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PERSPECTIVE

Collaborative Design and Risk Allocation in Infrastructure Design-Build

How WSDOT Saved $89M With Design-Build

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Last winter, I had a chance to review a freeway interchange project that was recently completed using the Design-Build style of procurement. I assumed what I would find would be deadly dull and not suitable dinner party conversation. Instead, I found the project's procurement and design process to be very sophisticated, with multiple layers of collaborative design and risk allocation. It's now in my rotation of thrilling conversation starters.

Historically, the classic procurement method for infrastructure and large public projects, as well as large private projects, has been Design-Bid-Build. The owner (or agency representing the owner) completes all property surveys and studies, prepares extensive plans and specifications, and then solicits competitive fee and timing proposals from contractors. Once construction starts, if there are site conditions that were improperly described or mistakes or constructability issues in the plans, the increased costs are passed on to the owner as change orders.

Design-Build is very different. The owner defines the function and size of the project and prepares preliminary plans and specifications. Contractors and their engineers join forces to bid, and each contractor/engineering team provides a competitive design and cost proposal. The winning contractor/engineering team (the "Design-Builder") is responsible for both engineering and construction. Mistakes and constructability issues are the Design-Builder's problem and do not result in change orders. A key point here is that the engineering completed by the competing Design-Build teams is fairly complete, say 80% to 90%. Upfront, it is expensive and "inefficient" to have the same project engineered by three different teams. In order not to penalize the two losing teams, they receive an allowance to offset costs (in the case described below, each losing team was paid $750,000).

ABOUT THE AUTHOR

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Owners have created many different varieties of Design-Build contracting, ranging from hands-off/sign-the-check to full-on owner micromanagement. Knowing a project is Design-Build only tells you what questions to ask.

The recent Washington State Department of Transportation (WSDOT) I-405/SR 167 Direct Connector ("SR 167 Connector") project offers a fascinating case study, as my dinner guests would no doubt agree.

As background on WSDOT and Design-Build, WSDOT received legislative directives in 2015 that "authorized and strongly encouraged [WSDOT] to use the design-build procedure for public works projects over two million dollars" and for projects with "highly specialized" construction activities, opportunities for greater innovation and efficiencies between the designer and builder, or significant savings in project delivery time.[1, 2]

WSDOT's specific protocol for Design-Build is fairly standard compared to DOT's in other states, but it does include a very rigorous, upfront agency-wide process to determine whether Design-Build is the best method for any specific project.

SR 167 CONNECTOR: PROJECT SNAPSHOT

SR 167 Connector is a new set of on- and off-ramps and represents a classic "bread-and-butter" project for a state DOT. It is unexciting, uncontroversial, and boring. But, as an example of WSDOT's implementation of Design-Build and of the Agency's substantial evolution over the past decade, I found a lot to be interested in.

Here's a project snapshot:

- Early 2015: WSDOT completed preliminary engineering
- July 2015: Funding approved with cost estimate of $205 million
- July 2016: RFP process completed and awarded to winning Design-Build team for $116 million (the two other bids were $120 million and $141 million)
- Sept 2016: Ceremonial groundbreaking
- Feb 2019: Construction completed

That is correct – the final contract price was $89 million less than the cost estimate, a whopping 43% savings. The project was completed on time in just over two years, and there were no major traffic disruptions during that timeframe.

How often do you hear results like that? How was this accomplished?

WSDOT engineers Sharif Shaklawun and Gil McNabb told me it was achieved through risk allocation, collaborative design, and "practical design," the three key pillars of WSDOT's implementation of Design-Build.

RISK ALLOCATION

Risk allocation is now a very focused and structured part of WSDOT's front-end work, and a risk magnitude and allocation analysis is completed at the start of any project over $5 million, Design-Build or not.

"WSDOT's risk allocation matrix reflects a best practice risk sharing philosophy where WSDOT takes responsibility for project risks that are not reasonably under the control of the design-builder, and transfers risks to the design-builder that industry can more effectively manage."[3]

WSDOT completes tasks such as:

- intergovernmental negotiations and planning
- right of way acquisition

- early environmental assessment and permitting
- NEPA permitting
- large-scale utility relocation

Notable shared risks include unanticipated hazmat clean-up, archeological discoveries, and community engagement.

The allocation of risks and responsibilities, especially on the design side of the project, is a major departure from the classic Design-Bid-Build method. With Design-Bid-Build, the roles and tasks for the owner and the contractor are largely fixed. By contrast, Design-Build allows the owner to determine upfront which party is best suited to each task and its associated risks. Clear and appropriate risk allocation very likely contributed to reduced project cost and time for SR 167 Connector by reasonably shifting some key risks from owner to contractor.

COLLABORATIVE DESIGN: PRIOR TO BID AWARD

In a typical WSDOT Design-Build project, once the Agency completes a preliminary design and selects three Design-Builder team finalists, the finalists begin the Collaborative Design process with the Agency. The three teams work for six to nine months to draft their team's own complete engineering plan, battle plan for actual construction, and mitigation plans for impacts on travelers and adjacent neighborhoods. During this time, there are weekly meetings between WSDOT engineers and each competing team. Meanwhile, the Agency staff is working full throttle to respond to each team's engineering questions, to provide design clarifications, and to finalize survey work.

During my interviews with the WSDOT engineers, it was clear this was the most fun they had ever had on the job. They had six months of intense engagement with three top-notch engineering firms that were proposing and testing numerous alternative designs. With that came immediate feedback from the competing contractors on constructability and cost/time estimates. The WSDOT engineers were adamant that this helped improve the final product, reduced project cost, and improved delivery time. This heightened level of engagement with bidders simply does not happen in Design-Bid-Build. That classic method has some collaboration and value engineering, but nothing on the scale and sophistication of what occurs during Design-Build. Would the innovative engineering and designs resulting from the SR 167 Connector's Design-Build collaborative process have seen the light of day in a Design-Bid-Build process? Probably not.

The output of the Collaborative Design process has the horribly mundane name Alternative Technical Concepts (ATCs). The major ATC on the SR 167 Connector project was the decision to not reconstruct the existing six-lane freeway bridge/overpass in order to add new on- and off-ramps to each side. Instead, the new ramps are parallel to the existing overpass, but they are structurally separate from the existing overpass. This meant not having to seismically retrofit and build a new foundation for the existing overpass.

There were other notable collaborative design results. By shrinking the roadway footprint on the south side by 50 feet, excavation on the adjacent hillside was reduced by 100,000 cubic yards. The winning Design-Builder team developed a plan to build the project "off-line" and keep it separate from any active traffic lanes until it was open for service. As one of the five most congested interchanges in the state, this was an important outcome. In addition, the final design was able to reuse many old components, including moving the existing 1,400-lineal foot noise wall up the hill to a new location, reusing pavement panels, and keeping most of the existing stormwater facilities, utilities, and signage.

PRACTICAL DESIGN – AFTER BID AWARD

"Practical Design" is the third pillar of WSDOT's Design-Build implementation. Practical Design is another painfully vague civil engineering term. It is actually the last Collaborative Design process before the notice to start construction, and it occurs after awarding the contract. SR 167 Connector was the first WSDOT project of its size to use the Practical Design process. It is a month-long, formal, post-contract engineering review process. The Design-Builder can propose designs that don't meet the exact engineering requirements of the original RFP, as long as they meet the functional requirements for the project. These can be compared to variances in the land use code. They might violate the technical engineering requirements that WSDOT specified for the project, but they meet or exceed the original functional requirements for the project. After closing out the Practical Design process, all further design changes must meet WSDOT's technical standards.

Out of 32 design ideas brought up during the Practical Design phase, five were included in final design and provided additional cost savings of $7.5 million. Most of these changes are rather "boring," pertaining to shoulder and ramp widths and seismic engineering, but the cost savings are real money.

DESIGN-BUILD SUCCESS: AGENCY STAFF EXPERIENCE AND PROCESS

WSDOT's Design-Build process is not a simple case of outsourcing project design and engineering. The institutional knowledge, experience, and dedication of the owner's engineers – and their wholehearted engagement in the Design-Build process – are crucial to the outcome. In the historic Design-Bid-Build process, much of the design and engineering work was already being completed by outside firms. But that work was not taking place in a structured and competitive, yet collaborative, way. Moreover, those outside engineers did not have the same incentives to design structures that were easier to build and less expensive.

Furthermore, WSDOT has discovered that it is difficult and disadvantageous to outsource the management/oversight of its Design-Build process. Third-party consulting engineers have been resistant in past Design-Build projects to innovative designs proposed by the contractor/engineering teams. Also, too many outside engineers on a project reduce the opportunity for WSDOT staff to gain expertise and project management skills.

As a key takeaway from my review of the SR 167 Connector project, WSDOT sees significant benefits from having senior staff continuity in the Design-Build process from start to finish. Moving the Agency's design leads off the project after the start of construction removes institutional memory and can slow response times to unanticipated design and construction problems. I found this nuance to be particularly fascinating: While Design-Build extends more project responsibility to contractors, it seems to make agency/owner staff more deeply engaged and critical to final project success.

DESIGN-BUILD CLEARLY HAS A ROLE IN INFRASTRUCTURE CONTRACTING

Before my research on the SR 167 Connector project, I was skeptical about the cost and time savings attributed to Design-Build. I have changed my mind. It was refreshing to see the positive results that came out of both the pre-award Collaborative Design process with the shortlisted firms as well as the post-award Practical Design process with the winning bidder.

I was also highly skeptical about vague terms like collaboration, structured competition, and community engagement. These qualitative goals in the RFQ, which could sound warm and fuzzy when applied to a freeway interchange, were taken very seriously by the Agency. Reducing impacts on adjacent neighborhoods and the traveling public, as well as reusing and recycling materials and entire structures, were substantively addressed.

WSDOT engineers repeatedly told me that a contractor/engineer team's track record on collaboration, as well as their internal methods and structure for collaboration, were very important in the Agency's selection of the three finalist teams. Collaboration was at the core of the selection process, not window dressing. WSDOT sees the Collaborative Design process as an enormous and advantageous transformation from the design process of Design-Bid-Build projects.

Costs for the final design of this project were far lower than the engineer's cost estimate. It's impossible to know if standard owner-directed, Design-Bid-Build engineering for this project would have identified factors that led to the considerably lower bids coming out of the Design-Build Collaborative Design process. But it is probably safe to say that fewer design improvements would have been achieved through the traditional process, just by virtue of greater time, attention, and emphasis that the Design-Build process puts on collaborative and practical design.

Beyond the SR 167 Connector, other Design-Build projects have also shown cost and time savings. WSDOT staff told me that the Design-Build process results in fewer change orders and less variance in the final cost after the project goes under contract. Design-Build often eliminates one to two years of design work. That time savings allows the Agency to set a fixed, lump sum price on the work one to two years earlier, to prevent price escalation.

Design-Build is clearly a better way to contract certain projects. But lunch is never free. It's obvious from WSDOT's implementation that a significant amount of effort and expertise is needed at the owner level. Another obvious requirement is the participation of construction and design bidding teams that are skilled at the collaborative design and constructability process. Design-Build is frequently promoted as an effective way for agencies lacking construction management and engineering expertise to do large projects. I doubt this project would have come out so well without the combined expertise of the Agency engineers and the bidding teams, and without such well laid out protocols.

Design-Bid-Build will not disappear. It remains an excellent approach for projects that have straightforward designs and a large number of bidders who are capable of constructing that project type. And, Design-Bid-Build can be implemented effectively by agencies with limited in-house engineering and construction management resources by using experienced design firms.

But Design-Build has clearly proven its value. For WSDOT, their version of Design-Build leverages their institutional knowledge and staff experience to result in strong outcomes. Design-Build isn't easy to implement, but it is one approach to infrastructure development that is now building a strong track record of reducing costs and improving delivery time.

For new real estate development, infrastructure is a necessity. With many governments required to pass those infrastructure costs on to builders and landowners, efficiency and innovation will be important to developers' total costs. Design-Build is used more frequently by private developers as well, especially for complex projects where both the owner and the contractor can benefit from collaborative engineering and a focused analysis on constructability.

Now, if you could just pass the salt… •

ENDNOTES

1. RCW 47.20.780. Washington State Legislature. https://apps.leg.wa.gov/RCW/default.aspx?Cite=47.20.780 (accessed August 3, 2021).
2. RCW 47.20.785. Washington State Legislature. https://apps.leg.wa.gov/RCW/default.aspx?Cite=47.20.785 (accessed August 3, 2021).
3. Design-Build Manual. Washington State Department of Transportation. https://wsdot.wa.gov/publications/manuals/m3126 (accessed August 3, 2021).

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