appropriate delivery method under the primary factors of Delivery Schedule, Project Complexity & Innovation, and Initial Risk Assessment. It was evaluated as an appropriate delivery method under Level of Design. For the four secondary factors of Cost, Staff Experience/Availability(owner), Level of Oversight & Control, and Competition & Contractor Experience, CM/GC was evaluated as an appropriate delivery method.

CM/GC was evaluated to have three most appropriates under the Primary Factors and all other factors were rated at least appropriate. Design-Bid-Build was evaluated to have three appropriate ranks and one least appropriate ranks under the Primary Factors. Under secondary ranks, Design-Bid-Build had three appropriate and one most appropriate. Under the instructions and guidance of the I-70 Twin Tunnels Project Delivery Selection Approach Matrix, the Primary Factors show that CM/GC is the recommended delivery method for the Twin Tunnels Widening Project.

1) Delivery Schedule: Delivery schedule is the overall project schedule from scoping through design, construction and opening to the public. Assess time considerations in getting the project started or funding dedicated and assess project completion importance.

DESIGN-BID-BUILD *Requires time to perform sequential design and procurement, but if design time is available has the shortest procurement time after the design is complete.*	
Opportunities	**Obstacles**
• Use of A+B (Cost + Time) Delivery. • Shortest procurement period • Elements of design can be advanced prior to permitting, construction, etc. • Time to communicate/discuss design with stakeholders	• Schedule demands a faster design and procurement timeframe • May require multiple phases to complete construction schedule. Linear design and procurement of 1 phase may not be optimal. • Design and construction schedules can be unrealistic due to lack industry input

DESIGN-BUILD *Can get project under construction (and meet funding obligations) before completing design. Parallel process of design and construction can accelerate project delivery schedule; however, procurement time can be lengthy due to the need for an accurate RFP.*	
Opportunities	**Obstacles**
• Procurement of capable Design-Build Team would provide innovation to complete on schedule. • Potential to accelerate schedule through parallel design-build process • Industry input into design and schedule • Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design) • More efficient procurement of long-lead items	• Schedule does not provide enough time for adequate procurement of Design-Build Team. • Shifting schedule risk to DB team could impact budget and schedule. • Undefined events or conditions found after procurement, but during design can impact schedule and cost • Time required to define technical requirements and expectations through RFP development can be lengthy • Time required to gain acceptance of quality program • Requires agency and stakeholder commitments to an expeditious review of design

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CM/GC

Quickly gets contractor under contract and under construction to meet funding obligations before completing design. Parallel process of development of contract requirements, design, procurements, and construction can accelerate project schedule, but schedule can be slowed down by CM/GC design process and Guaranteed Maximum Price (GMP)negotiations and contracting.

Opportunities	Obstacles
• Phased GMPs can be utilized. • Having a contractor on board before NEPA is complete to help with complicated tunnel design and construction phasing will allow the schedule to be met. Also an ICE. • Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design) • More efficient procurement of long-lead items • Early identification and resolution of design and construction issues (e.g., utility, ROW, and earthwork) • Can provide a shorter procurement schedule than Db • Team involvement for schedule optimization • Continuous constructability review and VE • Maintenance of Traffic improves with contractor inputs	• Multiple GMP and PS&E packages can be challenging to manage and administer. • Separate bid packages must be complete biddable packages. • Potential for not reaching GMP and substantially delaying schedule • GMP negotiation can delay the schedule • Schedule-driven goals may drive up cost • Designer-contractor-agency disagreements can add delays

Delivery Schedule Summary

	DBB	DB	CM/GC
1. Delivery Schedule	+	X	++

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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2) Project Complexity & Innovation: Project complexity and innovation is the nature of project that seeks for the applicability of new designs or processes to resolve complex and technical issues.

DESIGN-BID-BUILD

Allows CDOT to fully resolve complex and qualitative designs before procurement. Innovation provided by CDOT/Consultant expertise and through traditional owner directed processes such as VE studies, contractor bid alternatives, and post-bid VE.

Opportunities	Obstacles
• CDOT can procure geotechnical and tunnel expertise for design. CDOT& consultant expertise can select innovation independently of contractor abilities • Opportunities for value engineering studies and constructability review during design, more time for design solutions • Full control in selection of design expertise	• Desired solution requires geotechnical and tunnel • expertise • Unknown costs due to pricing of risk • Innovations can add cost or time and restrain contractor's benefits • No contractor input to optimize costs • Limited flexibility for integrated design and construction solutions (limited to constructability) • Difficult to assess construction time and cost due to innovation

DESIGN-BUILD

Incorporates design-builder into design process through best value selection and contractor proposed Alternate Technical Concepts (ATCs) – which are a cost oriented approach to providing complex and innovative designs. Requires that desired solutions to complex projects be well defined through contract requirements.

Opportunities	Obstacles
N/A	N/A

CM/GC

Allows independent selection of designer and contractor based on qualifications to jointly address complex innovative designs through three party collaboration of CDOT, designer and Contractor. Allows for a qualitative (non price oriented) design but requires agreement on GMP.

Opportunities	Obstacles
• Innovations, risk mitigation, and cost approaches can be negotiated within the team. • Having a contractor on board to help with • complicated tunnel design and construction • phasing will allow the schedule to be met. • Highly innovative process through 3 party collaboration • Allows for owner control of a designer/contractor process for developing innovative solutions • Allows for an independent selection of the best qualified designer and best qualified contractor • VE inherent in process and enhanced constructability • Risk of innovation can be better defined and minimized and allocated • Can take to market for bidding as contingency	• Innovations, risk mitigation, and added value can increase project budgets, introduce scope creep, and add complexity. • Cost competitiveness – single source negotiated GMP • Limited competition in design after designer is selected • Scope additions can be difficult to manage • Innovations can add cost or time

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Project Complexity & Innovation Summary

	DBB	DB	CM/GC
2. Project Complexity & Innovation	-	N/A	++

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery
Notes and Comments: .....
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3) Level of Design: Level of design is the percentage of design completion at the time of the project delivery procurement

DESIGN-BID-BUILD

100% design by CDOT, with CDOT having complete control over the design.

Opportunities	Obstacles
• 100% design by owner • Agency has complete control over the design (can be beneficial when there is one specific solution for a project) • The scope of the project is well defined through complete plans and contract documents • Well-known process to the industry	• Design is conceptual at this time and CDOT does not have enough tunnel experience on staff for project. • Owner design errors can result in a higher number of change orders, claims, etc. • Minimizes competitive innovation opportunities • Can reduce the level of constructability since the contractor is not bought into the project until after the design is complete • Final design cannot start until NEPA complete.

DESIGN-BUILD

Design advanced by CDOT to the level necessary to precisely define contract requirements and properly allocate risk (typically 30% or less).

Opportunities	Obstacles

CM/GC

Can utilize a lower level of design prior to contracting and joint collaboration of CDOT, designer, and contractor in the further development of the design. Iterative nature of design process risks extending the project schedule.

Opportunities	Obstacles
• Joint development of the best construction • methods and phasing • Risk Assessment and Mitigation shared between the project team. Negotiations determined who can handle risk better. • Can utilize a lower level of design prior to selecting a contractor then collaboratively advance design with owner, designer and contractor • Contractor involvement in early design improves constructability • CDOT controls design • Design can be responsive to risk minimization	• Risk allocation and mitigation can still cost more. Risk elimination costs money. Detailed risk analysis will be required. • Teaming and communicating concerning design can cause disputes • Three party process can slow progression of design • It's not a well known process to CDOT or industry.

Level of Design Summary

	DBB	DB	CM/GC
3. Level of Design	+	N/A	+

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery
Notes and Comments: .....

4) Initial Risk Assessment: Risk is an uncertain event or condition that, if it occurs, has a negative effect on a project's objectives. Risk allocation is the assignment of unknown events or conditions to the party that can best manage them. An initial assessment of project risks is important to ensure the selection of the delivery method that can properly address them. An approach that focuses on a fair allocation of risk will be most successful. Refer to the risk discussion and checklists in the appendix.

DESIGN-BID-BUILD

Risk allocation for design-bid-build best is understood by the industry, but requires that most design-related risks and third party risks be resolved prior to procurement to avoid costly contractor contingency pricing and change orders and claims.

Opportunities	Obstacles
• CDOT can take on the risk and mitigate it through CMOS and F/A pools. • Known protocols for permitting • CU Risk Assessment could help define cost and schedule impacts.	• Too many risks and unknown parameters at this time. • All risk mitigations cannot be assessed for price and schedule impacts until decision document is signed.

DESIGN-BUILD

Provides opportunity to properly allocate risks to the party best able to manage them, but requires risks allocated to design-builder to be well defined to minimize contractor contingency pricing of risks.

Opportunities	Obstacles

CM/GC

Provides opportunity for CDOT, designer, and contractor to collectively identify and minimize project risks, and allocate risk to appropriate party. Has potential to minimize contractor contingency pricing of risk, but can lose the element of competition in pricing.

Opportunities	Obstacles
• Complex design and construction needs the collaboration of CDOT, the designer and a contractor. • More flexibility to assess and share risk. CU Risk Assessment could help define cost and schedule impacts.	• Tough negotiations. Owner needs to understand difference between what it thinks decisions costs and what decisions really cost. • More involvement and project management required. • Multiple Permits may be required.

Initial Risk Assessment Summary

	DBB	DB	CM/GC
4. Initial Risk Assessment	+	X	++

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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5) Cost: Project cost is the financial process related to meeting budget restrictions, early and precise cost estimation, and control of project costs.

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DESIGN-BID-BUILD

Competitive bidding provides a low cost construction for a fully defined scope of work. Costs accuracy limited until design is completed. More likelihood of cost change orders due to contractor having no design responsibility.

Opportunities	Obstacles
• Competitive bidding provides a low cost construction to a fully defined scope of work • Construction unit costs are contractually set before construction begins	• Cost reductions due to contractor innovation and constructability is difficult to obtain • More potential of cost change orders due to owner design responsibility

DESIGN-BUILD

Designer-builder collaboration and ATCs can provide a cost-efficient response to project goals. Costs are determined with design-build proposal, early in design process. Allows a variable scope bid to match a fixed budget. Poor risk allocation can result in high contingencies.

Opportunities	Obstacles
N/A	N/A

CM/GC

CDOT/designer/contractor collaboration to reduce risk pricing can provide a low cost project however non-competitive negotiated GMP introduces price risk. Good flexibility to design to a budget.

Opportunities	Obstacles
• Owner/designer/contractor collaboration to reduce project risk can result in lowest project costs. • Early contractor involvement can result in cost savings through VE and constructability • Cost will be known earlier when compared to DBB • Integrated design/construction process can provide a cost efficient strategies to project goals • Can provide a cost efficient response to the project goals • Independent Cost Estimator validation.	• Non-competitive negotiated GMP introduces price risk • Difficulty in GMP negotiation introduces some risk that GMP will not be successfully executed requiring aborting the CM/GC process.

Cost Summary

	DBB	DB	CM/GC
5. Cost	+	N/A	+

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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6) Staff Experience/Availability: Owner staff experience and availability as it relates to the project delivery methods in question.

DESIGN-BID-BUILD *Technical and management resources necessary to perform the design and plan development. Resource needs can be more spread out.*	
Opportunities	**Obstacles**
• Excellent experienced staff resources are available. • Agency and consultants have high level of experience with the traditional system • Designers can be more interchangeable between projects	• Minimal Tunnel Construction Experience. • Staff's responsibilities are spread out over a longer design period

DESIGN-BUILD *Technical and management resources and expertise necessary to develop the RFQ and RFP and administrate the procurement. Concurrent need for both design and construction resources to oversee the implementation.*	
Opportunities	**Obstacles**
N/A	N/A

CM/GC *Strong, committed CDOT project management resources are important for success of the CM/GC process.*	
Opportunities	**Obstacles**
• Strong committed CDOT PM is available.	• Need additional staff for management of multiple projects and teams. • Owner expertise is limited in tunnel design/construction and CM/GC. • Existing staff may need additional training to address their changing roles • Agency must learn how to negotiate GMP projects

Availability Summary

	DBB	DB	CM/GC
6. Staff Experience/ Availability	++	N/A	+

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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7) Level of Oversight and Control: Level of oversight involves the amount of agency staff required to monitor the design or construction, and amount of agency control over the delivery process

DESIGN-BID-BUILD *Full control over a linear design and construction process*	
Opportunities	**Obstacles**
• Full owner control over a linear design and construction process • Oversight roles are well understood • Contract documents are typically completed in a single package before construction begins • Multiple checking points through three linear phases: design-bid-build • Maximum control over design	• Design is conceptual at this time. • Requires a high-level of oversight • Increased likelihood of claims due to owner design errors and omissions.

DESIGN-BUILD *Less control over the design (design desires must be written into the RFP contract requirements). Generally less control over the construction process (design-builder often has QA responsibilities)*	
Opportunities	**Obstacles**
N/A	N/A

CM/GC *Most control by CDOT over both the design, and construction, and control over a collaborative owner/designer/contractor project team*	
Opportunities	**Obstacles**
• Preconstruction services are provided by the CM/GC • Getting input from construction to enhance constructability and innovation • Provides owner control over an integrated design/construction process	• Agency must have experienced staff to oversee the CM/GC

Level of Oversight and Control Summary

	DBB	DB	CM/GC
7. Level of Oversight and Control	+	N/A	+

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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8) Competition and Contractor Experience: Competition and availability refers to the level of competition, experience and availability in the market place and its capacity for the project.

DESIGN-BID-BUILD *High level of competition, but limited ability to choose based on qualifications. High level of marketplace experience*	
Opportunities	**Obstacles**
• Transparency and fairness • Reduced chance of corruption and collusion • Contractors are familiar with DBB process	• Limited marketplace experience in tunneling. • Risks associated with selecting the low bid (the best contractor is not necessary selected) • No contractor input into the process • Limited ability to select contractor based on qualifications • Promotes high level of competition in the marketplace

DESIGN-BUILD *Allows for a balance of qualifications and price in the selection process. Medium level of marketplace experience*	
Opportunities	**Obstacles**
N/A	N/A

CM/GC *Allows for the selection of the single most qualified contractor, but GMP can limit price competition. Low level of marketplace experience*	
Opportunities	**Obstacles**
• Allows for qualifications based contractor procurement • Agency has control over an independent selection of best qualified designer and contractor • Contractor is part of the project team early on, creating a project "team" • Increased opportunity for innovation due to the diversity of the project team	• Average Bid Approach • Teamwork and communication among the project team • Working with only one contractor to develop GMP can limit price competition

Competition and Contractor Experience Summary

	DBB	DB	CM/GC
8. Competition and Contractor Experience	+	N/A	+

Key: **+ +** Most appropriate delivery method **+** Appropriate delivery method
– Least appropriate delivery method **X** Fatal Flaw (discontinue evaluation of this method)
NA Factor not applicable or not relevant to the selection of project delivery

Notes and Comments: .....
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APPENDIX

Opportunity and Obstacle Checklists

(With Project Risk Assessment Discussion and Checklists)

I-70 TWIN TUNNELS RISK ASSESSMENT AND PROJECT DELIVERY SELECTION
THIS WAS USED FOR EVALUATION PURPOSES ONLY. SEE RISK LIST ABOVE FOR MORE INFORMATION:

1) Delivery Schedule

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Schedule is more predictable and more manageable ❒ Milestones can be easier to define ❒ Projects can more easily be "shelved" ❒ Shortest procurement period ❒ Elements of design can be advanced prior to permitting, construction, etc. ❒ Time to communicate/discuss design with stakeholders	❒ Requires time to perform a linear design-bid-construction process ❒ Design and construction schedules can be unrealistic due to lack industry input ❒ Errors in design lead to change orders and schedule delays ❒ Low bid selection may lead to potential delays and other adverse outcomes.

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Potential to accelerate schedule through parallel design-build process ❒ Shifting schedule risk to DB team ❒ Encumbers construction funds more quickly ❒ Industry input into design and schedule ❒ Fewer chances for disputes between agency and design-builders ❒ More efficient procurement of long-lead items ❒ Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design)	❒ Request for proposal development and procurement can be lengthy ❒ Undefined events or conditions found after procurement, but during design can impact schedule and cost ❒ Time required to define technical requirements and expectations through RFP development can be lengthy ❒ Time required to gain acceptance of quality program ❒ Requires agency and stakeholder commitments to an expeditious review of design

CM/GC	
Opportunities	**Obstacles**
❒ Ability to start construction before entire design, ROW, etc. is complete (i.e., phased design) ❒ More efficient procurement of long-lead items ❒ Early identification and resolution of design and construction issues (e.g., utility, ROW, and earthwork) ❒ Can provide a shorter procurement schedule than DB ❒ Team involvement for schedule optimization ❒ Continuous constructability review and VE ❒ Maintenance of Traffic improves with contractor inputs	❒ Potential for not reaching GMP and substantially delaying schedule ❒ GMP negotiation can delay the schedule ❒ Schedule-driven goals may drive up cost ❒ Designer-contractor-agency disagreements can add delays ❒ Strong agency management is required to control schedule

2) Project Complexity & Innovation

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ CDOT can have more control of design of complex projects ❒ CDOT& consultant expertise can select innovation independently of contractor abilities ❒ Opportunities for value engineering studies during design, more time for design solutions ❒ Aids in consistency and maintainability ❒ Full control in selection of design expertise ❒ Complex design can be resolved and competitively bid	❒ Increased costs due to pricing of risk ❒ Innovations can add cost or time and restrain contractor's benefits ❒ No contractor input to optimize costs ❒ Limited flexibility for integrated design and construction solutions (limited to constructability) ❒ Difficult to assess construction time and cost due to innovation

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Designer and contractor collaborate to optimize means and methods and enhance innovation ❒ Opportunity for innovation through draft RFP, best value and ATC processes ❒ Can use best-value procurement to select design-builder with best qualifications ❒ Constructability and VE inherent in process ❒ Early team integration ❒ Sole point of responsibility	❒ Requires desired solutions to complex designs to be well defined through technical requirements (difficult to do) ❒ Qualitative designs are difficult to define (example. aesthetics) ❒ Risk of time or cost constraints on designer inhibiting innovation ❒ Some design solutions might be too innovative or unacceptable ❒ ATC process fosters cost based innovation but not necessarily innovation to improve quality ❒ Quality assurance for innovative processes are difficult to define in RFP

CM/GC	
Opportunities	**Obstacles**
❒ Highly innovative process through 3 party collaboration ❒ Allows for owner control of a designer/contractor process for developing innovative solutions ❒ Allows for an independent selection of the best qualified designer and best qualified contractor ❒ VE inherent in process and enhanced constructability ❒ Risk of innovation can be better defined and minimized and allocated ❒ Can take to market for bidding as contingency	❒ Process depends on designer/CM relationship ❒ No contractual relationship between designer/CM ❒ Innovations can add cost or time ❒ Scope additions can be difficult to manage ❒ Preconstruction services fees for contractor involvement ❒ Cost competitiveness – single source negotiated GMP ❒ Limited competition in design after designer is selected

3) Level of Design

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ 100% design by owner ❒ Agency has complete control over the design (can be beneficial when there is one specific solution for a project) ❒ Project/scope can be developed through design ❒ The scope of the project is well defined through complete plans and contract documents ❒ Well-known process to the industry	❒ Owner design errors can result in a higher number of change orders, claims, etc. ❒ Minimizes competitive innovation opportunities ❒ Can reduce the level of constructability since the contractor is not bought into the project until after the design is complete

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Design advanced by the owner to level necessary to precisely define the contract requirements and properly allocate risk ❒ Does not require much design to be completed before awarding project to the design-builder (between ~ 10% - 30% complete) ❒ Contractor involvement in early design, which improves constructability ❒ Plans do not have to be as detailed because the design-builder is bought into the project early in the process and will accept design responsibility	❒ Must have very clear definitions and requirements in the RFP because it is the basis for the contract ❒ If design is too far advanced it will limit the advantages of design-build ❒ Potential for lacking or missing scope definition if RFP not carefully developed ❒ Over utilizing performance specifications to enhance innovation can risk quality through reduced technical requirements ❒ Less agency control over the design ❒ Can create project less standardized designs across agency as a whole

CM/GC	
Opportunities	**Obstacles**
❒ Can utilize a lower level of design prior to selecting a contractor then collaboratively advance design with owner, designer and contractor ❒ Contractor involvement in early design improves constructability ❒ CDOT controls design ❒ Design can be used for DBB if the price is not successfully negotiated. ❒ Design can be responsive to risk minimization	❒ Teaming and communicating concerning design can cause disputes ❒ Three party process can slow progression of design ❒ If design is too far advanced it will limit the advantages of CMGC or could require design backtracking

4) Initial Risk Assessment

Three sets of risk assessment checklists are provided to assist in an initial risk assessment relative to the selection of the delivery method:

A. Typical CDOT Transportation Project Risks
B. General Project Risks Checklist
C. Opportunities/Obstacles Checklist (relative to each delivery method)

It is important to recognize that the initial risk assessment is to only ensure the selected delivery method can properly address the project risks. A more detailed level of risk assessment should be performed concurrently with the development of the procurement documents to ensure that project risks are properly allocated, managed, and minimized through the procurement and implementation of the project.

A. TYPICAL CDOT TRANSPORTATION PROJECT RISKS

Following is a list of project risks that are frequently encountered on CDOT transportation projects and a discussion on how the risks are resolved through the different delivery methods.

A.1: Site Conditions and Investigations (How unknown site conditions are resolved)

DESIGN-BID-BUILD

Site condition risks are generally best identified and mitigated during the design process prior to procurement to minimize the potential for change orders and claims when the schedule allows.

DESIGN-BUILD

Certain site condition responsibilities can be allocated to the design-builder provided they are well defined and associated third party approval processes are well defined. Caution should be used as unreasonable allocation of site condition risk will result in high contingencies during bidding. CDOT should perform site investigations in advance of procurement to define conditions and avoid duplication of effort by proposers. At a minimum CDOT should perform the following investigations:

1) Basic design surveys
2) Hazardous materials investigations to characterize the nature of soil and groundwater contamination
3) Geotechnical baseline report to allow design-builders to perform proposal design without extensive additional geotechnical investigations

CM/GC

CDOT, the designer, and the contractor can collectively assess site condition risks, identify the need to perform site investigations in order to reduce risks, and properly allocate risk prior to GMP.

A.2: Utilities

DESIGN-BID-BUILD

Utility risks are best allocated to CDOT, and mostly addressed prior to procurement to minimize potential for claims when the schedule allows.

DESIGN-BUILD

Utilities responsibilities need to be clearly defined in contract requirements, and appropriately allocated to both design-builder and CDOT:

Private utilities (major electrical, gas, communication transmission facilities): Need to define coordination and schedule risks as they are difficult for design-builder to price. Best to have utilities agreements before procurement. Note – by state regulation private utilities have schedule liability in design-build projects, but they need to be made aware of their responsibilities.

Public Utilities: Design and construction risks can be allocated to the design-builder, if properly incorporated into the contract requirements.

CM/GC

Can utilize a lower level of design prior to contracting and joint collaboration of CDOT, designer, and contractor in the further development of the design.

A.3: Railroads (if applicable)

DESIGN-BID-BUILD

Railroad risks are best resolved prior to procurement and relocation designs included in the project requirements when the schedule allows.

DESIGN-BUILD

Railroad coordination and schedule risks should be well understood to be properly allocated and are often best assumed by CDOT. Railroad design risks can be allocated to the designer if well defined. Best to obtain an agreement with railroad defining responsibilities prior to procurement

CM/GC

Railroad impacts and processes can be resolved collaboratively by CDOT, designer, and contractor. A lengthy resolution process can delay the GMP negotiations.

A.4: Drainage/Water Quality Best Management Practices (construction and permanent)

Both drainage and water quality often involve third party coordination that needs to be carefully assessed with regard to risk allocation. Water quality in particular is not currently well defined, complicating the development of technical requirements for projects.

Important questions to assess:

1) Do criteria exist for compatibility with third party offsite system (such as an OSP (Outfall System Plan))?
2) Is there an existing cross-drainage undersized by CDOT Criteria?
3) Can water quality requirements be precisely defined? Is right-of-way adequate?

DESIGN-BID-BUILD

Drainage and water quality risks are best designed prior to procurement to minimize potential for claims when the schedule allows.

DESIGN-BUILD

Generally, CDOT is in the best position to manage the risks associated with third party approvals regarding compatibility with offsite systems, and should pursue agreements to define requirements for the design-builder.

CM/GC

CDOT, the designer, and the contractor can collectively assess drainage risks and coordination and approval requirements, and minimize and define requirements and allocate risks prior to GMP.

A.5: Environmental: Meeting environmental document commitments, (noise, 4(f) and historic, wetlands, endangered species, etc.)

DESIGN-BID-BUILD

Risk is best mitigated through design prior to procurement when the schedule allows.

DESIGN-BUILD

Certain environmental approvals and processes that can be fully defined can be allocated to the design-builder. Agreements or MOUs with approval agencies prior to procurement is best to minimize risks.

CM/GC

Environmental risks and responsibilities can be collectively identified, minimized, and allocated by CDOT, the designer, and the contractor prior to GMP

A.6: Third Party Involvement: Timeliness and impact of third party involvement (funding partners, adjacent municipalities, adjacent property owners, project stakeholders, FHWA, PUC)

DESIGN-BID-BUILD
Third party risk is best mitigated through design process prior to procurement to minimize potential for change orders and claims when the schedule allows.

DESIGN-BUILD
Third party approvals and processes that can be fully defined can be allocated to the design-builder. Agreements or MOUs with approval agencies prior to procurement is best to minimize risks.

CM/GC
Third party approvals can be resolved collaboratively by CDOT, designer, and contractor.

B. GENERAL PROJECT RICK CHECKLIST (items to consider when assessing risk)

Environmental Risks	External Risks
❒ Delay in review of environmental documentation ❒ Challenge in appropriate environmental documentation ❒ Defined and non-defined hazardous waste ❒ Environmental regulation changes ❒ Environmental impact statement (EIS) required ❒ NEPA/ 404 Merger Process required ❒ Environmental analysis on new alignments required	❒ Stakeholders request late changes ❒ Influential stakeholders request additional needs to serve their own commercial purposes ❒ Local communities pose objections ❒ Community relations ❒ Conformance with regulations/guidelines/ design criteria ❒ Intergovernmental agreements and jurisdiction
Third-Party Risks	**Geotechnical and Hazmat Risks**
❒ Unforeseen delays due to utility owner and third-party ❒ Encounter unexpected utilities during construction ❒ Cost sharing with utilities not as planned ❒ Utility integration with project not as planned ❒ Third-party delays during construction ❒ Coordination with other projects ❒ Coordination with other government agencies	❒ Unexpected geotechnical issues ❒ Surveys late and/or in error ❒ Hazardous waste site analysis incomplete or in error ❒ Inadequate geotechnical investigations ❒ Adverse groundwater conditions ❒ Other general geotechnical risks
Right-of-Way/ Real Estate Risks	**Design Risks**
❒ Railroad involvement ❒ Objections to ROW appraisal take more time and/or money ❒ Excessive relocation or demolition ❒ Acquisition ROW problems ❒ Difficult or additional condemnation ❒ Accelerating pace of development in project corridor ❒ Additional ROW purchase due to alignment change	❒ Design is incomplete/ Design exceptions ❒ Scope definition is poor or incomplete ❒ Project purpose and need are poorly defined ❒ Communication breakdown with project team ❒ Pressure to delivery project on an accelerated schedule ❒ Constructability of design issues ❒ Project complexity (scope, schedule, objectives, cost, and deliverables are not clearly understood)
Organizational Risks	**Construction Risks**
❒ Inexperienced staff assigned ❒ Losing critical staff at crucial point of the project ❒ Functional units not available or overloaded ❒ No control over staff priorities ❒ Lack of coordination/ communication ❒ Local agency issues ❒ Internal red tape causes delay getting approvals, decisions ❒ Too many projects/ new priority project inserted into program	❒ Pressure to delivery project on an accelerated schedule. ❒ Inaccurate contract time estimates ❒ Construction QC/QA issues ❒ Unclear contract documents ❒ Problem with construction sequencing/ staging/ phasing ❒ Maintenance of Traffic/ Work Zone Traffic Control

C. OPPORTUNITIES/OBSTACLES CHECKLIST (relative to each delivery method)

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Risks managed separately through design, bid, build is expected easier ❒ Risk allocation is most widely understood/used ❒ Opportunity to avoid or mitigate risk through complete design ❒ Risks related to environmental, railroads, and third party involvement are best resolved prior to procurement ❒ Utilities and ROW best allocated to CDOT and mostly addressed prior to procurement to minimize potential for claim ❒ Project can be shelved while resolving risks	❒ Owner accepts risks associated with project complexity (the inability of designer to be all-knowing about construction) and project unknowns ❒ Low-bid related risks ❒ Potential for misplaced risk through prescriptive specifications ❒ Innovative risk allocation is difficult to obtain ❒ Limited industry input in contract risk allocation ❒ Change order risks can be greater ❒ Contractor may avoid risks

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Performance specifications can allow for alternative risk allocations to the design builder ❒ Risk-reward structure can be better defined ❒ Innovative opportunities to allocate risks to different parties (e.g., schedule, means and methods, phasing) ❒ Opportunity for industry review of risk allocation (draft RFP, ATC processes) ❒ Avoid low-bid risk in procurement ❒ Contractor will help identify risks related to environmental, railroads, ROW, and utilities ❒ Designers and contractors can work toward innovative solutions to, or avoidance of, unknowns	❒ Need a detailed project scope, description etc., for the RFP to get accurate/comprehensive responses to the RFP (Increased RFP costs may limit bidders) ❒ Limited time to resolve risks ❒ Additional risks allocated to designers for errors and omissions, claims for change orders ❒ Unknowns and associated risks need to be carefully allocated through a well-defined scope and contract ❒ Risks associated with agreements when design is not completed ❒ Poorly defined risks are expensive ❒ Contractor may avoid risks or drive consultant to decrease cost at risk to quality

CM/GC	
Opportunities	**Obstacles**
❒ Contractor can have a better understanding of the unknown conditions as design progresses ❒ Innovative opportunities to allocate risks to different parties (e.g., schedule, means and methods, phasing) ❒ Opportunities to manage costs risks through CM/GC involvement ❒ Contractor will help identify and manage risk ❒ Agency still has considerable involvement with third parties to deal with risks ❒ Avoids low-bid risk in procurement ❒ More flexibility and innovation available to deal with unknowns early in design process	❒ Lack of motivation to manage small quantity costs ❒ Increase costs for non-proposal items ❒ Disagreement among Designer-Contractor-Owner can put the process at risk ❒ If GMP cannot be reached, additional low-bid risks appear ❒ Limited to risk capabilities of CM/GC ❒ Designer-contractor-agency disagreements can add delays ❒ Strong agency management is required to negotiate/optimize risks ❒ Discovery of unknown conditions can drive up GMP, which can be compounded in phased construction

5) Cost

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Competitive bidding provides a low cost construction to a fully defined scope of work ❒ Increase certainty about cost estimates ❒ Construction costs are contractually set before construction begins	❒ Cost accuracy is limited until design is completed ❒ Construction costs are not locked in until design is 100% complete. ❒ Cost reductions due to contractor innovation and constructability is difficult to obtain ❒ More potential of cost change orders due to owner design responsibility

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Contractor input into design should moderate cost ❒ Design-builder collaboration and ATCs can provide a cost-efficient response to project goals ❒ Costs are contractually set early in design process with design-build proposal ❒ Allows a variable scope bid to match a fixed budget ❒ Potential lower average cost growth	❒ Risks related to design-build, lump sum cost without 100% design complete, can compromise financial success of the project.

CM/GC	
Opportunities	**Obstacles**
❒ Owner/designer/contractor collaboration to reduce project risk can result in lowest project costs. ❒ Early contractor involvement can result in cost savings through VE and constructability ❒ Cost will be known earlier when compared to DBB ❒ Integrated design/construction process can provide a cost efficient strategies to project goals ❒ Can provide a cost efficient response to the project goals	❒ Non-competitive negotiated GMP introduces price risk ❒ Difficulty in GMP negotiation introduces some risk that GMP will not be successfully executed requiring aborting the CM/GC process. ❒ Paying for contractors involvement in the design phase may increase total cost

6) Staff Experience/Availability

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Agency and consultants have high level of experience with the traditional system ❒ Designers can be more interchangeable between projects	❒ Can require a high level of agency staffing of technical resources ❒ Staff's responsibilities are spread out over a longer design period ❒ Can require staff to have full breadth of technical expertise

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Less agency staff required due to the sole source nature of DB ❒ Opportunity to grow agency staff by learning a new process	❒ Limitation of availability of staff with skills, knowledge and personality to manage DB projects ❒ Existing staff may need additional training to address their changing roles ❒ Need to "mass" agency management and technical resources at critical points in process (i.e., RFP development, design reviews, etc.)

CM/GC	
Opportunities	**Obstacles**
❒ Agency can improve efficiencies by having more project managers on staff rather than specialized experts ❒ Smaller number of technical staff required through use of consultant designer	❒ Strong committed owner project management is important to success ❒ Limitation of availability of staff with skills, knowledge and personality to manage CMGC projects ❒ Existing staff may need additional training to address their changing roles ❒ Agency must learn how to negotiate GMP projects

7) Level of Oversight and Control

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Full owner control over a linear design and construction process ❒ Oversight roles are well understood ❒ Contract documents are typically completed in a single package before construction begins ❒ Multiple checking points through three linear phases: design-bid-build ❒ Maximum control over design	❒ Requires a high-level of oversight ❒ Increased likelihood of claims due to owner design responsibility ❒ Limited control over an integrated design/construction process

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ A single entity responsibility during project design and construction ❒ Continuous execution of design and build ❒ Getting input from construction to enhance constructability and innovation ❒ Overall project planning and scheduling is established by one entity	❒ Can require high level of design oversight ❒ Can require high level of quality assurance oversight ❒ Limitation on staff with DB oversight experience ❒ Less owner control over design ❒ Control over design relies on proper development of technical requirements

CM/GC	
Opportunities	**Obstacles**
❒ Preconstruction services are provided by the construction manager ❒ Getting input from construction to enhance constructability and innovation ❒ Provides owner control over an integrated design/construction process	❒ Agency must have experienced staff to oversee the CM/GC ❒ Higher level of cost oversight required

8) Competition and Contractor Experience

DESIGN-BID-BUILD	
Opportunities	**Obstacles**
❒ Promotes high level of competition in the marketplace ❒ Opens construction to all reasonably qualified bidders ❒ Transparency and fairness ❒ Reduced chance of corruption and collusion ❒ Contractors are familiar with DBB process	❒ Risks associated with selecting the low bid (the best contractor is not necessary selected) ❒ No contractor input into the process ❒ Limited ability to select contractor based on qualifications

DESIGN-BUILD	
Opportunities	**Obstacles**
❒ Allows for a balance of qualifications and cost in design-builder procurement ❒ Two-phase process can promote strong teaming to obtain “Best Value” ❒ Increased opportunity for innovation possibilities due to the diverse project team	❒ Need for DB qualifications can limit competition ❒ Lack of competition with past experience with the project delivery method ❒ Reliant on DB team selected for the project ❒ The gap between owner experience and contractor experience with delivery method can create conflict

CM/GC	
Opportunities	**Obstacles**
❒ Allows for qualifications based contractor procurement ❒ Agency has control over an independent selection of best qualified designer and contractor ❒ Contractor is part of the project team early on, creating a project “team” ❒ Increased opportunity for innovation due to the diversity of the project team	❒ Currently there is not a large pool of contractors with experience in CMGC, which will reduce the competition and availability ❒ Working with only one contractor to develop GMP can limit price competition ❒ Requires a strong project manager from the agency ❒ Teamwork and communication among the project team