NUMBER 316

JULY–AUGUST 2018

# TR NEWS

## Transportation Project Delivery

*Alternative Contracting Methods Research*

The National Academies of
SCIENCES · ENGINEERING · MEDICINE
TRB
TRANSPORTATION RESEARCH BOARD

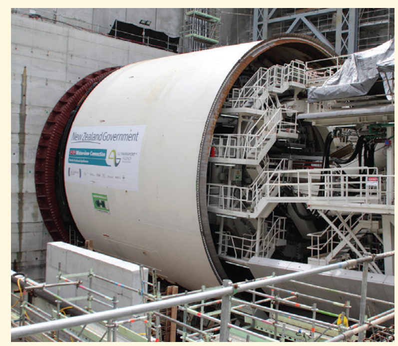
# TR NEWS

NUMBER 316 JULY–AUGUST 2018




3

18



31

**COVER:** The twin bridges of the 460 Connector project are the tallest in Virginia. The state transportation agency deployed alternative technical concepts such as design–build for better and more streamlined infrastructure renewal. (Photo: Trevor Wrayton, Virginia DOT)

# TR NEWS

features articles on innovative and timely research and development activities in all modes of transportation. Brief news items of interest to the transportation community are also included, along with profiles of transportation professionals, meeting announcements, summaries of new publications, and news of Transportation Research Board activities.



***TR News*** (ISSN 0738-6826) is issued bimonthly by the Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001. Internet address: www.TRB.org.

**Editorial Correspondence:** By mail to the Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, by telephone 202-334-2986, by fax 202-334-3495, or by e-mail lcamarda@nas.edu.

**Subscriptions:** North America: 1 year $75; single issue $19. Overseas: 1 year $100; single issue $19 plus shipping. Inquiries or communications concerning new subscriptions, subscription problems, or single-copy sales should be addressed to the Business Office at the address below, or telephone 202-334-3216, fax 202-334-2519. Periodicals postage paid at Washington, D.C.

**Postmaster:** Send changes of address to *TR News*, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001.



Graphic design: Michelle Wandres, Publishing Solutions



## ALSO IN THIS ISSUE:



## COMING NEXT ISSUE


PHOTO: JONATHAN UPCHURCH

A changeable message sign warns travelers on Utah's I-15 of impending traffic congestion from the total solar eclipse in August 21, 2017.

In the September–October issue of *TR News*, Canadian activity in connected and automated vehicles technology testing and development—including government and industry associations and research facilities and programs—is examined. Also explored are automated vehicles for transit—driverless metro, automated people movers, and personal rapid transit technologies—in various planning, construction, and operation stages in jurisdictions across the globe. Other articles offer a look at lessons learned from the traffic congestion related to the August 2017 solar eclipse, state department of transportation project selection case studies, finding the balance in freight mobility, and achieving rural health equity and well-being.

# Transportation Project Delivery

## *Alternative Contracting Methods Research*

MOUNIR EL ASMAR

*The author is Co-Director, National Center of Excellence on SMART Innovations, and Senior Sustainability Scientist, Global Institute of Sustainability, School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe.*

A score of D+ on the American Society of Civil Engineers' (ASCE's) *2017 Infrastructure Report Card* is not exactly stellar (*1*). Transportation infrastructure grades for the United States include a D for roads and aviation, a B for rail, a C+ for bridges and ports, and a D− for transit. A tremendous amount of work is needed from all stakeholders to renew the nation's transportation systems.

Tragic failures, like the I-35W bridge collapse in Minnesota in 2007 (*2*), underscore the need to renew transportation infrastructure; this momentous objective will require technological solutions, workforce solutions, procurement solutions, and more. Alternative contracting methods (ACMs)—also referred to as alternative delivery methods or alternative project delivery methods—is an area that has experienced continuous innovation since the 1990s.

A contracting method defines the roles, responsibilities, and timing of the engagement of project stakeholders—including owners, design engineers, and constructors—working together to design and build a facility. The traditional design–bid–build contracting method offers limited opportunities for collaboration between project stakeholders. Such ACMs as design–build (DB) and construction manager–general contractor (CM/GC) evolved over past decades to allow more collaboration and innovation in designing and building a facility.

ACMs rely heavily on early contractor engagement to inform design. In 1990, the Federal Highway Administration (FHWA) established Special Experimental Project 14 (SEP-14): Innovative Contracting to encourage and enable state transportation agencies to test and evaluate these methods on an experimental basis (*3*). With the success of SEP-14 pilot projects, the methods were no longer deemed experimental; in 2012, the next transportation authorization bill strongly promoted the use of "innovative contracting methods, including the design–build and the construction manager–general contractor contracting methods" (*4*).

Research funded by many organizations—including TRB's Cooperative Research Programs, the U.S. Department of Transportation, FHWA, the Charles Pankow Foundation, the Design–Build Institute of America, and several state and local transportation agencies—played a considerable role in the national rise of ACMs. This research was supported strongly

Photo: Kevin Rofidal, U.S. Coast Guard

The collapse of the I-35W Mississippi River Bridge in Minnesota magnified the critical need for infrastructure improvements.

by government, industry, and academic stakeholders over the past two decades, resulting in the discovery of new knowledge and its widespread implementation, and is gaining national visibility, with many organizations benefiting from various types of delivery methods. Projects and research findings are featured regularly in diverse venues, conferences, and publications by such organizations as ASCE, TRB, the American Bar Association, and others.

Among the local and national committees dedicated to ACM is TRB's Standing Committee on Project Delivery Methods, which is supporting this special issue of *TR News*. This issue will highlight ACM innovations and case studies taking place across the country and internationally, covering the most prominent ACM methods through the eyes of practitioners and researchers.

## Performance, Performance, Performance

ACM performance research results have been overwhelmingly positive, with many distinguished researchers contributing to this literature from the United States and abroad. Ample empirical performance data support ACMs as effective methods; a team from Arizona State University (ASU) recently conducted a meta-analysis to combine and compare the quantitative results of 30 project delivery performance studies over the past two decades and collectively analyzed data from thousands of projects (*5*). This technique presents a significant aggregate sample to even out the effects of different research methods and project samples, producing more representative results and further confidence in the published performance studies.

The results show that some ACMs—particularly DB—are more effective at controlling cost and schedule growth than the traditional design–bid–build method. Interestingly, no delivery system was significantly superior in terms of unit cost, but the data showed that, on average, ACM projects were delivered 35 percent faster. A recent FHWA Tech Brief shows even better performance of ACMs on

Photo: Washington State DOT

During a project to widen Washington State's Snoqualmie Pass, the design–bid–build contractor proposed an alternative design, called a value engineering change proposal, to replace the avalanche snowshed structure with two elevated bridges. Washington State DOT approved this as an "equal or better" alternative, which reduced operations costs.

federally funded highways (*6*).

It is worth noting, however, that these reported values are based on averages. Some agencies did not have the same experiences with ACM, especially when trying a new project delivery method for the first time. Some pitfalls include not working closely with industry partners on these new methods or not training or preparing internal agency staff for the new processes. These and other lessons learned point to prospective research areas to ensure ACMs are used to their full potential.

## Record of Growth

Many project successes have fueled ACMs' growth in popularity. In fact, revenue growth of ACM firms has increased significantly on a yearly basis for the past decade, according to *Engineering News Record*'s (ENR's) annual "Top 100 Construction Project Delivery Firms" list as well as a recent study that statistically analyzed published ENR data over the past decade (*7–8*).

Some of the latest research investigates whether ACMs can affect the quality and performance of a facility itself over its life cycle. Designing and building a highway faster is significant, but it would be even more powerful if the pavement itself were to show improved performance and require less maintenance—saving more cost, time, fuel, and materials over its life. To that end, the ASU team investigated the effect of delivery systems on the operational performance of highways built in the past 10 years (*9*). Early findings show a significant improvement in pavement life-cycle performance for DB projects.

Recently, research investigating the efficacy of ACM for transportation projects has included public–private partnerships (PPP) in the mix. A system that allows public agencies to attract private financing to fund the capital needs of a project, with repayment over the life of the facility, PPPs were shown to provide superior project cost and schedule performance—even compared to other ACMs (*10*).

This specific result is in line with literature about ACMs and was expected, given the increase in team integration inherent in PPPs. What was surprising, however, was the extent of funding invested in PPPs. Recent findings disclosed a one-to-one ratio of public and private funds used in some types of PPP transportation projects (*11*). This means that leveraging private funds using PPP can nearly double the amount of infrastructure delivered.

## Delivering a Brighter Future

Many ACM research studies focus on specific methods and their variations, performance, and implementation. These ongoing studies are charting new territory, providing the evidence for practitioners to make the case for effective employment of ACMs on their projects. One example is National Cooperative Highway Research Program Project 08-104, which is developing new FHWA guidebooks for ACM post-award contract administration (*12*).

Proponents of ACM have been changing national and state legislation to allow ACMs on a greater number of public projects. The transportation industry is well aware of labor shortages and needs at all levels and so is helping to expose students to ACMs through national competitions and ACM student chapters. Students also are assisting faculty members with ACM research and are offered new ACM courses at universities and by professional organizations. Certifications have emerged as a training and education tool to ensure that experienced ACM professionals are recognized and can pursue education to stay current in the field.

With the current administration's support of a

Photo: Thomas Hawk, Flickr

The replacement of the Willamette River Bridge was Oregon DOT's first CM/GC venture. The project was completed four months early and $18 million under budget.


Photo: NAParrish, Flickr

On average, ACM projects are delivered faster than traditional methods. Alaska's Whittier Tunnel, a 2.5-mile, one-lane tunnel that serves both cars and trains, was a DB project. It was completed two months ahead of schedule and $2.6 million under budget.

Utah's Pioneer Crossing bridge project was a DB venture that used accelerated bridge construction techniques, reducing onsite construction by four months.

PHOTO: UTAH DOT

potential infrastructure package and the possibility of broader PPP use in delivering infrastructure projects, ACMs offer proven alternatives to enhance and optimize prospective investments. The economic impact of improved infrastructure for industry and business is crucial in a competitive global market.

ACM research helped fuel innovative practices for delivering infrastructure faster and with improved cost certainty—resulting in facilities that can last longer—and helped to identify new funding resources. This line of research strengthens transportation infrastructure with novel integrated and efficient methods to deliver projects. Together with technological, labor, and other solutions, ACMs will continue to support the renewal of the nation's transportation infrastructure. The timing for successful implementation of ACM could not be any better.

## References


1. American Society of Civil Engineers. ASCE's 2017 Infrastructure Report Card. www.infrastructurereportcard.org. Accessed Feb. 7, 2018.
2. Minnesota Department of Transportation. I-35W St. Anthony Falls Bridge: Mississippi River Crossing in Downtown Minneapolis. www.dot.state.mn.us/i35wbridge/collapse.html. Accessed Feb. 7, 2018.
3. Federal Highway Administration. Special Experimental Project No. 14: Alternative Contracting (Formerly Innovative Contracting). www.fhwa.dot.gov/programadmin/contracts/sep_a.cfm. Accessed Feb. 7, 2018.
4. Moving Ahead for Progress in the 21st Century Act of 2012, Pub. L. No. 112-141, 126 Stat. 405 (2012).
5. Sullivan, J., M. El Asmar, J. Chalhoub, and H. Obeid. Two Decades of Performance Comparisons for Design–Build, Construction-Manager-at-Risk, and Design–Bid–Build: Quantitative Analysis of the State of Knowledge on Project Cost, Schedule, and Quality. *Journal of Construction Engineering and Management*, Vol. 143, No. 6, 2017.
6. *Alternative Contracting Method Performance in U.S. Highway Construction*. Report FHWA-HRT-17-100. FHWA, U.S. Department of Transportation, 2018.
7. *Engineering News Record*. Engineering News Record Top Lists. www.enr.com/toplists. Accessed Feb. 7, 2018.
8. Vashani, H., J. Sullivan, and M. El Asmar. DB 2020: Analyzing and Forecasting Design–Build Market Trends. *Journal of Construction Engineering and Management*, Vol. 142, No. 6, 2016, pp. 04016008-1–04016008-12.
9. Sanboskani, H., N. Cho, M. El Asmar, and S. Underwood. Evaluating the Ride Quality of Asphalt Concrete Pavements Delivered Using Design–Build. In *Construction Research Congress 2018: Infrastructure and Facility Management* (C. Wang, C. Harper, Y. Lee, R. Harris, and C. Berryman, eds.), American Society of Civil Engineers, 2018, pp. 424–433.
10. Ramsey, D. W., and M. El Asmar. Cost and Schedule Performance Benchmarks of U.S. Transportation Public–Private Partnership (PPP) Projects: Preliminary Results. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2504, 2015, pp. 58–65.
11. Ramsey, D. W., and M. El Asmar. Funding Streams of Design–Build–Finance–Operate-Maintain (DBFOM) Public–Private Partnerships (PPP) in the U.S. Transportation Sector. Presented at Engineering Project Organization Conference, Edinburgh, Scotland, 2015.
12. National Cooperative Highway Research Program. A Guidebook for Post-Award Contract Administration for Highway Projects Delivered Using Alternative Contracting Methods. http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4032. Accessed Feb. 7, 2018.



NOTE: The *TR News* Editorial Board thanks Mounir El Asmar, Nelson Gibson, and the TRB Standing Committee on Project Delivery Methods for their work in assembling and developing this issue.


PHOTO: D. ALLEN COVEY, VIRGINIA DOT

# Risk Sharing and Transfer Using Alternative Project Delivery Methods and Contracting

NANCY C. SMITH AND STEPHANIE W. KAM

*Smith is Partner and Kam is Associate at Nossaman LLP, Los Angeles, California.*

Construction of the Southgate Connector in southwestern Virginia. By adopting alternative contract and delivery methods, states can mitigate or transfer risks.

Many transportation agencies seek ways to reduce the costs of developing, operating, and maintaining facilities and to obtain greater certainty regarding future costs. Techniques to avoid and manage risk are important tools in achieving this goal. One such technique is alternative contracting to manage and transfer risk. Recommended by a 2009 report issued by the National Surface Transportation Infrastructure Financing Commission, alternative contracting increasingly is embraced by the transportation industry (*1*).

## Project Risk Management

The 2012 Moving Ahead for Progress in the 21st Century Act required each state department of transportation (DOT) to implement a risk-based management plan by 2015 to preserve the condition of their assets and to improve the performance of the National Highway System. The legislation was enacted largely in response to growing budget constraints, project complexity, and stakeholder involvement. Furthermore, transportation agencies' approaches to risk management were less sophisticated than those adopted by the private sector in banking, insurance, information technology, and other industries.

National Cooperative Highway Research Program Project 20-24, Executive Strategies for Risk Management by State Departments of Transportation, found that most state DOTs already practice project delivery risk management (*2*). Risk management helps avoid surprises and provides a foundation supporting better planning, performance, cost control, stakeholder relationships, and safety and environmental outcomes.

It is particularly important for an agency to assess project risks when it is planning to use an alterna-

Photo: Washington State DOT

Barges reinforce the trusses as part a project to expand and strengthen the George Sellar Bridge in Washington State. The traditional, design-bid-build project came in under budget, but it took extra working days because of unusual site and field conditions that were accommodated within the contract.

Winona Bridge, Minnesota's first construction manager–general contractor (CM/GC) project. CM/GC offers faster design and construction time, more cost control, and higher quality than traditional delivery methods.

tive delivery method that deviates from its standard practices. A risk workshop can be a useful tool for examining significant risks and considering how best to allocate them in the contract documents. As a rule, risks should be shared by the parties or assigned on a case-by-case basis to the party that can best control them (3). Additionally, contractual risk-allocation provisions provide incentives for both parties to manage the consequences of risks and to minimize damages.

## Project Delivery Methods and Associated Risks

Choosing an overall project delivery and contracting strategy is one of the most important decisions made by any transportation project owner. Several different delivery methodologies follow, along with an examination of how certain risks are addressed in each of them.

Photo: Doug Wallick, Flickr

### *Design–Bid–Build*

The traditional project delivery method in the United States involves three sequential phases: design, procurement, and construction. Under this linear approach, the owner solicits a construction contractor to build the project after design completion, with the contract awarded to the lowest bidder. Despite—or perhaps because of—the price competition, the final cost of design–bid–build (DBB) contracts can be significantly higher than the bid amount. Such contracts often rely on unit pricing, with the owner bearing the risk (and reward) if actual quantities differ from the estimates that formed the basis for the bids. The owner also bears a significant risk of cost overruns and project delays associated with design defects.

### *Construction Manager–General Contractor*

Construction manager–general contractor (CM/GC) projects allow owners to reduce the risk of cost overruns and project delays and transfer certain risks to the contractor. Since the contract is awarded while design is still ongoing, the contractor has the opportunity to comment on the design, thus reducing the likelihood of design flaws affecting construction. The contractor may also perform specified preconstruction work to further mitigate project risks. Once the design reaches an appropriate level, the parties finalize the schedule and price for construction work, usually involving either a fixed or a guaranteed maximum price (GMP). If a GMP is used, the contractor bears some of the risk of excess quantities, providing an incentive to minimize cost growth.

### *Design–Build*

Design–build (DB) contracts combine design services and construction work under one contract. The design–builder accepts responsibility for design errors and incomplete design, as well as other risks specified in the contract. Depending on state licensing laws and other factors, the design–builder can be a joint venture between a contractor and designer, a contractor with a design subcontractor, a designer with a construction subcontractor, or a single firm that performs both design and construction functions. DB facilitates synergies between the designer and constructor; combined with the design–builder's ability to start construction while the design process is still under way, DB often results in significant schedule acceleration.

These same factors also can generate significant cost savings for some projects, compared to DBB. DB contracts often include risk-sharing provisions that encourage the parties to work together to resolve issues affecting the project. Some contracts use a band, or tiered, approach, with the contractor responsible for 100% of certain risk or risks, up to a specified dollar amount or set time (lower band). Above that (middle band), the parties share the risk or risks, and the owner is responsible for the risk or risks that exceed the limits of the middle band (upper band). The opposite scenario is possible as well, with the owner having responsibility for certain risk or risks in the lower band, and the contractor in the upper band.

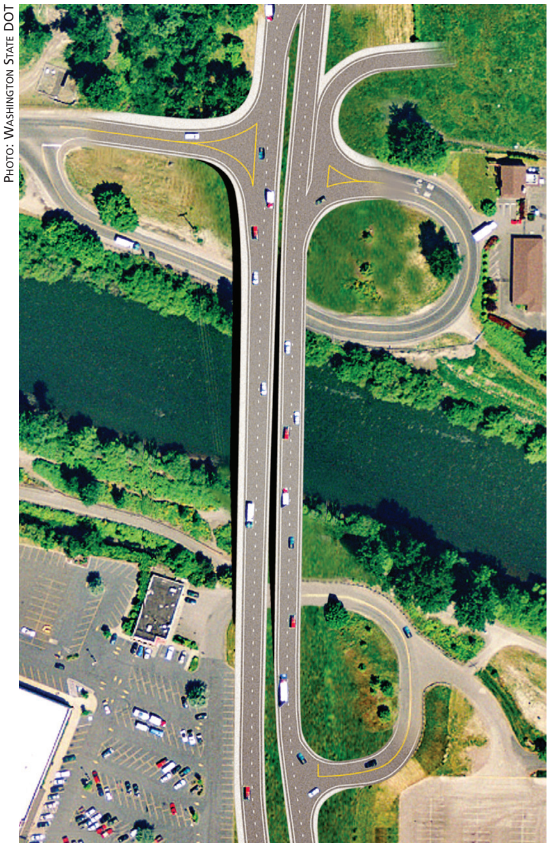
***Design–Build–Finance–Operate–Maintain***

One dilemma faced by project owners is how to balance project construction costs against future costs of operation and maintenance. In DBB and CM/GC, this is addressed through the owner's management of the design as well as through quality assurance during construction. For DB projects, the owner typically reviews the design and remains involved in quality assurance, but then focuses on developing specifications that incentivize the DB contractor to factor operations costs into its decisions.

Although public–private partnerships come in many forms, the most typical approach involves all design–build–finance–operate–maintain (DBFOM) components, with contractor compensation based on predetermined payments or user fees (*4*). In the DBFOM model, operations and maintenance typically are delegated to the contractor over an extended time period (e.g., 20 to 30 years). The contractor also is responsible for project financing, which typically includes borrowing funds, investing equity in the transaction, or both, relying primarily on the project's cash flow for repayment. For projects that include the right to collect toll or other revenues from the project, the contractor may leverage revenue streams to obtain up-front financing; for other projects, such financing may be supported by performance-based availability payments from the public agency sponsor. At the end of the concession term, the facility is returned to the public sponsor.

In DBFOM projects, transferring risk and responsibility for operations, maintenance, and financing to the contractor creates incentives for developing optimal and innovative solutions and factoring life-cycle cost considerations into the decision-making process. Similar to DB, DBFOM contracts typically include risk-sharing provisions to encourage cooperation between the parties. According to a recent study, more than 80 percent of large-scale North American DBFOM highway projects—that is, projects costing more than $90 million—have had no cost or schedule increase from the contract requirements (*5*). Cost control may be attributable to financial incentives, such as life-cycle cost savings, and liability for the financing encourages the contractor to complete the project in accordance with applicable requirements in a timely fashion.

Photo: Washington State DOT



Washington State DOT rendering for the new Puyallup River Bridge. The agency turned to DB when it realized an opportunity to gain efficiencies through contractor innovation and expertise to reduce public impacts during construction, including improvements to staging, reduction of closures, and more.

## Risk Allocation in Project Contracts

Although many owners are interested in shifting as much risk as possible to the contractor, they should be aware that risk transfer results in higher pricing. To avoid having the owner pay for the same contingency twice—once upfront and, later on, through a

Photo: Pietro, Wikimedia

Port of Miami projects, including the construction of a tunnel, were completed using a DBFOM delivery method that gave the concessionaire a 35-year contract to operate and maintain the facilities.


PHOTO: VIRGINIA DOT

Powhite Parkway in Virginia. In a DBFOM contract, contract-holders can collect tolls or other methods of revenue until the end of the concession term.

# Alternative Contracting Methods Leverage Construction Dollars

## *FHWA Perspective*

**R. DAVID UNKEFER**

*The author is Construction and Project Management Engineer, Federal Highway Administration, Atlanta, Georgia.*

The Federal Highway Administration (FHWA) has promoted alternative contracting methods (ACMs) for many years because of the significant improvements these methods bring to project delivery. ACMs have generated substantial value in safety, cost, and time benefits—and these are being collated at FHWA's Turner–Fairbank Highway Research Center as part of its Quantification of Cost, Benefits, and Risk Associated with Alternate Contracting Methods and Accelerated Performance Specifications research project.[1]

FHWA's Special Experimental Project 14 (SEP-14) for alternative contracting was created to allow state departments of transportation (DOTs) to evaluate nontraditional and competitive techniques in search of more effective delivery methods.[2] SEP-14 supported the incubation and eventual FHWA approval of powerful contracting tools, including

- Price plus time bidding,
- Alternate pavement–type bidding,
- Design–build (DB),
- Construction manager–general contractor (CM/GC) project delivery methods, and
- Alternative technical concepts (ATCs) on DB projects.

State DOT partners continue to evaluate additional promising ACMs: ATCs for design–bid–build (DBB) projects; indefinite delivery–indefinite quantity, including job-order contracting; and fixed budget–variable scope contracting.

With Every Day Counts, FHWA's "innovation deployment" partnership with the states, the agency encouraged a more-widespread use of such ACMs as DB, CM/GC, and ATCs—under the right circumstances—because of the proven results realized by state DOTs, local and tribal agencies, and contractors. FHWA also created a library of national ACM resources to facilitate sharing of good practices and lessons learned.[3] Included in the resource library are

PHOTO: GEORGIA DOT

[1] www.fhwa.dot.gov/publications/research/infrastructure/17100/index.cfm

[2] www.fhwa.dot.gov/programadmin/contracts/sep14list.cfm?sort=state

[3] www.fhwa.dot.gov/construction/contracts/acm

claim—it is critical to draft contractual risk allocation provisions carefully and to be aware of potential legal arguments affecting enforceability. The owner should consider the underlying reasons for using a particular methodology and ensure that the contract as a whole promotes those goals.

Public agencies that use alternative delivery methods typically develop their own contract forms instead of relying on industry forms, to deal properly with the myriad rules that apply to the agency's contracts. Some agencies deal with differences between delivery methodologies by using special provisions to modify their standard contract specifications. This reduces the cost of document production but makes the overall contract more difficult to understand and may lead to ambiguities.

As discussed in Smith and Papernik (6), to increase the probability that risk allocation provisions will be enforceable, project owners should consider applying contract drafting rule, including:

◆ If a provision is intended to be mandatory, do not use words such as "should" or "may." The word "must" is generally recommended to avoid ambiguity, although "shall" still is used in many contracts to mean "must" (7).

◆ To the extent possible, use performance specifications instead of prescriptive specifications and allow preapproved alternative technical concepts to be included in proposals.

links to examples for enabling legislation, requests for proposals and contracts, manuals and process guidance, quality assurance and contract administration methods, as well as actual case studies—these help states enhance their ACM deployment.

Key lesson learned: ACMs must be used in the appropriate situation and selected wisely.[4]

## Case Studies

Three ACM success stories are worth highlighting. More case studies are available from FHWA.

◆ **Design–Build ATCs**. At the program level, California DOT (Caltrans) has reported a 50-to-1 return on investment for its DB ATCs, with an overall savings of $164 million for eight projects. The DB program has been so successful that the state's legislators and leadership have given permission for 10 additional projects. Furthermore, Caltrans' first program of six CM/GC projects has gone so well that the agency is planning 16 more.

◆ **Design–Bid–Build ATCs**. Because of Every Day Counts, Michigan DOT decided to use ATCs for traffic control and phasing for a DBB project. This approach resulted in the project's completion nearly a year ahead of the date specified in the original contract. In addition to the benefits in safety, cost, and time, early completion of projects reduces the delays caused by work zones, which brings significant intangible benefits to the DOT in terms of public credibility.

◆ **Construction Manager–General Contractor**. The Pueblo of Acoma Tribe in New Mexico delivered a 7-to-10 year capital program in less than 10 months by utilizing CM/GC—resulting in a savings of more than $1.15 million. This was the first programmatic use of CM/GC in the nation to bundle contracting for several projects and included unique work such as bridge replacements, road stabilization, maintenance crew training, parking lot design and construction, Federal Emergency Management Agency work, and road rehabilitation and paving.

[4] www.colorado.edu/tcm/projects/alternate-contracting-methods

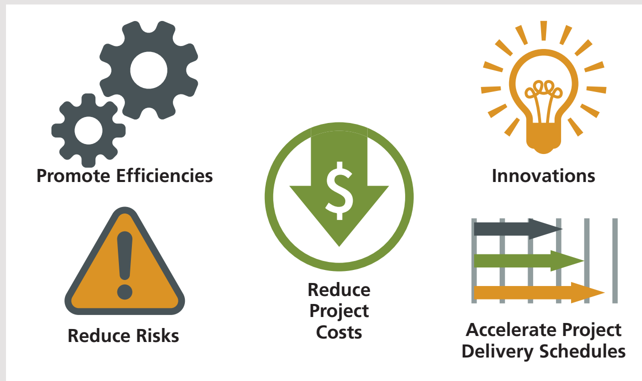



Image: Georgia DOT

**Benefits of ATC.**

ACMs are revolutionizing how FHWA is partnering with industry to deliver more value for highway dollars. Many enhancements come from integrating design and construction so that consultants and contractors can contribute creative ideas early and help generate a more competitive environment. This proven success has prompted FHWA, the National Cooperative Highway Research Program, and others to sponsor ongoing studies and to develop guidance for leveraging the benefits of ACMs, ATCs, project–bridge bundling, and risk management. Some of these guidance documents are available and others will be published soon.[3]

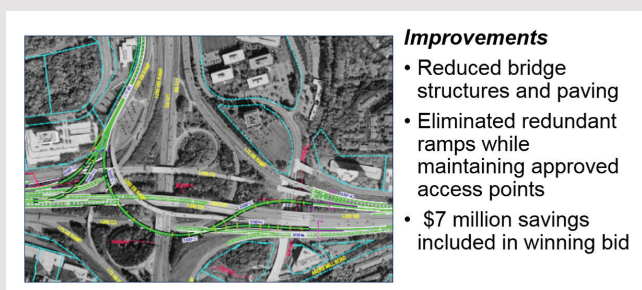



Image: Georgia DOT

**Northwest Corridor ATC benefits in Georgia.**

Ohio DOT used DBFOM to renovate the Brent Spence Bridge in Cincinnati. The bridge corridor had been deemed functionally obsolete, and adequate funds were not available to replace or refurbish it.


Photo: PunkToad, Flickr

◆ For cases in which the contract is based on the owner's preliminary design, include clear statements in the procurement documents specifying that the contractor is ultimately responsible for meeting contract requirements and cannot rely on the owner's preliminary design to satisfy such requirements (*8*).

◆ Allow sufficient time for the proposer to perform investigations before the proposal due date. Pay a stipend if the proposal requires significant effort by the proposer.

## Conclusion

Alternative project delivery and contracting requires thorough risk identification and assessment, along with careful contract drafting. Although the transfer of risks to the contractor means that the contract price will include contingencies associated with those risks, the cost associated with such contingencies may be offset by other factors, such as the contractor's ability to incorporate creative solutions into the design and construction process, as well as price certainty and schedule acceleration associated with alternative delivery.

The reconstruction of I-15 was Utah DOT's first DB project—and its largest to date.


Photo: Garrett, Flickr

## References


1. Atkinson, R. D., et al. *Paying Our Way: A New Framework for Transportation Finance*. National Surface Transportation Infrastructure Financing Commission, 2009.
2. D'Ignazio, J. *Executive Strategies for Risk Management by State Departments of Transportation: Final Report for NCHRP Project 20-24(74)*, 2011.
3. Anderson, S., K. Molenaar, and C. Schexnayder. *NCHRP Report 658: Guidebook on Risk Analysis Tools and Management Practice to Control Transportation Project Costs*, 2010.
4. National Council for Public–Private Partnerships. Types of Partnerships. www.ncppp.org/ppp-basics/types-of-partnerships. 2018.
5. Chasey, A., W. Maddex, and A. Bansal. Comparison of Public–Private Partnerships and Traditional Procurement Methods in North American Highway Construction. *Transportation Research Record: Journal of the Transportation Research Board, No. 2268*, 2012, pp. 26–32.
6. Smith, N. C., and B. G. Papernik. Lessons Learned: What Owners Should (and Shouldn't) Do to Transfer Design Risk to Design–Builders. *Design–Build Dateline*, 2005, pp. 44–47.
7. Garner, B. A. Shall We Abandon Shall? *ABA Journal*, 2012.
8. Loulakis, M. C., N. C. Smith, D. L. Brady, R. E. Rayl, and D. D. Gransberg. *NCHRP Legal Research Digest 68: Liability of Design–Builders for Design, Construction, and Acquisition Claims*, 2015.

Photo: Mrouse, Wikimedia

# Innovation via Early Contractor Involvement

## *Missouri DOT Experience with ATCs*

GHADA M. GAD AND KEVIN MCLAIN

*Gad is Assistant Professor, Civil Engineering Department, California State Polytechnic University, Pomona, and McLain is Geotechnical Director, Missouri Department of Transportation, Jefferson City.*

The New Mississippi River Bridge in Missouri, renamed the Stan Musial Veterans Memorial Bridge in 2013.

The Federal Highway Administration's (FHWA's) Every Day Counts program objective, as stated by former Administrator Victor Mendez, is to identify and implement innovation "aimed at shortening project delivery, enhancing the safety of our roadways, and protecting the environment. … [I]t's imperative we pursue better, faster, and smarter ways of doing business" (*1*).

Proven to yield innovative solutions for thorny design and construction problems on a wide range of projects, alternative technical concepts (ATCs) in procurement are considered a smarter way of doing business, integrating the collective expertise and creativity of various stakeholders. According to Forgues and Koskela, "there is an emerging view in the construction industry that better performance or better value for money can be achieved by integrating teamwork for planning, design, and construction of projects" (*2*).

An integrated construction project includes the contractor early in the design phase to provide input into the design process. The designs of some alternative contracting methods (ACMs) are based primarily on an integrated approach like design–build (DB) or construction manager–general contractor (CM/GC). By definition, traditional design–bid–build (DBB) contracts are not integrated; however, the introduction and use of ATCs in DBB prove that early contractor involvement is technically possible in all forms of project delivery (*3*).

(Photo: Mitchell Schultheis, Wikimedia)

Data show that ATC projects reduce cost, shorten schedules, and result in better constructability.

## Why ATCs?

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 or request for proposal document" (*4*). Research on ATCs shows that they accrue sizable benefits such as cost savings, better constructability, and schedule reduction (*5–6*).

ATCs capitalize on contractor innovation and minimize the risk of costly change orders by allowing contractors to change project designs to their preferred means and methods. It also promotes best-value solutions by providing an equal or better product during procurement and allowing owners to receive the full value of savings rather than a 50 percent share through value engineering change proposals.

ATC submittals by other contractors also increase competition, resulting in more bids. Some states ensure in their contract language that the alternative systems developed could also be implemented in other projects in the future, which makes the benefits of an innovative design widely applicable (*4*).

## Challenges and Lessons Learned

Although ATC implementation has many advantages and benefits, its legal and contractual issues are quite diverse and create challenges for both the procuring agency and the bidders. According to Gransberg et al., these challenges can be summarized into four major areas: first, contractors need to make sure the confidentiality of their ATCs is maintained and that their competitors do not gain the benefits of their idea. An agency needs to reinforce the principles behind confidentiality and the various federal, state, and local agency record disclosure requirements that might have implications on ATC confidentiality (*3*).

Second, ownership rights associated with ATCs are important in protecting the bidders' commercial investment, especially if the bidders are not awarded the project. This might be handled by agencies offering a stipend to the unsuccessful bidder to compensate them for the ATC's development. Through a stipend agreement, the agency is granted full ownership rights to all information submitted in their ATC proposal, thus avoiding any ambiguity on who owns the rights to the ATC (*3, 7*). Third, to avoid the risk of protests, adequate procurement guidelines

The Missouri and Kansas Departments of Transportation contracted with the American Bridge Company for a DB replacement of the Fairfax Bridge.


Photo: Missouri DOT

In replacing the Hurricane Deck Bridge over the Lake of the Ozarks, Missouri DOT benefited from ATC in its traditional DBB approach.

must be followed that consider nontraditional ATC process as well as nonprice selection factors to select the bidder (*3*).

Finally, the designer of record bears the responsibility for any design defects. Depending on the project delivery, the agency might assume the risk of designing the ATC in a DBB and CM/GC case but not in a DB case. Theories of mutual mistakes may result in risk being shared by both parties in a DB setting, however—especially when the ATC is so significant that it is unfair to require the design–builder to perform the original design based on its commercial terms (*3*). Therefore, it is important that the contractual issues associated with ATCs be addressed clearly in the procurement documents.

## Case Study Project Outcomes

The Missouri Department of Transportation (DOT) has been on the leading edge of ATC implementation. Missouri DOT proved that obtaining early contractor involvement to achieve integrated project delivery is possible on all types of ACM projects. In the words of one contractor, "We elected to pursue an ATC because we felt we could derive a solution that would be more economical for us to build than the baseline design" (*8*).

### *Hurricane Deck Bridge Project*

The Hurricane Deck Bridge carried Route 5 over a portion of the Lake of the Ozarks in Camden County, in a region of Missouri called Hurricane Deck. A DBB project, the 2,200-ft, two-lane bridge is located in a tourist area of Missouri. The shortest alternate route that does not include this bridge is 42 miles, so the agency endeavored to minimize traffic impacts.

The project went to bid in December 2011. The baseline design included building temporary piers adjacent to the current bridge, constructing the new bridge on these piers, removing the superstructure, repairing the current bridge piers, then sliding the new bridge onto the repaired piers.

Missouri DOT's motivation for deploying ATCs can be seen in an agency slogan: "BOLD Approach = Industry + Missouri DOT = One Team = Best Value" (*9*). Decision-makers believed that creating opportunities for innovative ideas would offer economical solutions and save the state money. Unlike a DB ATC, DBB also allows Missouri DOT to retain design ownership, making it more encouraging for smaller contractors (*8*). During the preaward process, Missouri DOT received substantial input from three of the five bidders. One bidder proposed a change to the baseline design and the other two proposed entirely new designs.

Missouri DOT ensured that the environmental document referenced the ATC process and maintained open communication with both contractors and the environmental office, disclosing potential designs that could lead to a redo of the National Environmental Policy Act document. The process

PHOTO: KBH3RD, WIKIMEDIA

Construction of the New Mississippi River Bridge. Bidding contractors were prequalified based on past work and proposal requirements.

resulted in a low bid that included an approved ATC to build the entire structure on a new alignment. The new design eliminated a seven-day road closure and required less than half the amount of fabricated structural steel than the base design. The engineering estimate for the project was $40.4 million and the contract award was $32.3 million—$8.0 million under the engineer's estimate for the baseline design. The two bidders that did not propose ATCs were approximately $10 million over the low bidder (*10*).

Ensuring confidentiality for the contractors was key during the preaward phase. The details of the final proposed improvement and right-of-way negotiations were not available to communicate with the public until after the project went to bid. Although the ATC process potentially could increase the overall project design cost with multiple suitable alternatives requiring additional design expense, this increase is mitigated by Missouri DOT's ability to use any approved ATC design concept on future projects, allowing captured innovations and efficiencies to be implemented in any applicable projects—even if the ATC proposal is not bid or is not included with the low bid (*11–12*).

### *New Mississippi River Bridge Project*

The project to build a four-lane, long-span, cable-stayed bridge across the Mississippi River also is a DBB project. The New Mississippi River Bridge includes a new North I-70 interchange roadway connection between the existing I-70 and the new bridge. The 1,500-ft main span is the third-longest cable-stayed span in the United States.

Missouri DOT modified its typical process, prequalifying contractors to bid with ATCs based on their past performance of work and including a set of defined limitations—for example, the ATCs proposed should net a savings of $100,000 and all aspects of the approved Access Justification Report must be adhered to (*3*).

To clarify any ambiguity surrounding contractor liability for ATC designs, Missouri DOT chose to complete the designs for the approved ATCs in house. This entailed a two-stage process with bidders submitting a conceptual ATC for merit, which, if approved, would be followed by a formal ATC proposal.

The formal ATC then would be fully developed by Missouri DOT designers so that bid quantities are determined and the ATC could be included in the contractors' final bids. Missouri DOT approved confidential ATC submittals of four contractors; these ATCs were fully designed and their quantities were determined prior to bid (*10*). The major ATC of the winning bidder was a change to the main span foundation that ultimately reduced the total number of shafts with different diameters and soil–structure interaction. Thus, even though the winning bidder's ATC accrued an additional redesign cost of $73,000, the ATC generated $7.5 million in savings (*3*).

## Conclusion

Public agencies have been working with their industry partners to develop transparent and fair ATC procedures that treat all proposers fairly and provide management with cheaper, faster projects. The feedback and collaboration that Missouri DOT received from industry partners indicates that early involvement of contractors during the preaward phase leads to the best value for the public. Additionally, the integration of the contractors' experiences and opening the process to accommodate innovation has resulted in better competition and lower bids (*11*).

Missouri DOT has demonstrated that the benefits outweigh the costs by using and refining DBB ATCs over the past 5 years. Most projects that have used ATCs have seen a good return on investment—even after consideration of staff time and redesign costs—either as initial savings or life-cycle cost benefits.

According to Missouri DOT, the most important lesson from this process is to make sure leadership is on board, which ultimately is reinforced by the cost savings accrued and the innovations resulting from the contractor's involvement. ATCs also provide protection in low-bid DBB settings by demonstrating that alternate designs can be an equal or better solution. Project teams should learn to handle ATCs with an open mind and should let contractors know that they sincerely want their input. Although ATC implementation is expanding nationwide, it should be treated as an evolving process in every project and should be customized to every project need (*13*).

## Acknowledgments

Special thanks to Randy Hitt, Missouri DOT Construction and Materials Liaison Engineer, and Natalie Roark, Missouri DOT Assistant Central District Engineer, for providing information on the New Mississippi River and Hurricane Deck Bridges.

## References

1. Mendez, V. *Every Day Counts: Innovation Initiative*. FHWA, Washington, D.C., 2010, pp. 1–2.
2. Forgues, D., and L. Koskela. Can Procurement Affect Design Performance? *Journal of Construction Procurement,* Vol. 14, No. 2, 2008, pp. 130–142.
3. Gransberg, D. D., M. C. Loulakis, and G. M. Gad. *NCHRP Synthesis 455: Alternative Technical Concepts for Contract Delivery Methods*, 2014.
4. Actis, C., D. Unkefer, and J. Lewis. Alternative Contracting Methods: Alternative Technical Concepts. FHWA, U.S. DOT, 2012. www.fhwa.dot.gov/innovation/everyday-counts/edc-2/pdfs/edc_atc.pdf. Accessed Aug. 10, 2017.
5. Carpenter, J. *Annual Report on Alternate Technical Concept Programmatic Waiver*. SEP-14 Progress Report, Washington State DOT, 2012.
6. Coblentz, M. A. Alternative Technical Concepts Used on the ICC Project. Presented at 91st Annual Meeting of the Transportation Research Board, Washington, D.C., 2012.
7. Design–Build Project Delivery Guidance Statement. Office of the State Construction Engineer, Washington State DOT, 2010.
8. Design–Bid–Build Alternative Technical Concepts: Frequently Asked Questions. Unpublished paper, July 2017. http://epg.modot.org/files/2/26/147.3.1_FAQ.docx.
9. Missouri DOT. Hurricane Deck Bridge Replacement Project Meetings, 2011. www.modot.org/central/major_projects/camden.htm. Accessed Aug. 10, 2017.
10. Missouri DOT. Alternate Technical Concepts: History of Projects. Unpublished paper, January 2017.
11. Missouri DOT. Alternative Technical Concepts: Innovative Contracting Practices. https://epg.modot.org/files/4/40/147.3.1_white_paper.pdf. Accessed Aug. 10, 2017.
12. Roark, N. Alternative Technical Concepts Case Study: Missouri DOT Achieves Best Value on Design–Bid–Build Projects Through Teamwork with Industry on Alternative Technical Concepts. Report FHWA-CAI-14-012. FHWA, U.S. Department of Transportation, 2014.
13. Unkefer, D. Alternative Technical Concepts: Use with Traditional Design–Bid–Build Contracting. FHWA, U.S. DOT, 2014. www.agcnys.org/files/2014_Industry_Conference_forms/Presentations/ATCs_in_DBB_-_AGC_12-11-14_-_4_per_page.pdf. Accessed Aug. 10, 2017.

## Michigan Success Story

### *Limited-Scope Alternative Technical Concepts in Design–Bid–Build Projects*

Michigan Department of Transportation’s (DOT’s) US-10 bridge rehabilitation project in Midland County involved rehabilitating eight bridges and the 6.9 miles of roadway that ran between them. Maintenance of traffic during construction was a key success factor, and because Michigan DOT also included alternative pavement bidding (APB) in the procurement, it recognized that the potential differences in the competing contractors’ means and methods could have significant impacts on the traffic management and construction staging plans. Michigan DOT therefore decided to allow competitors to submit these vital plans confidentially as alternative technical concepts (ATC) during procurement and, if approved, to bid their individual plans. The winning contractor was required to engage a prequalified consultant to complete the final plans at its own expense after the award was received.

To implement this concept, Michigan DOT extended the advertising and bidding period to six weeks to furnish additional time for competing contractors to develop and submit their ATCs, and to have them evaluated and approved. Five contractors proposed a total of six ATCs, indicating the high level of industry interest and support for this innovative contracting approach. The spread between the two low bids was only 1.3 percent.

The winning contractor’s ATC permitted the construction of traffic-disrupting work to be completed in one construction season; the baseline design would have required two full construction seasons. The roadwork was completed nearly one year ahead of schedule.

The success of this project underscores the value of obtaining early contractor involvement with the project’s design using both ATCs and APB. These methods effectively moved the focus from a single design solution to a construction-centric set of competitively priced alternatives to Michigan DOT’s project design.

A secondary benefit of the combination of ATCs and APB, in which the bid price is a function of the proposed pavement’s life-cycle cost, is that pavement selection is based on market prices on bid day rather than on assumptions made several years before letting. Additionally, the construction schedule becomes a function of the traffic control requirements of the winning contractor’s specific means and methods. The ultimate outcome, then, is a final design that has been fully optimized in the context of constructability—greatly increasing safety both for workers and for the traveling public.

Michigan DOT’s upfront investment in dedicated staff to review and approve the confidential ATCs expeditiously yielded dividends to its Michigan constituents.

*—Doug Gransberg, Gransberg & Associates*

# Delivery Success

## *Best Practices in Design–Build*

LISA WASHINGTON, ERIN DONOVAN, JIM AVITABILE, AND SHAILENDRA PATEL

*Washington is Executive Director and CEO, Design–Build Institute of America, Washington, D.C.; Donovan is Associate, Whitman, Requardt, and Associates, LLP, Fairfax, Virginia; Avitabile is Strategic Initiatives Market Leader, RS&H, Orlando, Florida; and Patel is Division Administrator, Alternative Project Delivery, Virginia Department of Transportation, Richmond.*

Many transportation agencies are embracing the benefits of design–build (DB), realizing significant savings in schedule, construction costs, improved quality, and the benefits of innovative solutions. Design–build can benefit transportation agencies and their customers but is most effective when best practices and lessons learned are properly deployed.

Key best practices include effective design management, transparency in the procurement process, and use of alternative technical concepts (ATCs). The following case studies further examine each of these best practices.

### Systematic Design Management: Intercounty Connector

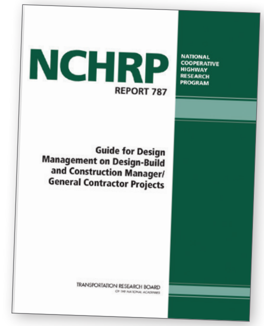
The Intercounty Connector (ICC) is an 18-mile, six-lane toll highway that is owned, operated, and maintained by the Maryland Transporta-

Photo: BeyondDC, Flickr


Photo: Famartin, Wikimedia

The Intercounty Connector—a DB project in Maryland—in construction (*right*) and finished (*below*).

Photo: Doug Kerr, Flickr




The RFPs for the ICC project used similar best practices as those outlined in *NCHRP Report 787: Guide for Design Management on Design–Build and Construction Manager/ General Contractor Projects*. The report is available from the TRB online bookstore at www.mytrb.org/Store/Product.aspx?ID=7399. To view the book online, go to www.trb.org/Publications/Blurbs/171479.aspx.

tion Authority (MDTA). The corridor provides a link between Montgomery and Prince George's Counties. The Maryland State Highway Administration (SHA) managed the planning, contracting, and administration of ICC's project delivery.

The ICC project budget of $2.6 billion was delivered through four separate DB contracts, as summarized in Table 1 (below, right). The language used in the requests for proposal (RFPs) for all four DB segments included the requirement that each proposing team provide a systematic design management process. This process needed to include many recognized best practices as described in *National Cooperative Highway Research Program (NCHRP) Report 787: Guide for Design Management on Design–Build and Construction Manager/General Contractor Projects*.

According to *NCHRP Report 787*, agencies must provide an appropriate level of preliminary design in the RFP to obtain competitive, effective, and innovative proposals. For the ICC project, the team of engineering consultants working on behalf of SHA prepared preliminary design plans—approximately 30 percent design—to facilitate the design–builders' response to the RFP. The RFP also contained applicable technical provisions that established the general standards and project-specific limits that would be required in the final design completed by the successful DB team.

When the four DB teams were awarded their contracts, each coordinated quickly with the SHA project management team to deploy the systematic design management approach described in the accepted proposal. The best practices used most consistently—many of which are described further in *NCHRP Report 787*—are briefly discussed below.

***Discipline Task Force Meetings***

Weekly meetings of designers, SHA design oversight staff, and construction representatives addressed design scope limits, conflicts, challenges, and historical context; clarified expectations; and considered possible solutions. These task force meetings allowed for regular, timely discussion among the involved parties and typically led to quick resolution of any potential stumbling blocks.

The RFP for the ICC project required definitive design submittals—recommended in NCHRP Report 787—and encouraged stakeholder engagement and cooperation early and often throughout the project, all of which were achieved by meetings of the task force as well as by over-the-shoulder (OTS) reviews.

**TABLE 1 ICC Project Contracts**

| Contract | Limits | Contractor | Contract Amount (Million) |
|---|---|---|---|
| A | I-270/I-370 to East of MD-97 | **Intercounty Constructors**<br>» Granite, Corman, and Wagman Joint Venture (Parsons, Lead Designer) | $478 |
| B | East of MD-97 to West of US-29 | **MD-200**<br>» Kiewit, Corman, and Wagman Joint Venture (Parsons, Lead Designer) | $560 |
| C | West of US-29 to East of I-95 Interchange; I-95 Improvements | **ICC Constructors (IC3)**<br>» Shirley, Clark, Atkinson, Facchina, and Trumbull Joint Venture (Dewberry & Davis, Lead Designer) | $528 |
| D/E | East of I-95 Interchange to US-1; I-95 Improvements | **ICC Constructors (IC3)**<br>» Shirley, Clark, Facchina, and Trumbull Joint Venture (Dewberry & Davis, Lead Designer) | $89 |


Photo: Maryland GovPics, Flickr

Ribbon-cutting ceremony for ICC. The completion of the major project included four DB teams, Maryland SHA, FHWA, and other Maryland state agencies.

### *Over-the-Shoulder Reviews*

Presented and discussed at the task force meetings were draft versions of design development submissions required by the contract. These discussions allowed SHA and other third-party stakeholders to facilitate a quick turnaround when formally reviewing each submission as well as great improvement in design products. According to NCHRP Report 787, OTS reviews offer a direct and informal line of communication between the agency and designer–builder, which can help solve issues and identify possible design innovations.

Designers from other disciplines also conducted OTS reviews, commonly called interdisciplinary design reviews. Construction team members provided constructability reviews as design progressed.

### *Value-Added Comments*

As soon as design products were formally submitted, both SHA and affected third parties—for example, other Maryland state agencies, utility owners, the Federal Highway Administration (FHWA), and the Maryland Department of the Environment—could offer formal comments to the design team. Comment resolution meetings then were scheduled to review and discuss any remarks that were unclear or raised questions, to ensure the best resolution for the project.

### *Design Change Management*

The systematic design management process resulted in a solid final design model and a set of readiness-for-construction plans that could be constructed efficiently by the DB construction team. Throughout construction, necessary changes to the model were identified quickly, causing the design plans to be modified in one of three ways, including

- ◆ Notice of design change, or a change to the plans before construction;
- ◆ Field design change, or a change to the plans as a result of a previously unknown field condition; and
- ◆ Change order, or an addition or subtraction to the contracted scope of work.

The resulting as-built drawings then became the project's record of completion.

The key element of a systematic design management process for the ICC project was consistently defined in each RFP, setting the stage for successful completion of the design. It often is important to establish effective design management procedures and processes early in a project's lifespan.


Photo: Dan TD, Wikimedia

The pedestrian bridge that permits the Upper Tampa Bay Trail to traverse a major roadway was one of Florida's 33 DB pilot projects.

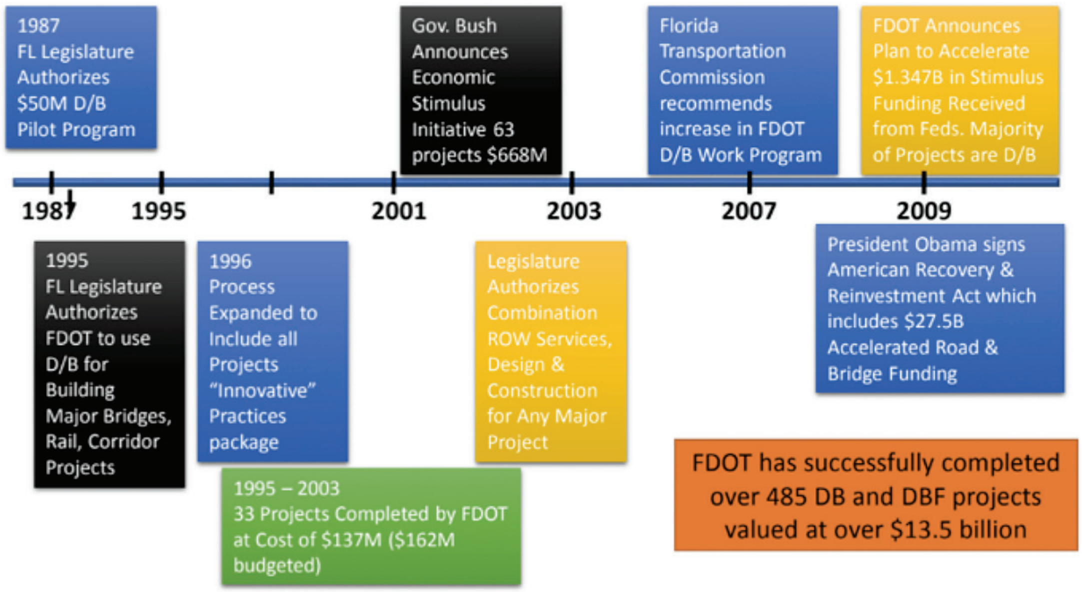



**FIGURE 1 Evolution of Florida DOT's DB program.**

## Transparency in the Procurement Process: Florida DOT

The Florida Department of Transportation (DOT) launched its Alternative Contracting Program in 1987, with $50 million in DB projects authorized in conjunction with newly enacted DB transportation legislation. In 1995, Florida DOT initiated a pilot program of 33 DB projects of varying scope and size to monitor the benefits of DB project delivery. The projects were successfully completed at a cost of $137 million—$25 million below budget.

Because of the program's success, Florida DOT and the Florida Transportation Commission supported the increased use of DB project delivery for the transportation agency's work (see Figure 1, above).

### *Transparent Process*

More than 500 DB projects have been completed successfully to date—a total of $13.5 billion—as well as 10 design–build–finance projects and three major public–private partnership projects that total more than $5.5 billion. Much of the success can be accredited to Florida DOT's highly transparent process, which includes

- Development of an alternative contracting task team,
- Standardization of RFPs and scope-of-work packages across the state, and
- Open dialogue with DB teams before initiating procurement and after selection.

Since the earliest DB project was initiated, Florida DOT documented the results fully. The agency shared the information with the design consulting industry, via the Florida Institute of Consulting Engineers, and with the general contracting industry, via the Florida Transportation Builders Association. Florida DOT also created an alternative contracting task team, chaired by the agency's Alternative Project Delivery Office, to enable transparency and allow open access. This team meets biannually and is attended by representatives of each Florida DOT district, as well as representatives from Florida's Turnpike Enterprise.

Open to consultants and construction industry representatives, these meetings offer a forum to share lessons learned, address industry concerns, and ensure all participants have a voice.

### *Open Dialogue*

The Florida DOT program is based on open dialogue with the construction industry, engineering community, and local public officials, whose combined support is paramount to success. Florida DOT allows each group direct access to information and offers a chance to see the benefits of the program firsthand. This creates buy-in and trust, which are critical to the support of DB and public–private partnership programs. Through conferences and technical committee assignments, Florida DOT creates opportunities for industry professionals to interact, to hear and appreciate each other's concerns, and to understand the positive or negative impacts of these concerns.

Because of the open and transparent dialogue, Florida DOT elected to standardize the DB RFP and scope of work package across all of its districts

Photo: Tom Saunders, Virginia DOT

The High Rise Bridge project in Chesapeake, which added one managed lane in each direction to the 65-ft-tall bridge, is Virginia's largest DB contract to date.

statewide, which allowed for a consistent approach and continuity. A valued partner invested in overall project success, Florida DOT continues to apply best practices gleaned from open dialogue with the industry to refine and improve its alternative contracting program.

Before procurement, Florida DOT staff generally meet with DB teams to discuss the project freely and to highlight the key areas they expect DB teams to address. This process provides the design and construction community with valuable feedback on how to structure their team and how to respond better to the required scope of work to maximize value for Florida DOT and the public.

Once the project bids have been posted, Florida DOT staff typically accommodate the unsuccessful teams by offering score sheets and by conducting debriefings for the teams to understand areas in which their proposal could have been strengthened or why another proposal ranked higher. This approach allows the entire industry to learn and improve—one proposal at a time.

## Alternative Technical Concepts: Virginia DOT

Design–build promotes integration, innovation, flexibility, and risk sharing by providing one entity the sole responsibility for design and construction of a project. The primary objective of Virginia DOT's Design–Build Program is to use the most appropriate procurement and contract methods that satisfy the agency's goals and objectives for each project.

A leader and innovator in the industry, Virginia DOT's DB program has received noteworthy national recognition as the recipient of the 2015 Design–Build Leadership Award and of the 2016 Transportation Owner of the Year award, both from the Design–Build Institute of America.

Since 2002, Virginia DOT's DB program has delivered projects with contract values ranging from $1 million to $500 million. The program's portfolio

Photo: Trevor Wrayton, Virginia DOT

High-occupancy toll lane construction at the Springfield intersection in Virginia was the result of 10 years of planning, procurement, and review of DB contracts on one of the nation's most congested corridors.

includes 64 projects completed since 2002 that are valued at $1.58 billion; 20 active projects valued at $1.4 billion; four active proposals valued at $268 million; and 2 candidate projects valued at $17 million.

***History of DB in Virginia***

In 2001, Virginia's General Assembly amended Code of Virginia §33.1-12 to authorize the Commonwealth Transportation Board (CTB) to award DB contracts for construction projects. The amendment authorized five projects under $20 million per year and five projects over $20 million per year. In 2006, the General Assembly modified the Code provision again; HB 666 removed restrictions on the number of DB projects the CTB may award per year, and HB 671 allowed localities to use DB when awarding transportation contracts. In 2014, the DB code section reference was revised to §33.2-209 (b), and in 2016, the use of ATC was permitted.

In 2004, Virginia DOT's use of DB contracting began to take off. A separate base proposal requirement by the FHWA DB regulation hindered Virginia DOT from using a formal ATC process. The agency allowed innovative ideas to be incorporated into final proposals via proprietary meetings, but its ability to fully utilize these ideas was limited by the state statute.

The Office of the Attorney General's (OAG's) review of the procurement laws indicated that Virginia DOT was at risk for accepting deviations from requirements of the RFP without issuing addenda. This discouraged design–builders from sharing innovative ideas with Virginia DOT, specifically ideas that would need significant changes to the RFP requirements.

Virginia DOT encouraged design–builders to continue to propose innovative ideas that could be used in the value engineering process after the award. The agency was successful until a protest was filed on a project that allowed an innovative design concept that differed significantly from the RFP design concept.

This protest further validated the OAG's concern regarding Virginia DOT accepting the proposal containing deviations from the RFP requirements without issuing an addendum. Although the protest was withdrawn due to Virginia DOT's open communication and relationship with the industry, it highlighted the importance of enacting a statutory change.

Photo: Trevor Wrayton, Virginia DOT

These twin bridges are part of the 460 Connector project, a multicontract design that faced protests in the procurement process.

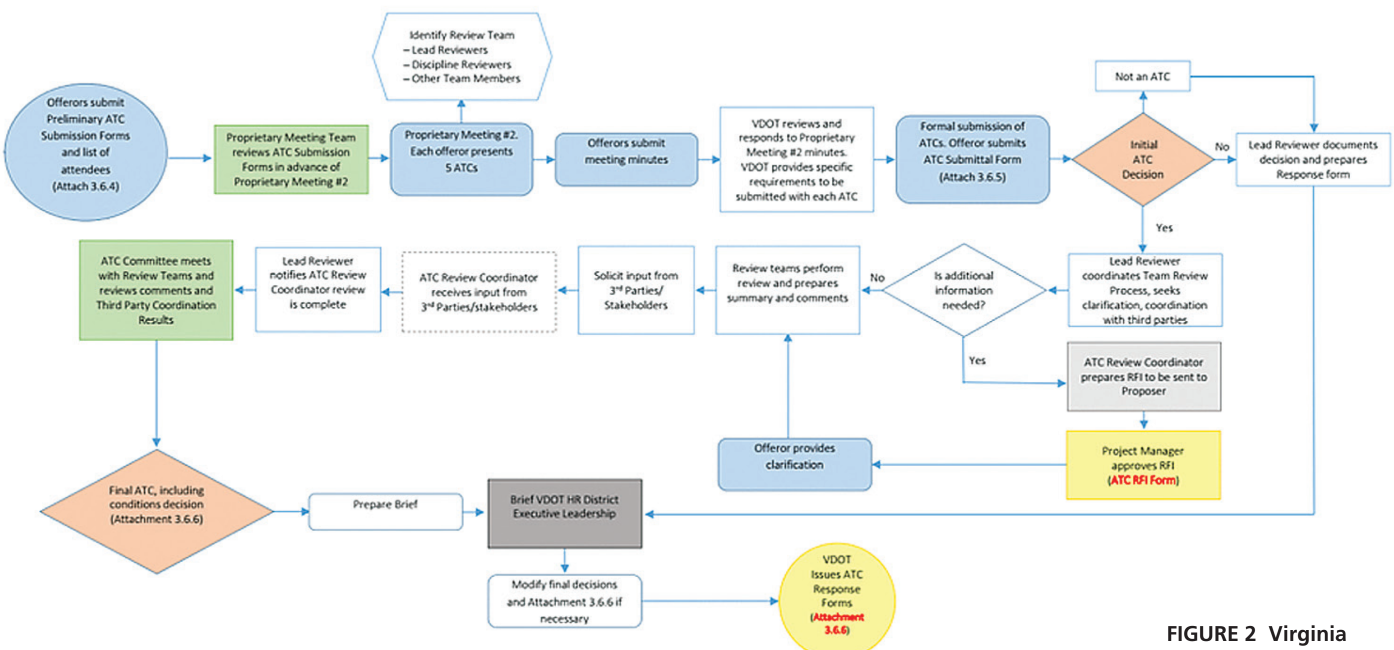



**FIGURE 2 Virginia DOT's ATC process.**

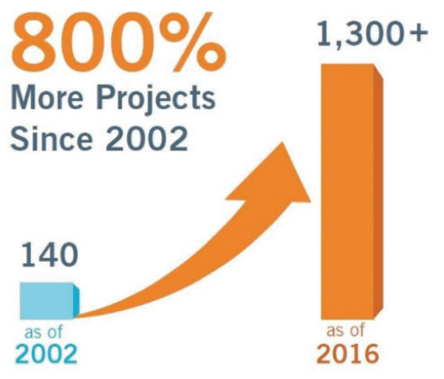



**FIGURE 3 Completed transportation DB projects, according to a survey of state DOTs.**

### *Making a Change*

Virginia DOT discussed this issue with the Virginia Transportation Construction Alliance (VTCA), which represents contractors, consultants, and aggregate suppliers. The industry agreed that this change would allow the full use of innovative ideas without the ideas being disclosed to competitors. Working together, VTCA and Virginia DOT drafted an amendment that was introduced during the 2016 General Assembly session. This change in law allowed formal ATCs to be accepted while maintaining confidentiality and provided flexibility to Virginia DOT to use the ATC process for the best-suited projects. Figure 2 (page 23) outlines Virginia DOT's ATC process.

Confidentiality is of utmost importance in projects featuring ATCs, as these respondents to RFPs invest tremendous effort into developing their ideas. ATC submissions are considered proprietary until the contract is awarded; unsuccessful respondents have accepted stipends. According to Virginia DOT, tight restrictions on the review and approval process during procurement are important. The agency will adhere to the policies outlined in the *Virginia DOT Design–Build Evaluation Guidelines* to ensure that confidentiality is maintained.

Virginia DOT consistently receives improved solutions to proposed projects that reduce cost and schedules and that deploy design and construction innovation. The agency and the public have benefited from the use of innovative ideas, and the formal ATC process further enhances Virginia DOT's ability to realize the potential of creative and alternative solutions.

## Conclusion

A 2016 survey of state DOTs showed an 800-percent increase in the use of DB between 2002 and 2016 (Figure 3, above left). Eighty-seven percent of those agencies say they will continue to use DB on transportation projects. This response also mirrors the findings of new research—commissioned by DBIA and released in June by FMI Management Consultants[1]—predicting that the use of DB will see the greatest increase compared with all other project delivery methods (Figure 4, below).

[1] https://dbia.org/impact/

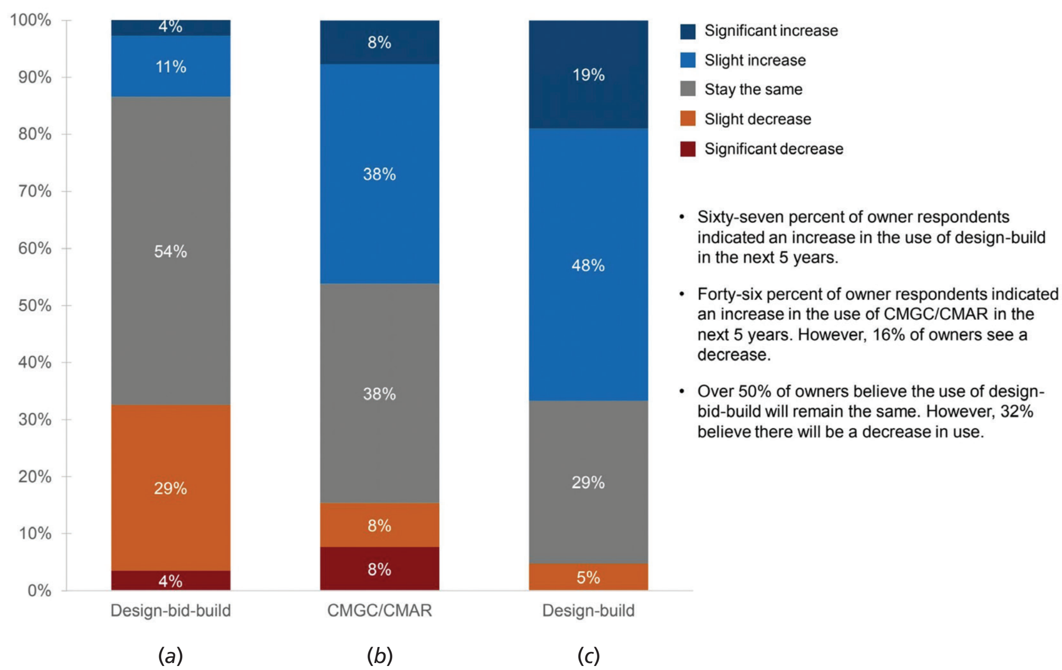



**FIGURE 4 Predicted use of project delivery methods (*a*) design–bid–build; (*b*) construction manager–general contractor, also known as construction manager at risk; and (*c*) design–build.** (Source: FMI Management Consultants)

# Devore Interchange

## *California Design–Build Success Story*

RAYMOND TRITT

The I-15–I-215 interchange project near Devore, California, known as the Devore Interchange project, added northbound and southbound truck bypass lanes to separate trucks from vehicles, reducing congestion and improving weaving. The interchange was a principal bottleneck on a designated trade corridor that is critical to interstate and international trade. Initially estimated to cost $240 million, the project was jointly delivered by the San Bernardino Associated Governments (SANBAG) and the California Department of Transportation (Caltrans) using the design–build methodology.

Caltrans was authorized to conduct a design–build demonstration program for 10 projects. The authorizing legislation required that half were to be awarded using a low-bid approach and that the other half were to be awarded using a best-value approach. All but one of the projects included alternative technical concepts in the procurement process. Since design–build was new to Caltrans, the department invested in an extensive training program furnished by the American Society of Civil Engineers.

Caltrans staff selected design–build delivery because they wanted to accelerate delivery of this critical project, enable innovation, and realize the benefits of early cost certainty. The Devore Interchange project team received both pre- and post-award training. A design–build training period occurred before the preliminary engineering for the design–build request for proposals commenced, and this effort acted as an interagency partnering workshop between Caltrans engineers and the representatives of SANBAG. The training greatly facilitated the development of the contract documents and the dialogue necessary to coordinate this complex project.

The project was awarded in 2012 and completed in 2016. During procurement, alternative technical concepts were approved that changed the project's geometrics, improved route continuity through the interchange, and reduced the right-of-way requirements—saving nearly $25 million. The project was awarded 12 months earlier than the traditional delivery process, resulting in cost certainty at the conclusion of the environmental process rather than at the conclusion of the design process. Additionally, the ability to begin early work packages before the final design was complete allowed Caltrans to deliver this critical project 30 months earlier than it would have using the traditional delivery process.

The Devore Interchange project is an example of the value of collaboration and integration that can be achieved using design–build project delivery. Clearly demonstrated were the benefits that can be accrued when design–build is applied to an appropriately selected project and is delivered by a multiagency team that has not only been well trained, but also has invested in a formal team-building process.

---

*The author is Chief, Office of Innovative Design and Delivery, California Department of Transportation, Sacramento.*

PHOTO COURTESY OF THE AUTHOR

Caltrans selected design–build and alternative technical concept procurement to complete the Devore Interchange project.

Photo: Garrett, Flickr

# Leveraging Early Contractor Involvement

## *Construction Manager–General Contractor Project Delivery*


RANDALL PARK AND DOUG GRANSBERG

*Park is Director of Project Development, Utah Department of Transportation, Salt Lake City, and Gransberg is President, Gransberg & Associates, Norman, Oklahoma.*


Utah Department of Transportation explored alternative contracting methods that allowed them to make project decisions based on factors beyond price.

The use of construction manager–general contractor (CM/GC) project delivery, also called CM-at-risk, is growing in the transportation industry. According to the prevailing literature, the rise in CM/GC is due to a desire to gain constructability input from the construction contractor to reduce costs and construction time, increase on-time schedule and budget certainty, reduce risk, and encourage innovation.

The shift in contractual relationships is less radical in CM/GC than in design–build (DB) project delivery. As in design–bid–build (DBB), the owner in a CM/GC project retains control over the design details either by using in-house design personnel or by employing a consultant on a design contract (see Figure 1, page 27). The major change, however, is that the construction contractor is selected before the design is complete via a preconstruction services contract that provides the legal mechanism to obtain input to the final design. Once the construction price is fixed—a process commonly called establishing the guaranteed maximum price—the contractor is awarded the construction contract.

Construction procurement procedures are different in each state, but the one common thread is the commitment to low bid award in DBB projects. Alternative contracting methods like CM/GC allow the selection criteria to range from pure qualifications-based selection (QBS), which does not include pricing data, to best-value selection, which includes some pricing data.

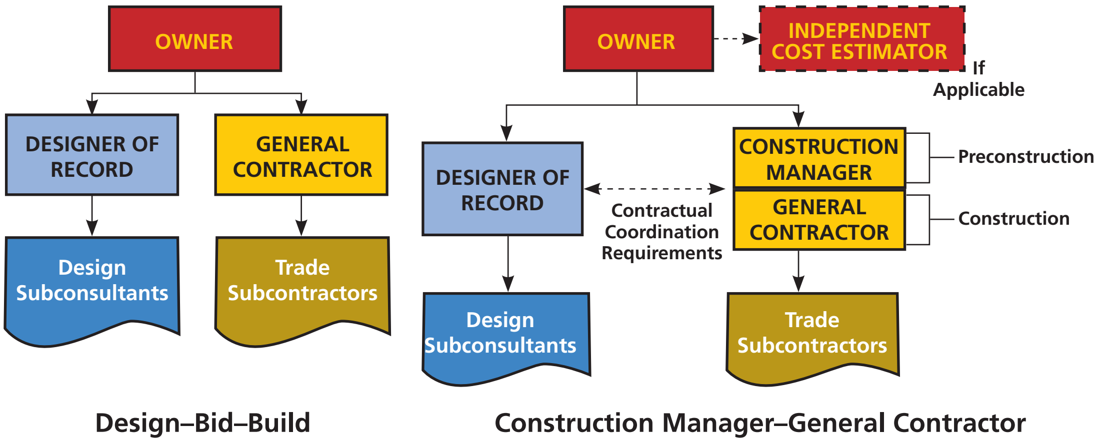



**FIGURE 1** **Project delivery method contract structures.**

Nevertheless, the idea of a qualifications-based selection of a general contractor remains an anathema to most public agencies. The use of best-value selection offers an attractive solution by providing a way to include pricing that is established on a competitive basis rather than negotiated after contract award in QBS.

## Utah DOT Experience

Utah Department of Transportation (DOT) began its CM/GC implementation and experimentation journey in 2004. The agency patterned its first few solicitations after the Arizona DOT model, which itself is based on enabling legislation that mandated QBS. After completing several projects, Utah DOT decided that it needed to add some pricing to counter industry claims that, because of the subjective nature of the evaluation, quality-based selection was a "beauty contest." The result was the addition of a few unit prices for key pay items on a project-specific basis. The initial introduction of pricing and best-value awards was given a 50-percent weight relative to all other criteria. As Utah DOT gained more experience, it found that when identifying the best contractor for the job, it was key to understand each competitor's approach both to preconstruction services and to the construction of the project.

Figure 2 (below) details the change in the weight assigned to price versus nonprice criteria over Utah DOT's first 17 CM/GC projects: the weight of the price factor drops as the agency gains more experience with this alternative contracting method. This graph demonstrates the value of making competitive pricing less important than picking the best contractor for a particular job. To put this in context, the final project on the graph is the Mountain View Corridor, a complex, $400 million megaproject in northern Utah.

This trend continued until 2016, when both Utah DOT and its industry partners realized that the value of pricing was minimal, and the agency decided to return to a QBS process for its CM/GC projects.

**FIGURE 2** **Change in price versus nonprice evaluation criteria over time.**

Photo: Utah DOT

An October 2011 landslide destroyed parts of SR-14, requiring a 60-mile detour. Utah DOT chose a CM/GC delivery method to expedite reconstruction.

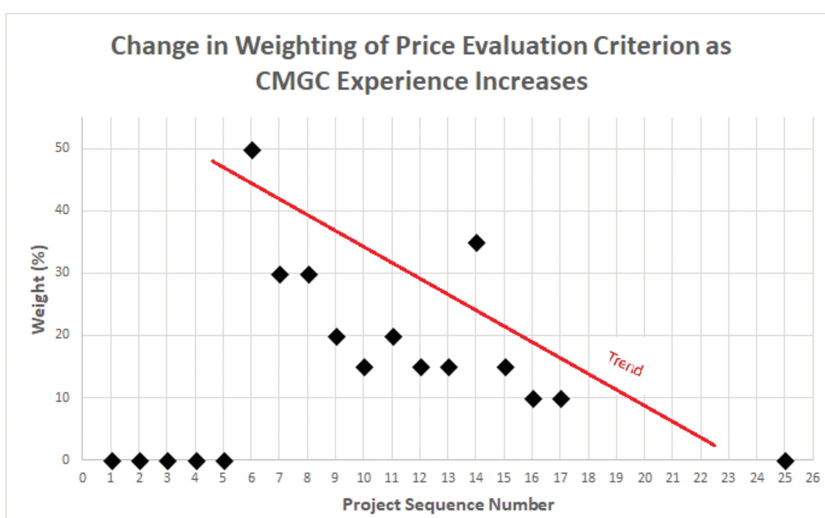



Photo: Utah DOT

Slide-in bridges and self-propelled modular transporters were used in the SR-145 Pioneer Crossing project.

## Qualifications-Based Selection Opportunities and Barriers

CM/GC contracting provides an opportunity for increased integration among the owner, designer, and contractor. According to the American Consulting Engineers Council (ACEC), "When multiple prices are on the table, the owner is not in control; the price is. When price is on the table it trumps other considerations, even quality and innovation" (*1*). The ostensible reason for employing CM/GC is to enhance the quality of the design product through continuous constructability review and to leverage potential innovations in the contractor's preferred means and methods; therefore, adding price to the package seems to run counter to the objectives of CM/GC project delivery.

Additional research by Alleman et al. identified many reasons for selecting QBS over best-value selection, including unit pricing (*2*):

- Fixing unit prices early in the design process forces the contractor to build in contingencies for risks that may not be realized. Additionally, if subsequent iterations of the design process cause the quantities of work to change materially, the assumptions used to develop the initial unit pricing may no longer be applicable and may require that the fixed-unit prices themselves be recalculated, rendering moot the attempt to obtain competitive pricing.
- Because the markups on direct costs are contained in the unit prices and the open-books option has been effectively eliminated by the requirement to submit competitive pricing, it becomes difficult to negotiate the final construction costs.
- Pricing redirects the preconstruction focus away from innovation and toward ensuring that the final design does not violate preaward pricing assumptions.
- Committing to unit pricing also fixes the project risk profile rather than furnishing an opportunity to discuss project risk and determine the best way to allocate or share the risks.

Diverging diamond interchanges were one of the early innovative solutions Utah DOT explored through alternative contracting methods.

Photo: Utah DOT

The above challenges also contribute to a preconstruction environment that hinders the ability to build trust, to collaborate actively, and to make decisions on a best-for-project basis. No matter how close the partnership among the parties to the CM/GC project, the suspicion remains that the contractor will inflate its pricing; without the transparency furnished by open-books negotiations, the parties can do very little to dispel that perception. As ACEC maintains: "When price is on the table it trumps other considerations."

The opposite is true in pure QBS, with the greatest benefit to the owner the ability to negotiate using open-books accounting for most cost items. If the procurement is structured in a manner in which the CM/GC contractor is paid a lump-sum preconstruction fee and a lump-sum construction fee that includes its profit, overhead, and general conditions, the negotiations can be confined to elements of direct cost—labor, equipment, materials, subcontracts, and more. Thus, the focus of the negotiations can be on items that are measurable and directly related to the quantities of work, with the fallback that if a disagreement occurs, an audit of the payrolls, invoices, equipment usage, and more, can easily determine the actual unit costs. Because of this, the focus stays on scope, schedule, and risk.

## Utah DOT Results

Utah DOT recognized the value of early contractor involvement in preconstruction and determined that adding a pricing component to the selection process did not add value to the project in the long run, for many of the reasons cited above. The agency's return to QBS sent a clear signal to its industry partners that Utah DOT wanted to retain the best contractor for each project and that its selection procedures could be developed in a manner that provided a fair and equitable chance for all qualified contractors to compete.

By the time the decision was made, the Utah construction industry had observed the awarding of 34 CM/GC projects. Realizing that their fears of a "beauty contest" were unfounded, industry partners supported the change.

Opponents of CM/GC will claim that the negotiated price is going to be higher than the low bid, regardless of facts to the contrary. After implementing CM/GC, Utah DOT also implemented a project performance–measuring program that sought to capture the value of innovations brought to its projects by CM/GC contractors. Across the board, Utah DOT estimates an average of approximately six to 10 percent cost and time savings.


PHOTO: JIM MAURER, FLICKR

Utah DOT used CM/GC to extend its FrontRunner commuter line from Salt Lake City to Provo.

## Possible Alternatives

The perception that construction contract awards should include pricing is pervasive, especially among the stakeholders that do not understand the mechanics of the CM/GC process—legislators, financial programmers, and other nonengineers. Additionally, some jurisdictions are required to include some form of pricing in their enabling legislation. Other agencies have dealt with this issue by requiring that the CM/GC contractors submit their lump-sum preconstruction and construction fees along with their qualifications. In some cases, the fees are assigned a weight in evaluation; in others, they are merely received and then fixed when the contract is awarded. Thus, the agency can argue that those are competitively priced and that the differences in the direct costs among competing contractors is minimal, as most general contractors will purchase their materials from the same sources, use the prevailing wages for their labor, and generally bid the same means and methods.

The important takeaway from Utah DOT's experience is that CM/GC projects using both QBS and BV with unit pricing were delivered successfully and that the agency and the traveling public reaped the benefits of early contractor involvement.

### References

1. American Council of Consulting Engineers. Qualifications-Based Selection. Presented at European Federation of Engineering Consultancy Associations Conference, Brussels, Belgium, 2004.
2. Alleman, D., A. Antoine, D. D. Gransberg, and K. R. Molenaar. A Comparison of Qualifications-Based Selection and Best-Value Procurement for Construction Manager–General Contractor Highway Construction. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2630, 2017, pp. 59–67.

# Value of Early Contractor Involvement

## *Sellwood Bridge Replacement Project*

JOHN CARLSON AND DOUG GRANSBERG

Photo: Oregon DOT

(*Above*) Crowds gather to watch Oregon's old Sellwood Bridge (*below, left*) moved for use as a detour while the new bridge is constructed (*below, right*). Use of alternative technical concepts and alternative contracting reduced the project's cost and schedule.

Photos: Eric Prado, Flickr

In 2011, Multnomah County, Oregon, changed the delivery method for the Sellwood Bridge Replacement Project from a traditional design–bid–build (DBB) to construction manager–general contractor (CM/GC), because the budget had become increasingly tighter as the design had advanced. The county realized the benefit of a contractor not only to assist with constructability issues for a more efficient design, but also to provide real-time market pricing capabilities and insight on how to most efficiently schedule and phase the work. Preconstruction services, which only construction contractors can provide, would enhance budget, cost, and schedule certainty.

The decision demonstrated the value of early contractor involvement in overcoming scope creep as well as in offering alternative technical concepts (ATC) that never would have been considered in a traditional, low-bid procurement.

During the design process of the Slayden–Sundt joint venture—Sundt Construction was the managing partner—presented many valuable constructability concepts. Chief among these ATCs was a proposal to jack the existing bridge 40 feet to the north laterally, install it on temporary foundations, and make it the construction detour. This concept was credited with saving $6 million and reducing the schedule by nearly a year, which produced an additional field overhead savings of $5 million. The ATC also allowed the entire bridge to be built at once rather than in two halves and allowed better public access across the Willamette River during construction. By providing the same capacity as before construction and improving the safety of the construction team and the traveling public, the detour greatly reduced traffic disruption.

The project delivery team was co-located on the project site during design and construction, facilitating an information-rich dialogue about design impacts on the construction process and on Multnomah County's project budget and schedule. This approach kept costs and schedules in check and provided the early certainty that comes with a lump-sum, guaranteed-maximum price contract.

Unlike DBB, which is design-centric, CM/GC is construction-centric; that is, design decisions are made based on priced alternatives and constructability efficiencies provided by the CM/GC contractor, with the ability for judicious allocation of risk to keep costs down.

The Sellwood Bridge replacement project was named 2017 Project of the Year by the *Oregon Daily Journal of Commerce* and selected for the top Build America award by the Associated General Contractors of America. Design consultant T.Y. Lin, Inc., received an Honor Award in the 2017 Engineering Excellence Awards competition of the American Council of Engineering Companies.

---

*Carlson is Senior Vice President, Sundt Construction, Inc., San Antonio, Texas, and Gransberg is President, Gransberg & Associates, Norman, Oklahoma.*

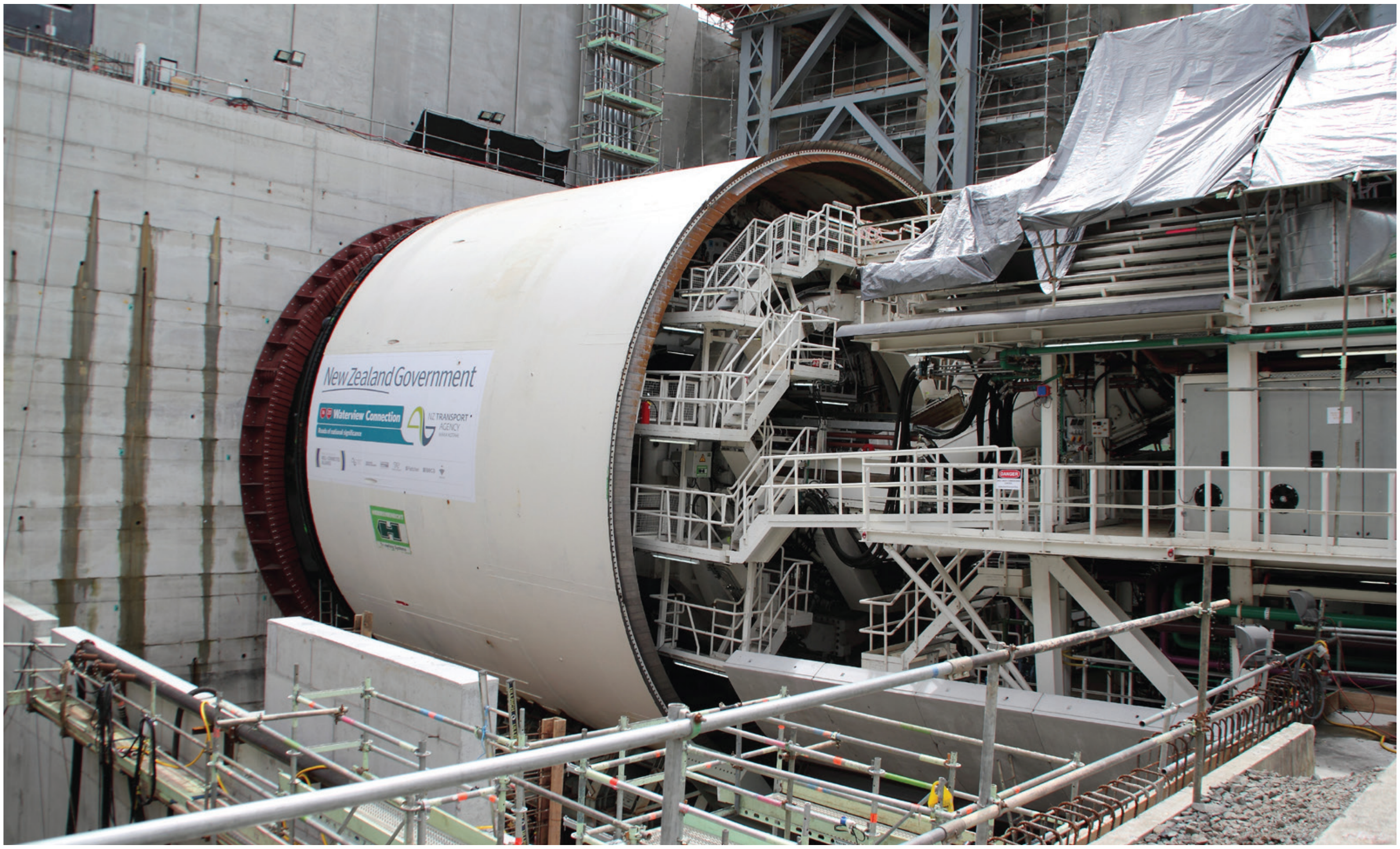



PHOTO: NOEL JONES, FLICKR

# Alliance Contracting

## *Advancing Collaboration and Integration in International Project Delivery*

ERIC SCHEEPBOUWER AND BRYAN PIDWERBESKY

*Scheepbouwer is Director, Construction Management Programme, University of Canterbury, Christchurch, New Zealand. Pidwerbesky is National Technical Manager, Fulton Hogan Ltd., Christchurch.*

A boring machine digs tunnels in the Waterview Connection project, guided by a collaborative partnership known as an alliance. In New Zealand and other countries, alliances are used to maximize revenue and minimize risk.

Limited transportation agency budgets and a need to speed up project delivery in infrastructure projects have coincided with an increase in size of such projects, creating a high degree of instability, irregularity, and randomness. Although part of the solution must include a quicker uptake of new technologies, perhaps a new way of working may add benefits.

Recently, several new forms of collaborative procurement methods have grown in popularity all over the world. In the U.S. highway sector, public–private partnerships (PPPs) and construction manager–general contractor project delivery methods have been introduced. In many European and Australasian nations, the new methods include early contractor involvement and alliances. Alliances are in many aspects similar to the integrated project delivery methods in use in vertical construction in the United States. Washington State Department of Transportation almost started the first alliance in the United States—but at the final moment, the project was reassigned to be a design–build (DB).

## Alliance Contracting

### *Definition*

Alliance contracting is a project delivery model in which the owner, contractor, and consultant form a single team working collaboratively on a project or program. The number of parties, reward mechanism, and amount of work for each party can vary among alliances, but the risks and rewards are shared equitably. In fact, in an alliance the rewards are described for the team; that is, the rewards depend on the amount of work that is allocated to each of the parties at the beginning of the project. This amount is added to the reimbursement for services and corporate overhead.

This setup instills a “whole team wins or whole

The Waterview tunnel is a 2.4-km-long twin-bored tunnel—a rarity in New Zealand.


Photo Courtesy of the Authors

team loses" attitude. To emphasize the collaborative atmosphere, the members of an alliance sign a clause agreeing not to sue each other. Since all activities are done by integrated teams, the needs or opportunities to sue are reduced as well. Also helping to reinforce an attitude of teamwork is the creation of integrated groups that are co-located, requiring staff to wear work clothing branded with the alliance's logo rather than those of the original companies.

Similar to PPP and DB project delivery methods, in alliance contracting all expertise is present and available when needed, and contractor input from the start of the project facilitates better constructability and risk management. The idea is to share more risks that are small, rather than to bear fewer large risks alone.

Since the creation of alliances, a few varieties of the method have been developed to emphasize demonstrated value or increased flexibility during construction—but the basic setup has remained the same. In an alliance, contractors' commercial goals are to maximize revenues and minimize risk; this is achieved by locking in a fair profit margin, which is negotiated and reviewed by independent external party; avoiding major downside risk; and retaining the opportunity for upside risk—shared pain and gain. Downside risk sharing by the contractor is typically limited to the profit margin.

A unique collaborative alliance was needed to address the extensive damage caused by the 2011 earthquakes near Christchurch, New Zealand.

Photo: Bernard Spragg.NZ, Flickr

### *When to Use*

Reasons for choosing alliances revolve primarily around the complexity or the amount of risk in a program or project. With its increased collaboration and streamlined communication, the alliancing model is ideally suited for projects that have larger uncertainties—a certain size is needed to make a business case, and the regular minimum size is NZ$50 million. Compared to a PPP, an alliance project offers more value for the money. The financing cost for PPPs—absent in publically funded projects—can be significant. Compared to design–bid–build and DB project delivery methods, the lump-sum lowest bid undoubtedly will result in a lesser cost as long as the added risks are not major, since changes are not competitively tendered.

## New Zealand Case Studies

### *Waterview Connection Alliance*

The Waterview Connection Alliance project was special. It included a 2.4-km-long twin-bored tunnel, a specialty not used often in New Zealand. When the connection opened in 2017, it had cost NZ$1.4 billion to build; traffic models forecast that by 2026, approximately 90,000 vehicles will use the Waterview Connection each day.

Before procurement, the Waterview Connection Procurement Steering Group was initiated to establish whether the project could progress as a PPP. Group members compared various options for suitability, including DB, alliance, and PPP. The choice between an alliance and a design-and-construct contract was based on the assessment of best value for money and the flexibility of the procurement method to deal with change; project complexity and scope for innovation; scale; quantum and nature of risk; program constraints; and the competitiveness of the market.

Project owners concluded that a PPP would offer the best value. The estimate of the project cost was NZ$1.89 billion (2015). They identified many factors that would be critical to the success of a PPP project delivery method, including

- Unequivocal public-sector commitment to the project's funding, process, and timeline;
- Clear project objectives;
- Adequate resources and clearly defined roles;
- Ensuring competitive tension; and
- Network optimization.

It became clear, however, that the PPP option involved a significant finance cost of more than NZ$500 million over the 40-year obligation. As more stakeholders started to voice their concerns, the inflexibility for future expansion of the connection became more of a concern to decision makers. In the end, the New Zealand Transport Agency decided to switch to an alliance contracting method.

***SCIRT Alliance***

After the 2011 earthquakes in Canterbury, New Zealand, caused an estimated NZ$20 billion in damage to commercial and infrastructure assets, an infrastructure reconstruction program was initiated. The project delivery model had been developed to cope with the difficulties of disaster rebuild programs—unknown scope, political pressures, and intense public scrutiny. This model was based on alliance contracting, but included both competition and collaboration between the participants. The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) was a unique alliance in that it aligned commercial drivers with high-performance objectives to deliver mutually agreed outcomes. The SCIRT collaborative alliance had introduced competitive tension without upsetting the fundamental collaborative focus. The overall effect was that participants had a continuous incentive to raise performance—not only as separate entities but also as part of a team.

In the United States, the indefinite delivery–indefinite quantity (IDIQ) contract framework already has been successful at procuring large-scale, multiple-award disaster recovery construction projects. Although the level of collaboration in the United States' IDIQ model is less comprehensive than the New Zealand alliance contracts, the model could be used as a template to implement alliance-style contracts.

The major barrier to implementing alliance contracts in the United States seems to be the development of an approach to "pain–gain" sharing that is compatible with both U.S. federal and state procurement statutes.

## Benefits of Alliances

Alliances offer more flexibility because the scope can be changed easily during construction. For non-owner participants, direct costs are reimbursed and profits can be doubled, limiting the potential to make a loss. Better risk management for all parties limits the need to price up risk. An alliance is not a long-term commitment that potentially stifles future upgrades; the method is better suited for projects that need flexibility. Although a standard project would provide less value for money than a DB project, attempting DB on a project of unclear scope could prove very costly.

As collaboration between parties in alliances is much more pronounced, the work atmosphere is substantially different from other project delivery methods. This places demands on staff, primarily the flexibility to change the mindset from a client or a contractor to that of a member of a team. Collaboration also provides advantages, as expertise needs to be present in a team, not just in every individual. This could help mediate the effects of the loss of expertise that occurs along with workforce turnover.

Photo: ShakyIsles, Wikimedia

An alliance supported the construction of the Victoria Park Tunnel, which would take 150,000 cars off the motorway every day.

## Trends in Alliancing

To date, alliances have a very good track record in mature, developed markets. This project delivery method likely will spread to new markets such as the United States as agencies define newer variants to emphasize aspects like price competition before selecting. Because of this, some alliances have resembled other procurement methods such as DB. In the future, the boundaries for alliances, PPP, and DB project delivery methods will become better defined.

Now, alliances are formed exclusively between the client and larger parties, since projects are upwards of NZ$50 million. This leaves many smaller companies unable to partake in alliances. Options that are being introduced, developed, or examined are frameworks to enable smaller parties to participate in a similar way. Strategic alliances or partnerships could allow clients to team up to increase in size and to negotiate better deals.


Photo: brendangates, Flickr

# Project Delivery Selection Matrix

## *Colorado Department of Transportation's Project Delivery Selection Process*

CHRISTOFER M. HARPER AND NABIL HADDAD

*Harper is Assistant Professor, Department of Construction Management, Louisiana State University, Baton Rouge, and Haddad is Innovative Contracting Program Manager, Colorado Department of Transportation, Denver.*

The demand to deliver highway design and construction projects in less time and with limited budgets has led transportation agencies like the Colorado Department of Transportation (DOT) to adopt alternative methods of contracting. Highway agencies often use three fundamental project delivery methods: design–bid–build (DBB), design–build (DB), and construction manager–general contractor (CM/GC). Of these methods, Colorado DOT has the most experience with DBB but also has used DB methods since the mid-1990s and CM/GC since 2011.

When starting a project, an agency must determine the appropriate delivery method. Previous research has established that no single delivery method is right for all projects, but each project is best suited to its own appropriate method (*1–2*).

Selecting an appropriate delivery method is a complex decision process. Usually, DOTs make the project delivery decision in the scoping phase, before completing the majority of a project's design. The lack of definition in the design's details—although typical during this early design phase—can present risks to the agency. Therefore, a project delivery selection tool allows agencies to address the limited design available and to evaluate risks at this critical point in project development.

Recent Transit Cooperative Research Program (TCRP) and Airport Cooperative Research Program (ACRP) studies proposed project delivery selection approaches for transit and airport projects. The TCRP approach includes 24 pertinent issues that influence the project delivery decision for transit projects. The selection approach categorizes these factors into five groups: project-level, agency-level, public policy and regulatory, life cycle, and other issues (*3*). Based on the TCRP approach, the ACRP study uses similar factors but also includes operation, flow of passengers, and security issues (*4*). Although these two tools address the factors related to project delivery selection for transit and airport projects, they may not specifically address highway-related projects.

## Development of the Matrix

To assist with the critical process of project delivery method selection, in 2011 Colorado DOT charged the Innovative Contracting Advisory Committee (ICAC) with developing a tool to select an appropriate delivery method for transportation projects occurring throughout the state. Consisting of members from Colorado DOT and academia and representatives from Associated General Contractors, the Federal Highway Administration, the state of Colorado, and the American Council of Engineering Companies, ICAC used its collective experience, as well as previous studies and selection tools, to create the Project Delivery Selection Matrix (PDSM).

ICAC began by conducting two workshops. The

The design–build construction of E-470 express lanes in Colorado expanded the highway.

first workshop convened 27 ICAC members—each offering more than 10 years of professional experience in delivery methods—who reviewed potential factors related to issues that can influence the decision of a delivery method.

First, workshop participants determined critical selection factors. They then identified opportunities and challenges for each delivery method, corresponding to the 13 factors that had a major impact on the delivery selection for highway projects. The information collected from this workshop was distributed to all ICAC members for review and comments. After rigorously analyzing comments and suggestions, workshop participants agreed to streamline the process by consolidating five of the 13 factors that overlapped. As a result, the selection matrix featured eight selection factors and the associated opportunities and challenges for each delivery method.

ICAC then conducted a second workshop, which included many of the participants from the first workshop, to discuss the information for the project delivery selection factors. Participants in the second workshop strongly agreed that the eight selection factors identified in the first workshop were sufficient to include in the PDSM. The eight selection factors were classified into primary and secondary factors:

- Primary project delivery selection factors
  1. Project complexity and innovation
  2. Delivery schedule
  3. Project cost considerations
  4. Level of design
  5. Initial project risk assessment
- Secondary project delivery selection factors
  6. Staff experience and availability
  7. Level of oversight and control
  8. Competition and contractor experience

A final version of the PDSM was developed and tested with several Colorado DOT projects in different regions of the state. Using projects in different regions allowed various agency staff to be exposed to the new tool and for developers to gain feedback from potential users. Several refinements occurred between the initial and current versions of PDSM, now used regularly by Colorado DOT.

## Three-Stage Approach

Figure 1 (page 36) presents a flowchart of the PDSM approach that Colorado DOT has used for 25 highway transportation projects since 2011. This approach encompasses three stages:


Photo: Bidgee, Wikimedia

High complexity, a need for innovation, and identified project risks led Colorado DOT to choose a CM/GC approach to widening I-70's twin tunnels.

- Stage 1: listing project attributes, reviewing project goals, identifying project constraints, and discussing project risks;
- Stage 2: assessing the primary selection factors; and
- Stage 3: conducting a pass–fail analysis of the secondary factors and selecting the appropriate delivery method.

During Stage 1, decision makers review and list specific project attributes that could contribute to the selection of a delivery method and develop a set of project goals. Understanding and aligning a team on project goals and constraints helps decision makers identify opportunities and challenges in each delivery method.

In Stage 2, decision makers evaluate opportunities and challenges of each delivery method against the first four primary factors. If this evaluation process indicates an appropriate delivery method, they perform an initial project risk assessment (fifth primary factor) on that specific delivery method. If no clear indication emerges for any of the potential delivery methods, then an initial risk assessment is conducted for all delivery methods.

For Stage 3, once an appropriate delivery method is determined based on the risk assessment, a pass–fail analysis of secondary factors completes the entire project delivery selection process. By the end of this stage, the selection team usually has a clear choice for a delivery method. If not, the decision makers need to reanalyze all three stages more rigorously.

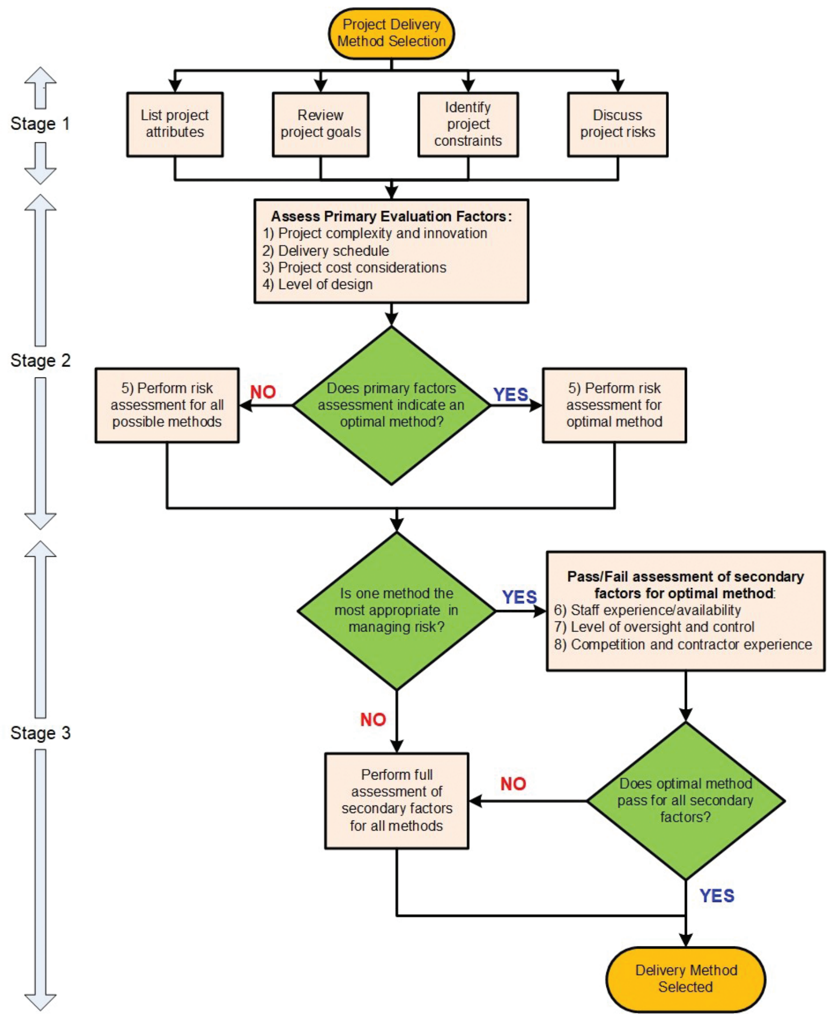



**FIGURE 1 Project delivery selection matrix approach.**

| PROJECT DELIVERY METHOD OPPORTUNITY/OBSTACLE SUMMARY | | | |
|---|---|---|---|
| | DBB | DB | CMGC |
| **Primary Selection Factors** | | | |
| 1. Project Complexity & Innovation | + | ++ | + |
| 2. Project Delivery Schedule | - | ++ | + |
| 3. Project Cost Considerations | - | + | + |
| 4. Level of Design | - | ++ | ++ |
| 5. Risk Assessment | X | ++ | + |
| **Secondary Selection Factors** | | | |
| 6. Staff Experience/Availability (Agency) | | Pass | |
| 7.Level of Oversight and Control | | Pass | |
| 8. Competition and Contractor Experience | | Pass | |

**FIGURE 2 Example project delivery selection summary.**

## Using the Matrix

The process begins with blank forms for each of the eight selection factors. A Colorado DOT selection team, including a facilitator, works together to complete the forms by first discussing, evaluating, and documenting project attributes, goals, and constraints. Then, based on the project attributes, goals, constraints, and an initial risk discussion, the project team members 1) evaluate the primary selection factors and 2) perform an initial risk assessment by discussing and documenting specific opportunities and challenges, called considerations, against the selection factors.

The selection team summarizes their findings for each selection factor by rating the delivery method as most appropriate (++), appropriate (+), least appropriate (–), fatal flaw (×), and not applicable (NA). The project team documents their findings in the Project Delivery Method Opportunity and Obstacle Summary table, as shown in Figure 2 (below).

Finally, the selection team performs a pass–fail analysis of the three secondary factors to check that the appropriate delivery method from the primary factors is appropriate for all the selection factors.

After completing each selection factor evaluation, the selection team can consult checklists of general considerations for each selection factor, provided as an appendix. To maximize the benefits of this approach, however, the project team uses the blank forms and discusses their own considerations before referencing the checklists. The objective of the checklists is to ensure that the project team members do not miss any common issues in the evaluation process, but they are not all-inclusive lists.

At the completion of Stage 3, the project team documents the process and the reasoning for the final decision. By creating a documented report, Colorado DOT ensures a defensible delivery decision for justification and later reference. The documentation then serves as the evidence for using a specific delivery method and assists in investigating the lessons learned at the project's conclusion.

## References


1. Ibbs, C. W., Y. H. Kwak, T. Ng, and A. Odabasi. Project Delivery Systems and Project Change: Quantitative Analysis. *Journal of Construction Engineering and Management*, Vol. 129, No. 4, 2003, pp. 382–387.
2. Love, P. E. D., D. J. Edwards, Z. Irani, and A. Sharif. Participatory Action Research Approach to Public-Sector Procurement Selection. *Journal of Construction Engineering and Management*, Vol. 138, No. 3, 2012, pp. 311–322.
3. Touran, A., D. D. Gransberg, K. R. Molenaar, K. Ghavamifar, D. J. Mason, and L. A. Fithian. *TCRP Report 131: A Guidebook for the Evaluation of Project Delivery Methods*, 2008.
4. Touran, A., D. D. Gransberg, K. R. Molenaar, P. Bakhshi, and K. Ghavamifar. *ACRP Report 21: A Guidebook for Selecting Airport Capital Project Delivery Methods*, 2009.

Photo: Alejandro C, Flickr

Los Angeles Union Station, one of the five design–build trial projects chosen by the Federal Transit Administration.

TCRP REPORT 131

# Project Delivery Method Selection Tool for Transit Projects

ALI TOURAN AND ILDEFONSO BURGOS

*Touran is Professor, Department of Civil and Environmental Engineering, Northeastern University, Boston, Massachusetts, and Burgos is Assistant Vice President, Project Delivery, Amtrak, Philadelphia, Pennsylvania.*

In 2008, TRB published *Transit Cooperative Research Program (TCRP) Report 131: A Guidebook for the Evaluation of Project Delivery Methods* to assist transit agencies in evaluating and selecting the most appropriate project delivery method for their projects and in documenting their decision via a project delivery decision report (*1*). One of the main motivations for the research was to improve the project delivery process using methods other than the traditional design–bid–build (DBB) approach.

Until the early 1990s, DBB was the main method of delivering transit projects. In 1992 the Federal Transit Administration (FTA) initiated the Turnkey demonstration program and selected five projects for design–build (DB) implementation (2), allowing the agency to experiment with DB for the first time: the Los Angeles Union Station Intermodal Terminal, Baltimore Light Rail Transit in Maryland, San Juan TrenUrbano in Puerto Rico, Bay Area Rapid Transit in San Francisco, and Hudson–Bergen Light Rail in New Jersey.

The Federal Acquisition Reform Act of 1996 explicitly allowed the use of DB in federally funded projects. Consequently, the use of construction manager–general contractor methods also was allowed; by the early 2000s, alternative project delivery methods for procuring transit projects were commonplace. Under these circumstances, TCRP funded a research project for developing a system that allowed the transit project owner to evaluate the characteristics of a project under consideration and to select the best delivery option. The delivery methods considered in the published guidebook were determined to be acceptable to FTA (*1*).

## Characteristics of Transit Projects

### *Challenges*

Capital transit projects—especially rail projects—usually are more complex than a typical roadway or bridge project. They often are larger and built in major urban population centers, with the increased

Photo: Bastian, Flickr

Delivery of transit rail projects in urban areas—like the Powell Street Station in downtown San Francisco—can be more complex than other projects.

complexity of dealing with various stakeholders. For that reason, the capacity of various delivery methods to handle project stakeholders and project planning becomes a major decision criterion. Some additional challenges in transit projects include the following:

1. **Working in active environments**. This requires coordination with the railroad's hours of operation and may affect project schedules if off-hours work was not considered in advance.

2. **Cutover to live systems**. Working to connect a new system with an existing system has its own challenges. In the case of the Dulles Corridor Metrorail Project in metropolitan Washington, D.C., the existing line and new line each had different train-control technologies. This required extensive outages and system integration tests at the merging point.

3. **Lack of standard specifications**. Some transit or rail organizations lack standard specifications and must depend on other industry standards to develop project-specific standards for their own projects. In some instances, differences between parties are hard to reconcile.

4. **Control of the construction contract**. In some projects, the owner of the contract is not the future owner of the asset. For example, the Dulles Corridor Metrorail Project's construction contract is managed by the airport authority that oversees Dulles International Airport, the end-of-line station, rather than by the transit agency that owns and operates the line itself. The transit agency is responsible for oversight, however.

Fixed guideway, or rail, projects consist either of a single contract or of multiple contracts, depending on the project's size. With a single contract, a general contractor usually is the one to perform major functions, such as civil and structural work, and to subcontract other elements, such as power and train control systems. Multiple contracts often involve different contractors who are required to work closely with each other.

Photo: Fairfax County/Stephen Barna, Flickr

The Greensboro Station on the new Dulles Corridor serves Dulles International Airport in Virginia. The rail contract is managed by the Metropolitan Washington Airports Authority instead of by the local transit agency.

In many rail projects, several large contractors work in close proximity of each other; in many commuter rail projects, the owner also may have to use and work with the freight lines that share the track under construction.

***Unique Needs***

Another distinguishing characteristic of transit projects is that they may involve many architectural features that extend beyond the scope of a normal engineered project. These features require a range of professionals, from architecture to interior design. The integration of "vertical" construction features—parking structures and transit stations—with "horizontal" construction features—track bed, bridges, and roadway elements—necessitates a comprehensive set of design and construction services that are not normally found in roadway and bridge projects. Consequently, coordination between various parties and stakeholders becomes critical for transit projects to be at all successful or feasible.

Finally, because transit projects usually are not money makers like toll roads or tunnels, the case for public–private partnerships (PPPs) is more difficult to make, as marketing the project to potential bidders is more complicated.

## Owner Objectives and Pertinent Issues

*TCRP Report 131* is based on a comprehensive analysis of relevant literature across all types of capital projects and interviews with several transit project owners in which they identified the objectives and factors affecting their chosen delivery method. Transit agencies have different motivations when selecting an alternative delivery method.

The research concluded that no single project delivery method was superior to all others and that transit agencies need to analyze the characteristics of each project carefully, seeking the project delivery method whose benefits align most closely with project requirements. According to face-to-face interviews with project directors and managers, the most

Photo: Joshua Goodwin, Wikimedia

Transit projects often involve unique architectural challenges. The College Park University Metro station near Washington, D.C., integrates vertical construction—parking garages—with horizontal construction, such as tracks.


Photo: Isaac Kim, Wikimedia

Union Station in Denver, Colorado, redesigned with an open-air train hall, is part of the city's massive expansion of bus, commuter, and light-rail services using PPPs for design and financing.

important reasons for selecting a delivery method other than the traditional DBB include

◆ Reducing, compressing, or accelerating the project delivery period;
◆ Encouraging innovation;
◆ Promoting early budget establishment and early contractor involvement; and
◆ Addressing flexibility needs during the construction phase.

The research also identified a comprehensive set of factors for consideration when deciding on the delivery method. These factors, called pertinent issues, are organized under five categories:

1. **Project-level issues**. Issues relevant to the specific project under consideration—for example, size, cost, schedule, risk, and LEED certification.
2. **Agency-level issues**. An agency's experience with alternative delivery methods and workforce requirements; agency goals regarding capital improvement.
3. **Regulatory and policy issues**. The legality of the delivery method in a certain locality, labor unions, and mandated social programs.
4. **Life-cycle issues**. Maintainability, sustainable design, and construction goals.
5. **Other issues**. Claims and adversarial relationships caused by various delivery methods.

## Delivery Selection

After considering the owner's objectives and the pertinent issues affecting the project, a three-tiered approach is suggested for the selection process:

◆ Tier 1: Analytical approach.
◆ Tier 2: Weighted matrix approach.
◆ Tier 3: Optimal risk-based approach.

The general idea is for the decision maker to go through these tiers depending on the size and complexity of project and the level of competition among delivery methods. For example, after going through Tier 1, it is possible that one or two delivery methods will be considered infeasible and eliminated from consideration, leaving only the best option on the table.

### *Tier 1*

This is the starting point for using *TCRP Report 131*. First, the owner carefully describes project characteristics and goals and then considers relevant factors to decide if any delivery method should be eliminated from further consideration. This approach creates a "go" or "no go" decision point for every project delivery method. After this stage, decision makers examine the list of pertinent issues and evaluate the advantages and disadvantages of each delivery method against each issue.

These issues can be used as a checklist in the

Photo: MTA New York

The newly opened World Trade Center Transportation Hub in New York City, operated by Port Authority Trans-Hudson, is an example of a transit project in which the complexity of architectural features loomed large in the face of other engineering challenges.

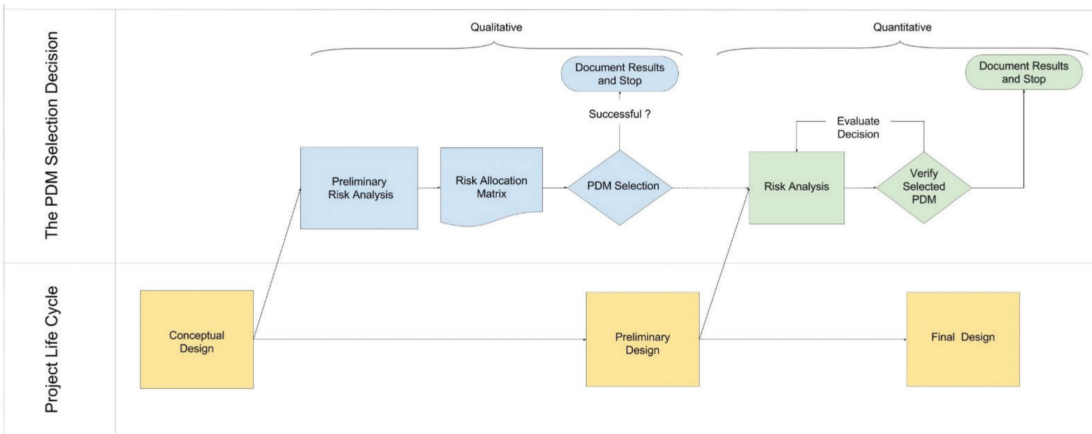



**FIGURE 1 Overview of Tier 3 Approach (*1*).**

analysis, and several may not be applicable to every project. This qualitative approach allows the decision-maker to come up with a summary of advantages and disadvantages of each delivery method for the project under consideration. The decision-maker then will review the summary and can decide which method is most appropriate.

### *Tier 2*

The Tier 2 method, used in the absence of a definitive outcome after Tier 1, is based on scoring each delivery option against a set of selection factors in a weighted matrix. For Tier 2 implementation, decision makers work with delivery methods that survived the Tier 1 process and develop a set of between four and seven selection factors based on overall project and agency goals and the most critical pertinent issues discussed in Tier 1.

The importance of each selection factor is established by assigning a weight to each factor after consultation and collaboration among project team members. The decision makers assign a numerical score to each selection factor for the delivery method being evaluated; using the selection factors' scores and their assigned weight, a total score for each delivery method can be calculated and compared. The method with the highest score is the most appropriate for the project.

### *Tier 3*

In the past 10 years, FTA has used probabilistic risk analysis to establish budget and schedule for large New Start transit projects. The Tier 3 selection approach is a risk-based method that leverages the probabilistic cost estimating methods that have emerged in transit and highway agencies.

Tier 3 is used when Tiers 1 and 2 have not identified a clear choice for a delivery method. In its most detailed form, Tier 3 is feasible only if a comprehensive risk assessment has already been conducted on the proposed project. Figure 1 (above) provides an overview of the methodology.

The first step under Tier 3 is to develop a Risk Allocation Matrix in which the major project risks under competing delivery methods are listed in a matrix and compared qualitatively. If a best choice does not emerge, then the outcome of the quantitative risk assessment for the project can be used to evaluate each delivery method.

In such a case, only risks that are sensitive to the choice of project delivery method are considered and quantified probabilistically. The total negative impact of risks under each method then is compared.

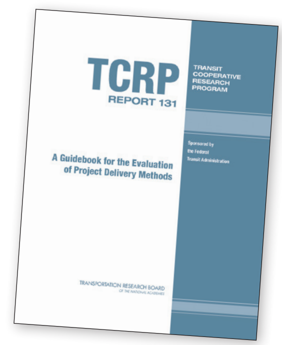
## Conclusion

The selection system framework described here and in *TCRP Report 131* outlines how to document the decision in the form of a project delivery decision report, which gives a clear and defensible documentation of the decision process. The framework developed is quite flexible—each transit agency can tailor the framework to fit its needs. In fact, even highway agencies and other modal agencies can use the approach. The Airport Cooperative Research Program published a similar document for airport projects.

This documentation is extremely important when explaining the use of a project delivery decision to project stakeholders, particularly if an alternative delivery method not common to the project locality is being suggested.


## References

1. Touran, A., D. D. Gransberg, K. R. Molenaar, K. Ghavamifar, D. J. Mason, and L. A. Fithian. *TCRP Report 131: A Guidebook for the Evaluation of Project Delivery Methods*, 2008.
2. Turnkey Demonstration Program. *Federal Register*, Vol. 57, No. 157, August 13, 1992.
3. *Project and Construction Management Guidelines*. Federal Transit Administration, Washington, D.C., 2016.


*TCRP Report 131: A Guidebook for the Evaluation of Project Delivery Methods*, is available from the TRB online bookstore, www.mytrb.org/Store/Product.aspx?ID=6047; to view the book online, go to www.trb.org/Publications/Blurbs/161690.aspx.

# Georgia's Path to Innovation

## Alternative Delivery Breathes Life into State Transportation Infrastructure

DARRYL D. VANMETER

*The author is Assistant P3 Director and Administrator for the Office of Innovative Delivery, Georgia Department of Transportation, Atlanta.*

The state of Georgia makes significant investments in transportation and infrastructure, but the Georgia Department of Transportation (DOT) does not work alone. With leading academics and expert practitioners joining the effort, the agency's use of alternative delivery transformed the approach to infrastructure improvements statewide. Georgia DOT uses alternative methods to compress and accelerate the delivery of projects from engineering through construction through public–private partnerships (PPPs) and design–build (DB) methods. As with most DOTs, the delivery of capital infrastructure has deployed a prescriptive design–bid–build approach. Alternative delivery generally affords the private sector much more opportunity to engage in the design and innovate in delivery.

### Problem

Considering Georgia's population growth and aging infrastructure, new ways were needed to tackle the delivery of transportation projects that would serve the state and its citizens. In 2003 and 2004, Georgia passed key legislation that opened new pathways to infrastructure project delivery.[1] The PPP legislation allowed Georgia DOT to accelerate projects through alternative delivery and private financing. DB legislation allowed partnerships between engineering and contracting firms to take place earlier in the development process.[2] These approaches contrasted sharply with the usual way Georgia DOT functioned, however. With nearly 100 years of infrastructure delivery practices vested in the old way of doing business combined with highly complex, important projects, it was a challenge for the agency to tackle a different approach.

Georgia DOT believed a research-focused approach would determine and document the best way forward. With the high level of interest for Georgia DOT to exercise alternative delivery methods, the agency set out to become more knowledgeable and proficient not just in methods but also in the next generation of best practices in procuring, managing, and delivering some of the most complex projects in its history.

Once Georgia DOT was able to procure PPP and DB contracts, the private sector could compete for a broader array of services, bringing value-added innovations that strategically leveraged available funds in new ways. The new laws also challenged the agency to develop the procedures needed to use these tools.

Although early experimental projects led to some success, Georgia DOT not only wanted to perform one-off efforts but also to strengthen its growing institutional knowledge with research, ensuring long-term delivery reliability within the construction industry. A key factor to success in developing the agency's alternative delivery practices was preserving creditability and competence to procure and manage large-scale projects.

### Solution

#### *Research*

To build institutional knowledge for success, Georgia DOT first reflected on its objectives and considered the knowledge of prevailing trends in the industry, tapping the research community and collaborating with practitioners from Florida, Texas, North Carolina, Virginia, and other states. Georgia DOT researchers also partnered with such experts as Baabak Ashuri of the Georgia Institute of Technology (Georgia Tech), who is known for develop-

The design–build–finance Northwest Corridor project in metropolitan Atlanta is scheduled to open in late summer 2018.

Photo: Georgia DOT

1 Georgia Code § 32-2-78–80 (2017).

2 Georgia Code § 32-2-81 (2017).

ing best practices in construction. Ashuri conducted research on current and emerging alternative delivery approaches, including a full scale of considerations from project selection to procurement design and execution to effective complex project management.

Georgia DOT used its authority to advance alternative delivery of its program, managing and building on the new knowledge gleaned by experience and insights from multiple DOTs that were leading similar efforts. Along with practicing alternative delivery, a forward-looking Georgia Tech research project helped document best practices. The study gathered knowledge from other states using alternative delivery methods, synthesized the information, and developed tools and procedures to inform good policy and practice.

Photo: Georgia DOT

By facilitating alternative project delivery methods, Georgia DOT hoped to enhance individual projects as well as its body of institutional construction knowledge.

***Best Practices***

The resulting report, *Recommended Guide for Next Generation of Transportation Design–Build Procurement and Contracting in the State of Georgia*, consolidated and compared practices and identified practical best practices in alternative delivery (*1*). The report helped crystallize the idea that the total project delivery approach—early agency due diligence, procurement method selection, and varied contract management approaches—can save not only time and money, but also can facilitate a competitive environment to help reach agency goals.

One of the most significant findings is the recognition that an objective assessment of the project characteristics must be performed to determine a project's fitness for alternative delivery. This exercise inherently forces the facility owner to decide on the true goals for any given infrastructure project, a step that otherwise takes a back seat to the routine activities required by the bid process.

Another key finding—not unique to this research, but nonetheless important—is that the odds for success are improved by an award process that rewards innovation by considering not only the bid but also the technical merits of the bidder's proposal. Called "best value" in the transportation industry, this is a shift from the customary process of awarding solely on the basis of lowest bid.

In 2013, the *Recommended Guide* was named a Sweet Sixteen high-value research project by the American Association of State Highway and Transportation Officials. A major change to Georgia DOT practices included chartering a specialized unit to house, procure, and manage its alternative delivery program. This allowed the opportunities that only specialized procurement could provide but also allowed the traditional construction bidding process—still a valuable delivery method—to continue.

***Collaboration***

Meanwhile, opportunities arose through the active participation of Georgia DOT representatives in various professional organizations, such as the TRB Standing Committee on Project Delivery Methods and a project oversight panel for the second Strategic Highway Research Program (SHRP 2). By doing this, Georgia DOT researchers were able to collaborate and engage with other practitioners at the national level, bringing value and maturity to Georgia's approach to this delivery method—as well as information to help adapt this approach when there is little practical and formal information to go by. Georgia DOT developed a *Design–Build Manual* to capture this knowledge, and elements of the manual often were employed as a direct result of engagement with lessons learned from other DOTs.

Georgia DOT and others benefited from the connections to the broad network of practitioners with similar duties and perspectives that were provided by TRB, National Cooperative Highway Research Program, and SHRP 2. In 2015, SHRP 2 published *Project Management Strategies for Complex Projects*, which revisited the scope, schedule, and other dimensions of project management and outlined practical strategies, methods, and tools for complex project management (*2*). Georgia DOT adapted information from the guide into its *Design–Build Manual*.

By implementing research products and maintaining a healthy, transparent record of lessons learned from alternative delivery options, Georgia DOT has been able to match best practices to on-the-ground needs. The resources, experience, and the innovation-fostering mindset that these research projects have provided helped to create a knowledge-sharing environment within Georgia DOT, empowering practitioners to apply this knowledge to ever-changing project needs. New methods always

Photo: Georgia DO


Georgia DOT selected Northwest Express Roadbuilders from three bidders to deliver the NWC project.

come with challenges, however, such as challenging the way an institution usually works or deploying a new management approach that includes risk and complexity in decision making.

### *Cost Savings*

The Northwest Corridor (NWC) project was awarded as a design–build–finance contract in 2013 and will open this year, and the Transform 285/400 interchange improvement project in metropolitan Atlanta is scheduled for completion in 2020. Both projects are on a path to successful delivery, and through DB, over-the-shoulder plan reviews, and market competition, have produced hundreds of millions of dollars of savings. The NWC project has saved $150 million and the Transform 285/400 project has saved more than $370 million.[3]

A large part of these savings are attributed to alternative technical concepts (ATCs) such as innovative "equal or better" structure techniques to add value and reduce amount of structure-related costs that were otherwise not allowed by the solicitation. By using ATCs, contractors can engage Georgia DOT confidentially before the final bid is due and, through a structured process, can employ creative thinking to help them win the job.

Although the ATC approach is not formalized as a traditional delivery process at Georgia DOT, the influx of innovation via this method adds value to the project delivered and allows the agency to consider implementing innovative ideas in its regular program standards, once the ideas become Georgia DOT property post let. Ultimately, the ATCs become the project—as evidenced by the nearly complete NWC project.

[3] Based on final Georgia DOT DB construction estimates.

## Benefits

Armed with lessons learned, a respectable track record, and practical research results, Georgia DOT is turning alternative delivery into a statewide practice, particularly with the new Major Mobility Investment Program (MMIP), which sets aside $11 billion for 11 initial projects statewide to be under contract by 2026.

MMIP is an unprecedented investment in Georgia transportation infrastructure for widening, express lanes, interchanges, and commercial vehicle lanes: four projects will take a DB approach, four projects will be design–build–finance, and three projects will be design–build–finance–operate–maintain. These projects will add more than 300 new lane miles of capacity, improve freight movement, provide operational improvements, enhance safety, and decrease travel time. To deliver this program on schedule and on budget, reliably and credibly, is highly important to Georgia DOT.

The successful use of repeatable best practices gives the agency confidence in delivery of MMIP, which is not achievable on the same accelerated timeline by traditional delivery methods. For example, a one-month delay of MMIP would cost an additional $20–30 million.[4] Traditional delivery also would not be able to foster the necessary innovations for success, such as leveraging resources and financing approaches for large-scale projects.

Borne out of a well-developed initiation period, alternative delivery has become a robust, trend-setting practice at Georgia DOT, beginning with new PPP legislation and continuing through MMIP and beyond. The agency found success by investing in early research, garnering lessons learned, and framing each new partnership as a value-building experience.

Public transportation agencies have an opportunity to bring the innovation and expertise of the private sector into alignment with government objectives. As more departments utilize alternative delivery, DOTs across the nation can benefit from fast, efficient transportation renewal.

[4] MMIP has an assumed 4% annual escalation cost.

Editor's Note: Appreciation is expressed to Nelson Gibson and Inam Jawed, Transportation Research Board, for their efforts in developing this article.

## References


1. Ashuri, B. and H. Kashani. *Recommended Guide for Next Generation of Transportation Design–Build Procurement and Contracting in the State of Georgia*. Report FHWA-GA-1023. Office of Research, Georgia Department of Transportation, 2012.
2. Shane, J., D. Gransberg, and K. Strong. SHRP 2 Report S2-R10-RW-1: *Project Management Strategies for Complex Problems*. Transportation Research Board, 2015.


Suggestions for Research Pays Off topics are welcome. Contact Stephen Maher, Transportation Research Board, Keck 486, 500 Fifth Street, NW, Washington, DC 20001; 202-334-2955; smaher@nas.edu.

# CALENDAR

## TRB Meetings

### July

22–24 Geospatial Data Acquisition Technologies in Design and Construction
*Sacramento, California*

23–25 GeoChina International Conference*
*Hangzhou, Zhejiang, China*

29–Aug. 1 Association for Commuter Transportation International Conference*
*Anaheim, California*

### August

1–3 2018 Summerail Conference*
*Chattanooga, Tennessee*

7–9 3rd International Greenshields Conference on Traffic Flow Theory
*Woods Hole, Massachusetts*

8–9 National Household Travel Survey Data for Transportation Applications Workshop
*Washington, D.C.*

22–24 16th National Tools of the Trade Transportation Planning Conference
*Kansas City, Missouri*

28–31 National Hydraulic Engineering Conference*
*Columbus, Ohio*

### September

5–6 Implementing a Freight Fluidity Performance Measurement System
*Washington, D.C.*

10–13 TRB Workshop at the 69th Highway Geology Symposium*
*Portland, Maine*

16–18 Disrupting Mobility Summit*
*Cambridge, Massachusetts*

19–21 Annual Conference of the Florida Association of Environmental Professionals*
*Orlando, Florida*

25–27 Managing Roadways and Transit
*Bellevue, Washington*

30–Oct. 3 23rd National Conference on Rural Public and Intercity Bus Transportation
*Breckenridge, Colorado*

### October

4–6 International Symposium on Emerging Trends in Transportation*
*Waikiki Beach, Hawaii*

9–10 Transportation Resilience Innovations Summit and Exchange
*Denver, Colorado*

22–24 European Road Congress: Corridors for Shared Prosperity and Sustainable Mobility*
*Dubrovnik, Croatia*

### November

5–7 1st International Conference on Stone Matrix Asphalt*
*Atlanta, Georgia*

7–9 Forum on the Impact of Vehicle Technologies and Automation on Users: Vulnerable Road Users and Driver Behavior and Performance*
*Iowa City, Iowa*

24–28 GeoMEast International Conference: Sustainable Civil Infrastructures—Structural Integrity*
*Cairo, Egypt*

27–28 6th Florida Automated Vehicles Summit*
*Tampa, Florida*

### December

2–5 6th International Symposium on Nanotechnology in Construction*
*Hong Kong*

## Upcoming Webinars

### July

23 Port Data Portals for 21st-Century Shipping

26 Strategic War Games

31 Bridge Superstructure Tolerance to Foundation Movements

### August

2 Cell Phone Location Data for Travel Behavior Analysis

6 Construction of Mass Concrete Transportation Infrastructure

7 Current and Evolving Practices in Asset Management for Highway Agencies

14 Emergency Preparedness Against Infectious Diseases on Public Transit

15 Optimal Replacement Cycles for Highway Operations Equipment

Additional information on TRB meetings, including calls for abstracts, meeting registration, and hotel reservations, is available at www.TRB.org/calendar, or e-mail TRBMeetings@nas.edu.

*TRB is cosponsor of the meeting.

# Lily Elefteriadou

*University of Florida Transportation Institute*

As director of the University of Florida (UF) Transportation Institute, Lily Elefteriadou leads a multidisciplinary team of researchers. In a current project funded by the National Science Foundation and the Florida Department of Transportation, Elefteriadou's team is developing methods and tools for joint optimization of signal control and vehicle movement, to improve mobility by exploiting the capabilities of connected and autonomous vehicles.

"We have developed several versions of optimization algorithms and data fusion algorithms, which we have tested in a closed-course environment with UF's autonomous vehicle using dedicated short-range communications," Elefteriadou comments. Through simulations and field testing, the team is refining the algorithms, with the goal of implementing the methods and tools at a signalized intersection on the UF campus in Gainesville.

"In order for research advancements to materialize, multidisciplinary and multiagency collaboration is more important than ever."

Elefteriadou also is leading a collaboration with Florida DOT and the City of Gainesville to develop I-STREET, a real-world testbed located on UF's campus and on the surrounding highway network. "I-STREET will deploy and evaluate many advanced technologies, including connected and autonomous vehicles, smart devices, and sensors," she notes. "It will also develop and apply novel applications to enhance mobility and safety. These technologies and their application will work within the existing highway network and will accommodate the presence of conventional vehicles."

I-STREET's first project will be the deployment of an autonomous bus, which will operate in the downtown Gainesville area starting in late summer. "This will be the first deployment in the country to operate multiple vehicles in mixed traffic and offer transportation to the public," adds Elefteriadou.

Elefteriadou received a graduate diploma in surveying and environmental engineering from Aristotle University of Thessaloniki, Greece, and a master's degree in civil engineering from Auburn University in Alabama. At the Polytechnic University of New York University, she wrote her doctoral dissertation on modeling breakdowns at freeway–merge junctions. In 1994, Elefteriadou joined the faculty at Pennsylvania State University's Department of Civil and Environmental Engineering and by 2002 had become associate director of the Pennsylvania Transportation Institute (PTI).

After serving nearly a year as interim director of PTI, Elefteriadou moved to Florida to lead the Transportation Institute at UF, then called the Transportation Research Center. She also has served as professor of civil and coastal engineering.

"Research is essential to understanding the world and helping to improve lives," Elefteriadou comments. She first joined the Transportation Research Board's (TRB's) Standing Committee on Truck Size and Weight in 1996. She was a longtime member of the Standing Committee on Traffic Flow Theory and Characteristics and now is a member of the Operations and Preservation Group.

In 2003, Elefteriadou joined the Standing Committee on Highway Capacity and Quality of Service. The committee provides guidance on the research and enhancement of the *Highway Capacity Manual*, a fundamental reference that details the procedures and guidelines for the measurement, analysis, and interpretation of data quantifying highway capacity and quality of service. She served as chair of the committee from 2010 to 2016.

"This is a great time to be involved in transportation research, as many new and evolving technologies have the potential to revolutionize the way we live and travel," Elefteriadou affirms, emphasizing the importance of collaboration across disciplines and organizations. "In order for these advancements to materialize, multidisciplinary and multiagency collaboration is more important than ever: transportation engineers, computer scientists, mechanical engineers, industry representatives, public servants, and academics all need to work together. I am finding through my work with automated vehicles and the I-STREET testbed that we all have a lot to learn from each other."

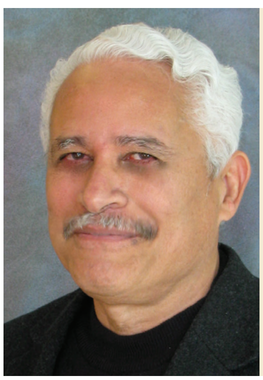
In 2001, Elefteriadou received a Fulbright grant to study at the Technical University Delft in the Netherlands. She also is the recipient of the 2015 James Laurie Prize from the American Society of Civil Engineering and the 2015 Ethel S. Birchland Lifetime Achievement Award from the American Road and Transportation Builders Association. At TRB, she received a 2000 Fred Burggraf Award for excellence in transportation research by young researchers, for her paper "Development of a New Procedure for Evaluating the Horizontal Alignment Design Consistency of Two-Lane Rural Highways."

# Delmar Salomon

*Pavement Preservation Systems LLC*

Delmar Salomon's 36-year career has spanned the fields of research and development, chemical industry, quality, and asphalt materials, and the countries of Canada, Mexico, and the United States. The president of Pavement Preservation Systems LLC, which he founded in 2005, Salomon focuses on technology transfer, modified asphalt, pavement preservation, and technical marketing in the asphalt field, as well as the promotion of processes that contribute to improving asphalt materials for long-lasting pavements. Pavement Preservation Systems works closely with private industry, governmental agencies, professional organizations, and universities in North and Latin America.

After receiving a Ph.D. in chemistry from Worcester Polytechnic Institute in Massachusetts, Salomon worked at the University of Calgary in Alberta, Canada, as a postdoctoral fellow. After that, he spent a year as an exchange scientist in the Radiation Laboratory at the University of Notre Dame in Indiana, examining laser multiphoton ionization spectroscopy.



"Be a champion for implementing research."

Salomon moved to Mexico in 1979, joining Industrias Negromex in Cuernavaca as Manager of Product Development. He successfully developed two new industrial products and worked on pilot projects that resulted in two new commercial products. He then returned to Canada to work as the project coordinator at the University of Calgary, overseeing the Heavy Oil Sands Research Program and working with the university and major oil companies. Research topics included low-temperature oxidation of asphaltenes in the Alberta tar sands.

In 1987, Salomon was invited to work as a manager for the polymer membrane fuel cell development program with Ballard Advanced Materials in Vancouver, Canada. There, he worked to identify low-cost polymers to convert to conducting low-cost membranes for fuel cells. He was then invited to be project manager at Bovar Engineered Products–Western Research in Calgary, focusing on commercializing a sulfur analyzer for emission control for pulp and paper recovery furnaces. In the process, he identified and demonstrated a new online technology for the pulp and paper industry.

Throughout his career, Salomon has worked and advocated for the importance of research. "Be a champion for implementing research," he affirms.

Salomon was invited by GIRSA, Inc., (now Dynasol), an elastomeric polymer marketing company in Houston, Texas, to be the technical and quality manager for elastomeric polymers sold into the asphalt industry. GIRSA obtained ISO Quality Certification under Salomon's leadership. In 1996, he joined Idaho Asphalt Supply, Inc., as technical, quality, and purchasing manager, implementing technical development such as formulations and research and obtaining accreditation for the company's laboratory. He also optimized plant processes and instituted a quality management program.

Salomon recently demonstrated the use of nondestructive testing of asphalt mixtures by the use of portable infrared spectroscopy to evaluate asphalt mixtures in the field. This was demonstrated jointly with Iliya Yut of the University of Connecticut.

"We demonstrated this in the field with an Idaho Transportation Department project in 2015 and 2016, Improving Quality Control of Asphalt Pavement with Recycled Asphalt Pavement Using a Portable Infrared Spectroscopy Device," Salomon notes. This infrared application now is American Association for State Highway and Transportation Officials Provisional Standard TP 128, Standard Method of Test for Evaluation of Oxidation Level of Asphalt Mixtures by a Portable Infrared Spectrometer.

Salomon also has had three consensus standards approved by ASTM International for emulsified asphalt—D7404, D7226, D7229.

"The focus of recent work has been on showing the feasibility of using near infrared spectroscopy for nondestructive testing to measure the aging rate of asphalt materials, similar to what was demonstrated with traditional infrared spectroscopy," Salomon notes, adding that he believes "one cannot manage what one does not measure." The infrared devices will allow quick measurements for a contractor's asphalt job mix formula, production, and final in-place pavement.

"This truly is an opportunity for the industry to follow, or fingerprint, the consistency and quality of an asphalt mixture, from laboratory to production to pavement laydown," he comments.

Affiliated with the Transportation Research Board (TRB) since 1997, Salomon joined the Standing Committee on Asphalt Binders in 2005. He served as chair of that committee from 2008 to 2014. He also served on the TRB standing committees on Pavement Preservation and on Sealants and Fillers for Joints and Cracks.

In 2017, Salomon was named Person of the Year by the Association of Modified Asphalt Producers.

PHOTOS: KAREN FEBEY

**BIKE TO WORK DAY**—Despite a rainy Bike to Work Day on Friday, May 18, many TRB staff rode in to the office—a few even riding more than 10 miles. An annual event, the Washington, D.C., Bike to Work Day features 130 pit stops across the city, sponsored by local businesses and organizations and offering t-shirts, swag, refreshments, and prizes. Pictured are TRB staff members (*first photo*) Robert J. Summersgill, B. Ray Derr, C. Doug English, Katherine A. Kortum, and Ann M. Hartell.

## COOPERATIVE RESEARCH PROGRAMS NEWS


PHOTO: UTAH DOT

### Vehicle Identification Updates

Roadway operations equipment used by transportation agencies for construction, maintenance, incident response, and similar activities operate on all types of roadways, day and night and in all weather conditions. To improve safety, vehicles and equipment must be easily seen and identified. Because of significant technology changes and changes in driver habits, current American Association of State Highway and Transportation Officials guidelines on the lights, colors, and markings of roadway equipment may be outdated.

Texas A&M has been awarded a $600,000, 30-month contract [National Cooperative Highway Research Program (NCHRP) Project 05-24, FY 2018] to develop guidelines for the selection and application of color, retroreflective markings, and lighting.

### Roundabouts Revisited

Since the publication of the second edition of *NCHRP Report 672: Roundabouts: An Informational Guide* in 2010, roundabouts technology has changed, many more roundabouts have been constructed, and roundabouts research has increased. Research to address gaps in roundabout guidance is needed to incorporate new technology, knowledge, and lessons learned.

Kittelson & Associates, Inc., has been awarded a $750,000, 30-month contract (NCHRP Project 03-130, FY 2018) to develop a guide for roundabouts that incorporates updated information and guidance.

PHOTO: LUCAS KLAPPAS, FLICKR

# NEWS BRIEFS

## Hazmat Crash Factors Identified

Crashes involving hazardous materials (hazmat) trucks not only cause catastrophic damage to property, public health, and the environment, they also result in injuries that are more severe than those from crashes caused by other types of trucks.

In a recent study, University of South Carolina researchers analyzed California crash data from 2005 to 2011, provided by the Highway Safety Information System, to identify factors that contributed to injury severity from hazmat truck crashes.

Among 1,173 hazmat truck crashes, major injuries were more prevalent in rural locations than in urban locations and were more likely to involve male drivers. Additionally, crashes that occurred in dark conditions—with or without streetlights—were more likely to result in severe injury.

Conversely, crashes involving drivers 60 years or older and those occurring on higher-speed-limit highways or on flat terrain were associated with decreased probability of major injury.

*—Majbah Uddin and Nathan Huynh, University of South Carolina*

*To read the full report, visit https://doi.org/10.1016/j.ijtst.2017.06.004.*

## Drowsy Driving Prevalent in Crash Data

Although U.S. government statistics show that 1–2 percent of motor vehicle crashes involve drowsy driving, recent studies suggest that these numbers may be closer to 10 percent. Researchers from the AAA Foundation for Traffic Safety (AAAFTS) analyzed data from the second Strategic Highway Research Program's naturalistic driving study (NDS), which gathered data from 3,593 drivers continuously over a three-year period, using in-vehicle cameras and other data collection equipment.

Using NDS video data that showed lapses in attention, lane departures, and eye closures, AAAFTS researchers were able to identify drowsy behavior moments before a crash in approximately 9 percent of all crashes and in nearly 11 percent of severe crashes.


Prior estimates of drowsy driving crashes have relied on police reports from post-crash investigations.

*For more information, visit https://publicaffairsresources.aaa.biz/wp-content/uploads/dlm_uploads/2018/01/FINAL_AAAFTS-Drowsy-Driving-Research-Brief.pdf.*

## Dredged Sediment Useful for Paving

Every year, more than 1.5 million cubic yards of sediment are dredged from Ohio ports, creating a costly disposal problem. Last year, researchers at the Ohio Department of Transportation (DOT) tested sediment dredged from harbors in Toledo and Cleveland to evaluate its potential use as lightweight aggregate (LWA) in embankment backfill and bridge construction.

Although traditional LWA is known to reduce the weight and improve the workability and durability of concrete, its cost is significantly higher than that of conventional aggregates. In their 2018 study, Ohio DOT researchers evaluated the possibility of using dredged sediment as raw LWA material. Examined were the engineering properties of the dredged sediment, including specific gravity, loose and compacted bulk densities, organic impurities, and abrasion resistance. A sustainability measurement was performed to assess cost effectiveness and environmental impacts.

Researchers found that the Toledo samples in particular met construction requirements specified by Ohio DOT—and that the dredged sediment would be cost-competitive and would have less environmental impact than conventional LWA.

*To read the full report, visit http://cdm16007.contentdm.oclc.org/cdm/ref/collection/p267401ccp2/id/16123.*

## Solving the Empty Container Problem

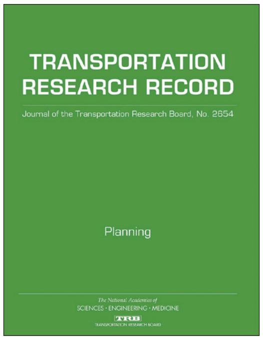
Although significant progress has been made on moving loaded containers efficiently, little change has been made to the ways in which ports reposition empty containers. For example, of the 15.3 million containers moved by the Ports of Los Angeles and Long Beach in 2015, 4.3 million—or 30 percent—were empty.

The "empty container problem," as it is commonly known, was the subject of a recent study by the National Center for Sustainable Transportation. Researchers used flow models, new mathematical formulations, and experimental data to create a new model that decreases both the time and cost of moving containers from their location of use back to port.

The results yielded a reduction in truck miles by 12 percent for single-container truck transport and 55 percent for double-container trucks. Fewer truck trips could substantially reduce congestion and have a lower impact on the environment, researchers note.

*To read the full report, visit https://ncst.ucdavis.edu/project/congestion-reduction-through-efficient-empty-container-movement.*

## TRB PUBLICATIONS




***Planning***
**Transportation Research Record 2654**

Authors present research on various aspects of planning at Grand Teton National Park, Wyoming; the San Francisco Bay area of California; El Paso, Texas; and Colorado—as well as other locations.

*2017. Subscriber category: planning and forecasting. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2654/+.*

***Geological, Geoenvironmental, and Geotechnical Engineering, Volumes 1–3***
**Transportation Research Records 2655, 2656, and 2657**

Identified in these volumes are methods of evaluation and testing for various pavements, asphalts, aggregates, and soils.

*2017. Subscriber categories: Vols. 1 and 3: materials, pavements; Vol. 2: geotechnology, bridges and other structures, materials. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2655/+, https://trrjournalonline.trb.org/toc/trr/2017/2656/+, or https://trrjournalonline.trb.org/toc/trr/2017/2657/+.*

***Intersections of Transportation and Telecommunications***
**Transportation Research Record 2658**

The seven papers in this volume explore modeling for new transportation technologies, case studies for traffic management, and user interaction data from the back end of a smartphone app.

*2017. Subscriber categories: data and information technology, operations and traffic management, passenger transportation, planning and forecasting, public transportation, transportation, general. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2658/+.*

***Statistical Methods and Safety Data and Analysis***
**Transportation Research Record 2659**

The papers in this volume analyze such topics as speed data, bicycle collision modeling, road user volume, and more.

*2017. Subscriber categories: safety and human factors, data and information technology. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2659/+.*

***Operator Education and Regulation; Safe Mobility for Older Persons; Traffic Enforcement; Occupant Protection; Alcohol and Drugs***
**Transportation Research Record 2660**

Authors present research on transportation options for seniors, the delivery of advanced driver assistance systems, pedestrian right-of-way laws, seat belt use, and more.

*2017. Subscriber category: safety and human factors. 2017. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2660/+.*

***Pedestrians***
**Transportation Research Record 2661**

Explored in this volume is research on crosswalks with rapid flashing beacons, scrambled-phase signalized intersections, walkability assessments, crosswalk lighting, and more.

*2017. Subscriber categories: pedestrians and bicyclists, planning and forecasting, safety and human factors. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2661/+.*

***Bicycles***
**Transportation Research Record 2662**

Among the topics explored in these 19 papers are bicycle safety, bikesharing, aggressive driver–bicycle interactions, infrastructure planning, and signalized intersections.

*2017. Subscriber categories: pedestrians and bicyclists, planning and forecasting, safety and human factors. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2662/+.*

***Human Performance, User Information, and Simulation***
**Transportation Research Record 2663**

The papers in this volume present analysis of toll plaza safety features, strategies to assist drivers in automated vehicles, studies on the effectiveness of warning systems on drivers, and more.

*2017. Subscriber category: safety and human factors. For more information, visit https://trrjournalonline.trb.org/toc/trr/2017/2663/+.*

*The TRR Online website provides electronic access to the full text of more than 15,000 peer-reviewed papers that have been published as part of the* Transportation Research Record: Journal of the Transportation Research Board *(TRR) series since 1996. The site includes the latest in search technologies and is updated as new TRR papers become available. To explore TRR Online, visit www.TRB.org/TRROnline.*

***Field Performance of Corrugated Pipe Manufactured with Recycled Polyethylene Content***
NCHRP Research Report 870

This report explores the use of corrugated high-density polyethylene pipes manufactured with recycled content. Also proposed are guidelines for manufacturing these pipes to meet service life requirements.

*2018; 164 pp.; TRB affiliates, $62.25; nonaffiliates, $83. Subscriber categories: construction, hydraulics and hydrology, materials.*

***Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction***
NCHRP Research Report 871

A proposed standard for measuring long-term laboratory aging of asphalt mixtures is presented in this report. This method integrates climate into the method presented in American Association of State Highway and Transportation Officials (AASHTO) R 30.

*2018; 124 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber categories: design, materials, pavements.*

***Contribution of Steel Casing to Single Shaft Foundation Structural Resistance***
NCHRP Research Report 872

This report proposes revisions to the AASHTO Bridge Design Specifications based on testing programs that account for the resistance provided to shaft foundations by concrete-filled steel tubes and reinforced concrete-filled steel tubes.

*2018; 178 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber category: bridges and other structures.*

***Guidebook to Funding Transportation Through Land Value Return and Recycling***
NCHRP Research Report 873

Offered is guidance on ways to mobilize portions of property-value increases to fund maintenance and operations as well as investment in infrastructure.

*2018; 152 pp.; TRB affiliates, $62.25; nonaffiliates, $83. Subscriber categories: administration and management, finance, policy.*

***Transportation Research Thesaurus: Capabilities and Enhancements***
NCHRP Research Report 874

Presented is a structured vocabulary of terms used by TRB and other transportation organizations to support indexing, search, and retrieval of technical reports, research documents, and other transportation information.

*2018; 112 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber categories: administration and management, data and information technology, education and training.*

***Practices for Preventing Roadway Departures***
NCHRP Synthesis 515

This synthesis report summarizes practices used by state departments of transportation to prevent roadway departure crashes and identifies the data-driven advantages and disadvantages of these practices.

*2018; 58 pp.; TRB affiliates, $45; nonaffiliates, $60. Subscriber categories: highways, design, safety and human factors.*

***Tack Coat Specification, Materials, and Construction Practices***
NCHRP Synthesis 516

This volume offers guidance to state agencies on reevaluating the specifications, materials, and placement practices used in relation to tack coats on asphalt.

*2018. Subscriber categories: construction, materials, pavements. For more information, visit http://www.trb.org/Publications/Blurbs/177622.aspx.*

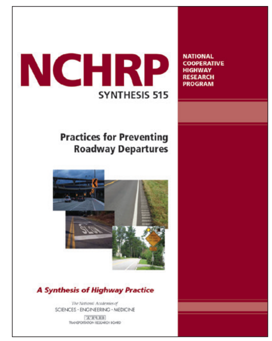
***Executive Summary for the Guidebook on Understanding FAA Grant Assurance Obligations***
ACRP Research Report 184

This volume presents each of the 39 grant assurances in the *Guidebook on Understanding FAA Grant Assurance Obligations* and includes a matrix that outlines major aspects of the program. The report is accompanied by four web-only documents and a PowerPoint presentation.

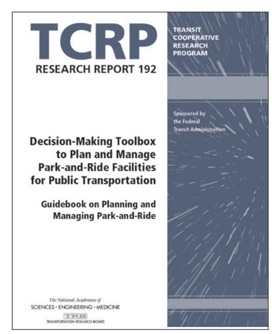
*2018; 25 pp.; TRB affiliates, $36.75; nonaffiliates, $49. Subscriber categories: administration and management, aviation, policy.*

***Decision-Making Toolbox to Plan and Manage Park-and-Ride Facilities for Public Transportation: Guidebook on Planning and Managing Park-and-Ride***
TCRP Research Report 192

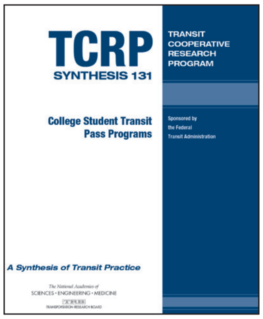
Offered in this guidebook are approaches to managing park-and-ride facilities, including design, implementation, operation, and maintenance. Accompanying this report is a web-only document





## TRB PUBLICATIONS *(continued)*




that includes case studies.

*2017; 192 pp.; TRB affiliates, $59.25; nonaffiliates, $79. Subscriber categories: highways, public transportation, finance.*

***Knowledge Management Resource to Support Strategic Workforce Development for Transit Agencies***
TCRP Research Report 194

This report explores the importance of knowledge management and provides guidance on implementing strategies in transit agencies. Action plans, analysis of knowledge management strategies, and a technology tools catalog are included.

*2018; 211 pp.; TRB affiliates, $68.25; nonaffiliates, $91. Subscriber categories: public transportation, education and training.*

***Private Transit: Existing Services and Emerging Directions***
TCRP Research Report 196

An overview and taxonomy of private transit services in the United States are presented in this report along with a review of the scope, effects on communities, and operating characteristics of these services.

*2018; 68 pp.; TRB affiliates, $48; nonaffiliates, $64. Subscriber category: public transportation.*

***Tools for a Sustainable Transit Agency***
TCRP Research Report 197

A suite of interactive tools assists transit agencies in developing a sustainability program. Among these are a sustainability checklist and an Excel workbook that quantitatively evaluates potential projects in terms of financial, social, and environmental returns. The accompanying report describes how these tools were developed.

*2018. Subscriber categories: public transportation, environment. For more information, visit www.trb.org/Publications/Blurbs/177296.aspx.*

***College Student Transit Pass Program***
TCRP Synthesis 131

Presented is information on developing and evaluating college student transit pass programs. Many transit agencies have student pass programs with colleges and universities, but these programs have different funding, fare and operating structures, and student demographics.

*2018; 141 pp.; TRB affiliates, $57; nonaffiliates, $76. Subscriber categories: public transportation, administration and management.*

***Public Transit and Bike Sharing***
TCRP Synthesis 132

Cooperative transit and bike sharing relationships are explored in the volume, including challenges, lessons learned, and gaps in information.

*2018; 1017 pp.; TRB affiliates, $55.50; nonaffiliates, $74. Subscriber categories: pedestrians and bicyclists, public transportation.*

***Administration of ADA Paratransit Eligibility Appeal Programs***
TCRP Synthesis 133

This volume identifies the eligibility appeal processes related to the Americans with Disabilities Act of 1990, or ADA, and documents the current practices of transit systems.

*2018; 102 pp.; TRB affiliates, $52.50; nonaffiliates, $70. Subscriber categories: administration and management, passenger transportation, public transportation.*

***Customer-Focused Service Guarantees and Transparency Practices***
TCRP Synthesis 134

The nature and prevalence of customer-focused practices among transit providers in North America, along with information from European transit providers, are examined in this synthesis report.

*2018; 131 pp.; TRB affiliates, $58.50; nonaffiliates, $78. Subscriber categories: public transportation, administration and management, data and information technology.*

***ADA Paratransit Service Models***
TCRP Synthesis 135

This volume provides information about current ADA-compliant paratransit service models and the underlying reasons why specific transit agencies have opted to keep or change their service model.

*2018; 258 pp.; TRB affiliates, $72.75; nonaffiliates, $97. Subscriber categories: public transportation, administration and management, planning and forecasting.*

***Contracting Fixed-Route Bus Transit Service***
TCRP Synthesis 136

This synthesis will assist transit agencies in their decision-making process as they consider contracting fixed-route transit services instead of directly operating the service.

*2018; 152 pp. Subscriber categories: public transportation, administration and management. For more information, visit www.trb.org/TCRP/Blurbs/177508.aspx.*

INFORMATION FOR CONTRIBUTORS TO

# TR NEWS

***TR News*** welcomes the submission of manuscripts for possible publication in the categories listed below. All manuscripts submitted are subject to review by the Editorial Board and other reviewers to determine suitability for *TR News*; authors will be advised of acceptance of articles with or without revision. All manuscripts accepted for publication are subject to editing for conciseness and appropriate language and style. Authors receive a copy of the edited manuscript for review. Original artwork is returned only on request.

**FEATURES** are timely articles of interest to transportation professionals, including administrators, planners, researchers, and practitioners in government, academia, and industry. Articles are encouraged on innovations and state-of-the-art practices pertaining to transportation research and development in all modes (highways and bridges, public transit, aviation, rail, marine, and others, such as pipelines, bicycles, pedestrians, etc.) and in all subject areas (planning and administration, design, materials and construction, facility maintenance, traffic control, safety, security, logistics, geology, law, environmental concerns, energy, etc.). Manuscripts should be no longer than 3,000 words (12 double-spaced, typed pages). Authors also should provide charts or tables and high-quality photographic images with corresponding captions (see Submission Requirements). Prospective authors are encouraged to submit a summary or outline of a proposed article for preliminary review.

**RESEARCH PAYS OFF** highlights research projects, studies, demonstrations, and improved methods or processes that provide innovative, cost-effective solutions to important transportation-related problems in all modes, whether they pertain to improved transport of people and goods or provision of better facilities and equipment that permits such transport. Articles should describe cases in which the application of project findings has resulted in benefits to transportation agencies or to the public, or in which substantial benefits are expected. Articles (approximately 750 to 1,000 words) should delineate the problem, research, and benefits, and be accompanied by one or two illustrations that may improve a reader's understanding of the article.

**NEWS BRIEFS** are short (100- to 750-word) items of interest and usually are not attributed to an author. They may be either text or photographs or a combination of both. Line drawings, charts, or tables may be used where appropriate. Articles may be related to construction, administration, planning, design, operations, maintenance, research, legal matters, or applications of special interest. Articles involving brand names or names of manufacturers may be determined to be inappropriate; however, no endorsement by TRB is implied when such information appears. Foreign news articles should describe projects or methods that have universal instead of local application.

**POINT OF VIEW** is an occasional series of authored opinions on current transportation issues. Articles (1,000 to 2,000 words) may be submitted with appropriate, high-quality illustrations, and are subject to review and editing.

**BOOKSHELF** announces publications in the transportation field. Abstracts (100 to 200 words) should include title, author, publisher, address at which publication may be obtained, number of pages, price, and ISBN. Publishers are invited to submit copies of new publications for announcement.

**LETTERS** provide readers with the opportunity to comment on the information and views expressed in published articles, TRB activities, or transportation matters in general. All letters must be signed and contain constructive comments. Letters may be edited for style and space considerations.

**SUBMISSION REQUIREMENTS:** Manuscripts submitted for possible publication in *TR News* and any correspondence on editorial matters should be sent to the *TR News* Editor, Publications Office, Transportation Research Board, 500 Fifth Street, NW, Washington, DC 20001, telephone 202-334-2986, or e-mail lcamarda@nas.edu.

◆ All manuscripts should be supplied in 12-point type, double-spaced, in Microsoft Word, on a CD or as an e-mail attachment.

◆ Submit original artwork if possible. Glossy, high-quality black-and-white photographs, color photographs, and slides are acceptable. Digital continuous-tone images must be submitted as TIFF or JPEG files and must be at least 3 in. by 5 in. with a resolution of 300 dpi. A caption should be supplied for each graphic element.

◆ Use the units of measurement from the research described and provide conversions in parentheses, as appropriate. The International System of Units (SI), the updated version of the metric system, is preferred. In the text, the SI units should be followed, when appropriate, by the U.S. customary equivalent units in parentheses. In figures and tables, the base unit conversions should be provided in a footnote.

NOTE: Authors are responsible for the authenticity of their articles and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used in the articles.

*The National Academies of*
SCIENCES · ENGINEERING · MEDICINE

The nation turns to the National Academies of Sciences, Engineering, and Medicine for independent, objective advice on issues that affect people's lives worldwide.
**www.national-academies.org**

TRN316