Benefit-Cost Analysis for Public-Private Partnership Project Delivery: A Framework

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1 Introduction

Value for Money (VfM) analysis is frequently used to evaluate Public-Private Partnership (P3) highway concession proposals. VfM analysis considers the financial impacts of choosing a P3 delivery model over a more conventional approach. The analysis is undertaken from the perspective of the procuring agency, and does not quantitatively estimate non-financial public benefits and disbenefits. For example, the public benefit from accelerated project delivery is one of the key reasons that State and local governments in the U.S. pursue P3s. Yet the current VfM analysis approach does not account quantitatively for benefits to travelers and others from delivering a project earlier than would have been possible under conventional procurement. Few attempts have been made to quantify and monetize benefits from accelerated project delivery or other improvements in service quality under a P3. Benefit-Cost Analysis (BCA) applied to project delivery models – hereafter referred to as Project Delivery Benefit-Cost Analysis (PDBCA) – could complement VfM analysis to address these issues and contribute to transparency and accountability in the P3 development and procurement process.

2 Difference between VfM and PDBCA

A basic assumption in VfM analysis is that conventional procurement is possible with public financing in the same time frame as the P3. However, this may not be true if the procuring agency is faced with budgetary or debt capacity constraints that limit its ability to tap into future revenue streams to pay for investments today. Thus, benefits to users that may accrue from earlier delivery of the project under a P3 are not considered in quantitative VfM analysis, although they may be considered in a qualitative fashion.

VfM analysis does not quantitatively capture benefits to users from changes in service quality provided to users under a P3. For example, a P3 may provide higher pavement ride quality, improved incident response, or reduced traffic disruption during construction and maintenance activities. PDBCA can account for these benefits to users quantitatively, while VfM analysis either ignores them or relegates them to qualitative assessment.

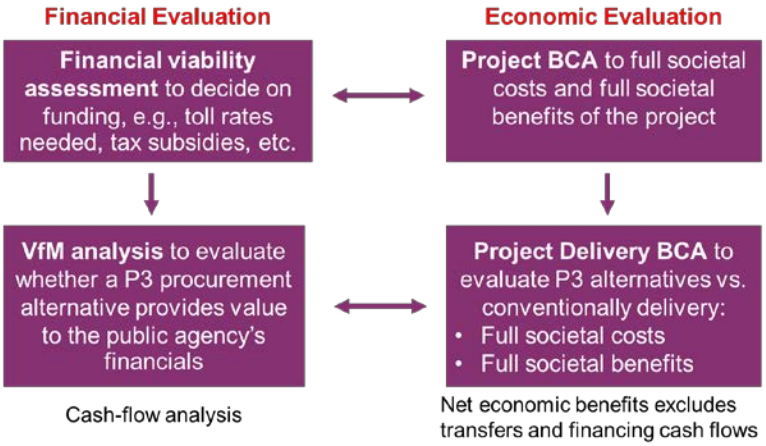
Finally, VfM analysis requires that the project scope under the P3 be exactly the same as under conventional delivery. Thus, any modifications to scope proposed in a P3 bid would need to be included in the conventional delivery option to make the VfM evaluation valid, and the benefits or disbenefits from P3 scope changes cannot be evaluated. PDBCA, on the other hand, when applied after receiving the P3 bids, is able to capture benefits or disbenefits from changes in scope proposed in a P3 bid.

The perspective taken with PDBCA is much broader than that taken with quantitative VfM analysis. Societal costs and benefits broader than those that accrue mainly to the public sponsor are quantified and monetized to the extent practicable. Thus PDBCA is a more appropriate framework to use than VfM in answering the question: "From society's perspective, will P3 delivery constitute an improvement compared to the conventional approach?"

3 Benefit-Cost Evaluation Process

A proposed P3 project may be evaluated (a) using *financial analysis* to evaluate its financial impact on the budget of the procuring agency; and/or (b) using benefit-cost analysis to compare societal benefits against societal costs, i.e., *economic efficiency analysis.* Each type of evaluation is described further below in the context of the project delivery process. The Figure below shows the relationship between financial and economic evaluation.

Figure 1: Financial Evaluation vs. Economic Evaluation



Financial Analysis

Project delivery financial evaluation will generally include an analysis of *Financial Viability* and *Value for Money* (VfM). Financial Viability Analysis evaluates the feasibility of the project on the basis of all the financial cash flows, including the ability to pay for the project through existing or potential new revenue streams. This may initially be done assuming conventional delivery. At a later stage, if a decision is made to consider P3 delivery, the analysis may again be undertaken assuming P3 delivery. VfM analysis can then be used to compare the P3 option to conventional procurement.

Economic Efficiency Analysis / Benefit-Cost Analysis (BCA)

The focus of this guide is on a process for comprehensive evaluation of societal benefits and costs associated with P3 design-build-finance-operate-maintain (DBFOM) project delivery. In the context of P3 project delivery, this analysis – the PDBCA – may be conducted in three steps:

1. *Project evaluation* (including evaluation of funding policy choices such as funding through broad-based tax sources vs. direct user charges), assuming conventional delivery of the project based on a financially feasible schedule, which may delay delivery compared to a P3 option;
2. *Incremental evaluation of an accelerated delivery schedule* assuming that the project can be conventionally procured in the (earlier) time frame proposed under the P3; and
3. *Incremental evaluation of the P3 procurement type*, focusing on the direct impacts of P3 delivery.

The first two steps assume conventional delivery of the project.[1] In the final step, the efficiency impacts relating directly to P3 procurement are estimated relative to accelerated conventional delivery of the project. This will include impacts of a P3 on costs, schedule, quality of service and travel demand relative to accelerated conventional delivery, as well as impacts of any modifications to scope proposed by a P3 bidder in response to a Request for Proposals (RFP). The economic efficiency analysis in the final step parallels VfM analysis, which (necessarily) assumes that conventional procurement is possible in the same time frame as the P3.

The rest of this guide describes how a State Department of Transportation (DOT) might apply the PDBCA framework *ex ante*, i.e., before bids are received. Two alternative delivery methods for a major project are compared:

- *Conventional delivery* using a series of design-bid-build (DBB) contracts. Construction would be delayed by several years, as the DOT faces severe budgetary constraints and limits on its debt capacity.
- *P3 delivery* implemented under a single 50-year DBFOM contract, with an annual availability payment to be paid by the public agency to the concessionaire during the operations phase. The project construction would begin immediately after reaching financial close.

As depicted in Figure 2, the State DOT would compare the two project delivery methods as follows using the three-step process:

1. A project BCA would first demonstrate the project's net costs and net benefits to society as a whole, comparing the Build alternative to the No Build. Any proposed tolling policy options, such as congestion pricing to maximize toll revenue vs. other objectives such as optimizing traffic

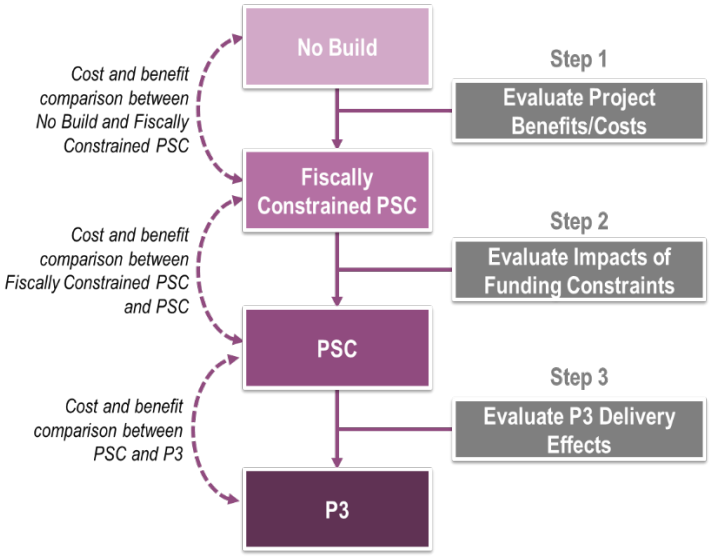
[1] Step 2 accounts for situations where the public agency does not expect that conventional delivery would be possible in the same time frame as the P3, due to budgetary or debt capacity constraints. If this is not the case, then this step in the analytical framework could be skipped.

flow on the facility, would be included in the project's scope. The Build alternative in this project BCA is termed the "Delayed Public Sector Comparator" or Delayed PSC, representing the most likely and realistic alternative to P3 delivery if the agency is fiscally constrained.

2. The next step would evaluate the accelerated Public Sector Comparator (PSC) based upon the same project delivery method as the Delayed PSC, but assuming that the project can start in the same time frame as the P3.

3. The final step would determine differences in costs and benefits between the P3 and the accelerated PSC attributable to P3 delivery.

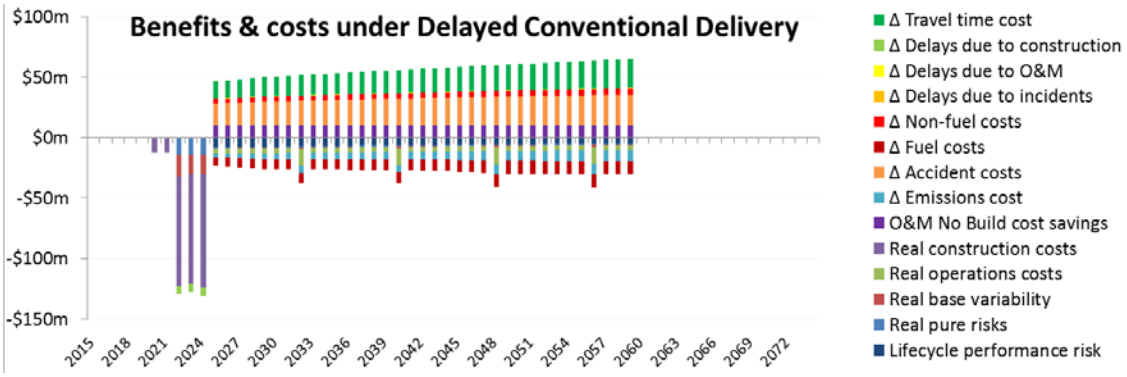
Figure 2: Benefit-Cost Analysis Framework



4 Step 1: Project Benefit-Cost Analysis

The first step assesses whether the project's economic benefits under the Delayed PSC (i.e., delayed conventional delivery) outweigh the economic costs and risks compared to the No Build alternative. The DOT would conduct a BCA for the project using standard methodologies. It would use real dollars to monetize costs and benefits, a real discount rate, a delayed construction start date, and an analysis timeframe of 50 years to match the proposed term of the concession. The analysis would include incremental consumer surplus benefits to induced traffic. The project's stream of costs and benefits is illustrated in the Figure below.

Figure 3: Delayed PSC Project Benefits and Costs relative to No Build



Toll revenues would be excluded from the BCA, as tolls are a transfer from an economic perspective. (They are a cost to toll-payers that provide an equal benefit to the facility operator, with a net societal economic benefit equal to zero.) Net present value (NPV) of the project would then be calculated as shown in the Table below.

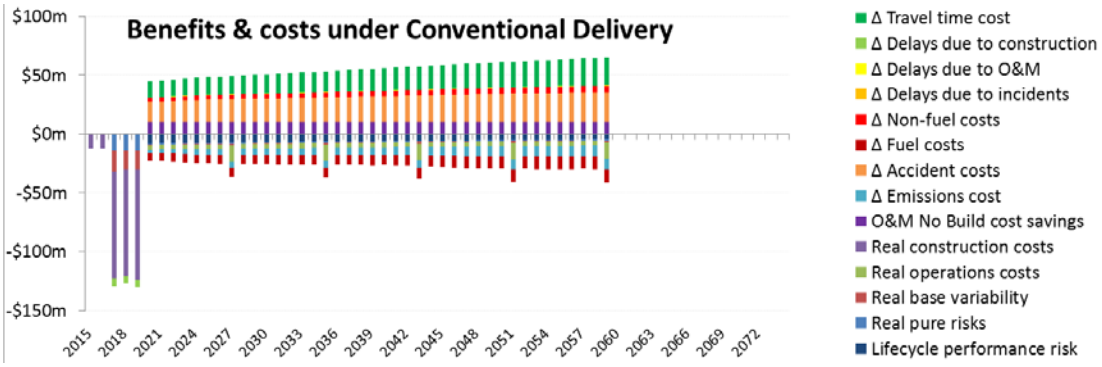
Table 1: Process to Estimate Delayed PSC Net Benefits relative to No Build

Cost/benefit item	NPV $
Incremental benefits relative to No Build	A
No Build costs saved	B
Incremental cost relative to No Build	C
Total Delayed PSC benefits	*X = A + B - C*

5 Step 2: Impacts of Funding Constraints

In this step, the incremental costs and benefits from an accelerated conventional delivery method (i.e., the accelerated PSC) are calculated compared to the Delayed PSC. To do so, the overall project benefits under the accelerated PSC are first compared to the No Build alternative, as shown in the Figure below. Construction would be advanced under this implementation schedule, i.e., it would be implemented in the same time frame as the P3. With the exception of this difference in starting date, the accelerated PSC follows exactly the same structure as the Delayed PSC (same number of contracts, contract size, real project costs, project end date, etc.).

Figure 4: Accelerated PSC Project Benefits and Costs relative to No Build



The acceleration has two direct impacts on the net benefits of the project:

- The present value of construction (and operations) costs will be higher as the construction schedule is shifted forward in time;
- Completion of the highway will advance, allowing earlier accrual of societal benefits.

To calculate the benefits under the accelerated PSC, the DOT would re-run its travel models to develop updated travel demand estimates, since earlier project delivery could affect economic and demographic drivers of travel demand in the earlier years. The cost impact of the different implementation schedule would be determined by simply shifting all costs forward in time. The net benefits would be calculated as shown in the Table below.

Table 2: Process to Estimate Net Benefits of PSC relative to Delayed PSC

Cost/benefit item	NPV ($)
Incremental benefits relative to No Build	E
No Build cost savings	F
Incremental costs relative to No Build	G
Total PSC benefits	*Y = E +F-G*
Total Delayed PSC benefits (from Table 1)	X
Net PSC benefits relative to Delayed PSC	*Y- X*

6 Step 3: Impacts of P3 Delivery Method

The final step is the evaluation of the P3 delivery method by determining the incremental costs and benefits that can be attributed directly to P3 project delivery. P3 project delivery is different from

conventional project delivery in terms of governance and incentive mechanisms, and reflects several value drivers, including:

- *Integration of phases*, allowing for lifecycle cost and benefit optimizations;
- *Output-based specifications*, allowing for innovative solutions;
- *Optimized risk allocation*, allowing for more efficient risk management;
- *Performance-based payment mechanisms*, providing incentives to deliver better performance; and
- *Best value evaluation criteria*, providing incentives to deliver better proposals.

The DOT estimates that these value drivers are likely to yield differences in timing, cost, quality and traffic demand, as listed in the Table below.

Table 3: State DOT Estimates of Expected Differences under P3 Delivery

Impact Type	Impact	Change
Timing	Start date due to longer project preparation and procurement time	+12 months
Timing	Construction period	-36 months
Cost	Public transaction costs	+$10M
Cost	Private transaction costs	+$15M
Cost	Lifecycle costs (% change)	-20%
Quality	Pavement quality (International Roughness Index score change)	-35
Quality	Lane unavailability due to work zone practices during construction phase	-5%
Quality	Lane unavailability due to work zone practices during operations phase	-7%
Quality	Delays due to improved incident response	-25%
Traffic demand	Tolled traffic during ramp up due to innovations and outreach activities	+5%

The change in construction schedule will most likely increase the present value of costs since costs during construction are compressed in a shorter and earlier period. However, the earlier opening of the road will also result in an earlier accrual of benefits. The higher public and private transaction costs combined with the lower lifecycle costs would either increase of decrease total costs.

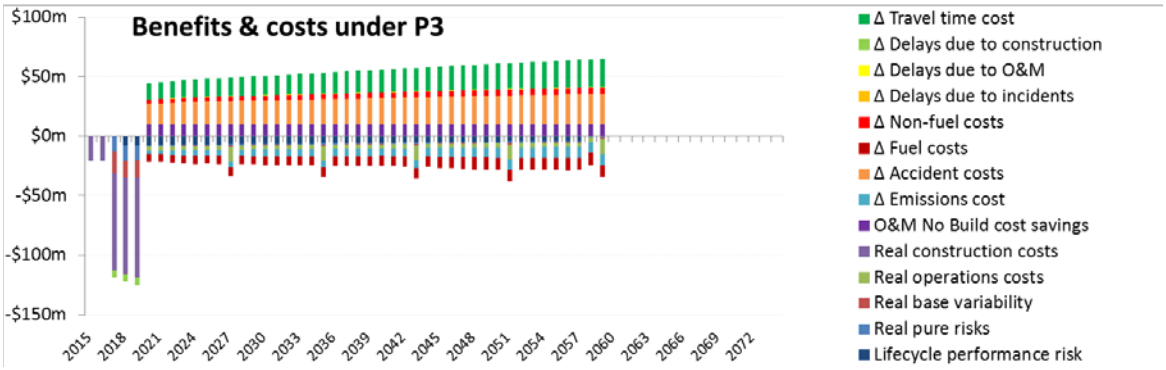
Improved pavement quality, fewer and shorter traffic disruptions during construction and O&M activities, and improved incident response would result in social benefits such as travel time savings, vehicle operating cost savings, and emission reductions.

A P3 concessionaire may also bring specific innovations and carry out outreach activities that increase traffic during the first few years of the project. Thus the project could benefit from a higher ramp up

in traffic volumes than under conventional delivery. The value of benefits to the additional travellers can be calculated based on standard consumer surplus theory[2].

After the DOT has received bids for the project, it can evaluate (*ex post*) the benefits of scope and design optimizations that have traffic and cost impacts (including alternative technical concepts, a.k.a. ATCs) by using an updated traffic study that includes those optimizations. The stream of project benefits and costs under P3 delivery relative to No Build is illustrated in the Figure below.

Figure 5: P3 Project Benefits and Costs relative to No Build



The DOT would estimate the expected direct benefits of P3 delivery (including timing, cost, quality and demand impacts) as shown in the Table below.

Table 4: Process to Estimate Net Benefits of P3 relative to Accelerated PSC

Cost/benefit item	NPV ($)
Incremental benefits relative to No Build	I
No Build cost savings	J
Incremental costs relative to No Build	K
Total P3 benefits	***Z = I+J-K***
Total Delayed PSC benefits (from Table 1)	Y
Net P3 benefits relative to Accelerated PSC	***Z- Y***

[2] See 3. FHWA. *Economic Analysis Primer*. August 2003. Available at: http://www.fhwa.dot.gov/infrastructure/asstmgmt/primer.pdf

7 Summary

The net benefits from each step of the BCA process may be summarized as shown in the Table below.

Table 5: Summary of Net Benefits Estimated in Each BCA Step

BCA Step	Source
"Base" project benefits	Delayed PSC benefits calculated in Table 1, i.e., "X"
Impacts of project acceleration	Acceleration benefits calculated in Table 2, i.e., "Y – X"
P3 delivery impacts	P3 delivery benefits calculated in Table 4, i.e., "Z – Y"
P3 scope optimization impacts	P3 scope optimizations can only be evaluated after bids have been received (*ex-post*)
Total project benefits	**Sum of results from above steps**

FHWA has developed this PDBCA framework to assist in estimating the overall social benefits of P3 project delivery. FHWA has enhanced its educational P3-VALUE analytical tool to incorporate the PDBCA framework and enhance VfM analysis. Research is underway to developing methodologies to estimate P3 impacts that can be expected based on project, context and delivery characteristics. The intent is to develop PDBCA methodologies that are sound on technical grounds as well as address the evaluation needs of the P3 stakeholder community.

Appendix 1: Key Questions and Answers

Question 1: Could the PSC rely on more advanced project delivery methods such as design-build or design-build-finance as opposed to design-bid-build?

Yes. The PSC reflects the most realistic fall back option for project delivery. Typically, a P3 consists of integrated contracts, whereas the conventional delivery method will be a combination of several contracts and insourcing by the public entity - depending on the level of expertise within the procuring organization. For construction or reconstruction, the conventional delivery method can be Design-Bid-Build (DBB), Design-Build (DB) or another contracting model – essentially whatever the public agency is familiar with. Design-Build-Finance (DBF) can also be considered as an alternative delivery method, particularly in cases where agencies are constrained by short-term borrowing limitations; in this situation DBF is an alternative way to leverage future available work program funds. Selecting the conventional delivery model is about defining the most realistic alternative if P3 is not selected.

Question 2: Could the project be financed using non-recourse public toll revenue bonds to avoid project funding delays under the PSC?

That depends on state DOT specific policies and regulations. P3 is often seen as an option to accelerate projects that cannot be implemented through conventional delivery methods due to budget constraints. However, P3 is not always the only solution to overcome funding constraints, since alternative solutions may be available, including DBF, public bonding or 63-20 corporations. The extent to which these alternative solutions are available may vary by state and are often the product of (self-imposed) policies and regulations. In case these alternative financing solutions are available, it would be incorrect to attribute the benefits of project acceleration to P3. This is the motivation for distinguishing acceleration effects from other impacts of P3 delivery in the BCA framework.

Question 3: How does public financing of P3s impact the PDBCA framework?

Financing costs are not reflected in the PDBCA. In the BCA methodology, financing costs are considered a transfer, and therefore irrelevant from an economic perspective. The lifecycle performance risk premium reflected in the financing costs, however, will need to be reflected one way or another. One approach is to calculate the present value of a virtual insurance premium that is based upon the market-based WACC (weighted average cost of capital). That WACC however is affected by the use of public financing components such as TIFIA loans. The risk premium in such a WACC contains public subsidies (e.g., through TIFIA loans) and is therefore no longer a market-based risk premium.

If the main objective is to have the most complete reflection of the costs, benefits and risks, the WACC that is used to determine the virtual risk premium will have to be corrected for the public

subsidy that is included in the public financing conditions. If the main objective is to make a fair comparison between delivery models, it may be acceptable to use the WACC that contains public financing conditions, as long as a similar calculation of lifecycle performance risk is included in the PSC as well.

Question 4: Could new public sector management solutions achieve similar efficiencies as those currently attributed to P3?

New public sector management solutions can certainly generate efficiencies. One should realize however that, whereas most of the P3 value drivers could theoretically be applied under conventional procurement methods, procuring agencies are often not in a position to implement these concepts in practice. For example, although states increasingly use accrual accounting, annual budgeting constraints limit the implementation of lifecycle costing.

Question 5: What is the relation between PDBCA and VfM?

While the VfM assessment captures the financial (or cash flow) differences between delivery models from the perspective of the procuring agency, the PDBCA includes all the economic costs and benefits of the delivery models being compared. On the cost side, the VfM assessment can be used as a starting point for the PDBCA. However a correction is required for 'transfers' that are not relevant from a PDBCA perspective, most importantly toll revenue cash flows and financing cash flows. Additionally, PDBCA generally uses real dollars along with a real discount rate to calculate the present values of future benefits and costs.

Consistent with the VfM assessment, the PDBCA considers all costs throughout the life of the project, requiring estimates and assumptions for planning and design costs, construction costs, maintenance costs and operational costs, as well as transaction costs and the value of risks and uncertainties under all delivery models considered.

Question 6: Why does the PDBCA not consider the benefits of accelerating other projects using the "freed up" funding or debt capacity when a P3 option is selected?

A commonly claimed benefit of P3s is that, by using private financing, they allow public agencies to retain funding and untapped debt capacity for other projects for which sufficient funding would otherwise not be available, and thus advance the benefits of those projects. This claim is based on the premise that public funding and/or debt capacity for transportation projects is limited and that by accessing private equity and private debt capacity to deliver one project, a public agency 'frees up' funding for other projects. From the perspective of benefit cost analysis, funding availability and debt capacity are political choices that are independent of the analysis of the benefits of a particular project. In other words, it is a political decision if a state, for example, chooses not to raise the gas tax or sets an arbitrary limit on the amount of debt the government can issue. The extent that these policies limit the state's ability to publicly fund and deliver projects that benefit-cost analysis shows would be

of net social benefit, or that a P3 helps to overcome these limitations, are not considered a benefit of P3 delivery in PDBCA. (Should there be a desire to estimate benefits of accelerating other projects using "freed up" debt capacity, an analysis similar to that done in Step 2 of the PDBCA process would need to be undertaken for all the affected projects.)