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Identifying and analyzing the relative advantages and disadvantages of public-private partnerships and traditional delivery for transport projects.

16. ABSTRACT

This project aimed to assess the advantages and disadvantages of Public-Private-Partnerships (P3) in comparison to traditional forms of project delivery and financing. This project's research focused on the State of California and the Pacific Northwest States of Oregon and Washington. With increasing budgetary pressures, state Departments of Transportation (DOT) are attempting to find innovative methods of procuring and building infrastructure at a reduced cost and reduced schedule. Many DOT's have begun to heavily use different types of contracting methods as an alternative to the traditional design-bid-build method. These alternative contracting methods, known as public private partnerships (P3's) generally move tasks traditionally done by the public sector to the private sector, notably changing which group absorbs the most risk. Examples of items moved to the private sector in P3's include design, construction management, financing, and maintenance.

The theory behind the move toward P3's is the economics of transaction costs. Transaction cost economics examines disaggregated costs and asks whether these costs are done more efficiently within a firm or in the market (Geyskens 2006), or more simply, an analysis of cost using a market (Coase 1937). Can the external transaction costs between companies in the market reduce the cost of infrastructure?

This research looked into one type of P3, known as design-build construction (DB) and compared bridge projects in Oregon and Washington that utilized both DB and conventional DBB. By parsing out the costs into small disaggregate categories; researchers were hoping to discover how costs varied and whether these changes agree with prevailing theory about internal vs. external transaction costs.

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IDENTIFYING AND ANALYZING THE RELATIVE ADVANTAGES AND DISADVANTAGES OF PUBLIC-PRIVATE PARTNERSHIPS AND TRADITIONAL DELIVERY FOR TRANSPORT PROJECTS

Draft Report (Final Report Forthcoming – Still Under Journals Review)

July 2017

DISCLAIMER

AUTHOR'S NOTE

Portions of text within the literature review of this report also were published in a recent Caltrans study concerning infrastructure improvements for the international border (US-Mexico), specifically from Task 6 of that study which focuses on a review of methods of project contracting, procurement and delivery. A more extensive review of contracting methods from that Caltrans study is provided in the appendix of this report.

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EXECUTIVE SUMMARY

With increasing budgetary pressures, state Departments of Transportation (DOT) are attempting to find innovative methods of procuring and building infrastructure at a reduced cost and reduced schedule. Many DOT's have begun to heavily use different types of contracting methods as an alternative to the traditional design-bid-build method. These alternative contracting methods, known as public private partnerships (P3's) generally move tasks traditionally done by the public sector to the private sector, notably changing which group absorbs the most risk. Examples of items moved to the private sector in P3's include design, construction management, financing, and maintenance.

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This research looked into one type of P3, known as design-build construction (DB) and compared bridge projects in Oregon and Washington that utilized both DB and conventional DBB. By parsing out the costs into small disaggregate categories; researchers were hoping to discover how costs varied and whether these changes agree with prevailing theory about internal vs. external transaction costs.

<u>KEY RESEARCH FINDINGS</u>

1. Literature showed that design-build was somewhat faster empirically but not statistically in most cases. On balance, projects done with DB were completed in a shorter time frame than their conventional DBB counterparts. However, there was significant variation and in many cases DB was actually longer. Only in a few specific categories did DB perform faster than DBB in a statistically significant way (P values <0.05). Furthermore, there is very little consensus on what the actual value of time should be when analyzing schedule growth, particularly in regards to freight.

2. Preliminary studies on costs with P3's can be misleading. This research evaluated the preliminary value engineering study for the Presidio Parkway in San Francisco and found many concerns. These included primarily the choice of discount rate in regards to financing but also variation in construction contingencies depending on the contractual method.

3. Disaggregation of costs revealed sharp differences in spending between DB and DBB. In Washington, the project examined two bridges on the same freeway of similar length, one constructed with DB and one with DBB. These bridges, with all costs lumped together, cost virtually the same amount. However, with DB much more money was spent on private contract administration and construction costs. These increases were offset by reductions in design costs and in change orders. Additionally, although the two bridges ended up costing the same and were roughly the same size, the bids differed by over $4 million dollars, nearly 20% of the final cost of the project.

4. In instances where construction is very straightforward ("cookie-cutter") there could be efficiencies with transaction costs by using design-build. In Oregon, DB construction bundles were not finished significantly faster than their DBB bundle counterparts or cheaper. However, the DB bundles had many more bridges in their package. The ability to not have to have different firms replicate design and construction procedures may have reduced schedule growth in these bundles where bridges were more similar or had a more simple replacement process.

5. Choices in contractual method can definitely affect the risk profile. State DOT's need to be aware of the changes to the risk profile that can be sizable. When moving to DB, risk is nominally moved from the public space to the selected designer-constructor consortium. However, in practicality, the taxpayers are still acting as a financial backstop against something dramatic and DOT's will feel the brunt of the criticism if the DB consortium moves too fast. Moving this risk can also reduce the amount of appropriate ancillary studies, such as examinations of necessary environmental mitigation.

An examination of bridges constructed with DB and DBB found significant differences in cost appropriations and efficiencies. State DOTs, particularly Caltrans, are encouraged to spend more time thinking about which contractual method works best for each project, and whether transaction costs will actually be reduced.

INTRODUCTION

This report describes the result of research to examine the institutional arrangements and outcomes of traditional and alternative contracts for small and mid-sized engineering and construction projects across two or more states.

This research is designed to compare the effects of nested institutional rules of contracting on efficiency and other public interests in a small sample of projects using mixed methods of quantitative analysis and qualitative interviews of program and project management. Such an approach is particularly useful for identifying the variables that should prove meaningful in large scale analyses to discern the relationships between the choice of contract, the cost and time of delivery, and factors that are less common but critical such the integrity of the environment, the role of government in delivery, and other factors of interest to the public.

The theory applied in this empirical research is transaction cost economics, which collects data adequate to compare the costs of tasks performed by contractors, consultants, and state agencies, after projects have been completed (Whittington 2012). The findings in this research build from Whittington's (2012) study of the outcomes of pairwise design-build and design-bid-build intersection projects delivered in the State of Washington, and expand to include several pairs of design-build and design-bid-build bridge replacement projects delivered as part of the OTIA III program. The findings in this report point to the comparative competence of the public sector in carrying out programmatic environmental and engineering evaluations of projects, and the benefits in efficiency and qualitative environmental outcomes when such evaluations are used as pre-contract information in design-build and design-bid-build delivery.

The findings in this report also support previous research documenting the difficulties of ascertaining the value of public-private partnerships (Semiatycki 2007). This research was motivated by the pairwise development of design-bid-build and public-private partnership projects for the Presidio Parkway replacement in San Francisco, yet project-level data for Presidio Parkway were not available for this research, owing in part to the perceived sensitivity of data regarding the public-private partnership. Similarly, efforts to obtain project-level data for design-build bridge projects in the State of New York were not successful.

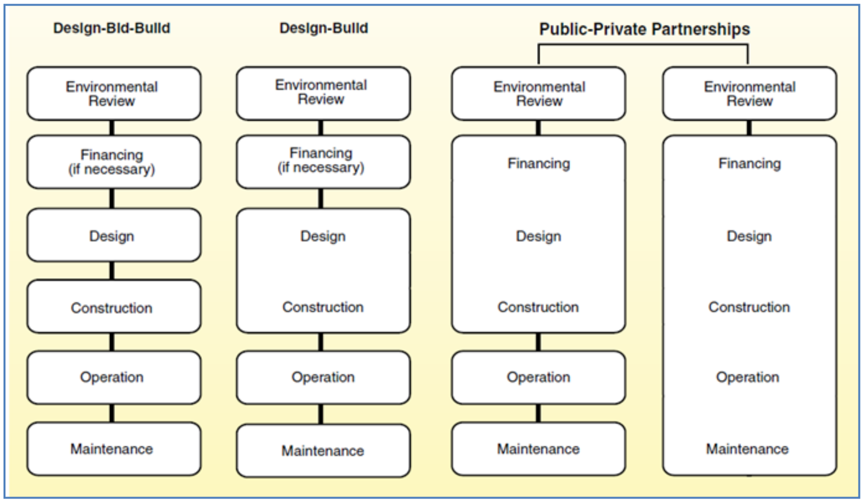
This report begins with a review of the literature regarding alternative contracts, followed by a comparative evaluation of the policies for public-private partnerships and design-build agreements in the states of interest, as well as the analyses to compare projects and the findings from this research.

LITERATURE REVIEW

In the State of California there are three relatively well-known forms of project delivery (also known as methods of procurement) for transportation projects implemented by government agencies: design-bid-build, design-build, and public-private partnerships. The most common and well-understood by stakeholders is the design-bid-build method, in which the public agency develops complete designs internally or through a consultant and then bids those designs out to contractors for construction (Geddes 2011). Criticism of design-bid-build usually centers on the cost and time to deliver a project. Design-build and public-private partnerships emerged in the 1980s and 90s as procurement alternatives. While many individuals, private organizations, and public entities have promoted alternatives such as design-build and public-private partnerships, others have recommended caution and careful evaluation.

The simplest way to interpret the differences between these contracting methods is to examine the allocation of tasks in project delivery between the public and private sectors. Project delivery can be divided into seven separate tasks; environmental review, financing, land acquisition, design, construction, operations, and maintenance. While each task may involve the work of contractors, alternative delivery methods bundle these tasks and engage firms in different types of markets (Figure 1). Design-bid-build methods allow each of the major tasks of project delivery to be treated separately and sequentially, while design-build and public-private partnerships bundle several of them together. During design-bid-build delivery, public transportation agencies complete project designs (in-house or with the assistance of a firm), prior to the request for proposals from firms interested in providing construction services. Design-build combines these two tasks, allocating the work to firms that provide professional architectural and engineering services in addition to construction. In public-private partnerships, engineering and construction firms are joined by financial investment firms and their associates in banking and insurance and, as is often the case, their financial interest includes the pursuit of return on investment over the course of several years, and thus includes the joining of the group with firms responsible for operations and maintenance of capital assets. Note that it all cases diagrammed by the California Legislative Analyst's Office the first step for the public agency is environmental review, regardless of contracting method.

Figure 1: State Procurement Approaches



Source: LAO 2012, Figure 1, page 5.

Contracting methods are one of many targets of blame when projects are over budget and behind schedule, but it is important to acknowledge that the diagnoses for these problems are a matter of debate. Researchers have considered many different explanations; optimism bias in project estimates, intentional underestimation of project costs, scope changes, and incomplete information at the time of approval (Ellis et al. 2007; Flyvbjerg 2009; Siemiatycki 2009b). Regardless of these potential causes, governments are dealing with greater financial constraints and as a result accuracy in project cost estimates is becoming a critical component in helping agencies allocate scarce resources (G. Hodge and Greve 2010; Geddes 2011).

Under the assumption that the choice of contracting method can play a role in ameliorating budgetary or scheduling concerns, there has been a range of academic-and practice-directed literature discussing alternatives to the standard design-bid-build contracting method. Alternatives have often been grouped under the public-private partnership heading (Little 2011; Chen, Daito, and Gifford 2015). Authors have defined public-private partnerships differently, but in many cases they are framed as any alternative to design-bid-build methods (Geddes 2011). Design-build specifically can be helpful to focus on, as it is at the core of the vast majority of public-private partnership agreements (Whittington 2012).

The existing literature on public-private partnership arrangements suggests that while improvements in delivery may be possible from alternative contracts, it is easy to overstate the benefits and understate the complexity of these contractual arrangements. Proponents of design-build and public-private partnerships suggest that the public sector share more risks, which would generally mean moving more risk of the design, construction, and maintenance process to the private sector, under the assumption that firms may manage risk better (Graeme A. Hodge and Greve 2007; Geddes 2011). Theory suggests that risk transfer should result in more accurate bid prices and schedules, which would reduce the prevalence of increases in costs that occur during the construction of projects (Geddes 2011, 78–81; Flyvbjerg 2009).

Another argument for public-private partnerships is that they make more money available for projects (Grimsey and Lewis 2004). However, private financing does not create any new money for infrastructure when the public sector pays private companies, and private finance simply amounts to a different, additional source of debt when user fees and tolls are used to fund projects (Graeme A. Hodge and Greve 2007). This, and the fact that public-private partnerships can allow for debt to be hidden from government balance sheets, has resulted in these arrangement being called ‘misleading accounting trickery’ (G. Hodge and Greve 2010). While problems in public-private partnership funding and finance should not be ignored, the claim that risks may be more efficiently shared in public-private partnerships to reduce cost and schedule overrun can be effectively analyzed in the comparison of design-build to design-bid-build contracts (Whittington 2012). In addition, research shows that reduced government flexibility, impaired transparency, and limited public involvement can result from agencies’ use of alternative contracts (Siemiatycki 2009a; Shaoul, Stafford, and Stapleton 2006). For example, an undisclosed non-compete clause in one toll lane project prohibited the expansion of parallel road facilities, and in other cases, contract terms have superseded public input, and thus limited the ability of citizens to make sure their concerns were addressed (Siemiatycki 2009a). Overall, alternative contracts such as design-build and public-private partnership arrangements bring about new challenges for public agencies as they strive to align public and private interests.

The Transaction Cost Economic Approach

> *"The central question of transaction cost theory is whether a transaction is more efficiently performed within a firm (vertical integration) or outside it, by autonomous contractors (market governance)...certain dimensions of transactions raise transaction costs and combine to create 'market failure,' making vertical integration more efficient than market governance. These dimensions are asset specificity, uncertainty, and transaction frequency (Williamson, 1975, 1985)."*

Based on foundational Nobel Prize winning work by Williamson (1998) and Coase (1937), and building on approaches applied in recent work (Whittington 2012; Jin 2013), the research described in this report applies transaction cost economic reasoning to the empirical examination of complex contracts and public-private partnerships. Transaction cost economic research has devoted considerable attention to the “make or buy” decisions of private firms (e.g., Shelanski and Klein 1995, Macher 2008, LaFontaine 1993) and, while public contracting presents different issues, such arrangements are equally amenable to transaction cost analysis (e.g., Spiller 2013, Guasch 2004, Iossa and Martimort 2015).

Transaction cost economic methodologies are particularly suitable for researching the claim that alternative contracts are purported to obtain more efficient outcomes by sharing more risks with the private sector. Transaction cost economics can be conceptualized as the analysis of the cost of using the market (Coase 1937). Recognizing that market prices (i.e., bid prices) may not be the only relevant indicator of efficiency, this methodology centers on the fact that despite the presence of competitive bids, inefficiencies can be experienced in the form of rising costs *ex post* (cost overruns) after contracts are signed and the work is underway (Coase 1937; Williamson 1998).

The costs that are relevant to transaction cost analysis include the costs of production (i.e., paid to contractors), and any other costs that accrue to the agencies or contractors for the purpose of completing the transaction (Whittington 2012). Institutional costs such as internal agency costs, financing, and the value of public time are also meaningful variables, though in the transportation sector, these values are often not included when considering or reporting total project expenses. In discussing transaction costs for Australian policies to reduce greenhouse gas emissions, for example, Ofei-Mensah and Bennett (2013) cite seven categories that may apply in the empirical examination of transaction costs for governmental agencies, including:

1. Research and Information costs
2. Enactment costs (legislation)
3. Implementation (permitting)
4. Administrative costs (keeping records, audits)
5. Contracting costs (bargaining)
6. Monitoring costs (supervision)
7. Enforcement (lawsuits)

Similarly Rajeh (et al., 2013) differentiate between costs occurred in procurement before a contract is signed (i.e., ex ante), including the costs of initiation, preliminary design, negotiation and contracting, and feasibility and related environmental studies, from the cost of monitoring, implementation, and the need to resolve disputes that arise after the contract is signed and construction is underway.

The theory of transaction cost economics has at times been applied without enough information on how the fields of study actually work (Schlag 2007). Such complaints, however, reflect shortfalls in the design of economic research, as occurs when empirical research is reduced to a limited set of variables, a single form of contract, or comparisons made between completed projects and hypotheticals (public sector comparators common in value for money analyses) or *ex ante* information (cost estimates or bid prices). Within California, for example, Bajari (2001) examined transaction costs for design-bid-build highway projects without the benefit of an *ex post* comparison to other forms of contract, and did so without including the cost of Caltrans' costs. This empirical study did demonstrate the effect of strategic bidding on *ex post* cost increases—a principle hypothesis of transaction cost economics. The claim that any alternative contract can offer superior performance can only be tested through comparative *ex post* analysis of projects completed both ways. Bajari and Tadelis (2014) show, for example, how lump sum arrangements (common in design-build and public-private partnerships) can reduce the cost-competitiveness of bidders and enhance the discretion of public agents in contractor selection, and thus result in inefficiencies that outweigh the transaction costs that arise from strategic bidding in cost-plus, low bid arrangements (of design-bid-build).

In sum, transaction cost economic theory cautions that all forms of contract are flawed; to understand the circumstances under which one may provide gains in efficiency over another requires the study of comparable transactions executed according to the terms of alternative forms of contract (Williamson 1998).

Project Evaluation

One of the most important parts of the debate over public-private partnerships is how a researcher should evaluate projects completed using different contracting methods. One of the first questions to ask for a rigorous comparison is: How can a researcher compare different projects? In an ideal experiment a number of variables could be controlled, but the development of infrastructure rarely allows for so clean of an effort. Many of the other open questions in project evaluation are related to the scope of an evaluation effort, such as:

- Which costs should be included?
- What should be considered the beginning and end of a project?
- What non-monetary costs should be evaluated, and how should they be accounted for?

These questions apply to both *ex ante* project estimates, which are almost always an important part of the contract method decision-making process, and *ex post* project evaluation to assess outcomes. Considerations and prior studies related to many of these questions are discussed below.

How can we compare different projects?

Many studies of experiences with public-private partnerships are collections of case studies, which have limited value in evaluating the cost and time outcomes of a contracting method. Determining if design-build and public-private partnerships represent a time or cost savings requires comparing similar projects to each other, not just comparing projects to initial estimates or bids. Ideally, projects should take place in similar timeframes under similar legal conditions, and have similar physical characteristics (Pollock, Price, and Player 2007; Whittington 2012).

Which costs should be included?

The inclusion or exclusion of certain costs can significantly affect the comparison between traditional contracting and a public-private partnership contract. If a project evaluation focuses on the cost of construction, it can miss internal agency costs incurred before and after the project goes out to bid (Whittington 2012). The cost of financing, especially the cost of interest, has been excluded in most of the research to date largely due to practical considerations (Flyvbjerg 2009). However, interest on bonds can double the nominal cost of large projects and there may be higher costs for private financing (Fernandes, Ferreira, and Moura 2015). There are many challenges to accounting for the less commonly tracked costs mentioned here, in addition to other costs, but they are critical for accurate *ex ante* estimates and *ex post* evaluation.

Although this research will not be evaluating costs associated with design, build, operate, maintain (DBOM) style contracts found in public-private partnerships, evaluating operation and maintenance costs is similarly important when examining a DBOM contractual arrangement. Historically, there has been minimal reporting on outcomes; most agreements of this type in the US were formed in recent years and are still underway.

What should be considered the beginning and end of a project?

This is a non-trivial question for *ex ante* and *ex post* analysis. It also has some overlap with the previous question, since internal agency costs prior to construction and operation and maintenance costs are included or excluded based on the timeframe of analysis. Estimates are often concerned with construction costs, and a common method of analysis is to compare those estimates at the time of decision to build to the final construction cost (Whittington 2012). However, many studies find that these estimates are not well documented (Nicolaisen and Driscoll 2016).

The most commonly discussed method of *ex ante* analysis for public-private partnerships is “value for money” analysis (VfM), which estimates the whole-life costs of a project under different contracting scenarios against a public sector comparator (G. A. Hodge 2004; Fernandes, Ferreira, and Moura 2015). VfM has been criticized because the estimates are highly dependent on the value of risk transfer, the cost reductions assumed to accrue under public-private partnership agreements, and most importantly the discount rate (Shaoul, Stafford, and Stapleton 2006; G. Hodge and Greve 2010). Quantifying risk transfer may amount to little more than a guessing game, which means that VfM project estimates can be adjusted to support the argument for a public-private partnership.

What non-monetary costs should be evaluated, and how should they be accounted for?

Criticisms of public-private partnerships have included that they reduce public participation, transparency, and environmental accountability in projects (G. A. Hodge 2004; Siemiatycki 2007; Whittington 2012). These elements of projects can be difficult to measure; they are not easily assigned monetary values and are often ignored, especially when studies focus on project cost and time. However, they are essential to ensuring that a project is in the public interest. Therefore, any comparison of projects under different contracting methods should take into account these non-monetary costs.

The Approach of This Research

The questions and considerations above illustrate how the scope and methods of public-private partnership analysis are critical for evaluating outcomes. In addition, “determining the real merit of infrastructure partnerships [public-private partnerships and design-build] requires more attention to how particular types of partnership arrangements best serve specific infrastructure problems based on empirical experience" (G. Hodge and Greve 2010). Ideally there should be a feedback loop, where *ex ante* predictions are then reevaluated *ex post*, in order to feed into the *ex ante* evaluations of future projects. Both of these should be compared to the stated objectives of public-private partnerships.

Most public-private partnership literature look at costs in the aggregate, but some researchers have looked at more disaggregate data to investigate specific differences between projects, and to assess tradeoffs in alternative contracting (Flyvbjerg 2009; Chasey, Maddex, and Bansal 2012, Whittington 2012). As Whittington (2012) has shown, transaction cost analysis disaggregates costs in ways that are particularly useful for both the determination of root causes of cost overrun (i.e., the difference between *ex ante* estimates and *ex post* outcomes) and the measure of trade-offs between cost-effectiveness and other concerns, such as the time to deliver, the privatization of service delivery, and the allocation of funding to environmental impacts. Such results are possible because costs are analyzed as they accrue to the client, contractor, and various other interested parties, from tasks that are performed over time. This analysis exists within a comparative institutional framework that allows for the comparison of actual costs of projects delivered using different methods of procurement and forms of contract.

METHODOLOGY

The research described within this report applies a transaction cost economics approach, to compare design-bid-build and one type of public-private partnership contract, design-build. It extends the transaction cost methodology of Whittington (2012) to projects delivered under the differing institutional rules and programmatic approaches that occur between and within state programs.

DATA COLLECTION PLAN

The research team used both quantitative and qualitative methods to perform pairwise comparisons of infrastructure projects. The team decided to focus primarily on bridge projects for this analysis since bridges are relatively discrete and localized. Projects for this study were initially screened using public reports of contracted or final cost to construct or, in the case of design-build, design and construct. Since cost alone is a poor method of assessing the comparability of projects, various data points regarding the project's size, design features, and other elements, such as the location of the project, were collected.

The quantitative monetary cost data for this analysis was provided by the agencies that carried out the projects based on a data collection template created by the researchers. The template differentiates costs paid during different phases, from the planning phase through the contraction and project close-out phases. It also distinguishes the amounts paid to each party such as the lead agency, consultants, and contractors.

In addition to monetary cost data, quantitative soft cost data was collected for each project as well as possible. Some of this data represents non-financial measurements of effort by state agencies, such as the number of formal agreements that were implemented for a project and the number of public meetings. Other soft cost data captures a different view of the monetary costs, such as the number of hours (FTEs) of staff in various roles, which allows for better comparisons of the effort involved in projects across jurisdictions. Additional data points help to measure costs that are not paid for by state agencies but incurred by other public entities, including the public itself.

Qualitative data consisted of a public-private partnership legislation review for each state and interviews. The team investigated the history of public-private partnership legislation within each state and compared the institutional contexts across states. Interviews were conducted with agency staff and community members who were involved in the case study projects. The interviewees were grouped into the following categories:

State or local employees in one of the following roles:

1. Program Management
2. Project Management or Engineering
3. Project Finance
4. Agency/Department Administration or Management

The interviews helped to fill in the story behind the case study projects and understand the political climate in each of the relevant jurisdictions. Interview questions were tailored to each interviewee group. For example, state or local employees in administration or management were asked about the political climate regarding infrastructure funding and public-private partnerships, while employees in project management or engineering were asked about specific details regarding the case study projects, and state or local elected officials and staff were asked about their involvement in project development and procurement. A sample of the interview questions are available in Appendix C.

COST COMPARISON

The method for comparing the different case studies follows the process found in Whittington (2012). The premise is that while projects with different contracting methods can have similar aggregated total costs, by disaggregating spending into smaller discrete tasks one can discern where gains or losses have been made by changes in contract. These tasks are as follows:

Table 1: Summary of eight discrete tasks

Task	Type	Description
Preliminary Administration (DOT)	*Ex Ante*	*Define the scope on the project and organize for project delivery*
Ancillary Studies (DOT)	*Ex Ante*	*Develop information in support of design such as environmental review, constructability, and value engineering*
Bid Administration (DOT)	*Ex Ante*	*Develop, publish, and administer RFP; contractor selection and negotiation*
Design Engineering (DOT or contractor)	*Ex Ante (DOT)* *Ex Post (Contractor)*	*Develop conceptual and detailed designs, construction drawings, and specs*
Contract Administration (DOT)	*Ex Post*	*Manage both the contract and the contractor*
Construction excluding taxes	*Ex Post*	*Build the project as designed*
Outside agreements and damages	*Ex Post*	*Payments from damage, compensation for ROW takings*
Change Orders / Disputes	*Ex Post*	*Costs from changes to the design after the contract is signed and disputes between the owner and the contractor*

(Source: Whittington 2012)

With the expenditures of each project disaggregated, there should be clear differences between the projects utilizing design-bid-build and design-build. This will allow the authors to discern the differences between transaction costs between stakeholders as opposed to the production costs of building the actual bridge.

Analysis and Results

Research began by identifying several states with a recent history of implementing public-private partnerships or design-build contracts for highway projects, and locating completed projects suitable for comparative analysis. Following Whittington's (2012) analysis of elevated intersections in Washington State, research focused on the analysis of small and medium-sized bridge projects. This section includes:

After a brief section describing the selection of states for this study, analysis proceeds to:

- A review of policies governing alternative contracts in selected states,
- A discussion pair of projects in California that inspired this research,
- the pair of elevated intersection projects in Washington, as presented in Whittington (2012), and
- a collection of paired projects in Oregon, implemented in a state-wide program to upgrade bridges

Selected States

Public infrastructure contracting is primarily regulated at the state level, so state enabling legislation is one of the most important factors in the institutional framework of public private partnerships (Iseki et al. 2009). Within transportation, the federal government has also played a role through highway toll regulations, rules on private sector involvement in highway procurement, and transit funding regulations (Iseki et al. 2009; Thomas 2014). This section illustrates the variety in state enabling legislation and sets the stage for comparative case study project evaluation.

The selected states for research were California, New York, Oregon, and Washington. California, Oregon, and Washington were included because they are within two US Department of Transportation districts in the western United States (California and Oregon are in District 9, Washington is in District 10). New York provides a contrasting case because the state passed transportation design-build legislation more recently and has completed bridge replacement projects using both design-build and traditional contracts. Detailed descriptions of bills related to transportation public-private partnerships in each of the selected states are available in Appendix A.

Federal regulations have generally become more permissive of public-private partnerships since the late 1980s. Toll roads and road pricing were first authorized by legislation in 1987, followed by a "federal pilot for toll-based public private partnerships" in the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) (Iseki et al. 2009). The 1998 Transportation Equity Act for the 21st Century (TEA-21) further increased state flexibility by allowing them to "levy tolls on new and reconstructed state highways, as well as new Interstate highways" (Iseki et al. 2009). In 2005, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) paved the way for broader public-private partnership authorization in public transit with a pilot program (Thomas 2014). SAFETEA-LU also “allowed greater use of toll finance and private sector involvement in highway procurement” (Iseki et al. 2009). The 2012 Moving Ahead for Progress in the 21st Century Act (MAP-21) contained broader authorization for public-private partnerships in public transit projects, and allowed for tolling of new capacity, among other provisions (Thomas 2014; Kessler and Davidson 2012). Most recently, the 2015 Fixing America’s Surface Transportation Act (FAST Act) communicated federal support of public-private partnerships by creating an Innovative Finance Bureau (Schmidt et al. 2015).

Some of the selected states’ legislatures began experimenting with alternative contracting in transportation shortly after toll roads were authorized in 1987, while others have only recently authorized these contracts for public infrastructure. California is considered the first state to enable transportation public-private partnerships, via AB 680 (1989) (Fishman 2009). In contrast, New York passed its first and only authorization in 2011.

State legislatures have experimented with public private partnerships for transportation in different ways. By naming specific projects within bills and authorizing limited numbers of projects, state legislatures place a check on alternative contracting. In Washington, specific individual projects were named within bills granting the Department of Transportation the authority to use public-private partnerships, followed by bills that authorized a limited number of demonstration projects. California has also authorized limited numbers of projects in its bills. Oregon’s legislature provided broader authorization in its initial bills, and perhaps as a result this state has passed relatively fewer bills related to alternative contracts in transportation than California and Washington. Still, Oregon’s legislation provided a check on the use of alternative contracts with language that grants the Director of Transportation the authority to approve, on a case-by-case basis, exemptions to the requirement that projects be awarded to the lowest competitive bidder (*Oregon HB 4010* 2002; ORS 279C.335).

Recently, New York and Oregon undertook statewide programs to rehabilitate and replace aging bridges (Tran et al. 2017). In doing so, both states incorporated the use of alternative contracting methods to expedite project completion, along with a programmatic approach to delivery. Both sought to benefit from economies of scale and provide employment within their home states, while delivering hundreds of projects. In doing so, both New York and Oregon grouped projects into bundles appropriate in size and scale for local contractors. When bids and contracts are bundled in this way, the availability of data at the level of the individual bridge project—critical for comparative analysis of the efficiency of alternative contracts—will depend on the measures put in place by the Department of Transportation to collect disaggregate data from firms and professional staff, and to ensure the availability of data for research. Attempts to collect project-level data on design-build work in New York for this research were not successful. In Oregon, however, the Department of Transportation had collected and archived data appropriate to this analysis.

The following sections describe the motivation provided for this research by paired projects developed in California, followed by a review of pairwise design-build and design-bid-build intersection projects in the State of Washington, and lastly, the analysis of several pairwise bridge projects in the State of Oregon.

MOTIVATION: CALIFORNIA'S PRESIDIO PARKWAY

The research in this report was motivated by the case of the Presidio Parkway reconstruction project in California. The Presidio Parkway in California offers a promising opportunity to perform a literal side-by-side comparison of two projects with similar characteristics constructed using different contracting methods. This report reviews the Value for Money (VfM) analysis performed for the Presidio Parkway, as the cost outcomes for this project were not available at the time of this report. Additional information can be found at the Presidio Parkway website (presidioparkway.org).

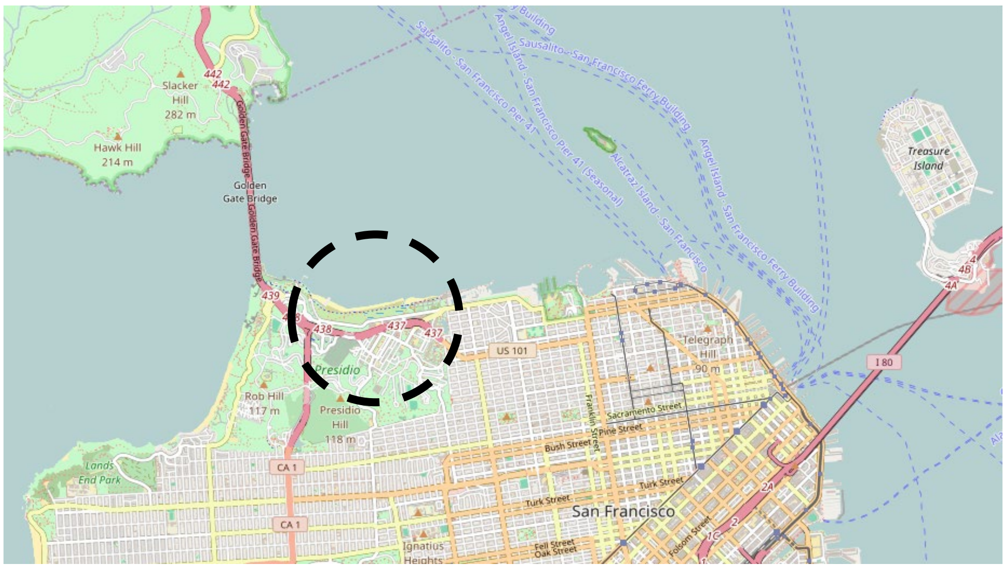
Figure 2: Construction of Phase II of the Presidio Parkway

(Photo courtesy of Caltrans)

The Presidio Parkway project replaced the aging roadway that connected the Golden Gate Bridge with San Francisco proper, with a series of tunnels, a bridge and an interchange (shown above) located immediately adjacent to the bridge toll plaza. This project was split into two phases. Phase I, which included one new bridge, one new tunnel, the westbound roadway and temporary structures, was built conventionally with design-bid-build methods. Phase II, consisting of additional tunnels and the eastbound roadway, was let to a consortium to perform design, construction, (partial) financing, operations, and maintenance in a 30-year public-private partnership (DBFOM).

The following figures show the locations (shown with a dashed circle), schedules, and basic elements of the two Phases of the Presidio Parkway project. Traffic was moved from a temporary to a permanent roadway in 2015; all major construction was scheduled for completion in 2016. The contract price for Phase I was $496 million, Phase II $360 million. With westbound traffic travel mostly on the Phase I structures, and eastbound on Phase II, Caltrans and the Golden Gate Bridge Authority should be able to easily compare the cost and quality of service provided on these projects by the agency, contractors, and the DBFOM consortium.

Figure 3: Location of the Presidio Parkway Project



(Map courtesy of OpenStreetMap)

Figure 4: Phases of Presidio Parkway

(diagrams courtesy of Caltrans)

To understand the motivation for *ex post* comparative research of design-bid-build and public-private partnership projects, consider the VfM analysis completed in advance of the Presidio Parkway procurement. The comparative costs of using design-bid-build, design-build-finance, and full public-private partnership (DBFOM), estimated by Arup and PB (Parsons Brinkerhoff) for Caltrans (2010), are summarized in Tables 3 and 4. As shown in Table 3, the estimated cost of the DBFOM in nominal dollars (today's dollars at the time of the study, 2009) was about 30 percent *more* expensive than the design-bid-build delivery. By contrast, the net present value (NPV) of these estimates, found in Table 4, suggests that a public-private partnership would be 23 percent *less* expensive than a design-bid-build procurement.

Table 2: Total Year-of-Expenditure Costs (millions)

	DBB	DBF	DBFOM
Oversight and transaction costs	96	61	51
Retained risk reserves	125	91	47
Construction completion payments	458	150	150
Annual availability payments	N/A	640	1,130
Tax adjustment	167	167	N/A
O&M and R&R through 2043	128	128	N/A
Total sum of nominal dollars (concession term, 2010 to 2043)	**974**	**1,237**	**1,378**
O&M and R&R from 2044 to 2073	417	417	591
Total sum of nominal dollars (2010 to 2073)	**1,391**	**1,654**	**1,969**

Note: for the DBFOM option, the O&M/R&R costs during the concession terms are included in the annual availability payments.

Source: Arup et al. 2010, Exhibit 8, page xv.

Table 3: Net Present Value [NPV] millions 2009$, 8.5% Discount Rate

	DBB	DBF	DBFOM
Oversight and transaction costs	77	50	32
Retained risk reserves	125	91	47
Construction completion payments	369	113	113
Annual availability payments	N/A	324	289
Tax adjustment	36	36	N/A
O&M and Replacement and Rehabilitation	28	28	7
Total net present value	**635**	**642**	**488**

Notes: For the DBFOM option, the O&M/replacement/ rehabilitation costs during the concession terms are included in the annual availability payments. NPV accounts for the 60-year maintenance and rehabilitation cash flows.

Source: Arup et al. 2010, Exhibit 6, page xiii.

The largest effects on the VfM are from controversial choices in regard to discount rates. In this analysis, the DBFOM arrangement was assumed to spread the cost of construction, using debt and equity to be repaid as interest and dividends, over the 30-year period of operations and maintenance, which is the period of relevance for discounting.

The costs of capital are usually estimated to be higher in a public-private partnership arrangement (i.e., private financing) than the cost of capital in a design-bid-build delivery option (i.e., public financing). However, as explained by the authors of the VfM analysis, the choice of discount rate used in this study gave the DBFOM arrangement a net benefit from private financing, because, "A large amount of relatively cheap TIFIA loan means that the post-tax time-weighted [weighted average cost of capital] WACC is equal to 6.5%, which is less than the [8.5%] discount rate for the NPV analysis; therefore spreading payments over time results in a benefit, and every extra year of spreading the cost results in a larger benefit" (Arup et al. 2010, 57).

The choice of discount rate of 8.5% for the design-bid-build estimate appears to have been based, at least in part, on the 1992 publication of Circular A-94 by the US Office of Management and Budget, which suggested that government agencies discount investments at the then current real Treasury bond interest rate of 7% (OMB 1992). This was used as the basis for the 8.5% discount rate for public financing in the VfM analysis, despite the fact that at the time of publication (February, 2010), real US Treasury bond rates at 30-year maturities (i.e., the rate of return on capital that investors demand on riskless investments for the period of the proposed public-private partnership contract) were at a post-Great Recession low of 2.7%, and had been there for over a year (OMB 2015). In the VfM analysis for the Presidio Project, the break-even point – the discount rate above which the public-private partnership arrangement became more beneficial than design-bid-build – was 4.4% (Arup et al. 2010, G5).

In other words, the assignment of a proper discount rate would have been adequate enough to demonstrate the financial inefficiency of DBFOM in the case of the Presidio Parkway. A more appropriate method of discounting would have recognized the use of current risk-free rates of borrowing on US Treasury Bonds to discount both the design-bid-build and DBFOM estimates; and if those methods were used design-bid-build would have out-performed the public-private partnership by a significant margin in the VfM.

Setting the choice of financing and discount rates aside allows the focus of analysis to narrow to the question of whether or not the cost of project delivery is reduced in the use of design-build procurement, which is the type of agreement that forms the basis for a DBFOM public-private partnership. The Presidio Parkway VfM analysis included several assumptions about the comparative efficiency of design-build arrangements. Construction risks borne by the public sector in the design-bid-build scenario were assumed to add 29 percent to baseline project costs, while construction risks in the alternative contracts were assumed to add 14 percent, because of the "approach to managing the project, the contractual and financial structures that transfer risks and impose discipline on delivery, and expected cost efficiencies for soft and hard construction-related costs." (Arup et al. 2010, xiii) This plays out in the assumption that 41 million dollars are saved from comparative efficiencies in construction management when using the design-build firm in the public-private partnership arrangement (Arup et al. 2010, 20).

Is the public actually saving money by going with a DBFOM arrangement and its underlying design-build contract, instead of simple design-bid-build contract? This case of comparative VfM analysis suggests that it would be helpful to know how accurate VfM estimates are, by following up with *ex post* analyses of actual costs.

Though the details of the Presidio Parkway projects were not available at the time of this writing, research continued through the examination of paired design-build and design-bid-build projects in Washington and Oregon.

WASHINGTON STATE PAIRWISE COMPARISON

SR 500 BRIDGES

In its first demonstrated use of design-build, Washington State's Department of Transportation arranged a controlled experiment in the simultaneous development of two elevated intersections on State Road (SR) 500 in Vancouver, one using design-build and the other design-bid-build contracting. Straddling I-5, with similar conditions for project development and similar scopes of work, these projects made excellent case studies for comparison (Whittington 2012; Molenaar et al. 2003).

The design-build interchange, SR 500 at Thurston Way, was completed in 2003 and the design-bid-build interchange, SR 500 at 112th Avenue, was finished in 2005. The following figure shows the SR 500 freeway and a large interchange with I-205, the loop road around Portland (OR) that extends into Washington in this area. SR 500 at Thurston is to the west of the I-205 interchange and SR 500 at 112 is to the east. Pictures of the two bridges are shown below.

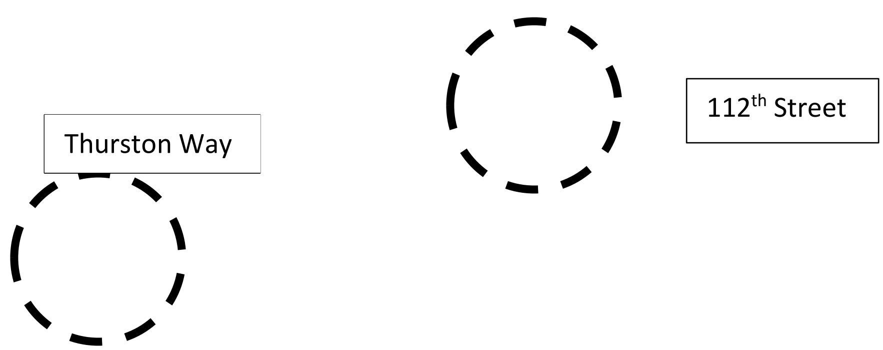
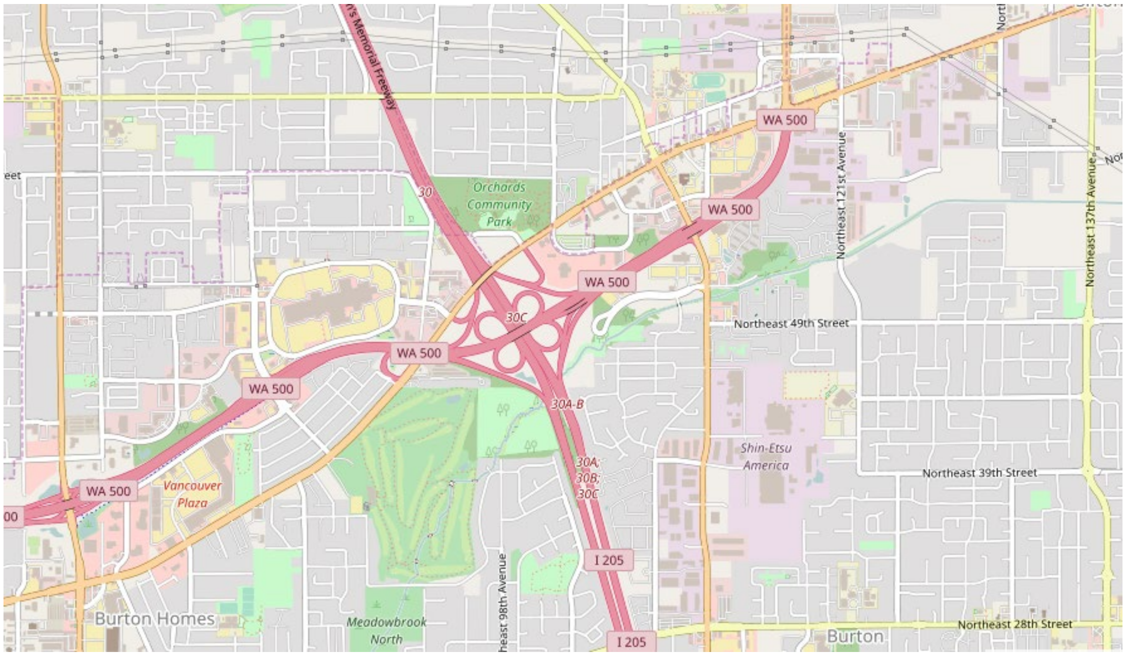


Figure 5: Pairwise Projects on State Route 500 in Vancouver, WA



(map courtesy of OpenStreetMap)

Figure 6: SR 500 over Thurston Way

(photo credit: Jan Whittington)

Figure 7: SR 500 over 112th Avenue

(photo credit: Jan Whittington)

Table 6 shows that the cost estimates for the two projects were similar, and though the design-bid-build project at 112th Street involved the development of a larger area of bridge deck, the two were comparable in size.

Table 4: Comparison of Bridges in Vancouver, WA

Variables	SR 500 Over 112th Street (design-bid-build)	SR 500 over Thurston Way (design-build)
Area of Footprint (sq ft)	1,614,600	1,334,800
Surface area (sq ft)	35,560	19,620
Cost Estimate ($)	$17,768,795	17,555,000

Washington Case Cost Comparison

Table 8 shows the differences in costs between the two bridges on SR 500 in Vancouver, Washington by the discrete tasks shown in Table 7.

Table 5: Costs by Task, Washington Bridges

Task	SR 500 Over 112th Street (DBB)	SR 500 over Thurston Way (DB)	Cost Difference
Ex Ante			
Preliminary Admin	$674,000	$257,623	($416,377)
Ancillary Studies	$1,734,389	$586,798	($1,147,591)
Bid Administration	$23,033	$707,925	$684,892
DOT Engineering	$3,651,000	$220,150	($3,430,850)
Subtotal	$6,082,422	$1,772,496	($4,309,926)
Ex Post			
Contractor Engineering	$956,000	$667,025	($288,975)
Contract Administration	$0	$2,937,910	$2,937,910
Construction	$17,578,190	$21,413,247	$3,835,057
Outside Agreements	$67,600	$79,107	$11,507
Change orders	$3,068,270	$259,813	($2,808,457)
Subtotal	$21,670,060	$25,357,102	$3,687,042
Final Cost	$27,752,482	$27,129,598	($622,884)
Bid Price	$18,162,105	$22,725,000	(4,562,895)
Cost Estimate	$17,768,795	$17,555,000	

Source: Whittington (2012), as provided by Washington State Department of Transportation.

As shown by the data, although the final costs for the two bridges in Washington were very similar, when they are disaggregated the costs were quite different for the specific tasks. This is to be expected when the risk is different for each type of contracting method.

Overall, the total cost of expenditures for the agency and the contractors for each bridge were about 55% above estimates. To understand the benefits and pitfalls of design-build and traditional contracting, it is important to examine differences in construction expenditures and differences between the bids and the total cost.

In the design-build case, the contractor's bid to complete design and construction was over $4.5 million dollars higher than the design-bid-build bid for construction. While some might attribute this increase to the need to complete the design process, the cost to have the public agency complete engineering on the design-bid-build project added only $3.5 million more to the cost of that project, and the public agency spent much less to administer the competitive low-bid administration process for design-build as well. This million dollar difference is significant; as noted in existing literature, proponents of alternative contracting methods have argued that design-build and similar lump sum agreements in public-private partnerships should have the effect of reducing or eliminating the strategic markups found in design-bid-build contracting. In practice, it appears that lower prices in lump sum deals may not occur. As Whittington (2012) has noted, strategic markups also occur in design-build agreements, in the form of front-loaded costs in bid packages, and this explains the $1 million additional cost to complete design and construction on the design-build job.

In addition, the complex approach required to administer the process by which firms develop and submit qualifications and designs as part of the bid, and have those bids qualitatively as well as quantitatively ranked by teams of experts working in or with the public agency, will undoubtedly be more expensive than low-bid procurement. An excess of $600,000 was spent to complete this process in the design-build project. And perhaps more importantly, the use of a lump sum contract does not relieve the public agency of the need to monitor the contractor. Instead, design-build work necessitates reviews for the quality of performance in both design and construction, and nearly $3 million more was spent on contract administration in the design-build case, which more than made up for any potential financial advantages of the lump sum contract.

One other difference that is revealed by the disaggregation method is in the price of ancillary studies, the two bridges differed by over $1 million in their expenditures for environmental and geotechnical studies. While some might argue that design-build streamlined the process, it is very likely that important reviews, particularly relating to environmental concerns, were brushed aside.

Lastly, it should be pointed out that in this circumstance, the bridge constructed with design-build contract (SR 500 over Thurston Way) was completed much faster than its design-bid-build counterpart, which Whittington (2012) found to be a result of the approach the Washington State Department of Transportation took in allocating funds. Funds were distributed geographically to districts and, in times of scarcity, the designs of projects were shelved, to be taken up again when funding was adequate to prepare for construction. While design-build has the potential to accelerate the schedule of delivery by overlapping the activities of design with construction, schedule differences are not necessarily the result of this feature of design-build delivery.

Oregon State Pairwise Comparison (OTIA III Program)

In 2003, the State of Oregon passed the Oregon Transportation Investment Act III (OTIA III), which, with an allocation of $1.3 billion, launched a statewide effort to replace and repair bridges across the state, many of which were at risk of load bearing capacities unfit for semis and other large vehicles used in the transport of cargo (ODOT 2014; otiabridge.org). Altogether, these funds were used to improve or enhance inspection of 365 structures over a 12 year period, including the repair or replacement of 271 bridges (ODOT 2015c).

Instead of fixing bridges based on need only, known as a “worst/first” approach, the program consolidated groups of bridges in corridors and put these bundles out to bid in a pre-set order, based on priority for goods movement. The program was focused on accommodating the large amount of truck traffic that travels on Oregon’s two interstates, I-5 and I-84, which intersect in Oregon’s largest city of Portland (e.g., OSU/ODOT 2003). The weight of semi-trailers (up to 105,000 pounds for triple trailers) was the most important factor in selecting the order of bundle procurement. The OTIA III program roughly followed 4 stages:

1. Fix bridges on alternate corridors providing border-to-border routes (e.g. California to Washington) for large loads.
2. With these alternate corridors in place, repair and replace bridges on I-84 followed by bridges on I-5.
3. Repair and replace all bridges on freight routes that connect to I-5 and I-84.
4. Improve other rural bridges to the maximum 105,000 pound capacity.

Bundles of the highest priority were allowed to proceed with design-build contracts in an attempt to accelerate the repairs or replacements. The size and scope of the program allows the selection of comparable projects for analysis; nearly all of the bridges were repaired or replaced through the use of reinforced concrete beams.

This analysis focuses on six pairs of bridges, twelve total (i.e., North-bound and South-bound), exclusively on I-5. ODOT personnel filtered the original list of 365 projects down, for:

- Projects that were originally scoped and actually executed as Replacements
- Projects on the Interstate (over-crossings of the Interstate excluded)
- Bridge pairs (twin structures) for each delivery method
- Initial Cost (OSU/ODOT 2003) for an initial review comparison, followed by the cost in October of 2014, representing the completed structure cost

Table 5 shows the selected projects and the approximate mile markers on I-5. Mile marker 0 is the southernmost point at the border with California. Table 6 shows the projects paired, as indicated in original budget estimates (2003) and completed cost (2014).

Table 6: Selected Bridges within the OTIA III Program

Crossing of Interstate 5	Approximate Milepost	Location (Town / County)	Contracting Type
Bear Creek	15	Ashland / Douglas	DBB
S. Umpqua River	104	Tri-City / Douglas	DB
Roberts Creek	117	Roseburg / Douglas	DB
Coast Fork Willamette River	172	Cottage Grove / Lane	DBB
Gettings Creek	177	Saginaw / Lane	DB
Sodom Ditch	220	Shedd / Linn	DBB

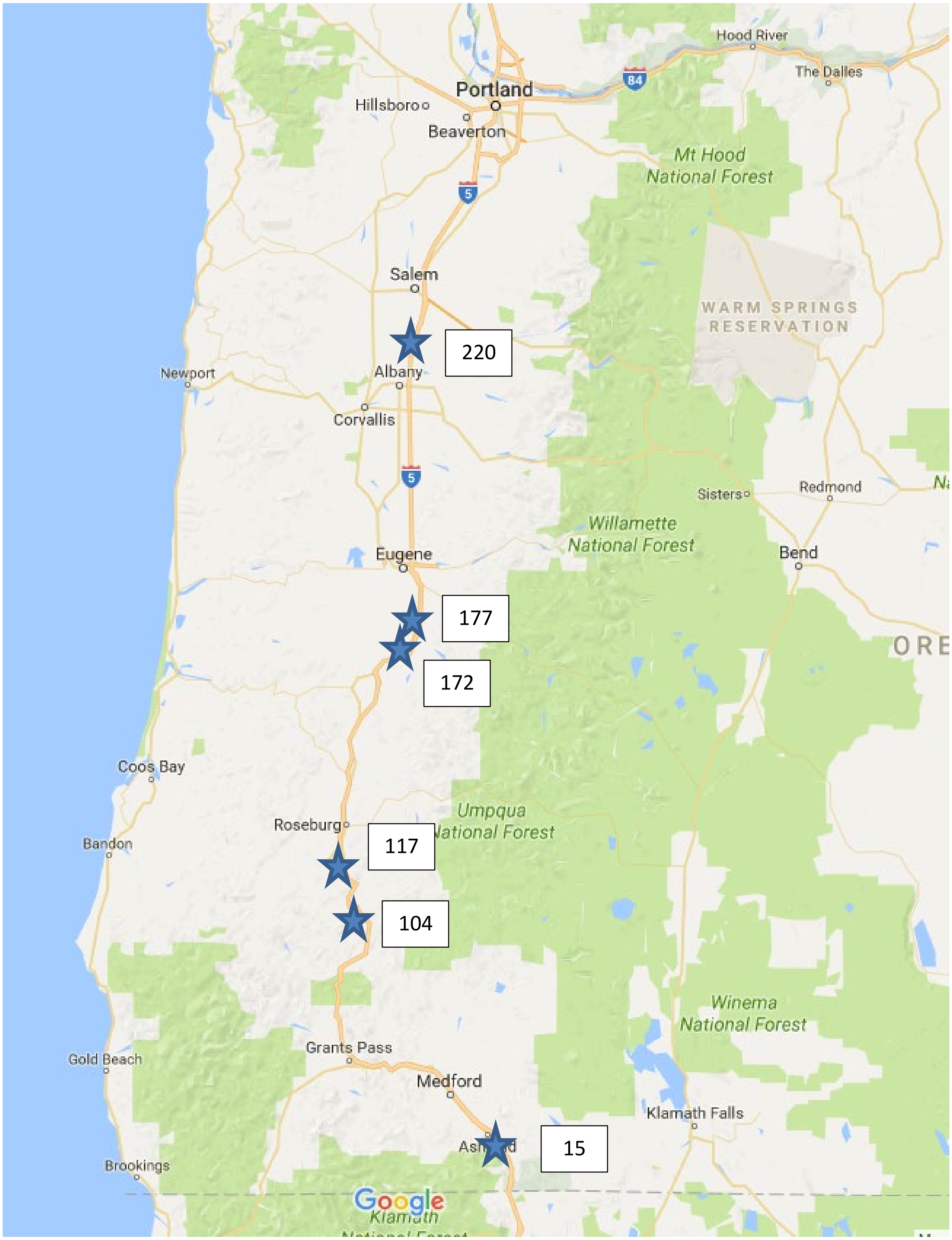
Source: Oregon Department of Transportation

Table 7: Paired Bridges for Comparison within the OTIA III Program

Crossing of Interstate 5	Contracting Type	Original Budget (2003)	Completed Budget (2014)
#1a Roberts Creek NB	DB	$3,536,000	$3,382,537
#1a Roberts Creek SB	DB	$4,243,200	$4,412,196
#1b Coast Fork Willamette River NB	DBB	$3,484,000	$3,441,924
#1b Coast Fork Willamette River SB	DBB	$3,484,000	$3,387,447
#2a Gettings Creek NB	DB	$4,963,200	$4,487,072
#2a Gettings Creek SB	DB	$4,963,200	$4,848,511
#2b Bear Creek NB	DBB	$3,958,000	$4,443,253
#2b Bear Creek SB	DBB	$4,749,600	$5,131,456
#3a S. Umpqua River NB	DB	$8,020,000	$11,873,879
#3a S. Umpqua River SB	DB	$8,020,000	$9,888,986
#3b Sodom Ditch NB	DBB	$5,512,800	$7,470,169
#3b Sodom Ditch SB	DBB	$5,512,800	$7,418,921

Source: Oregon Department of Transportation

Figure 8: Map of OTIA Oregon Project Locations



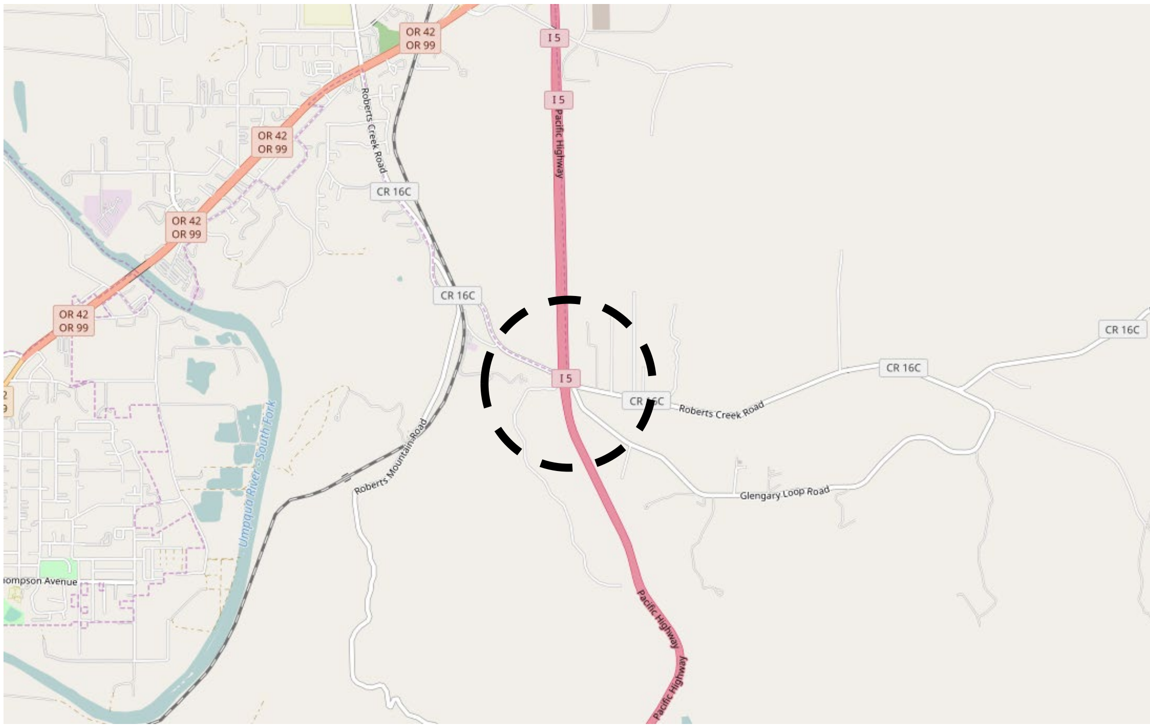
OTIA III BRIDGE DESCRIPTIONS

At the outset of the program, ODOT and its consultants (*David Evans and Associates*) prepared preliminary assessments for each bridge in the program known as "baseline reports." These reports included bridge descriptions, current structural issues, a preferred construction alternative and a cost estimate. The range of timeline was 38 to 70 months, with cost estimates ranging from $3.1 million to $10.4 depending on the size of the bridge. The South Umpqua River crossings were the most complex in terms of cost and schedule. The following is a summary of the baseline reports for each bridge, referring to each as paired in Table 7. All cost and scheduling information is courtesy of ODOT.

I-5 over Roberts Creek and Roberts Creek Road (Roseburg), length 234', contracted design-build (#1a)

Figure 9: I-5 over Roberts Creek and Roberts Creek Road

Source: Google Street View



Roberts Creek Project Location (courtesy of Open Street Map)

Table 8: Roberts Creek #1A Estimated Timeline

Item	Project Duration (months)
Environmental	0-12
Design	0-12
PS&E to NTP	13-16
Construction	17-48

Table 9: Roberts Creek Project (#1A) Preliminary Costs Estimate (x $1,000)

Item	Northbound	Southbound
Preliminary	398	475
Right-Of-Way	5	5
Roadway	326	351
Structure	1,725	2,166

Temporary Protection	164	202
Construction Contingencies	598	734
Construction Engineering	359	440
Mobilization	177	218
Total	3,752	4,591

I-5 over Coast Fork Willamette Project (#1b) and Latham Road (Cottage Grove), length 230' river only, contracted design-bid-build

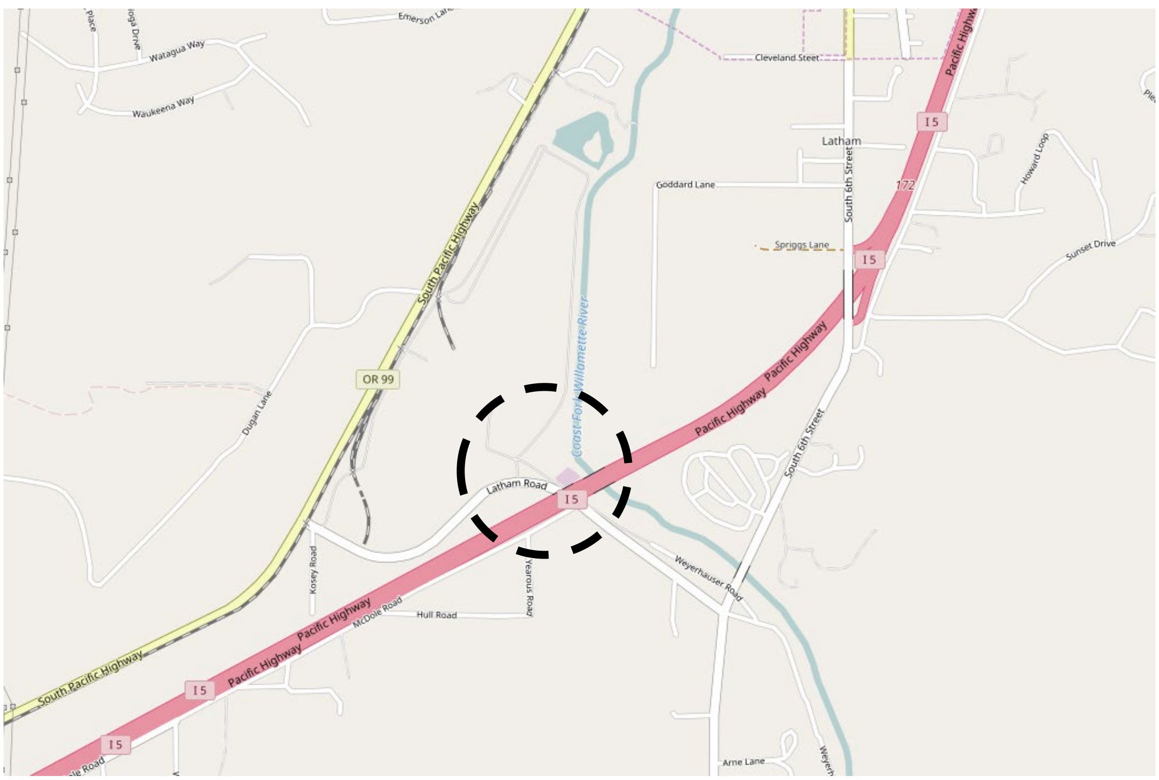
Figure 10: I-5 over C.F. Willamette

Source: Google Street View

Note that the crossing of the Coast Willamette is immediately adjacent to bridges over Latham Road, as shown in the second photo. The estimates are for the Coast Willamette pair of bridges only, even though the OTIA program planned on replacing all four bridges at once. This report is only considering the Coast Fork Willamette pair.

Figure 11: Distinction between C.F. Williamette and Latham Road Projects

Source: Google Street View



(courtesy of Open Street Map)

Table 10: C.F. Willamette (#1b) Estimated Timeline

Item	Project Duration (months)
Environmental	0-18
Design	0-18
PS&E to NTP	19-22
Construction	22-52

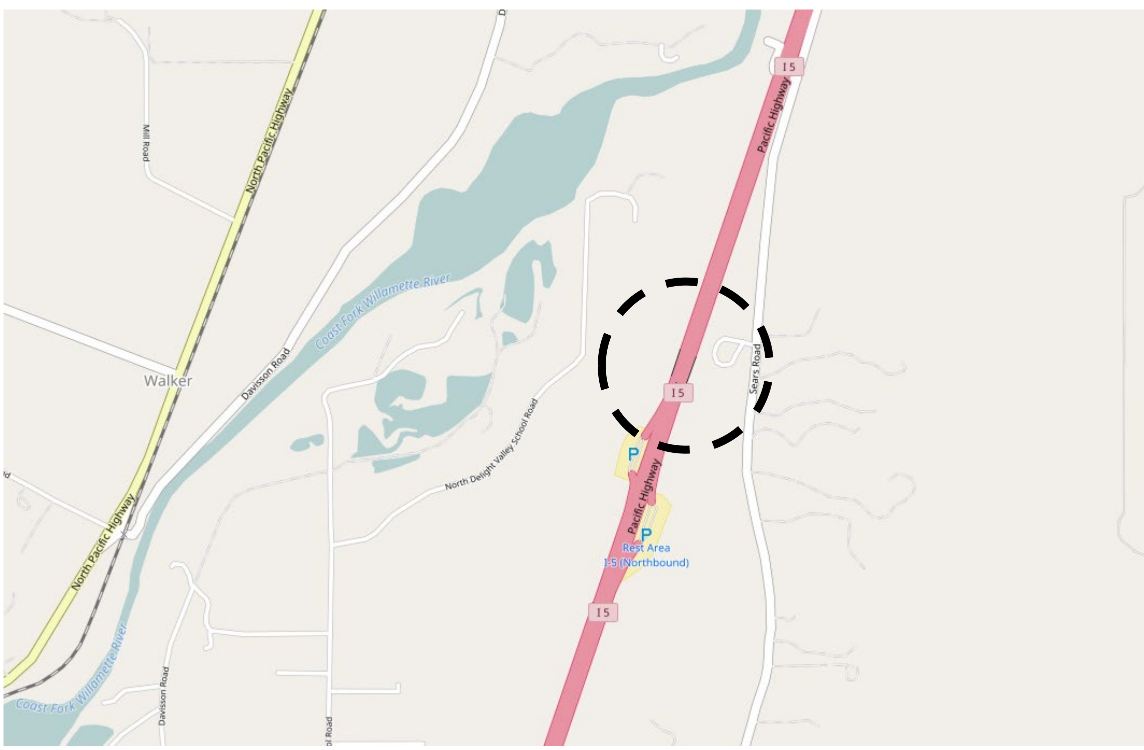
Table 11: C.F. Willamette (#1b) Preliminary Cost Estimate (x $1,000)

Item	Northbound	Southbound
Preliminary	330	333
Roadway	119	110
Structure	1,753	1,782
Temporary Protection	112	114
Construction Contingencies	536	541
Construction Engineering	321	325
Mobilization	159	160
Total	3,330	3,365

I-5 over Gettings Creek Project (#2a) (Cottage Grove), length 281', contracted design-build

Figure 12: I-5 over Gettings Creek

Source: Google Street View



(courtesy of Open Street View)

Table 12: Gettings Creek Project (#2a) Estimated Timeline

Item	Project Duration (months)
Environmental	4-12
Design	0-12
Utility	10-16
PS&E to NTP	12-16
Construction	16-40

Table 13: Gettings Creek Project (#2a) Preliminary Cost Estimate (x $1,000)

Item	Northbound	Southbound
Preliminary	416	426
Roadway	340	344
Structure	1,680	1,728
Temporary Protection	101	104
Construction Contingencies	573	587
Construction Engineering	344	352
Mobilization	170	174
Total	3,624	3,715

I-5 over Bear Creek Project (#2b) (Medford), length 267', contracted design-bid-build

Figure 13: I-5 over Bear Creek

Source: Google Street View

(Courtesy of Open Street Map)

Table 14: Bear Creek Project (#2b) Estimated Timeline

Item	Project Duration (months)
Environmental	0-12
Right-Of-Way	4-16
Design	
PS&E to NTP	17-20
Construction	21-38

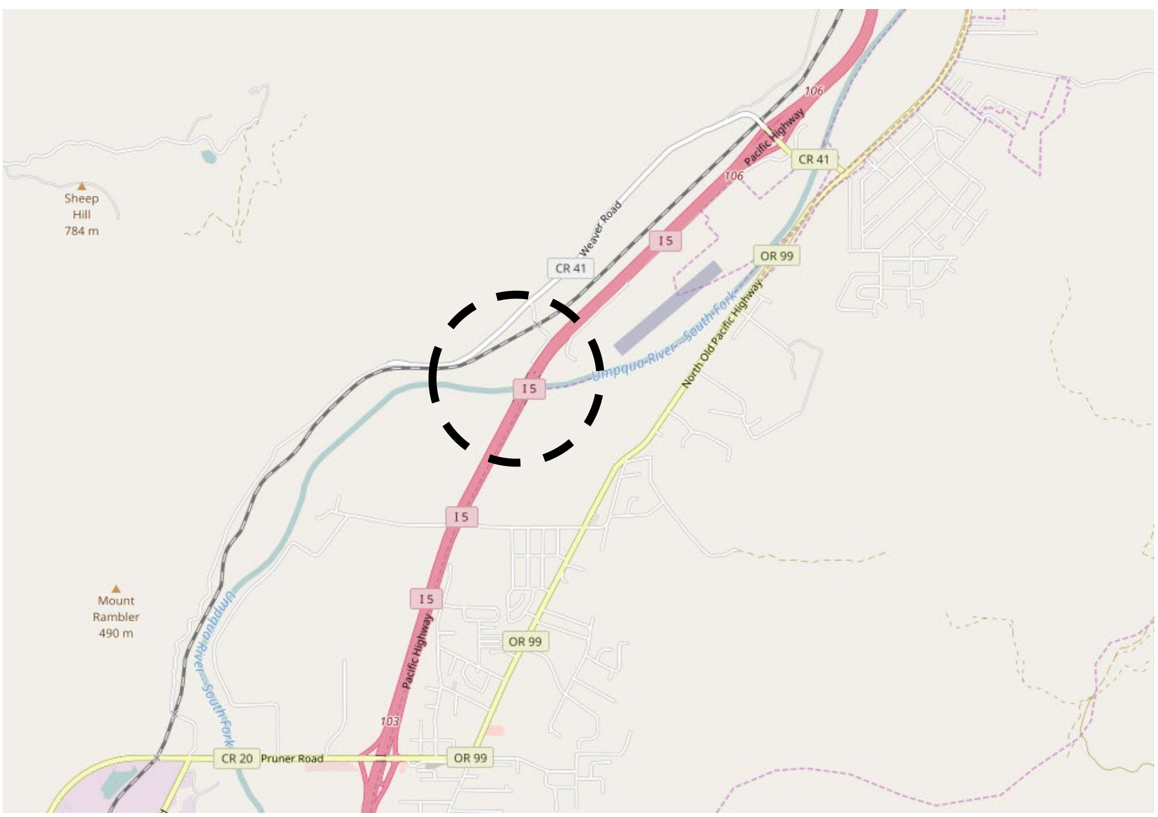
Table 15: Bear Creek Project (#2b) Preliminary Cost Estimate (x $1,000)

Item	Northbound	Southbound
Preliminary	372	299
Roadway	291	273
Structure	1,962	1,510
Temporary Protection	113	107
Construction Contingencies	640	515
Construction Engineering	383	309
Mobilization	189	170
Total	3,950	3,183

I-5 over South Umpqua River Project (#3a) (Tri-Cities), length 588’, contracted design-build

Figure 14: I-5 over South Umpqua River

Source: Google Street View



(courtesy of Open Street Map)

Table 16: South Umpqua Project (#3a) Estimated Timeline

Item	Project Duration (months)
Environmental	0-18
Right-Of-Way	12-18
Design	0-18
PS&E to NTP	18-22
Construction	22-70

Table 17: South Umpqua Project (#3a) Preliminary Cost Estimate (x $1,000)

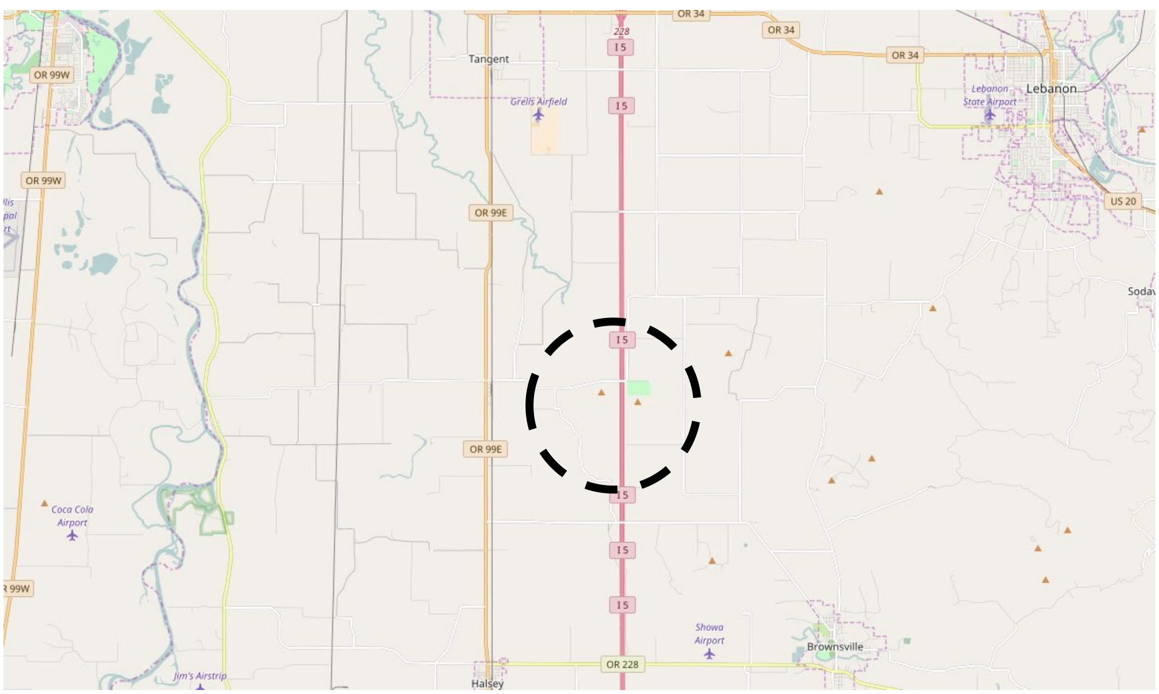
Item	Northbound	Southbound
Preliminary	980	980
Right-Of-Way	5	5
Roadway	504	504
Structure	5,249	5,249
Temporary Protection	460	460
Construction Contingencies	1,677	1,677
Construction Engineering	1,006	1,006
Mobilization	497	497
Total	10,378	10,378

Source: Oregon Department of Transportation

I-5 over Sodom Ditch Project (#3b) (Shedd), length 317’, contracted design-bid-build

Figure 15: I-5 over Sodom Ditch

Source: Google Street View



(courtesy of Open Street Maps)

Table 18: Sodom Ditch Project (#3b) Estimated Timeline

Item	Project Duration (months)
Environmental	0-12
Right-Of-Way	4-16
PS&E to NTP	17-20
Construction	21-38

Table 19: Sodom Ditch Project (#3b) Estimated Timeline

Item	Northbound	Southbound
Preliminary	441	441
Roadway	273	273
Structure	2,212	2,212
Temporary Protection	100	100
Construction Contingencies	698	698
Construction Engineering	419	419
Mobilization	207	207
Total	4,350	4,350

Oregon Case Cost Comparison

The preliminary set of cost results for the Oregon projects are shown in Table 20.

Table 20: Preliminary Results of Analysis of Oregon Case Studies

Name	Contract Type	Length & SF	Budget Estimate ($)	Final Cost ($)	Change ($)
Roberts NB	DB	234 / 8775	3,536,000	3,382,537	(153,463) -4.3%
Roberts SB	DB	234 / 8325	4,243,200	4,412,196	168,996 4.0%
CF Willamette NB	DBB	220 / 9387	3,484,000	3,441,924	(42,076) -1.2%
CF Willamette SB	DBB	220 / 9387	3,484,000	3,387,447	(96,553) -2.8%
Gettings NB	DB	281 / 12402	4,963,000	4,487,072	(475,928) -9.6%
Gettings SB	DB	10755	4,963,000	4,848,511	(114,489) -2.3%
Bear NB	DBB	267 / 8553	3,958,000	4,443,253	485,253 12.3%
Bear SB	DBB	267 / 8553	3,183,000	5,131,456	381,856 8.0%
S. Umpqua NB	DB	588 / 26598	8,020,000	11,873,879	3,853,879 48.1%
S. Umpqua SB	DB	588 / 26598	8,020,000	9,888,986	1,868,986 23.3%
Sodom NB	DBB	330 / 20460	5,512,800	7,470,169	1,957,369 35.5%
Sodom SB	DBB	330 / 20460	5,512,800	7,418,921	1,906,121 34.6%

Source: Oregon Department of Transportation.

Total budget estimates and final outcomes do not reveal any clear trends between the two contracting methods. Both methods had projects that were over budget and somewhat under budget. Of note, the width of the structures over Sodom Ditch were increased after the estimate was taken and additional Federal funds were accepted from the SAFETEA-LU program to build the wider bridges. The Federal funding, approximately $2.9 million dollars per bridge, was larger than the cost overrun. Excluding Sodom Ditch, with the exception of the bridges over the South Umpqua River all of the projects were either on-budget, under budget, or within 15% of the original estimate. Considering the concern for cost overruns, one might consider that construction of these bridges to be a success.

Also, excluding the bridges over Sodom Ditch (which had a true design change), there were very few change orders and these orders were generally fairly small. The lone exception was a change to the acceleration lane from a rest area which was south of the Getting Creek NB structure. Even in this case, where the change order exceeded $750,000, savings was made up elsewhere by the contractor and the overall increase was under $500,000, or under 10%. Without clear differences in the overall costs there can be no conclusions drawn without breaking down each bridge into individual tasks, as outlined above.

Table 21 shows the differences in costs between the Roberts Creek design-build project and the Coast Fork Willamette design-bid-build project in Oregon.

Table 21: Cost by Task, Oregon Bridge Pair #1

Task	Roberts Creek (NB and SB) (DBB)	Coast Fork Willamette (NB and SB) (DB)	Cost Difference
Ex Ante			
DOT Engineering	1,139,925	683,537	(456,388)
Subtotal	1,139,925	683,537	(456,388)
Ex Post			
DOT Construction Engineering	771,043	333,668	(437,375)
Contractor Engineering	-	814,000	814,000
Construction	4,601,528	6,160,500	1,558,972
Adjustments	19,442	2,143	(17,299)
Change orders	245,167	(199,589)	(444,756)
Subtotal	5,637,179	7,110,721	1,473,542
Final Cost	6,777,105	7,794,259	1,017,154
Cost Estimate	6,968,000	7,779,200	811,200

Source: Oregon Department of Transportation.

Table 22 shows the differences in costs between the I-5 Gettings Creek design-build project and the I-5 Bear Creek design-bid-build project in Oregon.

Table 22: Cost by Task, Oregon Bridge Pair #2

Task	Bear Creek (NB and SB) (DBB)	Gettings Creek (NB and SB) (DB)	Cost Difference
Ex Ante			
DOT Engineering	1,168,574	167,237	(1,001,337)
Subtotal	1,168,574	167,237	(1,001,337)
Ex Post			
DOT Construction Engineering	974,668	510,551	(464,117)
Contractor Engineering	-	785,000	785,000
Construction	7,239,516	6,857,000	(382,516)
Adjustments	138,284	2,112	(136,173)
Change orders	51,762	753,366	701,605
Subtotal	8,404,229	8,908,029	503,800
Final Cost	9,572,804	9,075,267	(497,537)
Cost Estimate	8,707,600	9,926,400	1,218,800

Source: Oregon Department of Transportation.

Table 23 shows the differences in costs between the South Umpqua River design-build project and the Sodom Ditch design-bid-build project in Oregon.

Table 23: Cost by Task, Oregon Bridge Pair #3

Task	Sodom Ditch (NB and SB) (DBB)	South Umpqua River (NB and SB) (DB)	Cost Difference
Ex Ante			
DOT Engineering	167,237	(1,001,337)	1,168,574
Subtotal	167,237	(1,001,337)	1,168,574
Ex Post			
DOT Construction Engineering	510,551	(464,117)	974,668
Contractor Engineering	785,000	785,000	-
Construction	6,857,000	(382,516)	7,239,516
Adjustments	2,112	(136,173)	138,284
Change Orders	753,366	701,605	51,762
Subtotal	8,908,029	503,800	8,404,229
Final Cost	9,075,267	(497,537)	9,572,804
Cost Estimate	9,926,400	1,218,800	8,707,600

Source: Oregon Department of Transportation.

The data for these three pairs of projects suggests that, on the whole, the use of design-build did not bring about savings in the direct costs of delivering projects. The state may have reduced the amount of time to deliver the design build projects and thus, indirectly brought about an economic benefit. In order for that economic benefit to be comparatively worthwhile, it would have to bring about gains in excess of the strategic markup paid to design-build firms above and beyond the cost of using design-bid-build methods of delivery. In the case of these paired projects, that strategic markup—a transaction cost—is about $7 million.

A Note on Schedule and Bundled Delivery

As stated previously, Oregon DOT issued the bridges in the OTIA project in bundles based on priorities agreed upon by major stakeholders early in the project. Unfortunately, it was not possible to discern the actual timeline of construction for individual projects from each construction bundle.

Table 10 shows the start and end dates of each bundle. Note, the bridges included are only those analyzed within this report; each bundle could have up to five total bridges. It is possible that other bridges, outside of those in this report, occupied the critical path to completion of a bundle. In all cases, the time from the signing of the contract to the start date was short (within two months) and is not included in the table.

Table 24: Schedule Details for OTIA Project Bundles

Bundle Number	Contract Type & Total Bridges	Bridges Included	Start Date	End Date	Total Days
301	DBB (5)	Bear Creek	4/21/08	3/25/11	1,068
306	DB (5)	S. Umpqua	11/2/06	6/20/11	1,691
A02	DB (9)	Roberts & Gettings	3/17/05	2/10/09	1,426
310	DBB (5)	Willamette	5/15/08	4/10/12	1,426
216	DBB (2)	Sodom	8/1/07	12/16/10	1,233
				Average	1,368
				Standard Deviation	234

Source: Oregon Department of Transportation

The table reveals fairly strong uniformity among the five bundles in terms of schedule length, with only Bundle 306 being somewhat greater than the others. Although Bundle 216 consisted of only two bridges, as stated above additional monies came in late to widen the bridge substantially. One could note that Bundles A02 and 310 took exactly the same amount days but the design-build contract was able to replace nine bridges to just five with design-bid-build.

However, without specific information on each bridge, this is only conjecture. It could be that the OTIA team deliberately put together similar bridges in the DB bundles knowing possible DB efficiencies be maximized.

CONCLUSIONS

This research examined the outcomes from designing and constructing infrastructure projects with alternative contracting methods, with the secondary target of looking that the changes in transaction costs that followed by using alternative contracting. The research looked at selected pairs of bridges in Oregon and Washington that utilized both traditional design-bid-build (DBB) and alternative design-build (DB) contracting on very similar bridge projects, some nearly adjacent to each other.

Although the overall costs of construction were similar across many bridge pairs, the method of disaggregation into different categories revealed strong differences when the choice of contracting method is made, largely related to moving the risk of design and administration from the public sector (DBB) to the private (DB). Transaction costs did not appreciably decline with the DB projects. State DOTs need to be aware of these challenges and atypical cost profiles before embarking on new alternative contracts. As always, the "*devil is in the details.*"

REFERENCES

Bajari, Patrick, Stephanie Houghton, and Steven Tadelis. 2014. "Bidding for Incomplete Contracts: An Empirical Analysis of Adaptation Costs." *American Economic Review* 104 (4): 1288–1319. doi:10.1257/aer.104.4.1288.

Bajari, Patrick, and Steven Tadelis. 2001. "Incentives versus Transaction Costs: A Theory of Procurement Contracts." *The RAND Journal of Economics* 32 (3): 387–407. doi:10.2307/2696361.

Becker, Gary S. 1965. "A theory of the Allocation of Time." *The Economic Journal* 75 (299): 493-517. doi:10.2307/2228949

State of California Legislative Analyst Office (LAO), 2012. "Maximizing State Benefits from Public-Private Partnerships." Available at: http://www.lao.ca.gov/reports/2012/trns/partnerships/P3_110712.aspx

Chasey, Allan, William Maddex, and Ankit Bansal. 2012. "Comparison of Public-Private Partnerships and Traditional Procurement Methods in North American Highway Construction." *Transportation Research Record: Journal of the Transportation Research Board* 2268 (August): 26–32. doi:10.3141/2268-04.

Chen, Zhenhua, Nobuhiko Daito, and Jonathan L. Gifford. 2015. "Data Review of Transportation Infrastructure Public–Private Partnership: A Meta-Analysis." *Transport Reviews* 36 (2): 228–50. doi:10.1080/01441647.2015.1076535.

Coase, R. H. 1937. "The Nature of the Firm." *Economica* 4 (16): 386–405. doi:10.1111/j.1468-0335.1937.tb00002.x.

Diraviam, G. and Tran, D., 2017. "An Empirical Performance Comparison of Design-Bid-Build and Design-Build Highway Projects by Work Types" *Proceedings of the Annual Meeting of the Transportation Research Board*. (No. 17-06258).

Ellis, Ralph, Jae-Ho Pyeon, Zohar J. Herbsman, Edward Minchin, and Keith Molenaar. 2007. "Evaluation of Alternative Contracting Techniques on FDOT Construction Projects," July. http://trid.trb.org/view.aspx?id=825920.

Fernandes, Carlos, Miguel Ferreira, and Filipe Moura. 2015. "PPPs — True Financial Costs and Hidden Returns." *Transport Reviews* 36 (2): 207–27. doi:10.1080/01441647.2015.1076905.

Fishman, Edward. 2009. "Major Legal Issues for Highway Public-Private Partnerships." *NCHRP Legal Research Digest*, no. 51 (January). http://trid.trb.org/view.aspx?id=884834.

Flyvbjerg, Bent. 2009. "Survival of the Unfittest: Why the Worst Infrastructure Gets Built—and What We Can Do about It." *Oxford Review of Economic Policy* 25 (3): 344–67.

Guasch, J.L., Laffont, J.J. and Straub, S., 2004. Infrastructure Concessions in Latin America. *World Bank Policy Research Working Paper 3749*.

Geddes, R. Richard. 2011. *The Road to Renewal: Private Investment in U.S. Transportation Infrastructure*. Washington, D.C. : Lanham, Md: AEI Press ; Rowman & Littlefield Pub. [distributor].

Geyskens, Inge, Jan-Benedict E. M. Steenkamp, and Nirmalya Kumar. 2006. "Make, Buy, or Ally: A Transaction Cost Theory Meta-Analysis." *The Academy of Management Journal* 49 (3): 519–43. doi:10.2307/20159779.

Ghoshal, Sumantra, and Peter Moran. 1996. "Bad for Practice: A Critique of the Transaction Cost Theory." *Academy of Management Review* 21 (1): 13–47. doi:10.5465/AMR.1996.9602161563.

Nikou Goftar, V., El Asmar, M. and Bingham, E., 2014. A meta-analysis of literature comparing project performance between design-build (DB) and design-bid-build (DBB) delivery systems. In *Construction Research Congress 2014: Construction in a Global Network* 1389-1398.

Grimsey, Darrin, and Mervyn K. Lewis. 2004. *Public Private Partnerships The Worldwide Revolution in Infrastructure Provision and Project Finance*. Cheltenham, UK: Edward Elgar Publishing, Inc. http://www.elgaronline.com/9781840647112.xml.

Hodge, G. A. 2004. "The Risky Business of Public-Private Partnerships." *Australian Journal of Public Administration* 63 (4): 37–49. doi:10.1111/j.1467-8500.2004.00400.x.

Hodge, Graeme A., and Carsten Greve. 2007. "Public–Private Partnerships: An International Performance Review." *Public Administration Review* 67 (3): 545–58. doi:10.1111/j.1540-6210.2007.00736.x.

Hodge, Graeme, and Carsten Greve. 2010. "Public-Private Partnerships: Governance Scheme or Language Game?" *Australian Journal of Public Administration* 69 (March): S8–22. doi:10.1111/j.1467-8500.2009.00659.x.

Idaho House Bill 600. 2010. http://legislature.idaho.gov/legislation/2010/H0600.htm.

Iossa, E. and Martimort, D., 2015. The simple microeconomics of public-private partnerships. *Journal of Public Economic Theory*, *17*(1): 4-48.

Iseki, Hiroyuki, Jeanette Eckert, Kansai Uchida, Ryan Dunn, and Brian D. Taylor. 2009. "Task B-2: Status of Legislative Settings to Facilitate Public Private Partnerships in the U.S." *PATH Research Report*, July. http://trid.trb.org/view.aspx?id=899949.

Jin, Xiao-Hua. 2013. "Risk Allocation, Transaction Cost Economics and PPP." In *The Routledge Companion to Public-Private Partnerships*, 97–126. Abingdon, Oxon; New York: Routledge.

Kawamura, Kazuya. 2000. "Perceived value of time for truck operators." *Transportation Research Record: Journal of the Transportation Research Board* 1725: 31-36. doi:10.3141/1725-05

Kessler, Fred, and Mari Davidson. 2012. "Treatment of Public-Private Partnerships Under Surface Transportation Reauthorization." *Nossaman LLP*. July 11. http://www.nossaman.com/MAP_21_PPP.

Lai, Lawrence W. C. 2016. "The Redevelopment of Bus Depots: A Transaction Cost Economic Analysis of a Change in the Use of Land in Hong Kong." *Planning Practice & Research* 31 (1): 80–98. doi:10.1080/02697459.2015.1110886.

Lafontaine, Francine. 1993. "Contractual Arrangements as Signaling Devices: Evidence from Franchising," *Journal of Law, Economics, & Organization 9:* 256-89.

Levin, Jonathan, and Steven Tadelis. 2010. "Contracting for Government Services: Theory and Evidence from U.s. Cities*." *The Journal of Industrial Economics* 58 (3): 507–41. doi:10.1111/j.1467-6451.2010.00430.x.

Little, Richard G. 2011. "The Emerging Role of Public-Private Partnerships in Megaproject Delivery." *Public Works Management & Policy* 16 (3): 240–49. doi:10.1177/1087724X11409244.

Macher, Jeffrey T, and Barak D Richman. 2008. "Transaction Cost Economics: An Assessment of Empirical Research in the Social Sciences." *Business and Politics* 10 (1). doi:10.2202/1469-3569.1210.

Minchin Jr, R.E., Li, X., Issa, R.R. and Vargas, G.G., 2013. "Comparison of cost and time performance of design-build and design-bid-build delivery systems in Florida." *Journal of Construction Engineering and Management*, 139 (10): 04013007.

Molenaar, K., Sencer, J., Parker, J., Stewart, T., Saller, B., Coggins, S., & Butler, C., 2003. "Washington State DOT design-build pilot project evaluation: A measurement of performance for the process cost, time, and quality." University of Colorado and Washington State Departments of Transportation.

Moses Leon N, and Harold F. Williamson. 1963. "Value of Time, Choice of Mode, and the Subsidy Issue in Urban Transportation." *Journal of Political Economy,* 73 (10): 247-264.

New York Infrastructure Investment Act of 2011. 2011. http://assembly.state.ny.us/leg/?default_fld=&bn=A40002&term=2011&Summary=Y&Text=Y.

Nicolaisen, Morten Skou, and Patrick A. Driscoll. 2016. "An International Review of Ex-Post Project Evaluation Schemes in the Transport Sector." *Journal of Environmental Assessment Policy and Management* 18 (01): 1650008. doi:10.1142/S1464333216500083.

Ofei-Mensah, Albert, and Jeff Bennett. 2013. "Transaction Costs of Alternative Greenhouse Gas Policies in the Australian Transport Energy Sector." *Ecological Economics*, Transaction Costs and Environmental Policy, 88 (April): 214–21. doi:10.1016/j.ecolecon.2012.12.009.

Oregon HB 4010. 2002. https://www.oregonlegislature.gov/bills_laws/lawsstatutes/2002orLaw0003ss1.pdf.

Oregon Department of Transportation (ODOT), *Economic and Bridge Options Report*, ODOT, Salem, Aug. 2003 [Online]. Available: http://www.otiabridge.org/static/bridge_options.pdf

Oregon Department of Transportation (ODOT), *Leaving a Legacy: Delivering the Oregon Department of Transportation's OTIA III State Bridge Delivery Program*, ODOT, Salem, Sept. 2014 [Online]. Available: http://www.otiabridge.org/static/ Leaving_a_Legacy_FINAL_101014_high_res.pdf

Oregon Department of Transportation (ODOT), "Program Awards," OTIA III Bridge Delivery Program, ODOT, Salem, 2015c [Online]. Available: http://www.otiabridge.com/awards

Pollock, Allyson M., David Price, and Stewart Player. 2007. "An Examination of the UK Treasury's Evidence Base for Cost and Time Overrun Data in UK Value-for-Money Policy and Appraisal." *Public Money & Management* 27 (2): 127–34. doi:10.1111/j.1467-9302.2007.00568.x.

Rajeh, M., J. E. Tookey, and J. O. B. Rotimi. 2013. "Determining the Magnitude of Transaction Costs in Construction Procurement Systems: An Exploratory Study." http://aut.researchgateway.ac.nz/handle/10292/5414.

Savage, James D. 2009. "The Administrative Costs of Congressional Earmarking: The Case of the Office of Naval Research." *Public Administration Review* 69 (3): 448–57. doi:10.1111/j.1540-6210.2009.01991.x.

Schlag, Pierre. 2007. "The Problem of Transaction Costs." SSRN Scholarly Paper ID 1026662. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=1026662.

Schmidt, John, David Narefsky, Joseph Saliga, and George Miller. 2015. "How The FAST Act Will Benefit Public-Private Partnership." *Law360*. December 15. http://www.law360.com/articles/736145/print?section=governmentcontracts.

Shaoul, Jean, Anne Stafford, and Pamela Stapleton. 2006. "Highway Robbery? A Financial Analysis of Design, Build, Finance and Operate (DBFO) in UK Roads." *Transport Reviews* 26 (3): 257–74. doi:10.1080/01441640500415243.

Shelanski, Howard A., and Peter G. Klein. 1995. "Empirical Research in Transaction Cost Economics: A Review and Assessment." *Journal of Law, Economics, & Organization* 11 (2): 335–61.

Shrestha, P.P., O'Connor, J.T. and Gibson Jr, G.E., 2011. "Performance comparison of large design-build and design-bid-build highway projects." *Journal of Construction Engineering and Management*, 138 (1): 1-13.

Siemiatycki, Matti. 2007. "What's the Secret? Confidentiality in Planning Infrastructure Using Public/private Partnerships." *Journal of the American Planning Association* 73 (4): 388–403.

———. 2009a. "Delivering Transportation Infrastructure Through Public-Private Partnerships: Planning Concerns." *Journal of the American Planning Association* 76 (1): 43–58. doi:10.1080/01944360903329295.

———. 2009b. "Academics and Auditors Comparing Perspectives on Transportation Project Cost Overruns." *Journal of Planning Education and Research* 29 (2): 142–56. doi:10.1177/0739456X09348798.

Spiller, P.T., 2013. Transaction cost regulation. *Journal of Economic Behavior & Organization*, *89:* 232-242.

Tadelis, Steven, and Oliver E. Williamson. 2012. "Transaction Cost Economics." SSRN Scholarly Paper ID 2020176. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=2020176.

Thomas, Larry. 2014. "Transit Public-Private Partnerships: Legal Issues." TCRP LRD 45. Legal Research Digest. Transit Cooperative Research Program. http://www.trb.org/Publications/Blurbs/170953.aspx.

Whittington, Jan. 2012. "When to Partner for Public Infrastructure?" *Journal of the American Planning Association* 78 (3): 269–85. doi:10.1080/01944363.2012.715510.

Wang, Zun, and Anne Goodchild. 2014. "GPS Data Analysis of the Impact of Tolling on Truck Speed and Routing: Case Study in Seattle, Washington." *Transportation Research Record: Journal of the Transportation Research Board* 2411: 112-119. doi:10.3141/2411-14

Wiggins, Steven N., and Gary D. Libecap. 1985. "Oil Field Unitization: Contractual Failure in the Presence of Imperfect Information." *The American Economic Review* 75 (3): 368–85.

Williamson, Oliver E. 1998. "Transaction Cost Economics: How It Works; Where It Is Headed." *De Economist* 146 (1): 23–58. doi:10.1023/A:1003263908567.

Zamparini, Luca, and Aura Reggiani. 2007. "Freight Transport and the Value of Travel Time Savings: A Meta-analysis of Empirical Studies." *Transport Reviews* 27.5: 621-636. doi:10.1080/01441640701322834

Additional References

California

Presidioparkway.org

New York

https://www.dot.ny.gov/portal/page/portal/news/press-releases/2015/2015-06-01
http://www.recordonline.com/article/20150601/NEWS/150609941
http://www.recordonline.com/article/20150704/NEWS/150709731
http://www.hvinsider.com/articles/funds-received-to-strengthen-route-211-bridge-over-wallkill-river/

http://www.recordonline.com/article/20150828/NEWS/150829425
http://www.wktv.com/news/Route_291_bridge_over_Nine-Mile_Creek_closes_for_replacement_construction_.html
http://romesentinel.com/county/marcy-bridge-upgrade-included-in-new-funding/QBqnhv!f@@hYUVEDUXG@mlZ@89ydg/
https://www.dot.ny.gov/portal/page/portal/news/traveler-advisories/2016/20160517

https://www.dot.ny.gov/main/business-center/cbow
https://www.dot.ny.gov/main/business-center/designbuildproject9
https://www.dot.ny.gov/main/business-center/cbow/dbb/contract20-region8

https://en.wikipedia.org/wiki/Bodine's_Bridge

Oregon

http://www.oregon.gov/ODOT/HWY/OPL/docs/word/Design-Build_Projects.doc
http://www.otiabridge.org

APPENDICES:

APPENDIX A: POLICY BRIEF

ISSUE

With increasing budgetary pressures, state DOT's are attempting to find innovative methods of procuring and building infrastructure at a reduced cost and reduced schedule. Many DOT's have begun to heavily use different types of contracting methods as an alternative to the traditional design-bid-build method. These alternative contracting methods, known as public private partnerships (P3's) generally move tasks traditionally done by the public sector to the private sector, notably changing which group absorbs the most risk. Examples of items moved to the private sector in P3's include design, construction management, financing, and maintenance.

The theory behind the move toward P3's is the economics of transaction costs. Transaction cost economics examines disaggregated costs and asks whether these costs are done more efficiently within a firm or in the market (Geyskens 2006), or more simply, an analysis of cost using a market (Coase 1937). Can the external transaction costs between companies in the market reduce the cost of infrastructure?

This research looked into one type of P3, known as design-build construction (DB) and compared bridge projects in Oregon and Washington that utilized both DB and conventional DBB. By parsing out the costs into small disaggregate categories; researchers were hoping to discover how costs varied and whether these changes agree with prevailing theory about internal vs. external transaction costs.

KEY RESEARCH FINDINGS

1. Literature showed that design-build was somewhat faster empirically but not statistically in most cases. On balance, projects done with DB were completed in a shorter time frame than their conventional DBB counterparts. However, there was significant variation and in many cases DB was actually longer. Only in a few specific categories did DB perform faster than DBB in a statistically significant way (P values <0.05). Furthermore, there is very little consensus on what the actual value of time should be when analyzing schedule growth, particularly in regards to freight.

2. Preliminary studies on costs with P3's can be misleading. This research evaluated the preliminary value engineering study for the Presidio Parkway in San Francisco and found many concerns. These included primarily the choice of discount rate in regards to financing but also variation in construction contingencies depending on the contractual method.

3. Disaggregation of costs revealed sharp differences in spending between DB and DBB. In Washington, the project examined two bridges on the same freeway of similar length, one constructed with DB and one with DBB. These bridges, with all costs lumped together, cost virtually the same amount. However, with DB much more money was spent on private contract administration and construction costs. These increases were offset by reductions in design costs and in change orders. Additionally, although the two bridges ended up costing the same and were roughly the same size, the bids differed by over $4 million dollars, nearly 20% of the final cost of the project.

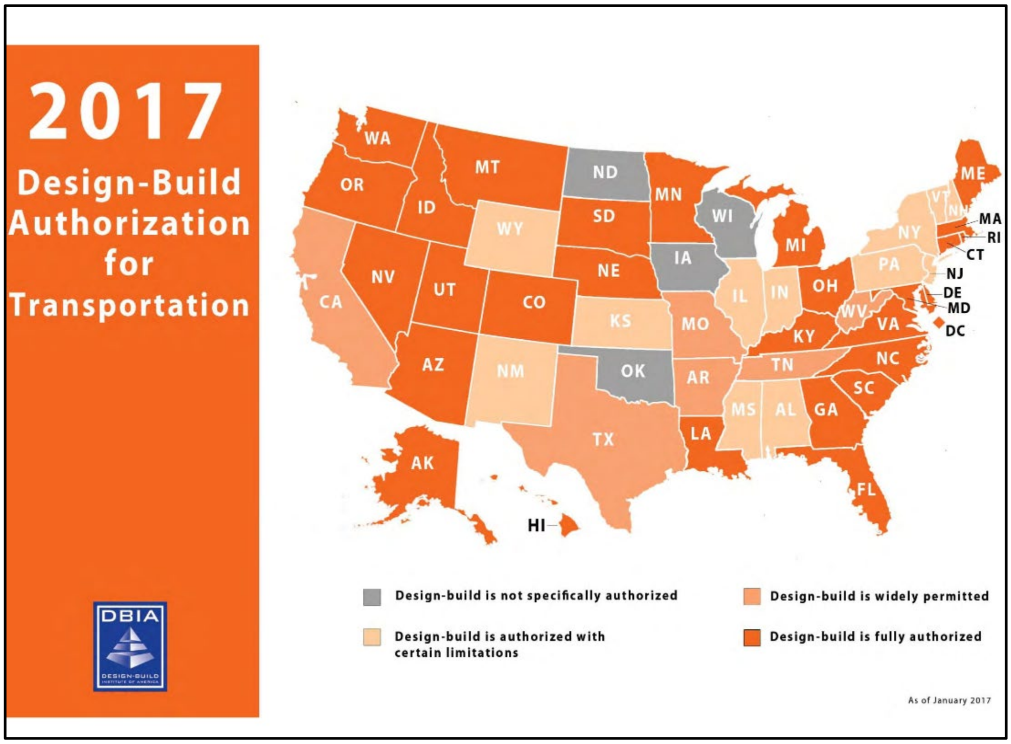
4. In instances where construction is very straightforward ("cookie-cutter") there could be efficiencies with transaction costs by using design-build. In Oregon, DB construction bundles were not finished significantly faster than their DBB bundle counterparts or cheaper. However, the DB bundles had many more bridges in their package. The ability to not have to have different firms replicate design and construction procedures may have reduced schedule growth in these bundles where bridges were more similar or had a more simple replacement process.

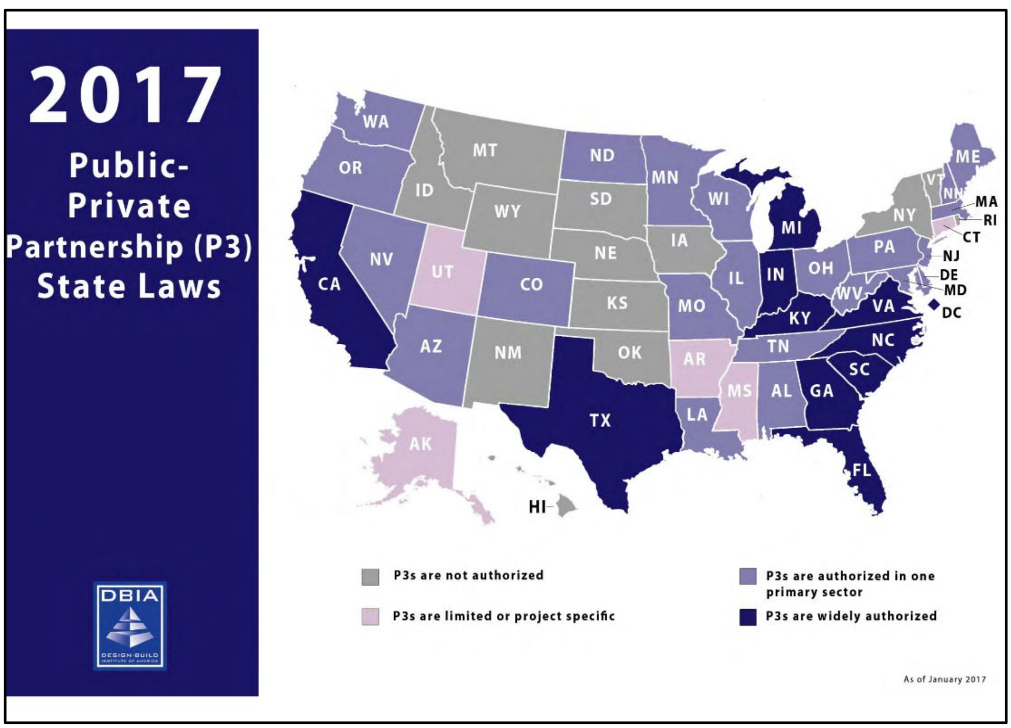
5. Choices in contractual method can definitely affect the risk profile. State DOT's need to be aware of the changes to the risk profile that can be sizable. When moving to DB, risk is nominally moved from the public space to the selected designer-constructor consortium. However, in practicality, the taxpayers are still acting as a financial backstop against something dramatic and DOT's will feel the brunt of the criticism if the DB consortium moves too fast. Moving this risk can also reduce the amount of appropriate ancillary studies, such as examinations of necessary environmental mitigation.

An examination of bridges constructed with DB and DBB found significant differences in cost appropriations and efficiencies. State DOTs, particularly Caltrans, are encouraged to spend more time thinking about which contractual method works best for each project, and whether transaction costs will actually be reduced.

APPENDIX B: DETAILED LEGISLATION

As an overview, the Design-Build Institute of America (DBIA) provides graphical maps showing which states allow design-build and other P3 contractual methods.





This appendix provides detailed text of legislation that approves alternative contracting for transportation projects in five states: California, New York, Oregon, and Washington. Note this appendix <u>does not include</u> every legislative bill that involves alternative contracting but rather those bills that provide the foundation for guidance in each state.

As a progenitor to the state legislation, the federal government allowed for the new construction of toll roads in 1987. This new legislation allowed states to signs contracts with private entities to build and operate toll roads.

Relevant language from the US Federal Code Title 23 Chapter 1 Section 129

(emphasis added)

(2)Ownership.—Each highway, bridge, tunnel, or approach to the highway, bridge, or tunnel constructed under this subsection shall—

(A)

be publicly owned; or

(B)

be ***privately owned*** *if the public authority with jurisdiction over the highway, bridge, tunnel, or approach has entered into a contract with 1 or more private persons to design, finance, construct, and operate the facility and the public authority will be responsible for complying with all applicable requirements of this title with respect to the facility.*

CALIFORNIA

Following the important 1987 federal legislation, California was an early adopter of alternative contracting for transportation infrastructure when it passed its own P3 law in 1989. This was part of a demonstration project authorizing private toll roads in Orange County. The SR 91 Express Lanes, a toll road in the median of the existing SR 91 freeway, opened in 1995.

Relevant language from AB 680 (1989) Chapter 107

Under existing law, the Department of Transportation is generally responsible for the design, construction, and operation of state-owned transportation facilities.

This bill would authorize the department to enter into agreements with private entities for the construction by, and lease to, private entities of 4 transportation demonstration projects, including at least one in northern California and one in southern California. The bill would authorize the department to lease rights-of-way in, and airspace over or under, state highways, to grant necessary easements, and to issue permits or other authorizations to enable private entities to construct transportation facilities supplemental to existing state-owned transportation facilities, and to lease those facilities to the private entities for up to 35 years. The privately constructed facilities *would at all times be state owned. The bill would authorize those agreements to contain provisions authorizing the private entity to charge tolls for the use of the privately constructed facilities, and would require the agreements to provide for reversion of the facilities to the state at the expiration of the lease.*

The bill would authorize the department to exercise any power possessed by it with respect to the development and construction of state transportation projects to facilitate the development and construction of the privately constructed projects, and would require the agreements to provide for reimbursement for maintenance and police services.

The bill would require the plans and specifications for a project to comply with the department's standards for state projects, and would deem a facility constructed by and leased to a private entity to be a part of the state highway system during the term of the lease.

The bill would declare that it is to take effect immediately as an urgency statute.

California authorized design-build contracting in 2009 and CM/GC alternative contracting in 2012. Finally, in 2014, a hodge-podge of different laws concerning design-build was consolidated into one set of rules. The 2014 rules are in place for 10 years.

Relevant language from SB 4 (2009)

Chapter 6.5 Section 6800 is added to the public code

The Legislature hereby finds and declares all of the following:

6800. The design-build method of procurement authorized under this chapter should be evaluated for the purposes of exploring whether the potential exists for reduced project costs, expedited project completion, or design features that are not achievable through the traditional design-bid-build method. A demonstration program will allow for a careful examination of the benefits and challenges of design-build contracting on a limited number of projects. This chapter shall not be deemed to provide a preference for the design-build method over other procurement methodologies.

Relevant language from AB 2498 (2012) Chapter 752

Chapter 6.3 Section 6700 is added to the public code

6700.

This chapter provides for an alternative procurement procedure for certain transportation projects performed by the Department of Transportation.

(1)

It is the intent of the Legislature in enacting this chapter to establish a pilot program to test the utilization of a Construction Manager/General Contractor method as a cost-effective option for constructing transportation projects, including the potential for partnering with local entities to deliver projects on the state highway system.

(2)

The Construction Manager/General Contractor method allows the department to engage a construction manager during the design process to provide input on the design. During the design phase, the construction manager provides advice including, but not limited to, scheduling, pricing, and phasing to assist the department to design a more constructible project.

Relevant language from SB 785 (2014) Section 1

It is the intent of the Legislature to consolidate existing design-build statutes and eliminate inconsistencies in statutory language by adopting authority of general application to identified agencies and repealing superseded sections.

New York

At this time, New York only has limited legislation in regards to the use of design-build and other P3 contracting. The first major transportation project to be authorized was the construction of the new Tappan Zee bridge, in 2011.

Relevant language from S50002 (2011) Part F

Section 1. This act shall be known and may be cited as the "Infrastructure investment act".

(5) For certain projects, the design-build project delivery method has the potential to achieve projects delivered on guaranteed or accelerated schedules, lower costs and risk shifting to the private sector generally retained in conventional design-bid-build projects as well as to accelerate capital investments throughout the state.

. . . . . .

an authorized state entity may utilize the alternative delivery method referred to as design-build contracts for capital projects related to the state's physical infrastructure, including, but not limited to, the state's highways, bridges, dams, flood control projects, canals, and parks, including, but not limited to, to repair damage caused by natural disaster, to correct health and safety defects, to comply with federal and state laws, standards, and regulations, to extend the useful life of or replace the state's highways, bridges, dams, flood control projects, canals, and parks or to improve or add to the state's highways, bridges, dams, flood control projects, canals, and parks; provided that for the contracts executed by the department of transportation, the office of parks, recreation and historic preservation, or the department of environmental conservation, the total cost of each such project shall not be less than one million two hundred thousand dollars ($1,200,000).

For the purposes of this act: "authorized state entity" shall mean the New York state thruway authority, the department of transportation, the office of parks, recreation and historic preservation, the department of environmental conservation and the New York state bridge authority.

This original bill from 2011 had three important limitations:

1) It was time-sensitive, as the law was only valid for 4 years.

2) All projects had to be over $1.2 million dollars, which eliminated small “on-call” style contracts.

3) The law was very specific on which entities could administer design-build as municipalities were excluded. This is significant because the city of New York could not engage in transportation design-build while the state of New York could. As such, the state DOT and the governor could utilize design-build for megaprojects within New York City and receive the credit for any potential speed or reduced cost. This scenario has played out with the reconstruction of the Kosciuszko Bridge connecting Brooklyn and Queens on the Brooklyn-Queens Expressway (BQE, I-278).

In 2014, despite the best efforts of state government, this legislation did in fact expire. In the spring of 2015, the same language was approved for two more years. It expired in April of 2017.

Relevant language from A06721 (2015) Part E Section 17

This act shall take effect immediately and shall expire and be deemed repealed 2 years after such date, provided that, projects with requests for qualifications issued prior to such repeal shall be permitted to continue under this act notwithstanding such repeal.

Additional legislation making design-build permanent has been inserted in 2017 A02008/S02008 legislation but this bill is currently in committee and has neither been voted upon by the committee members or the full state assembly.

Oregon

Oregon has had wording in the Oregon Revised Statutes (ORS) allowing the Department of Transportation to pursue alternative contracts as opposed to design-bid-build as early as 1975, which is extremely early compared to most states. According to the 1975 ORS, the Public Contract Review Board could “exempt certain public contracts or classes of public contracts” from competitive bidding if:

“(a) It is unlikely that such an exemption will encourage favoritism in the awarding of public contracts or substantially diminish competition for public contracts; and

(b) The awarding of public contracts pursuant to the exemption will result in substantial cost savings to the public contracting agency. In making such finding, the board may consider the

type, cost, amount of the contract, number of persons available to bid and other such factors the board may deem appropriate."

Oregon then had a series of bills directed at specific projects, notably two in 1995 and 1997. However in 2001 the state legislature passed SB 966, which formalized the process to pursue design-build and other P3 contracts. Oregon DOT also established an Office of Innovative Partnerships and Alternative Funding. The following is a synopsis from the 2001 Oregon Legislative Summary.

SB 966 directs the Oregon Department of Transportation (ODOT) to study the feasibility of joint private-public projects that use innovative financing methods. The measure directs the Transportation Commission to appoint an Advisory Committee on Innovative Finance to assist in the study and to advise on ways to solicit and encourage private participation. ODOT is required to report the results of the study to the Seventy-second

Legislative Assembly. SB 966 also authorizes local governments, intergovernmental entities, and nonprofit corporations to issue revenue bonds for the purpose of

financing tollway projects. The 1995 and 1997 Legislative Assemblies authorized

ODOT to enter into public-private partnerships to build and operate several specific tollway projects. The authorizing legislation contained a number of specific restrictions regarding the type of projects, project design features, and allowable financing methods. Some feasibility studies have been completed, but none of the projects have yet been funded. SB 966 replaces the previously approved specific authorizations with a general authority to form public-private partnerships as well as new authority for municipalities and nonprofit corporations to issue revenue bonds for tollway financing.

Since that time, a number of bills have modified the rules for contracting, including changes in 2013 that streamlined the process for using the CM/GC P3 method. However, there have not been any new summary/omnibus bills superseding the 2001 legislation. The following is the current ORS text supporting the Office of Innovative Partnerships and Alternative Funding, which was revised in 2015.

2015 ORS 367.800

The Legislative Assembly finds that:

(1) Entrepreneurial approaches to the acquisition, design, management and financing of transportation projects will accelerate cost-effective project delivery.

(2) Entrepreneurial approaches can bring substantial benefits to the public in transportation project development and execution.

(3) Risk management is a critical component of partnerships for transportation projects.

(4) Successful implementation of an Oregon innovative partnership program for transportation projects requires that risk in a project be managed and shared by public and private sector participants, with the partner best able to control a risk bearing responsibility for the risk.

(5) The Legislative Assembly and the executive branch of government accept responsibility for providing predictability for partnerships for transportation projects and for allowing negotiated agreements to be implemented.

(6) The development, acquisition and construction of transportation projects creates jobs and furthers economic development in Oregon by, among other things:

(a) Increasing the economy and efficiency of public transportation, improving the flow of commerce into and around the state and the surrounding region, improving the attractiveness of Oregon to new businesses and supporting the operations and prosperity of existing businesses; and

(b) Improving the movement of people into and around the state and the surrounding region, alleviating congestion and crowding and reducing the burdens on existing public transportation systems and transportation facilities. [2003 c.790 §1]

WASHINGTON

Similar to Oregon, Washington's foundation legislation for alternative contracting occurred in the early 2000's. HB 1680, 1681, 1682, and 1684, all from 2001, established rules governing design-build and other types of P3 contracting as well as rules for pilot projects. This was in reaction to both political opinion that Washington DOT was not being efficient with taxpayer dollars and the conclusions of a special committee called the Blue Ribbon Commission on Transportation formed by the governor at that time (Bremmer 2008). The legislation from HB 1680 was renewed in 2006.

Relevant language from HB 1680 (2001) Section 1

The legislature finds and declares that a contracting procedure that facilitates construction of transportation facilities in a more timely manner may occasionally be necessary to ensure that construction can proceed simultaneously with the design of

the facility. The legislature further finds that the design-build process and other alternative project delivery concepts achieve the goals of time savings and avoidance of costly change orders.

Relevant language from HB 1684 (2001) Section 1

The legislature finds that managed competition can be an effective way to unleash creative ideas from the work force and lead to improvements and greater efficiencies for the department of *transportation. Managed competition, however, should maintain a level playing field between the public and private sectors and should take into account issues such as wages, health care, and other benefits. Therefore, the legislature directs the department to introduce a pilot program, through negotiation between labor and management, that would provide for managed competition in transportation operations and maintenance functions and to seek private sector bids to compare with bids from the public sector staff currently performing the operation or maintenance function.*

Following the passage of new Federal transportation legislation such as SAFETEA-LU, Washington passed SB 1541 which outlined the process for exploring alternative contracts beyond the existing pilot projects from 2001.

Official Summary Digest from SB 1541 (2005)

From the effective date of this act, this chapter will provide a more desirable and effective approach to developing transportation projects in partnership with the private

sector by applying lessons learned from other states and from this state's ten-year experience with chapter 47.46 RCW. Creates the Transportation Innovative Partnerships

Act for the planning, acquisition, financing, development, design, construction, reconstruction, replacement, improvement, maintenance, preservation, management, repair, and operation of transportation projects. The goals of this act are to:

(1) Reduce the cost of transportation project delivery;

(2) Recover transportation investment costs;

(3) Develop an expedited project delivery process;

(4) Encourage business investment in public infrastructure;

(5) Use any fund source outside the state treasury, where financially advantageous and in the public interest;

(6) Maximize innovation; and

(7) Develop partnerships between private entities and units of government.

Declares that a transportation project may be financed in whole or in part with:

(1) The proceeds of grant anticipation revenue bonds authorized by 23 U.S.C. Sec. 122 and applicable state law

Very recently, another series of bills, SB 5250 (2012), HB 2208 (2014) and SB 5997 (2015) have set up new guidelines for design-build and P3.

Relevant language from SB 5250 (2012) Section 1

The department of transportation shall develop a process for awarding competitively bid highway construction contracts from department funds dedicated to highway improvements for projects over five million dollars that may be constructed using a design-build procedure.

"design-build procedure" means a method of contracting under which the department of transportation contracts with another party for the party to both design and build the structures, facilities, and other items specified in the contract. The process developed by the department must, at a minimum, include the scope of services required under the design-build procedure, contractor prequalification requirements, criteria for evaluating technical information and project costs, contractor selection criteria, and issue resolution procedures.

Official Summary Digest from SB 5997 (2015)

Authorizes and encourages the department of transportation to use the design-build procedure for public works projects over two million dollars when certain conditions exist.

Requires the joint transportation committee to:

(1)

Conduct a design-build contracting review study to examine the department of transportation's implementation and use of design-build contracting; and

(2) Provide a report detailing any recommended changes or improvements that the department of transportation should make to the design-build process in order to maximize cost and schedule efficiencies and ensure that design risk is borne by the appropriate party.

Requires the department of transportation to: (1) Develop a construction program business plan that incorporates findings of the committee's report and outlines a sustainable staffing level of state-employed engineering staff; and

(2) Convene an advisory group to assist in the development of the plan.

Appendix C: Sample Interview Questions for Project Management

1. Tell me about your participation in infrastructure development in your state.
2. We are interested in various aspects of how projects are identified and managed with respect to their contract type and financing. Are you familiar with / has your office dealt with projects governed by P3, DB, CMGC, or other contract types? Can you point us to policies that are currently used by your office to govern these types of procurement and delivery?
3. We would like to better understand how government agencies differ in their uses and outcomes with these methods. Is there anything you can share or suggest that could explain how the uses and outcomes of various types of contract and finance in your district differ from that of other districts?
4. We would also like to compare projects that are delivered in different ways, measuring their outcomes. To be able to compare outcomes, we need to improve our understanding of how projects differ from one another, and how those differences may affect the estimated cost of the project. What attributes of a project does your organization use to get a sense of the size, scale, or scope of an unfamiliar or new project?
    a. Of the attributes you mentioned previously, does your organization feel that any of these attributes will be prone to errors or differences in measurement?
    b. In addition to the attributes that you have previously mentioned, we've considered several others, including:
        i. footprint of the project
        ii. cubic mass of structure [or excavation for subsurface work]
        iii. surface area [for example, of bridge deck, noise wall, pavement]
        iv. weight of steel and concrete
        v. area of wall (e.g. retaining, noise)
        vi. area of wetlands impacted [or similarly protected habitats]
        vii. number / type of geotech borings
    c. Can you speak a little about the reliability of these measurements from firm to firm or agency to agency?
    d. Of the various attributes that we've discussed, which does your agency feel is the greatest source of risk for cost changes?
5. I would appreciate a chance to talk now about the SR 167 Puyallup River Bridge as a case study.
    a. When did this project begin? What was your title at the time and your role(s) on the project?
    b. What kinds of record-keeping did you or your team use for the management, design, and delivery of this project?
    c. What requirements for environmental review or mitigation and geotechnical analysis, were needed for this project?

        i. What other departments/divisions/consultants assisted with this work? Could you please help us quantify the expenditures made for this effort?
    d. What additional permitting and agreements, such as right-of-way acquisition or agreements with utilities or railroads, were required for this project?
        i. What other departments/divisions/consultants assisted with this work? Could you please help us quantify the expenditures made for this effort?
    e. What were some of your lessons learned and other challenges and opportunities from this project?
        i. Was this project similar in any particular way to other projects you have recently undertaken? If so, which projects and why?
        ii. Were there any surprises on this project? If so, please explain.
        iii. Were there any innovations incorporated into this project?
        iv. What would you have done differently (during planning/ during design/ during contract negotiations/ during construction/ after construction)?
        v. What is something you've done differently in a subsequent project because of this one?
    f. Were there any memorable events during project construction?
        i. What events are important for the story of the construction of this project?
        ii. Were there any unexpected events, decisions, or discoveries that changed the cost or schedule of this project?

6. I'm interested to know if there are any projects similar to project the SR 167 Puyallup River Bridge, that were developed using a different contracting, financing, or procurement method.
    a. Can you explain why you think they are similar?
7. What systems does your organization have in place to assess project costs after completion?
8. Where do you see opportunities for improved project delivery for your agency or state?
9. Did we miss anything during this interview that you think is important to understand project implementation?
10. Who else should I talk to about project design, development, finance, procurement, contracting, and project management in projects in your [state/city/county/district]?