

# Public Roads

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## July/August 2004

### Megaproject Procurement: Breaking from Tradition by Gerald Yakowenko

*Looking beyond design-bid-build to find another project delivery method that's right for the megaproject.*

Many factors determine the success of a major project. But one factor that is increasingly important is the selection of the best and most appropriate project delivery method or combination of methods—the system that sets the contractual arrangements for project design, construction, and in some cases, operations and maintenance. It is vital that megaproject managers establish an acquisition strategy early in project development because of the direct bearing on both the management's organization of roles and responsibilities and risk ownership allocation between the public and private sectors.



URS Creative Imaging Group/Earth Tech

**The future Miami Intermodal Center, shown here from above, is the first major transportation project to use the construction manager-at-risk approach to project delivery.**

Although contracting agencies historically have required the use of the traditional project delivery method known as "design-bid-build," the tide is shifting. More innovative project delivery methods are finding their way into transportation construction projects and changing how major projects are carried out.

Under the traditional design-bid-build approach, the contracting agency, or its designated engineering consultant, designs the project and prepares the construction contract documents. The construction contract then is bid publicly and awarded to the lowest responsive bidder. Over time, some in the industry have raised concerns about the efficiency of this contracting method in terms of project cost, schedule, and productivity.

In response, the Federal Highway Administration (FHWA) initiated an experimental program in 1990, called the Special Experimental Project No. 14 (SEP-14) Innovative Contracting Practices. This experimental program enables States to evaluate nontraditional contracting methods that are not in full compliance with FHWA's contracting policies but provide an open, competitive procurement. Under SEP-14, project owners seeking Federal aid may apply for approval to use nontraditional construction contracting techniques—methods of award other than the lowest responsive bid—to implement value-oriented procurement processes.

## Project Delivery Methods

Several public agencies have applied nontraditional project delivery methods to major projects in the United States by using this new flexibility in contracting practices. Two such methods are "design-build" and "construction manager-at-risk." Each of these delivery methods offers certain advantages and disadvantages in comparison with the traditional design-bid-build method. However, the appropriate use of a particular method will depend on many factors, including the project budget, schedule, risk allocation, the contracting agency's level of expertise, and the ability of the owner to define the scope of work clearly. No single project delivery strategy is appropriate for all major projects, and contracting agencies should consider the merits of each method in relation to their project needs. (See "[Key Considerations in Selecting Project Delivery Methods](#)".)

### Key Considerations in Selecting Project Delivery Methods

There is no one-size-fits-all delivery method for every project. In selecting a project delivery system that is right for a project, owners should gauge the level of complexity and uniqueness of the project, and maintain an appropriate level of control. Below are some key factors to consider:

- *Size of Project.* The more complex and costly a project, the greater the need for professional management and advice.
- *Owner Capabilities.* Realistically assess in-house capabilities in evaluating project procurement methods and construction management capabilities.
- *Time Considerations.* If the project needs to be constructed in a severely compressed timeframe, methods adaptable to fast-track construction should be considered, but also weighed against the increased cost and risk of fast tracking.
- *Likelihood of Changes.* If the scope of work cannot be defined adequately or if requirements are likely to change considerably during the project, this factor should be evaluated against the potential cost of such changes.
- *Risk Allocation.* The contracting agency should perform a study to assess the appropriate allocation of risk associated with all phases of the project development process and the costs associated with this allocation.

Although many owners have some experience in using design-build, this is a relatively new delivery system for most transportation agencies. Design-build uses a single contract for both the design and construction of a project. From the owner's perspective, the concept of having one firm responsible for both design and construction is appealing. On the other hand, the construction manager-at-risk method provides the contracting agency with the services of a construction management firm that will typically provide recommendations for the project schedule, budget, and constructability during the design phase. In addition, the contracting agency and the construction manager typically agree on a guaranteed maximum price for the construction of the project and then the construction manager becomes responsible for issuing subcontracts and managing all construction, just as a prime contractor would under the traditional design-bid-build method. Both alternatives allow construction to start as the design proceeds and can reduce project cost and duration.



FDOT, District Six/ Earth Tech

This panoramic photo shows the future site of the rental car facility that will be one component of the MIC project in Miami-



**Dade County, FL. The facility represents work that will be completed under the first contract package, using the construction manager-at-risk delivery method.**

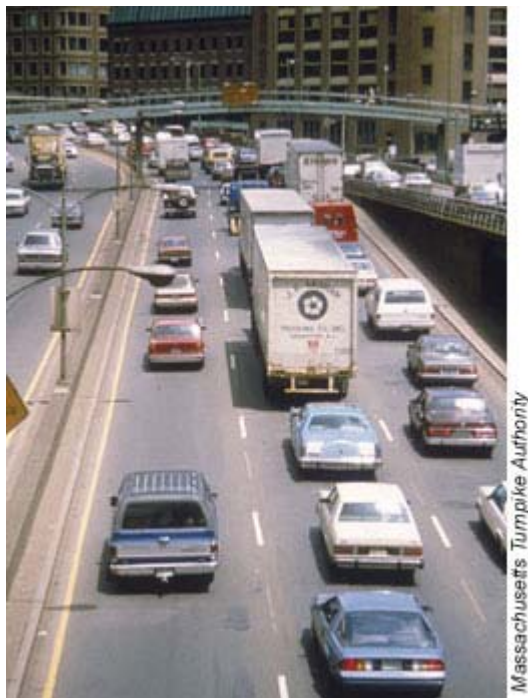
## **Sticking to Tradition**

The traditional design-bid-build method is the most popular project delivery system. It is intended to minimize risk to the contractor by defining all of the construction requirements in the plans, specifications, and contract documents. In this method, the project owner may contract with a consulting engineering firm to design the complete facility and prepare the contract documents. The contracting agency then solicits bids and awards a construction contract to the lowest responsive bidder. Because of its wide use and acceptance, the traditional design-bid-build system is well understood with well-established and clearly defined roles for the contracting agency and the contracting industry.

The design-bid-build method was used in the Nation's first megaproject, Boston's Central Artery/Tunnel (CA/T or the "Big Dig") Project. Managed by the Massachusetts Turnpike Authority, the project now totals \$14.6 billion and is in its 13<sup>th</sup> year of construction. The Big Dig's major components include:

- Replacement of the 6-lane elevated highway with an 8- to 10-lane underground expressway directly beneath the existing road, culminating at its northern limit in a 14-lane, 2-bridge crossing of the Charles River.
- Extension of Interstate 90 (the Massachusetts Turnpike) from its former terminus south of downtown Boston through a tunnel beneath South Boston and Boston Harbor to Logan Airport.

"When the preliminary engineering on the Big Dig started in the 1980s, the Massachusetts Highway Department had strict bidding requirements governed by Massachusetts law," says Carl Gottschall, project administrator at FHWA's Massachusetts Division Office. "Design-bid-build was our only option for project delivery—but that's not to say that it wasn't the right one."



**The Central Artery/I-93 in Boston, shown here, carried 190,000 vehicles per day, two and half times its original capacity. The Central Artery/Tunnel Project which replaces the elevated highway with a tunnel is the Nation's first transportation megaproject. The project team is using the traditional design-bid-build method of**

## delivery.

Located in the downtown of an old city, the Big Dig is "one of the most technically difficult and environmentally challenging infrastructure projects ever constructed," says Gottschall. Over time, the project's scope, cost, and schedule expanded considerably from original estimates, and the environmental review process took roughly 10 years. Inflation also added a considerable amount to the project cost over the more than 20-year period it is taking to complete the project. Given the value of the properties that were in the paths of the new roads, project development engineers worked not only with environmental and other oversight and permitting agencies, but also with community groups, businesses, and political leaders to create consensus on how the project could, should, and would be built.

"Overall, I think that design-bid-build was the most cost-effective project delivery method, given that the project was so large and complex," says Gottschall. "Building such infrastructure within a dense urban core—where extensive changes in project scope were inevitable—would have made it almost impossible to pin down a price upfront."

Michael Lewis, director of the design unit for the CA/T project, agrees: "Design-bid-build provided the owner with flexibility to modify the project in response to environmental, political, and community issues." He adds, "A contractor would have found it very difficult to react to such intrusions."

Despite the greater rigidity of that approach, design-bid-build provided enough room to expedite the project schedule and allow innovative design. The Massachusetts Turnpike Authority was successful in implementing a value engineering program for various phases of the project development. Innovations were proposed and evaluated based on merit (that is, cost, schedule, and quality). In addition, value engineering change proposals, submitted by construction contractors, also contributed to improved quality and cost savings.

"Still," says Lewis, "while design-bid-build didn't close the door on innovation, there may have been opportunities for additional innovation using alternative project delivery systems."

According to Lewis, certain segments—such as those that were particularly challenging from a technical perspective—could have benefited from a different style of delivery. Likewise, since the interface between design and construction was so important, increased collaboration between the design and contracting communities might have led to more efficient solutions. Lewis notes that other project delivery methods require less hands-on management by the owner and less mediation of the disputes that often arise between designers and constructors.

"Overall, design-bid-build was the right solution for the project as a whole," says Lewis, "but we would have benefited if the whole spectrum of delivery options had been available to us to use on individual project components with unique challenges."

### **Another Option: Design-Build**

With the design-build project delivery method, the project owner selects an organization to complete both design and construction under a single contract. Specifically, once the contracting agency identifies the end result parameters and establishes the design criteria, the prospective design-builders develop proposals that optimize their construction abilities. The contracting agency then typically conducts a best value analysis, based on cost and technical factors, such as design quality, timelines, and management capability. Once the contract is awarded, the design-builder becomes responsible for completing the design and all construction at the contract's fixed price, usually on a lump sum basis.



**The design-build contracting method enabled the contractor for Utah's I-15 project to incorporate innovative building techniques such as mechanically stabilized earth (MSE) walls, like the one shown here. MSE walls afforded flexibility, given the expected amount of settlement under embankments and fills.**

Design-build enables owners to fix total project costs earlier in the project development process and may simplify and expedite project administration because design and construction are completed by a single entity. By fostering collaboration between designers and contractors, construction knowledge can be incorporated into design. Additionally, by giving the contractor more flexibility in the selection of design, materials, and construction methods, this method allows the design-builders to provide innovation in the preliminary design.

The first major project to seek and win SEP-14 approval to use design-build was the Interstate 15 Corridor Reconstruction Project (I-15 Project) in Salt Lake City, UT. This \$1.59 billion project included the reconstruction and expansion of 27 kilometers (17 miles) of interstate, 144 bridges, and 3 major interchanges. Originally, a consulting firm hired by the Utah Department of Transportation (UDOT) estimated that the project would require between 8 and 10 years to construct using the design-bid-build contracting method. Six years later, in January 1996, after opinion surveys had indicated that the public preferred timelier construction (with more traffic disruption in less time rather than less traffic disruption over more time), and after Salt Lake City had been awarded the 2002 Winter Olympic Games, UDOT decided to use design-build instead.

"Utah needed to shorten the overall project duration and also hoped to promote innovation and improved performance," says Michael Morrow, field operations engineer at FHWA. "Design-build appeared to be the only contracting tool to get the job done."

UDOT provided proposers with "30-percent plans"—meaning that the entire job was designed to the 30-percent draft stage—which included alignment of the I-15 Project and extensive geotechnical investigations. This work enabled UDOT to identify conflicts with utilities and railroads and determine the additional right-of-way clearances that would be needed. The agency selected the team whose proposal was considered to be the best value.

"The best value selection process allowed UDOT to select the proposal that would create the most long-term value for its constituency," says Thomas Warne, former executive director of UDOT during the construction of the I-15 Project and current president of a management and marketing consulting firm. "The process creates an environment where contractors provide additional or enhanced work products for an equal or lower price."

In 1997, after the State obtained almost 400 right-of-way clearances and passed special legislation to use design-build, the project was awarded to a joint venture design-build firm.

To provide appropriate design services for the I-15 Project, the contractor subcontracted with more than 20 other firms to provide specific portions of the design services. To expedite construction, the contractor used a fast-track



process that allowed partially completed design plans and specifications to be released for construction. The design-builder also was able to incorporate more innovative approaches into design and construction than would have been used under the traditional project delivery system.



**An artist's rendering of the central station at the future Miami Intermodal Center shows a train passing through on the Earlington Heights Extension of Miami's Metrorail. The center links bus lines, Tri-Rail (commuter rail), and Amtrak®, along with Metrorail. Early in the planning process, the architect, engineers, contractor, and owner (FDOT) agreed on the budget, schedule, quality, and other factors—like the type of metal to use in the roof of the train station—to avoid unexpected surprises once the project is underway.**

"Design-build unleashed the creativity of the contractor to use construction methods previously not considered," says UDOT Executive Director John Njord. The company improved the seismic design criteria, for example, "and used new techniques to accelerate, reduce, or eliminate settlement," says Njord.

In the end, the I-15 Project was completed ahead of schedule and under budget. Use of design-build instead of design-bid-build saved the public an estimated 60 million vehicle hours of delay between 1996 and 2010.

"For the I-15 Project, design-build was clearly the right choice," says Njord. "UDOT gained a higher level of respect from the public by completing the work ahead of schedule and under budget."

Although design-build was right for the I-15 Project, it is not necessarily right for every project. Some projects, such as those with major unknowns in scope, unresolved environmental or permitting issues, or third party concerns that are not resolved, may not be suitable candidates for design-build. "Design-build isn't for every project," says Warne. "But where there are schedule issues, opportunities for innovation, or cost concerns, design-build may be the delivery system of choice."

The design-build project delivery method currently is available as an approved method for all contracting agencies in the Federal-Aid Highway Program. New regulations released by FHWA in December 2002 now allow the use of design-build contracting for transportation infrastructure projects. FHWA's final rule on design-build contracting, which was required by the Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21), was published in the December 10, 2002, *Federal Register*. TEA-21 defined "qualified projects" as those whose total estimated costs exceed (1) \$5 million for intelligent transportation system projects and (2) \$50 million for all other projects. In the final rule, FHWA allows contracting agencies to use design-build for nonqualified projects under SEP-14, and the FHWA division offices are delegated this approval authority.

### **Construction Manager-at-Risk**

A third project delivery method, construction manager-at-risk (CM@Risk) is widely used in the vertical building industry but seldom used in transportation projects. In the CM@Risk delivery system, the construction manager provides advisory assistance to the owner prior to construction and also acts as a general contractor during construction. In the preliminary design phase, the manager offers advice on schedule, budget, and construction.

The agency chooses a construction manager using qualifications-based selection procedures. Choosing a manager typically takes place at the same time or shortly after the contracting agency selects the consulting engineering firm, which will perform the project design. During the design phases of the project, the construction manager represents the interests of the owner, providing valuable recommendations on constructability and cost reduction opportunities. When the design is partially complete (typically 50 to 90 percent), the construction manager submits a guaranteed maximum price to the owner and warrants that the project will be built at a price not to exceed that figure. The construction manager assumes the risk of meeting that price by functioning as a general contractor and subcontracting most, if not all, of the construction work.

Because a commitment is made to the contractor earlier in the process and because the contractor assumes more risk than under traditional methods, upfront costs may be higher in comparison with the bid price of a traditional contract. Also, the contractual relationship between owner, designer, and construction manager can become strained once construction begins when the manager shifts from a professional advisory role of construction manager to the contractual role of general contractor.

The first major project in which the construction manager-at-risk approach was implemented was the Florida Department of Transportation's (FDOT) Miami Intermodal Center (MIC) in Miami-Dade County. The MIC is a \$1.35 billion multimodal center for the Miami International Airport and includes:

- A four-story rental car facility with spaces for approximately 6,500 vehicles, fleet storage capacity of approximately 3,500 vehicles, fueling and washing facilities, and customer service facilities.
- A MIC "core" consisting of facilities to accommodate a bus depot, Tri-Rail (commuter rail), patron parking, an MIC-MIA connector station, Amtrak, Metrorail, and employee services.
- Roadway improvements, including drainage, lighting, and MIC terminal access roadways.

"With construction manager-at-risk, FDOT was able to select the construction manager on qualifications-based criteria, not just cost," says Kouroche Mohandes, FDOT's MIC program manager. "This provided FDOT with the widest latitude to coordinate quality horizontal and vertical construction, which the MIC required."

The State agency selected construction manager-at-risk so that it could receive constructability input, uphold the project schedule, and control budget and costs. With CM@Risk, FDOT was able to form a project team early in the process and in a partnering environment, since the construction manager's advisory role fosters a more team-oriented approach.

"By incorporating the contractor's perspective and input into planning and design decisions, we can reach early agreement on project features to expedite construction," says Andrew DeTizio, major projects engineer at FHWA's Florida Division. "This also helps improve project quality and contain costs."

After being granted SEP-14 approval to use CM@Risk, FDOT selected a construction management company in May 2001. Construction is packaged into several separate guaranteed maximum price contracts, the first two of which are now underway. Because the MIC is just getting started, any successes or lessons that may be learned from FDOT's experience with CM@Risk are not yet known.

"Ultimately, construction manager-at-risk fosters teamwork between the architect/engineer, construction manager, and FDOT," says DeTizio. "We expect this teamwork to result in a better final product."

Approval from FHWA's headquarters on SEP-14 is necessary for using the CM@Risk delivery mechanism. Since the selection of a construction manager (and ultimately the firm that provides construction services) is qualifications-based, FHWA requires contracting agencies to evaluate this technique under SEP-14. CM@Risk has applicability for vertical buildings and also may be appropriate for other types of transportation projects, such as intelligent transportation system projects.

#### Additional Resources

- "Briefing FHWA Initiatives to Encourage Quality Through Innovative Contracting Practices Special Experimental Projects NO.14 - (SEP-14)" [www.fhwa.dot.gov/programadmin/contracts/sep\\_a.htm](http://www.fhwa.dot.gov/programadmin/contracts/sep_a.htm)
- Utah State University's "Innovative Contracting" Web site [www.ic.usu.edu](http://www.ic.usu.edu)
- "AASHTO Joint Technical Committee on Design-Build" Web site [http://design.transportation.org/db\\_references.html](http://design.transportation.org/db_references.html)

#### Going Forward

The Big Dig, I-15, and MIC megaprojects illustrate the diverse scenarios that warrant variations in project delivery methods.

"It's an understatement to say that managing the design and construction of a megaproject is a very challenging undertaking," says FHWA's Deputy Administrator J. Richard Capka. "The management and synchronization of a vast and complicated array of sequential and concurrent activities require a great deal of innovative planning to determine how the work will be packaged for the private sector team members to deliver."

Having the flexibility to select from a variety of contracting tools provides owners with an opportunity to tailor design and construction to specific project needs and constraints. Although a major project's delivery method may not be the sole contributor to success, it is key to the efficient and effective integration of public and private sector talent in a manner that postures the project for ultimate success.

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