**P3 Delivery Benefit-Cost Analysis Exercise**

**Objectives of this exercise**

* Learn how to enhance P3 Value-for-Money (VfM) analysis using benefit-cost analysis methods to include the societal perspective.
* Learn how test the impacts of alternative travel growth projections.
* Learn how to test the impacts of P3 quality of service assumptions.

**Project Background**

A study was done previously by a state DOT to estimate Value for Money of P3 delivery for a highway project. The various inputs required for the analysis are included in the P3-VALUE 2.0 spreadsheet model. The project information is as follows:

* 20 miles highway expansion
* Expansion from 3 lanes to 5 lanes in each direction:
  + 3 General Purpose Lanes (GPL)
  + 2 Managed Lanes (ML)
* Costs under PSC (excluding risks and financing):
  + Pre-construction & construction: $25M and $400M respectively
  + Routine O&M: $4M per year
  + Major maintenance: $10M (every 8 years)
* Preconstruction under PSC starts in 2015; 2 years duration
* Construction duration under PSC: 4 years
* Operations period under PSC: 40 years

**Analysis Steps**

**Part A:** Use the P3-VALUE Benefit-Cost Analysis training module to review:

1. How to develop the *Delayed* Public Sector Comparator
2. How to develop the Public Sector Comparator
3. How to develop the P3 Option
4. How to compare the alternatives from the perspective of society as a whole and identify:
   * Project benefits under delayed conventional delivery
   * Any incremental project benefits from an accelerated conventional project delivery
   * Any further benefits from P3 delivery

**Part B:** Test the impacts of uncertain travel growth assumptions on the analysis results.

**Part C:** Test the impact of P3 quality of service assumptions on the analysis results.

**Part A: P3 Delivery Benefit-Cost Analysis**

1. Open P3-VALUE 2.0 Excel file.
2. When opening the file, Excel may prompt you to approve the use of macros. To do so, click “Enable editing” and/or “Enable content” on the yellow bar across the top of the screen.
3. After the model opens, the following user form will appear.



1. Select the “Training Navigator” to access the training modules. The “Training Navigator” contains four training modules that provide limited access to only the most relevant inputs and outputs for a particular training session.
2. Select “Module 2: Project Delivery Benefit-Cost Analysis” and proceed with the steps below (Note that the Training Navigator window may be closed and reopened at any point. Also, the tool has already been optimized and therefore is not required for the remainder of the task).

***Step 1: Review the Delayed Conventional Delivery (PSC) Option***:

The Delayed PSC is comprised of: (1) Costs; (2) Risks (to be covered in topical webinar 4 on Risk Assessment); and (3) Benefits.

Review the timing, costs, and benefits inputs for the Delayed PSC as outlined below. Note that the only difference between Delayed PSC and PSC is the pre-construction start year and construction start year, with duration being the same.

* Timing (***InpTiming&Cost***)
  + Pre-construction start year
  + Pre-construction & construction duration
* Costs (***InpTiming&Cost***)
  + Costs for pre-construction & construction
  + Costs for operations
* Timing of expenses & traffic ramp-up (***InpSeries***)
* Benefit-cost analysis inputs (***InpBCA***)
  + Duration of construction and O&M activities that affect traffic flow, and speed adjustment factor to account for delays during those activities
  + Incident-related speed adjustment factor to account for incident-related travel delays averaged annually)
  + Pavement quality IRI to account for fuel and non-fuel travel cost changes relative to No Build.

Review and record below the delayed PSC net benefits (see ***PDBCA Output Summary*** sheet).

|  |  |
| --- | --- |
| **Item** | **Delayed PSC ($M)** |
| Social benefits (sum row 5-12) |  |
| No Build cost savings (row 13) |  |
| Construction costs (row 14) |  |
| Operations costs (row 15) |  |
| Risks (sum row 16-18) |  |
| **Total Net Benefits under Delayed PSC** |  |

Below, please respond to the following questions; we will also discuss them at the webinar:

1. Why are benefits due to construction-related travel delay differences (row 6) negative, while they are positive for O&M-related travel delays (row 7)?
2. Why are benefits due to fuel costs and emissions costs negative (rows 10 and 12 respectively), even though travel time benefits (row 5) are positive?
3. Is the discount rate of 3% selected to calculate present values reasonable? Why?
4. Why are revenue benefits to the Public Agency not accounted for?
5. Based on the analysis results, is implementing the project under delayed conventional delivery worthwhile? Why?

***Step 2: Review the PSC assumed to be implemented in the same time frame as P3***:

The PSC is comprised of: (1) Costs; (2) Risks (to be covered in topical webinar 4 on Risk Assessment); and (3) Benefits.

As you did for the Delayed PSC, review the key project information in the input sheets of the model provided. Note that the only difference between Delayed PSC and PSC is the pre-construction start year and construction start year, with duration of each being the same.

* Timing (***InpTiming&Cost***)
  + Pre-construction start year
  + Pre-construction & construction duration
* Costs (***InpTiming&Cost***)
  + Costs for pre-construction & construction
  + Costs for operations
* Timing of expenses & traffic ramp-up (***InpSeries***)
* Benefit-cost analysis inputs (***InpBCA***)
  + Duration of construction and O&M activities that affect traffic flow, and speed adjustment factor to account for delays during those activities
  + Incident-related speed adjustment factor to account for incident-related travel delays averaged annually)
  + Pavement quality IRI to account for fuel and non-fuel travel cost changes relative to No Build.

Record below the PSC benefits and costs (see **PDBCA Output Summary** sheet) and compare them to Delayed PSC benefits and costs from Step 1:

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **A. PSC benefits and costs ($M)** | **B. P3 benefits and costs ($M)** | **P3 difference ($M) (Col A – Col B)** |
| Social benefits (sum row 24-31) |  |  |  |
| No Build cost savings (row 32) |  |  |  |
| Construction costs (row 33) |  |  |  |
| Operations costs (row 34) |  |  |  |
| Risks (sum row 35-37) |  |  |  |
| **Total Net Benefits** |  |  |  |

Below, please respond to the following questions; we will also discuss them at the webinar:

1. Based on the analysis results, is advancing the project worthwhile? Why?
2. Why are costs for Operations higher under PSC than under Delayed Conventional Delivery (i.e., Delayed PSC), even though the same delivery method is employed?
3. Why are construction costs higher under PSC than under the Delayed PSC, even though the same delivery method is employed?
4. Why are social benefits higher under PSC than under the Delayed PSC, even though the same delivery method is employed?

***Step 3: P3 Option***:

P3 Option inputs comprise the following:

* **Costs:** PSC costs and timeline, but adjusted to take into consideration assumed P3 differences
* **Risks:** PSC risks, but adjusted to take into consideration assumed P3 differences
* **Benefits:** PSC benefits, but adjusted to take into consideration assumed P3 differences

Potential P3 differences relative to the PSC that affect societal costs and benefits can include:

* Longer project preparation and shorter construction duration
* Cost and risk differences (e.g., higher public procurements costs or lower lifecycle cost)
* Service quality changes resulting in differences in user benefits and externalities

Review differences assumed in***InpTiming&Cost****,* ***InpSeries, & InpBCA****.*

* Timing (***InpTiming&Cost***)
  + Pre-construction start year
  + Pre-construction & construction duration
* Costs (***InpTiming&Cost***)
  + Costs for pre-construction & construction
  + Costs for operations
* Timing of expenses & traffic ramp-up (***InpSeries***)
* Benefit-cost analysis inputs (***InpBCA***)
  + Duration of construction and O&M activities that affect traffic flow, and speed adjustment factor to account for delays during those activities
  + Incident-related speed adjustment factor to account for incident-related travel delays averaged annually)
  + Pavement quality IRI to account for fuel and non-fuel travel cost changes relative to No Build.

Record below the P3 delivery benefits and costs (see***PDBCA Output Summary*** sheet) and compare them to PSC benefits and costs from Step 2:

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **A. P3 benefits and costs ($M)** | **B. PSC benefits and costs ($M) from Step 1** | **P3 difference ($M) (Col A – Col B)** |
| Social benefits (sum row 43-50) |  |  |  |
| No Build cost savings (row 51) |  |  |  |
| Construction costs (row 52) |  |  |  |
| Operations costs (row 53) |  |  |  |
| Risks (sum row 54-56) |  |  |  |
| **Total Net Benefits** |  |  |  |

Below, please respond to the following questions; we will also discuss them at the webinar:

1. Compare the P3 outputs with those for the PSC. Is P3 delivery worthwhile from a societal perspective? Why?
2. Why are No Build O&M cost savings higher for the P3 that for the PSC?
3. Compare the social benefits for P3 with the social benefits for conventional delivery (PSC). Why are the benefit estimates different?

**Part B: Test Impacts of Uncertain Traffic Growth Projections**

Analyze the effect of traffic assumptions on the previously estimated net benefits by changing the PDBCA traffic sensitivity factor (F33 in ***InpTraffic&Toll***) from 100% first to 80%, then to 120%, and finally to 0%. Please note that the sensitivity factor is only applied to traffic above the No Build base year traffic (i.e., traffic growth).

After each input change, recalculate the spreadsheet (go to “Formulas” on the menu bar and click on “Calculate now” if “Automatic” is not checked under “Calculation options” or click calculate in the bottom left corner of the sheet) and record the revised NPV estimates *(****PDBCA Output Summary****) (Note you do not have to optimize the model):*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Net benefits @ 100% of traffic growth ($M)** | **Net benefits @ 80% traffic ($M)** | **Net benefits @ 120% traffic ($M)** | **Net benefits @ 0% traffic growth ($M)** |
| A. NPV of net benefits under Delayed PSC |  |  |  |  |
| B. NPV of net benefits under PSC |  |  |  |  |
| **C. Difference between A and B, i.e., NPV of project acceleration** |  |  |  |  |
| D. NPV of net benefits under P3 Option |  |  |  |  |
| **E. Difference between B and D, i.e., NPV of P3 delivery** |  |  |  |  |

Below, please respond to the following questions; we will also discuss them at the webinar:

1. Would accelerated project delivery be worthwhile under alternative travel assumptions that are 20% lower? Would it be worthwhile if they were 20% higher? Why do you think so?
2. Would P3 delivery be worthwhile under alternative travel assumptions that are 20% lower? Would it be worthwhile if they were 20% higher? Why do you think so?
3. Would accelerated project delivery and P3 delivery be worthwhile under alternative travel assumptions that assume no traffic growth at all?

**Part C: Test Impacts of P3 Quality of Service Assumptions**

For the 0% traffic growth scenario, check one by one the effect of key P3 quality of service assumptions on NPV. After each input change, recalculate the spreadsheet and record the revised NPV estimates. Each model run should be additive, i.e., do not reverse any changes you made in the prior run.

Step 1: Early Construction completion – Increase P3 construction duration to 4 years to match PSC schedule (L14 in ***InpTiming&Cost***), hit “Calculate”, and adjust ***InpSeries*** accordingly so that 25% of construction cost is expended in each of the 4 years (row 66-73). *Optimize the model* and record the results below.

Step 2: Pavement Ride Quality – Eliminate the improvement in P3 ride quality by increasing the International Roughness Index (IRI) so that it is the same as that for the PSC (140) (F70 in ***InpBCA***). Hit “Calculate” and record your results below. *(Note you do not have to optimize the model. Also, since the P3 assumed difference was small, you will not see any impact due to its insignificance ).*

Step 3: Travel delays related to construction and O&M – Eliminate the reduction in duration of construction and O&M activities for P3 by increasing the hours per day for each input so that they are the same as the PSC inputs (F27 and G27 in ***InpBCA***). Hit “Calculate” and record your results below. *(Note you do not have to optimize the model).*

Step $: Travel delays related to incidents – Eliminate the reduction in speed adjustment for incident delays for P3 by increasing the % speed reduction for P3 so that it is the same as the one for PSC (F39 in ***InpBCA***). Hit “Calculate” and record your results below. *(Note you do not have to optimize the model).*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Scenario** | **A. NPV of PSC ($M)** | **B. NPV of P3 Option ($M)** | **C. Difference between P3 and PSC ($M) = Col B – Col A** | **Incremental difference ($M) compared to prior model run** |
| Base Case assumptions with 0% traffic growth scenario (from Part B) |  |  |  | N.A. |
| 1. No early completion |  |  |  |  |
| 2. No ride quality improvement |  |  |  |  |
| 3. No reduction in const. and O&M duration |  |  |  |  |
| 4. No reduction in incident response time |  |  |  |  |

Below, please respond to the following questions; we will discuss at the webinar:

1. *Which P3 service quality improvement assumption appears to have the biggest impact on NPV?*
2. *If there were no service quality improvements under P3, would P3 delivery still be worthwhile from a societal perspective?*

**Thank you for your efforts! To receive a certificate from FHWA’s Office of Innovative Program Delivery acknowledging your participation in the Webinar and completion of the exercise, please email your completed answers by Monday, February 29 at 10:00am Eastern to Patrick DeCorla-Souza at:** [**patrick.decorla-souza@dot.gov**](mailto:patrick.decorla-souza@dot.gov)