



ACCELERATED BRIDGE CONSTRUCTION  
UNIVERSITY TRANSPORTATION CENTER

ABC-UTC GUIDE FOR:

# DELIVERY METHODS FOR ACCELERATED BRIDGE CONSTRUCTION PROJECTS: CASE STUDIES AND CONSENSUS BUILDING

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## **ABSTRACT**

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Accelerated bridge construction (ABC) has many advantages, such as reduced closure times and minimized traffic disruptions, and has grown in popularity in recent years. To take full advantage of the benefits of ABC, agencies should decide which projects are appropriate for ABC and which procurement and project delivery methods to use.

The research team compiled information on decision matrices for identifying ABC projects, alternative delivery methods, and the procurement methods used for ABC projects. Four ABC projects in three states (Georgia, Indiana, and Minnesota) were then investigated in detail. Note that this project coincides with a partner project which contained similar information collection efforts for bidding of ABC projects (Bidding of Accelerated Bridge Construction Projects: Case Studies and Consensus Building [ABC-UTC-2016-C1-ISU02]). The research team reached out to personnel involved in the projects to discuss bid items, contracting methods, and lessons learned. The results of this effort are included in four standalone case study summaries.

The case studies suggest that ABC can be successfully implemented using any of the delivery methods explored in this study: design-build, design-bid-build, and construction manager/general contractor. Regardless of delivery method, communication and collaboration between the contractor and agency results in a better project outcome. Effective communication with the public is also important during ABC projects and can be done by either the agency or the contractor. After a project is completed, the agency can benefit from reviewing the lessons learned and successful aspects of the project and applying these to future projects.

## **ACKNOWLEDGMENTS**

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## 1. INTRODUCTION

This work documented past ABC projects with a particular focus on the project delivery method that was used and the lessons learned from each project. The research plan included a detailed review of literature related to how the decision is made to use ABC on a project and how the delivery methods are selected. The research team also reviewed research related to project delivery methods with a specific application for accelerated bridge construction projects.

After the literature review was complete, several ABC projects were identified as candidates for further investigation via detailed case studies to obtain case-specific information on the selection of project delivery and procurement methods and the lessons learned from each project. The ABC projects were identified by using the ABC-UTC database that can be found on the ABC-UTC website (<http://utcdb.fiu.edu/>). To narrow the pool of projects, the research team focused on ABC projects completed within the last five years. The research team conducted interviews with agency staff and, when possible, the contractor to gather as much information about each project as possible. Representatives from the following states were interviewed as part of this project: Georgia, Indiana, Minnesota, and Tennessee.

Note that the information collection efforts for this project were done simultaneously with those needed for the partner project, *Bidding of Accelerated Bridge Construction Projects: Case Studies and Consensus Building [ABC-UTC-2016-C1-ISU02]*.

## 2. PROJECT DELIVERY METHODS

Several project delivery methods are used for ABC. The methods used and referenced in this study are design-bid-build (DBB), design-build (DB), and construction manager/general contractor (CMGC).

**Design-bid-build (DBB)** is the most widely used project delivery method for roadway and bridge construction in the United States. In this method, the three phases are sequential and have minimal to no overlap. In the design phase, detailed plans and specifications are prepared by engineers either from within a construction company, as a third-party consultant, or by the owner. About 5% to 10% percent of the project's total cost is spent on this phase. Construction companies then bid on the contract, and the project is usually awarded to the lowest responsible bidder. The build (or construction) phase involves the majority of the project costs and is completed by the construction company according to the contract. The benefits of a DBB contract include the ease with which designs can be changed before construction begins, the fact that the design is usually 100% complete before construction, the fixed cost of the contract, and the known bid costs. The disadvantages of this method consist of shared responsibility for delivery of the project, the sequential nature of the project usually producing longer schedules for completion, and the fact that the total cost is unknown until the contract is officially signed.

The next most common project delivery system is **design-build (DB)**. An advantage of design-build is that it combines the design and construction phases into a single contract. Design-build is used because it often offers time and cost savings over the conventional design-bid-build method (Orabi et al. 2016). It does this by allowing construction to begin before the plans are fully developed. In addition, design-build offers a lower likelihood of a discrepancy between the plans from the design stage and the construction itself. The project is awarded using either the low bid or best value method. The low bid method is the same as the method used in the design-bid-build process, while the best value method considers other factors, such as the



contractor’s qualifications and experience, innovation, technical approach, quality control methods, and project management. Design-build seems to outperform design-bid-build on almost every front, but design-bid-build can be a better fit for some projects depending on the situation, and its use is sometimes required by law (Orabi et al. 2016).

The least common of the three studied delivery methods is **construction manager/general contractor (CMGC)**. This delivery method allows the owner to include a construction manager, usually chosen based on qualifications and experience, in the design process to give input on constructability. During the design phase, the construction manager provides input regarding scheduling, pricing, phasing, and any other subject that he or she believes will create a more constructible project. When the project design phase reaches 60% to 90% completion, the owner usually negotiates a guaranteed maximum price with the construction manager that is based on the scope and schedule of the project. If that price is agreed upon, a contract is written and the construction manager becomes the general contractor. This method is also called construction manager at risk in some states (FHWA 2017).

### 3. CURRENT PRACTICES: ALTERNATIVE DELIVERY METHODS

Traditionally, state transportation agencies have used design-bid-build for all of their projects, though some states have been moving towards using alternative delivery methods such as DB and CMGC. Projects using these alternative delivery methods are often awarded based on the contractor’s qualifications, which can lead to push back from some contractors due to the subjectivity of the selection process. Another obstacle to using alternative delivery methods is that the project award process in some states is legislatively controlled. The table below presents an overview of the usage of DB and CMGC.

*Table 1: DB and CMGC usage overview*

Current Use of Alternative Delivery Methods	
<b>Design-Build</b>	Nationally, 44 states are able to use DB to some degree for transportation projects (DBIA 2019). However, only eight states are authorized to use qualifications-based selection for the procurement of DB projects as of 2019.
<b>CMGC</b>	CMGC can be procured using best value or qualifications-based selection. Twelve states were authorized to use CMGC in 2010 (Gransberg and Shane 2010). Since that report was written, California, Minnesota, and Tennessee have also authorized the use of CMGC.

The decision regarding which project delivery method to use on a project can be critical. A study by Bingham et al. (2018) found that the factors most influencing the choice of project delivery method are the urgency of the project, cost of the project, and best method for risk allocation.

A recently completed study (Bypaneni and Tran 2018) identified eight risk factors that impact the project delivery selection process:

- Delays in railroad agreements
- Project complexity
- Uncertainty in geotechnical investigation



- Delays in the right-of-way process
- Unexpected encounters with utilities
- Work-zone traffic control
- Challenges in obtaining environmental documentation
- Delays in delivery schedule

With any construction project, common general goals include the following: completing the project on schedule, with minimized project delivery time, minimizing the cost of the project and completing the project on budget, meeting or exceeding quality expectations and maximizing the life cycle performance of the project. To accomplish these goals, alternative delivery methods can be an attractive means to improve project efficiency. MnDOT, for example, uses an alternative delivery scoping checklist to identify projects early that may be candidates for alternative delivery methods. Since the vast majority of agency projects still use DBB, a checklist approach such as this is beneficial for identifying the unique projects that would benefit from alternative delivery methods. As an example, the project features that MnDOT considers in its scoping checklist are shown below (received via communication with MnDOT). Note that ABC, shown in bold, is identified as an element to consider.

- Total project cost estimate in excess of \$20,000,000
- Grading in excess of \$5,000,000
- Complex, costly, or otherwise substantial staging
- Complex (e.g., curved steel), unusual, or major bridges
- Work on historic bridges or other highly sensitive infrastructure
- Highly complicated third-party risks (e.g., railroad, major utilities, Section 4(f) impacts)
- Use of alternative pavements
- Multiple viable options for interchange type, alignments, or other components (bridge versus tunnel, stabilized embankment versus wall, etc.)
- Highly constrained budgets and room for “scope variation”
- Known acceleration needs (e.g., projects that are likely to be advanced in the future)
- Major constructability concerns (e.g. access problems, options that may affect design)
- Major construction schedule constraints
- Significant traffic impacts and delay on major routes (Interstates, principal arterials, etc.)
- Implementation of new technology (**accelerated bridge construction**, BIM, etc.)
- A lack of final design staff
- Existence of other, similar projects (that could potentially be packaged together)

Should an agency consider using an alternative delivery method (and if it is legislatively able to do so), a decision-making process for delivery method selection is recommended. Decision matrices have been developed by many agencies and often consider the following elements:

- Delivery schedule
- Project complexity
- Design responsibilities
- Cost
- Risks
- Experience with alternative delivery methods
- Level of desired agency involvement
- Contractor experience

While the elements of consideration included here reflect MnDOT practices, note that many states follow similar methodology for alternative delivery construction. A handful of other states are specifically identified in the full report for this project and can be referenced if more



information is desired. A project delivery method decision matrix that was developed by UDOT is shown below and provides helpful information regarding the project delivery methods that were the focus of this project.

Delivery Method	DBB	DB	CMGC
<b>Essential Elements</b>	<ul style="list-style-type: none"> <li>• Traditional delivery system</li> <li>• Owner contracts separately for design and construction services</li> <li>• Bid based on complete plans and specifications</li> <li>• Owner retains high level of control and risk</li> </ul>	<ul style="list-style-type: none"> <li>• Combines design and construction under a single contract</li> <li>• Two-phase selection process using qualifications in the first phase and price plus technical components in the second phase</li> <li>• Traditionally a lump sum contract</li> </ul>	<ul style="list-style-type: none"> <li>• Construction contract is negotiable</li> <li>• Selection criteria include qualifications, experience, strategic approach, and price elements</li> <li>• Owner contracts separately for design and construction services</li> <li>• Owner engages a construction manager to act as a construction advisor during preconstruction and general contractor during construction</li> </ul>
<b>Applicability</b>	<ul style="list-style-type: none"> <li>• Projects where the owner needs to completely define the scope</li> <li>• Project scope can be best defined using prescriptive specifications</li> <li>• Significant risks or third-party issues that can be best resolved or managed by the agency</li> </ul>	<ul style="list-style-type: none"> <li>• Projects that benefit from innovation in design or construction</li> <li>• Projects having a high sense of urgency that would benefit from an expedited project delivery</li> <li>• Well-defined project scope</li> <li>• Projects having manageable public controversy, third-party issues, or environmental issues</li> <li>• Performance specifications</li> </ul>	<ul style="list-style-type: none"> <li>• Projects where owner requires greater control of design</li> <li>• Projects with multiple phases and contracts</li> <li>• Go slow to go fast</li> <li>• Concept-level-only scope</li> <li>• Complete or obtainable environmental documents and permits for the entire project</li> <li>• Established project footprint</li> </ul>
<b>Advantages</b>	<ul style="list-style-type: none"> <li>• Applicable to a wide range of projects</li> <li>• Well established and easily understood</li> <li>• Owner retains design control</li> <li>• Provides the lowest initial price that is responsible,</li> </ul>	<ul style="list-style-type: none"> <li>• Streamlines and enhances coordination through a single point of responsibility for design and construction</li> <li>• May reduce design and</li> </ul>	<ul style="list-style-type: none"> <li>• Identifies and reduces/mitigates risk</li> <li>• Allows fast-tracking of early procurement items and construction phases prior to completed design</li> <li>• Transparent pricing</li> <li>• Owner issues addressed prior to price development, with cost</li> </ul>



	<p>competitive bidders can offer</p> <ul style="list-style-type: none"> <li>• No legal barriers in procurement and licensing</li> <li>• Well-established legal precedents</li> </ul>	<p>construction duration</p> <ul style="list-style-type: none"> <li>• Allows accelerated delivery by fast-tracking design and construction in phased packages</li> <li>• Earlier schedule and cost certainty</li> <li>• Can reduce owner risks</li> </ul>	<p>certainty earlier in the process</p> <ul style="list-style-type: none"> <li>• Can send project out to DBB if a fair price cannot be negotiated</li> <li>• Reduces errors, change orders, and material overruns</li> <li>• Minimizes/eliminates need for lengthy procurement</li> <li>• Owner retains control over design</li> <li>• Opportunity for shared savings provides an incentive for construction manager (CM) to control costs and work within funding limits</li> </ul>
<p><b>Risks/limitations</b></p>	<ul style="list-style-type: none"> <li>• Tends to yield base-level quality</li> <li>• Higher level of inspections/testing by the agency</li> <li>• Initial low bid might not result in ultimate lowest cost or final base value</li> <li>• Agency bears risk of design adequacy</li> </ul>	<ul style="list-style-type: none"> <li>• Allows for innovation, quality, and constructability review during design*</li> <li>• Improves constructability*</li> <li>• Potential to reduce opportunities for smaller construction firms</li> <li>• Less owner control over final design</li> <li>• Higher procurement costs and stipends for proposers</li> <li>• Traditional funding may not support fast-tracking construction or may require accelerated cash flow</li> <li>• Considerable time needed for RFP creation</li> </ul>	<ul style="list-style-type: none"> <li>• Potential appearance of unfairness in sole-source selection process</li> <li>• Potential for failure to agree on price and may require extra time to send project out for bid</li> <li>• Added CM fees during preconstruction</li> <li>• Fair market price, not lowest price</li> </ul>
<p><b>Procurement Methods</b></p>	<ul style="list-style-type: none"> <li>• Qualified low bid</li> <li>• A+B bidding</li> <li>• Alternate bids</li> <li>• Additive alternates</li> </ul>	<ul style="list-style-type: none"> <li>• Best value selection with price component</li> <li>• Qualified low bid</li> </ul>	<ul style="list-style-type: none"> <li>• Best value selection based solely on qualifications</li> </ul>





## 4. INTERVIEW SUMMARY

During the information collection efforts associated with this project, which included both interviews with agency representatives and a review of existing literature, the importance of letting the project drive the choice of delivery method was a common theme. A well-suited project delivery method is critical for projects that include complexities associated with, for example, traffic phasing or significant public relations needs. A CDOT representative noted that when CMGC is the method used, the contractor's qualifications that are necessitated by the project can be identified during the contractor selection process to ensure that the contractor has the requisite amount of relevant experience prior to the work beginning. This type of contractor preselection is not possible with traditional DBB projects and low bid procurement, though agencies are developing new methods to adapt to these needs via prequalified bidder identification efforts that would allow agencies to disqualify contractors that do not have the needed capabilities prior to bidding.

All of the agency representatives interviewed for this research project expressed that while they may not receive the lowest possible bid on a project that uses CMGC, they feel that they get a good value overall for the project. This is because of the savings due to the reduced number of change orders, increased innovation during the design process, a shift of risk from the agency to the contractor, and other factors. In other words, while the lowest bid may not always result from CMGC, the value added due to the collaboration between the contractor and the agency allows for other savings to be realized. When comparing the costs of different delivery methods for a project, it is important to identify where the cost of the project is being measured. If the cost of the project is measured on bid day, CMGC is typically costlier than traditional DBB. However, a UDOT representative noted during the interview that if the cost is measured at project close-out, the cost of CMGC is lower than or approximately equal to the cost of DBB. This close-out cost takes into account the savings due to the reduced number of change orders for CMGC compared to DBB delivery, which are associated with unforeseen conditions and utilities, right-of-way delays, and other risks.

Not all projects can or should be completed using alternative delivery methods, including ABC projects. Once particular ABC methods have been used by an agency and familiarity has been achieved, the benefits of alternative delivery methods begin to taper off unless other project complexities exist. Taking all variables into account during the project delivery selection process is therefore critical to achieving efficient and cost-effective project delivery.

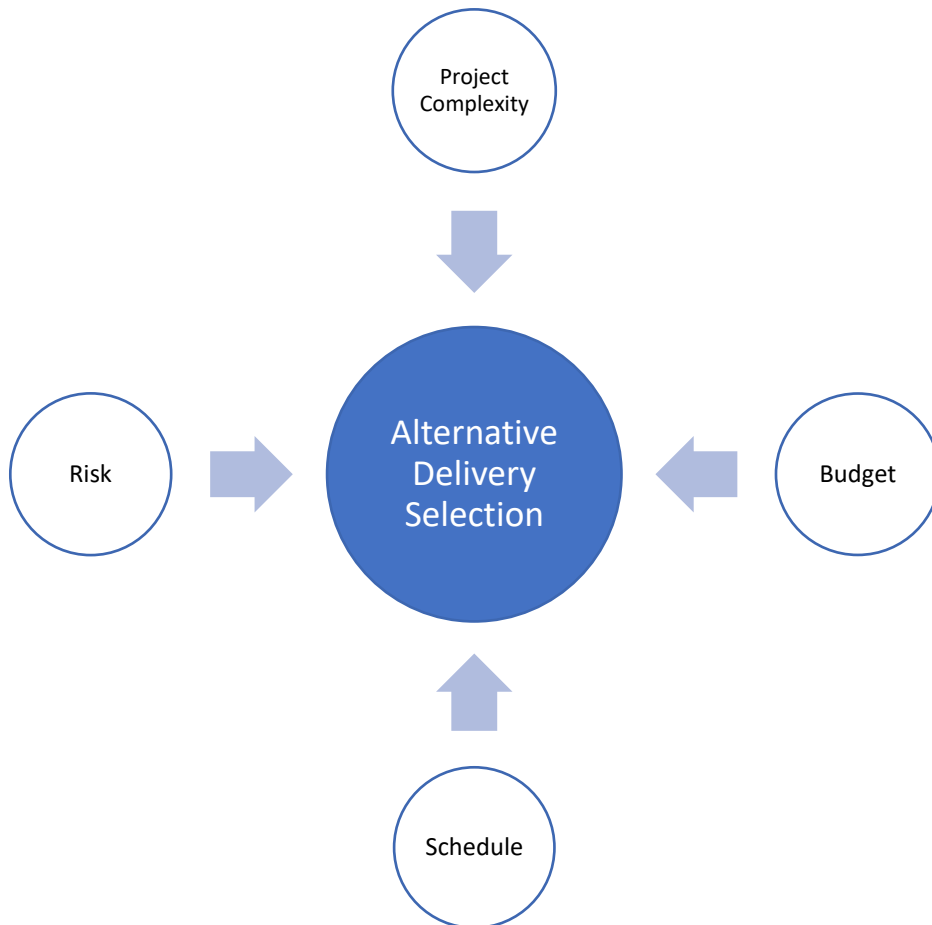
## 5. KEY TAKEAWAYS

Using ABC has many advantages, such as reducing the exposure of the public and construction workers to work zones, accelerating the construction process, and reducing environmental impacts. However, ABC might not be the best choice for every project because not all projects demand accelerated schedules and many can be completed using conventional construction practices. As such, several decision guidelines and processes have been developed to ensure that ABC is only used when warranted. Choosing to implement ABC techniques in a construction project is a critical decision that many states have specific matrices and processes to guide their decision.

Much like the decision to use ABC, the selection of project delivery method for a project is also well thought out by agencies. This decision is impacted by many project characteristics, including the following:



- **Project Complexity:** alternative delivery methods allow for multiple parties to address complex design components, and can allow for constructability to guide design considerations
- **Budget:** alternative delivery methods do not usually provide low-cost construction but often provide good value
- **Schedule:** if the design has not already been completed, alternative delivery methods offer accelerated project schedules as work can begin prior to design completion
- **Risk:** alternative delivery methods allow for allocated risk between parties, including the agency, designer and contractor





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