Evaluation -- Harrisburg Bridge Deck Replacement Project
Oregon Department of Administrative Services Exemption 344
As required by ORS 279.103

The Oregon Department of Transportation's (ODOT) Harrisburg Bridge Deck Replacement Project received an order from the Department of Administrative Services allowing an exemption from competitive bidding to allow the use of Design-Build (DB) project delivery. This project became one of two DB pilot projects used by ODOT to refine newly developed procedures for DB contracts.

ORS 279.103 requires an evaluation of the public improvement upon its completion. The evaluation must include the following:

1. The actual project cost as compared with original project estimates.
2. The amount of any guaranteed maximum price.
3. The number of project change orders issued by the public agency.
4. A narrative description of successes and failures during the design, engineering, and construction of the project.
5. An objective assessment of the use of the alternative contracting process as compared to the findings required by ORS 279.015.

In addition, ORS 279.015 requires that projects may not be exempted unless "it is unlikely that such exemption will encourage favoritism in the awarding of public contracts or substantially diminish competition for public contracts; and the awarding of public contracts . . . will result in substantial cost savings to the public contracting agency." Compliance with these criteria is also evaluated in this report.

The evaluation of project performance with respect to all of these criteria follows a brief summary of project highlights.

Project Overview

The Harrisburg Bridge Deck Replacement Project was scheduled for conventional Design-Bid-Build (DBB) project delivery. The design and construction concept was to replace the deteriorated bridge deck with precast concrete panels under nighttime traffic closures. This project was chosen as a DB pilot project because it offered some potential for innovation, while minimizing the risk associated with delivery of a project by a method with which most ODOT and industry personnel had little or no experience.

The procurement process resulted in selection of a Design-Build team that based their proposal on a new cast-in-place bridge deck constructed while traffic was diverted onto a detour bridge. The other responsive bidder proposed a similar approach. A third bid, judged non-responsive for violating the specified page limitation, followed the original ODOT concept. Because it was rejected, the submitted bid price of the third bidder was never opened.

The detour bridge allowed elimination of road user costs due to nightly detours. Construction work could be accomplished in daylight hours without daily set-ups and breakdowns to allow traffic to pass through the construction zone. The cast-in-place bridge deck has fewer joints than a precast design, resulting in maintenance advantages. The new bridge deck was opened to traffic four months ahead of schedule and was completed within the authorized budget. (See Table 1.)

Table 1. Harrisburg Bridge Project Summary

	Target	Actual
Cost	$2,487,139	$2,426,307
Restore Traffic	12/31/99	8/31/99
Project Completion	9/31/00	8/31/00

Actual Project Cost Compared with Original Project Estimates

Estimating is not an exact science, particularly when preparing estimates for comparison of the same project with different methods of project delivery. Consequently, several estimating approaches are presented.

First, a comparison is made between how estimated costs would have been estimated for DBB project delivery, how they probably would have occurred if delivered DBB, and how they resulted for the actual DB delivery. The Design-Build contract includes not only the traditional construction contract, but also engineering design costs that ODOT did not have to spend. ODOT's normal project authorization also adds any expected bonuses or incentives, 3.5% of contract amount for contingencies, and an allowance for "Engineering" costs, which are really costs incurred by ODOT in project administration. Table 2 shows this comparison.

CONCLUSION: Cost to ODOT delivered DB was about $242,000 (11%) more than the estimated actual cost of the project delivered DBB, and about $390,000 (19%) more than the DBB estimate. Combined cost for ODOT and road users of project delivered DB was about $1,560,000 less than estimated for project delivered DBB.

The next comparison presented follows the methodology prescribed in the findings required by ORS 279.015 for this project. This methodology prescribed use of factors based on historical relationship of engineers' estimates to contract price (0.95) and of final cost to initial contract price (1.025). Subsequent investigation shows that the 1.025 factor came from a Florida DOT study. A more accurate number for ODOT is 1.035. Also, a separate calculation is to be performed where the first factor is computed from other ODOT projects bid at the same time. Analysis with the 0.95 factor is shown in Table 3.

CONCLUSION: Project delivered DB cost $325,000 (18%) more than estimated as DBB.

Table 2. Estimating DBB costs vs. actual DB costs

	DBB Estimate	DBB Estimated Actual Cost		DB Actual Costs
Design Costs -- Complete Engineering Design	$75,000		$75,000	$200,000
Construction Contract	$1,700,000		$1,700,000	$1,976,001
Contingencies (3.5%)	$59,500	Change Order1 -- thicker deck	$0	$11,341
		Force Account #1 - Repair rust-damaged floor beam flanges and sidewalk supports	35,000	$35,000
		Force Account #2 - Repair rust-damaged floor beam @ bent 1	$145,000*	$40,000
		Anticipated Items	$30,000	$30,000
Engineering (8.26%)	$140,500		$140,500	$75,000
Subtotal	$1,975,000		$2,125,500	$2,367,342
Added Approach Spans Work		Change Order #2	$58,966	$58,966
Total Agency Costs	$2,033,966		$2,184,466	$2,426,308
Road User Costs -- 30 nights @ $60,000/night	$1,800,000		$1,800,000	$0
Total Agency plus Users Cost	$3,833,966		$3,984,466	$2,426,308

* Estimate by ODOT project management

Notes:

DB costs from 12/13/99 "Preliminary Progress Payment Report, Contract C12199."

DB contract cost of $2,176,001 is separated into $200,000 design (professional services pay item) and $1,976,001 construction.

DBB estimates from ODOT project management.

ODOT design required nightly lane closures -- estimated road user costs for closures, 30 nights @ $60,000/night = $1,800,000 (from DAS exemption order).

Table 3. Comparison of factored engineer's estimate (0.95 factor) for DBB with actual DB costs.

	Estimate Actual
Engineers' estimate of the construction contract as design-build-build (DBB)	$1,700,000
Multiply by 0.95 factor =	$1,615,000
Add 3.5% for change orders, etc.	$56,525
Allowance for stringer repair	$30,000
Subtotal	$1,701,525
Add engineers' estimate for engineering (ODOT project admin. costs)	$140,500
Estimated project costs as DBB	$1,842,025
Actual project costs at completion	$2,426,300
Less design costs in DB contract	

	($200,000)
Subtotal	
	$2,226,300
Less approach span scope addition	
	($59,000)
Comparable DB cost at completion	
	$2,167,300

Determination of average factors from other bids at the time of bid opening is shown in Table 4. The average for bridges is considered most valid. Table 5 shows the analysis using this average of 1.05.

Table 4. Contemporary factor determination.
Bids opened 10/22/98 and 11/19/98:
Average ratio for all bids (25) = 0.973
Average ratio for bridge jobs (8) = 1.05

CONCLUSION: Project delivered DB cost $149,000 (7%) more than estimated as DBB.

The engineers' estimate does not show the cost of the project constructed with a detour bridge. The two responsive bidders apparently had enough concern about the risks of ODOT's design with precast panels built under night closures with lane rentals to bid based on eliminating that risk by the construction of a detour bridge, even though it required additional time and effort to secure permits to work in the river. This risk concern would be expected o have appeared as added contingency costs in any contractor DBB bids.

Table 5. Comparison of factored engineer's estimate (1.05 factor) for DBB with actual DB costs.

	Estimate	Actual
Engineers' estimate of the construction contract as design-build-build (DBB)	$1,700,000	
Multiply by 1.05 factor =	$1,785,000	
Add 3.5% for change orders, etc.	$62,475	
Allowance for stringer repair	$30,000	
Subtotal	$1,877,475	
Add 8.3% of engineers' estimate for engineering (ODOT project admin. costs)	$140,500	
Estimated project costs as DBB	$2,017,975	
Actual project costs at completion		$2,426,300
Less design costs in DB contract		($200,000)
Subtotal		$2,226,300
Less approach span scope addition		($59,000)
Comparable DB cost at completion		$2,167,300

Apparently the contractors estimated that, accounting for risk, it was more economical to incur the obvious additional costs of constructing a detour bridge than build the bridge according to the precast panel concept. Therefore, it is likely that the engineer's estimate was too low. As shown above, the construction of the detour bridge also proved of great benefit to the motoring public.

Because the above comparisons are based on DBB costs for a bridge deck replacement with precast panels under lane closures, whereas the actual project was constructed cast-in-place with traffic re-routed over a detour bridge, this comparison is not the most meaningful. ODOT has stated that bridge rehabilitation estimates have variability of plus or minus 25%. Table 6 compares actual results with DB project delivery to the range of costs to be expected for this project.

CONCLUSION: ODOT costs for the project delivered DB is within the range of accuracy of ODOT's bridge rehabilitation estimating -- near the high end.

Comparing the likely result of delivering this project DB vs DBB, it may be argued that the DB approach produced a higher quality end product with combined reduction in costs to ODOT and road users of about $1,500,000. It is simply impossible to determine if ODOT paid more or less for the bridge rehabilitation than they would have if delivered DBB. They clearly received a better product, and the public clearly experienced reduced inconvenience and user cost as a result of the delivery of the project DB with the detour bridge.

Table 6. Cost variability for bridge rehabilitation estimates.

Engineers' estimate of the construction contract as DBB			$1,700,000
Bridge rehabilitation estimates have variability of plus or minus 25%			
Range of estimated construction contract becomes	$1,275,000 --	$2,125,000	
Add for engineering (ODOT project admin. costs) -- 8.3%	$ 105,825 --	$ 176,375	
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Subtotal	$1,380,825 --	$2,301,375	
Actual project costs		$2,426,300	
Less engineering design in DB contract		($ 200,000)	

Subtotal		$2,226,300	
Less approach spans work		($ 59,000)	

Comparable DB cost at completion		$2,167,300	

The Amount of Any Guaranteed Maximum Price -- Not Applicable

The Number of Project Change Orders Issued

Two change orders were issued. One change order, the approach spans change order, was for scope added because funding was available, and will therefore not be counted as a change order. The remaining change order was for $11,341. This represents about 0.5% of original contract. Two extra work orders for unforeseen structural degradation totaled $75,000. These three items together total $86,341, which represents about 4% of initial contract amount.

The extra work orders would have been required with DBB delivery as well, since the need for the work could not be determined until the structural members were exposed. It should be noted that the effects on cost, schedule, and road user inconvenience of the badly deteriorated floor beam at bent 1 were probably much less with the DB project delivery than they would have been with the design envisioned for DBB and without the detour bridge. Significant daylight closures would have been required without the detour bridge. This would have proved very costly for road users.

Successes and Failures During the Design, Engineering, and Construction of the Project

The project delivered to ODOT and the motoring public is superior to that envisioned at the beginning of the project. The cast-in-place deck actually built has fewer joints than the precast panel design of the original bid documents. Ride is better, longevity is likely improved, and maintenance costs and traffic delays due to maintenance should be less.

Traffic, never significantly disrupted due to the detour scheme, was restored to the redecked bridge four months ahead of schedule. This eliminated four months of maintenance on the deteriorated deck, and allowed travel on a safer bridge deck four months earlier.

The change in design and construction concept from precast panels under lane closures to cast-in-place deck with detour bridge could have been made in a DBB approach. The change was easier to make with DB because the construction contractor had much more influence on the priorities of the structural designer than they would have had with DBB delivery where design is completed prior to selection of a constructor. Even if the had been made with a DBB delivery it would have taken significantly more time. It is estimated that completion of the structure would have been delayed by one year. The closure period, estimated at between 30 days (by ODOT) and 70 days (by awarded DB contractor), would likely have included daylight closures, increasing user inconvenience and cost.

ODOT personnel and the members of the DB team worked together very well to assure the success of the project. Whether this was a result of DB project delivery is impossible to tell. This effective teamwork was an important factor in project success.

Objective Assessment Compared to Findings Required by ORS 279.015

Each of the eight findings from the exemption order are first stated, then followed by an evaluation at the conclusion of the project.

Finding 1. <u>Operational, Budget and Financial Data</u> - The only significant added effort due to pursuing the Harrisburg Bridge Deck Replacement Project as a Design/Build project has already been expended in research, methodology development, and coordination with interested and affected parties. In the future, as our Design/Build methodology is refined and appropriately applied, we anticipate realizing consistently significant cost and schedule benefits.

> **EVALUATION:** Statements are still valid.

Finding 2. <u>Public Benefits</u> - The anticipated benefit of reduced performance schedule, and associated reduction in public inconvenience, has been estimated to save the driving public as much as $420,000 by reducing the bridge closure period. In addition, a significant cost savings to the public agency, ODOT, of $79,000 is estimated.

> **EVALUATION:** The road users' cost savings were greater than anticipated -- two to four million dollars. It is impossible to determine if ODOT costs were reduced because of the change in design concept, the inherently high variability of costs for bridge rehabilitation projects, and the impact of the unforeseen deterioration of the floor beam at bent 1. It is most probable that ODOT paid a small premium for a superior product, for much greater benefit in reduced road user costs, and for non-recurring DB process validation costs.

Finding 3. <u>Value Engineering</u> - Innovation is expected under Design/Build contracting which should result in Value Engineering and the closure reduction and cost savings mentioned . . . Since a good deal of the project design and planning will be accomplished during the proposal phase, ODOT can expect to realize benefits in the initial contract price.

> **EVALUATION:** Value Engineering clearly occurred as manifested by the change from a design of precast panels under night closures to a cast-in-place alternate with detour bridge. The innovations had more effect on schedule, road user costs, quality, and safety than on contract price.

Finding 4. <u>Specialized Expertise Required</u> - No specialized expertise is required beyond that needed by performing this project in the traditional 2 contract phases, except for the procurement expertise concerning Design/Build contracting that is being acquired, in large measure, through this pilot program and the management of an integrated Design/Build project, which will become necessary to realize the full potential of Design/Build.

> **EVALUATION:** Statement is still valid.

Finding 5. <u>Public Safety</u> - We are confident that this procurement approach being pursued for the Harrisburg Bridge Deck Replacement will introduce no new safety concerns, and by minimizing bridge traffic disruption impacts to the public and the resulting detouring, our Design-build approach may improve safety.

> **EVALUATION:** The effect on public safety of the changes from DB delivery was positive.

Finding 6. <u>Market Conditions</u> - Indications through our Stakeholder contacts and meetings are that both the Construction and Design Engineering communities are becoming familiar with and accepting of, and even supportive of, ODOT's Design/Build pilot program.

> **EVALUATION:** Statement is still valid.

Finding 7. <u>Technical Complexity</u> - The Harrisburg Bridge Deck Replacement Project was selected as a Design/Build pilot project, in part because it is not technically complex, while still offering areas where some technical innovation may be applied.

> **EVALUATION:** Statement proved correct.

Finding 8. <u>Funding Sources</u> - The project is being funded by State of Oregon "Advance Construct" funding, holding open the possibility of subsequent Federal reimbursement, pending approval of ODOT's Special Experimental Project (SEP-14) approval which we expect to receive in mid-April, 1998.

> **EVALUATION:** SEP-14 approval not requested for this project.

Competition

Three DB teams submitted bids for this project. One bid was rejected as non-responsive, so only two cost proposals were evaluated. Three bidders are generally considered adequate to provide competition. Because of the additional effort required for DB proposals it is not wise to short-list more than three DB teams for final proposals.

The DB teams submitting bids had to take on additional risks in bidding a job that they perceived as experimental with ODOT. They were willing to take the risk because they saw promise in DB project delivery and wanted to gain a competitive advantage if future DB work developed. This risk should have been reflected in their bid prices. If ODOT ever reaches a position where projects are regularly procured DB, and ODOT continues its stakeholder efforts, the number of DB teams comfortable with DB project delivery will grow, competition should be adequate, and risk premiums will decrease.

Cost to ODOT

No cost savings to ODOT can be documented for this project, however without the detour bridge, the discovery of the corroded floor beam at Bent #1 could have resulted in a much more serious cost impact. The project was completed within the authorized budget. The cost benefit fell to the driving public. The lessons learned on this and the other pilot project should allow ODOT to effectively deliver future DB projects with greater potential for financial gains.

Conclusions

Analysis of the preceding information leads to the following conclusions:

1. The project did an excellent job of accomplishing its primary objective -- testing and refining newly developed ODOT procedures for DB in a low-risk environment.
2. Exact true cost impact relative to DBB can not be determined with accuracy, but it is clear that cost savings, if any, were not dramatic on this project. The project was completed 2.4% under ODOT target cost.
3. Road users enjoyed dramatically lower costs and much less inconvenience than they would have experienced with the design-construction concept that was likely to have resulted from DBB project delivery.