Cal-B/C Training Module 9a.2
Cal-B/C Sketch HOV Case Study
About This Module
This module will...

- Walk you through a hypothetical High-Occupancy Vehicle (HOV) lane construction project
- Provide details on where to get data to input into the example
- Discuss the benefit-cost analysis (BCA) results
Previous Modules…

- **Module 1** provided a basic introduction on benefit-cost analysis (BCA) and a general overview of how to conduct a BCA
- **Module 2** described the Cal-B/C suite of tools, discussed the types of projects that can be evaluated, and provided guidance on which tools to use for various project types
- **Module 3** presented the Cal-B/C results page, detailed what each output measure means, and explained how they are calculated
- **Module 4a** presented an overview of how Cal-B/C Sketch works including a review of all worksheets and inputs
  - This current module complements Module 4a
- **Module 5** highlighted the information in the Parameters worksheet and discussed key assumptions used by Cal-B/C
- **Module 6a** provided detailed information on how Cal-B/C Sketch calculates benefits
- **Module 7a** presented the 1-2-3 approach to starting a Cal-B/C Sketch analysis
  - This current module complements Module 7a
- **Module 8a** discussed potential data sources that can be used in a Cal-B/C Sketch analysis
HOV Lane Project Description
Constructing hypothetical HOV lanes in Northern California

**No Build Case:**
- 8 general purpose lanes

**Build Case:**
- 8 general purpose lanes plus 2 HOV lanes
1) Project Information Worksheet Overview (from Module 4a)

- The primary data entry worksheet for Cal-B/C Sketch
- Other worksheets should be modified if project specific information is available

1A Project Data
- Required for all projects

1B Highway Design and Traffic Data
- Required data for roadway geometrics, traffic demand, and speed data
- Data such as average vehicle occupancy (AVO) can be obtained from public sources
- On-ramp volume, queue length, and pavement condition sections do not need to be filled out

1C Highway Accident (i.e., Collision) Data
- Required data for roadway projects with expected safety benefits
1) Project Information Worksheet Overview (from Module 4a)

1D Rail and Transit Data
- Not needed for an HOV lane project

1E Project Costs
- Required to fill in for each year of construction period
- Recommended to estimate O&M costs based on existing relevant highway expansion projects. O&M costs should be the difference between the No Build and Build Scenarios.
Module 9a.2: Project Information Worksheet

**1A) Enter Project Data**

- **District:** HQ
- **PROJECT:** Hypothetical HOV Lane in Northern California

**Type of Project**
- Select “HOV Lane Addition” in pull-down menu

**Project Location**
- Enter “2” for Northern California
  - Length of Construction Period
    - Enter “3” for an estimated 3 years of construction
  - One- or Two-Way Data
    - Enter “2” to indicate that the average daily traffic (ADT) data represents two directions of the corridor

**Length of Peak Period(s)**
- Enter “6” for total peak period hours (e.g., 3 hours in the AM and 3 hours in the PM)

Input Project Identifier Data (optional):
- Input unique project identifiers (optional): Caltrans District, Project Name including the freeway exit name or corridor name and from postmile to postmiles, Expenditure Authorization (EA) number, and Planning and Programming Number (PPNO)
1B) Enter Highway Design and Traffic Data

**Roadway Type**
- Enter “F” (freeway)

**Number of General Traffic Lanes**
- Enter “8” for the No Build and Build scenarios because the number of general traffic lanes will not change

**Number of HOV/HOT Lanes**
- Enter “0” for the No Build and “2” for the Build scenario because the project will add two HOV lanes

**HOV Restriction (2 or 3)**
- Enter “2” indicating that the HOV lanes will require 2 or more people per vehicle
1B) Enter Highway Design and Traffic Data

Exclusive ROW (Right-of-Way) for Buses
- Default value of “N”, as this HOV facility will not provide exclusive bus only lanes

Highway Free-Flow Speed
- Input “65” for the design speed for this urban highway since the posted speed is 65 mph and the design speed is assumed to be the same

Ramp Design Speed (if auxiliary lane/off-ramp project)
- This is not needed for the analysis, so keep the default ramp speed

Length
- Input “7” for Highway Segment Length
- Cal-B/C Sketch will automatically assume that the Impacted Length is the same length as the Highway Segment. Only change this input if the project will affect traffic in an area different (larger or smaller) than the Highway Segment.
1B) Enter Highway Design and Traffic Data

**Average Daily Traffic (ADT)**

- **Current:** Enter “210,150” for general purpose highway ADT
  - In 1A), you entered a “2” to indicate that the ADT represents two-way traffic
- **Forecast:** Enter “280,000” for estimated ADT 20 years after the project opening date (opening year + 20) in the No Build scenario
  - This represents a growth rate of around 1.3% per year
  - Cal-B/C estimates Base (Year 1) volume for the No Build scenario
  - Cal-B/C can estimate both Base (Year 1) and Forecast (Year 20) traffic in the Build scenario
  - The formulas do not estimate any induced demand.
- **Overwrite the Build traffic estimates,** assuming that the project induces a 6% increase in traffic in the Base and Forecast years
  - Enter the values shown or formulas to calculate the Build traffic in each year

**Average Hourly HOV/HOT Lane Traffic**

- Percent Traffic in Weave: Enter 0.0%
- Percent Trucks (include RVs, if applicable): Enter 4% for Base and 4% for Forecast

**Not Needed for this Analysis**

**Average Vehicle Occupancy (AVO)**

- General Traffic: Enter values for No Build and Build
  - Peak: 1.30
  - Non-Peak: 1.30
- High Occupancy Vehicle (if HOV/HOT lanes): Enter values for No Build and Build
  - Base: 2.15
  - Forecast: 2.15
1B) Enter Highway Design and Traffic Data

**Average Hourly HOV/HOT Lane Traffic**
- Enter “2,800” for in the No Build (representing the demand for HOV lanes in the No Build)
- Enter “2,800” for the HOV lane traffic in the Build scenario

**Percent of Induced Trips in HOV (if HOT or 2-3 conversion)**
- Keep the “100%” default value

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**Table:**

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>No Build</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Base (Year 1)</td>
<td>Forecast (Year 20)</td>
</tr>
<tr>
<td><strong>Average Daily Traffic</strong></td>
<td>210,150</td>
<td>219,675</td>
<td>232,856</td>
</tr>
<tr>
<td><strong>Average Hourly HOV/HOT Lane Traffic</strong></td>
<td>2,800</td>
<td>2,800</td>
<td>2,800</td>
</tr>
<tr>
<td><strong>Percent Traffic in Weave</strong></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>Percent Trucks</strong> (include RVs, if applicable)</td>
<td>4%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Truck Speed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>On-Ramp Volume</strong></td>
<td>Peak</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Non-Peak</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Queue</strong></td>
<td>Arrival Rate (in vehicles per hour)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Departure Rate (in vehicles per hour)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Pavement Condition</strong></td>
<td>Base (Year 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Forecast (Year 20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average Vehicle Occupancy (AVO)</strong></td>
<td>Non-Peak</td>
<td>1.30</td>
<td>1.30</td>
</tr>
<tr>
<td></td>
<td>Peak</td>
<td>1.15</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>High Occupancy Vehicle (if HOV/HOT lanes)</td>
<td>2.15</td>
<td>2.15</td>
</tr>
</tbody>
</table>

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**Not Needed for this Analysis**
1B) Highway Design and Traffic Data – Where to Find Traffic Data?

Data Sources

- Caltrans Traffic Census Program website [https://dot.ca.gov/programs/traffic-operations/census](https://dot.ca.gov/programs/traffic-operations/census)

- Annual Average Daily Traffic by segment
  - Calculate a weighted average volume by distance
  - OR
  - Calculate a uniform average volume
    (based on the corridor segments and count location characteristics)
1B) Highway Design and Traffic Data – Average Vehicle Occupancy

Percent Traffic in Weave
- Do nothing. Project is not an operational improvement; data entry will not affect the analysis.

Percent Trucks
- Enter “4%” for percentage of trucks on highway segment (see next slide)

Truck Speed
- Leave blank since this is not a passing lane project

Average Vehicle Occupancy (AVO)
- Keep the default values for this analysis
- AVO data can be obtained from several sources including:
  - Caltrans Managed Lanes Annual Reports
  - Regional Travel Demand Models
  - U.S. Census American Community Survey Data (at county level)
  - Field data collection – vehicle classification and occupancy counts
1B) Highway Design and Traffic Data – Where to Find Percent Trucks?

Data Sources

- Caltrans Traffic Census Program website
  [https://dot.ca.gov/programs/traffic-operations/census](https://dot.ca.gov/programs/traffic-operations/census)

- Annual Average Daily Truck Traffic
  - Calculate a weighted average percentage by distance or volume
  - OR
  - Calculate a uniform average percentage (based on the corridor segments and count location characteristics)
1C) Enter Highway Accident Data

Actual 3-Year Accident Data

- Total Accidents (Tot)
  - Enter “4543” for total accidents in the ‘Count (No.)’ cells
- Fatal Accidents (Fat)
  - Enter “8” for fatal accidents
- Injury Accidents (Inj)
  - Enter “1262” for injury accidents
- Property Damage Only (PDO) accidents are calculated = Tot – Fat – Inj

**HIGHWAY ACCIDENT DATA**

<table>
<thead>
<tr>
<th>Actual 3-Year Accident Data (from Table B)</th>
<th>Count (No.)</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Accidents (Tot)</td>
<td>4543</td>
<td>2.82</td>
</tr>
<tr>
<td>Fatal Accidents (Fat)</td>
<td>8</td>
<td>0.005</td>
</tr>
<tr>
<td>Injury Accidents (Inj)</td>
<td>1262</td>
<td>0.78</td>
</tr>
<tr>
<td>Property Damage Only (PDO) Accidents</td>
<td>3273</td>
<td>2.03</td>
</tr>
</tbody>
</table>

**Statewide Basic Average Accident Rate**

<table>
<thead>
<tr>
<th>Rate Group</th>
<th>No Build</th>
<th>Build</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 65</td>
<td>0.73</td>
<td>0.67</td>
</tr>
<tr>
<td>Accident Rate (per million vehicle-miles)</td>
<td>0.4%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Percent Fatal Accidents (Pct Fat)</td>
<td>31.7%</td>
<td>31.0%</td>
</tr>
</tbody>
</table>
1C) Enter Highway Accident Data

Statewide Basic Average Accident Rate

- Rate Group
  - Enter "H 65" for the ‘No Build’ and “H 66” for the ‘Build’ scenario

- Accident Rate (accidents per million vehicle-miles)
  - Enter “0.73” for the ‘No Build’ and “0.67” for the ‘Build’

- Percent Fatal Accidents (Pct Fat)
  - Enter “0.4%” for the ‘No Build’ and “0.3%” for the ‘Build’

- Percent Injury Accidents (Pct Inj)
  - Enter “31.7%” for the ‘No Build’ and “31.0%” for the ‘Build’
1C) Highway Accident Data – Where Did It Come From?

2017 Collision Data on California State Highways (road miles, travel, collisions, collision rates)

Actual 3-Year Accident Data (from Table B)
- Total Accidents (Tot): 4543, Rate: 2.82
- Fatal Accidents (Fat): 8, Rate: 0.005
- Injury Accidents (Inj): 1262, Rate: 0.78
- Property Damage Only (PDO) Accidents: 3273, Rate: 2.03

Statewide Basic Average Accident Rate
- No Build: H 65, Accident Rate: 0.73, Percent Fatal Accidents (Pct Fat): 0.4%
- Build: H 66, Accident Rate: 0.67, Percent Fatal Accidents (Pct Fat): 0.3%

BASIC AVERAGE ACCIDENT RATE TABLE FOR HIGHWAYS


Link to 2017 Collision Data on California State Highways
1E) Project Costs - Overview

Initial Costs

- Enter the initial project costs for project support, right-of-way (R/W), and construction as shown.
- Since the project is expected to take 3 years as indicated in Section 1A), 3 years of initial cost data must be entered.
- For projects in the preliminary planning phases, it is not necessary to input detailed cost data. For highway projects, it is likely that cost estimates are available from a PS&E or project study report.

Subsequent Costs

- In the preliminary planning phase, data to estimate an appropriate net change in O&M costs may not be available. For this hypothetical example, enter no subsequent costs.
Model Inputs Worksheet
2) Model Inputs Worksheet

- Review this worksheet to make sure that your volumes and speeds make sense (peak and non-peak, base and forecasted, no build and build).

- Year 1 speeds (the year after construction is completed) can be visually examined as a “reality check” on Cal-B/C calculations.

- You can enter updated values in the green cells if better data is available.

Does this peak period speed (current and forecasted) make sense for your corridor?

Year 1 is only a few years away (3 years after construction), so speeds calculated by Cal-B/C should likely reflect what you know to be the operating conditions on the roadway.
2) Model Inputs Worksheet

- This worksheet also lists the accident rates calculated for the project in the No Build and Build scenarios. Review to ensure that the rates make sense.
- No Build accident rates are calculated from the three-year accident count data entered in Section 1C.
- Accident rates for the Build scenario are adjusted from No Build accident rates using the statewide average accident rates entered in Section 1C.

Does this accident reduction make sense for the project improvements?
2) Model Inputs Worksheet

- Update the **Highway Accident Rates** in the **Build** scenario based on results from a hypothetical Safety Analysis.

- In the green “Changed by User” column, enter “0.004” for Fatal Accidents, “0.75” for Injury Accidents, and “1.95” for PDO Accidents.
  - The value in the corresponding gray cell in the “Used for Proj. Eval.” column changes to match the user input.

- Include a reason for the change in the white “Reason for Change” column.
  - Here, we enter “Based on Project Safety Analysis Report” to explain the changes.
Results Worksheet
3) Model Results

- This project has a relatively large, economically efficient 3.6 B/C ratio.
- The payback period is 10 years.
  - Number of years it takes for the net benefits (lifecycle benefits minus lifecycle costs) to equal the initial construction costs.
- Most benefits are derived from travel time savings.
- Accident cost savings are positive due to the estimated reduction in accident rates.
- Vehicle operating cost savings are negative likely due to the increase in traffic and increase in speeds.
3) Model Results

- Adjusting input variables can be done to test the sensitivity of these results
  - What happens if highway demand grows faster or slower than what was input?
  - What happens if the project induces more or less demand?
  - What happens if the project costs more?

- Refer to Module 3 for more information on the Cal-B/C Results worksheet and BCA metrics
Conclusion
In this module, you learned…

- How to perform a BCA of a hypothetical HOV lane construction project
- What data sources can be used for this type of project
- How to review the corresponding BCA results with real numbers
Module 9a.2: Conclusion

What’s Next?

- **Module 10** is the final module in this training series and provides additional information and data sources for BCA in Cal-B/C tools.