Cal-B/C Training Module 8b
Cal-B/C Corridor
Understanding Project Input Sheets and Data
About This Module
This module will...

- Build on Modules 4b and 7b to provide more details on how to get data for your benefit-cost analysis (BCA) using Cal-B/C Corridor

- Identify data sources to use for demand, operational, and project cost data
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 4b** presented an overview of how Cal-B/C Corridor works including a review of all worksheets and inputs
  - This current module complements Module 4b

- **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 calculates benefits

- **Module 7b** presented the 1-2-3 approach to starting a Cal-B/C Corridor analysis
  - This current module complements Module 7b
Module 8b: About This Module

Requirements for Making Full Use of This Module

- Basic understanding of traffic engineering and transportation planning methodologies, data and terminology
- Basic understanding of micro- or macro-simulation outputs, Highway Capacity Manual (HCM) tool outputs
- Ability to navigate websites and download relevant data
- Knowledge of Microsoft Excel and data analysis features
02

Cal-B/C Corridor Data Entry Worksheets Overview
Cal-B/C Data Entry Worksheets

- For most analyses, two worksheets will be needed for data entry.
- Not all data entry needs will be covered such as:
  - Project specific information: project location, design and geometric data
  - How to extract travel demand/microsimulation model data

Worksheets where data will be entered

Worksheets where Cal-B/C performs calculations and tabulates results

<table>
<thead>
<tr>
<th>Title</th>
<th>Instructions</th>
<th>1) Project Information</th>
<th>2) Model Inputs</th>
<th>3) Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1) Project Information</td>
<td>2) Model Inputs</td>
<td>3) Results</td>
</tr>
<tr>
<td>Instructions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary instructions on how to fill out each data item in Cal-B/C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 1) Project Information
  - Project Description/Type of Project
  - Model Structure
  - Project Costs

- 2) Model Inputs
  - Model Data
    - VMT
    - VHT
    - # of Transit Trips
    - AVO
    - Percent Trucks
  - Safety
    - Collision Rate

- 3) Results
  - Travel Time
    - Calculates total travel time benefits on highway and transit
  - Consumer Surplus
    - Calculates consumer benefits associated with induced demand
  - Vehicle Operating Costs
    - Calculates highway No Build and Build fuel and non-fuel costs
  - Accident Costs
    - Calculates No Build and Build collision costs
  - Emissions
    - Calculates No Build and Build running and starting emissions and costs
  - Final Calculations
    - Tabulates final results, including:
      - Net present value
      - Internal rate of return
  - Parameters
    - Key default analysis parameters and assumptions for all Cal-B/C tools

Module 8b: Cal-B/C Corridor Data Input Overview
Review: Cell Color-Coding

- Cal-B/C Corridor requires few user inputs, but allows you to enter more inputs when data is available.

- Cells in the worksheets are color-coded:
  - **Green** cells indicate required data
    - You must input values for Cal-B/C to work for the type of analysis being performed.
    - Cal-B/C descriptions tell you what cells need to be used for a given analysis.
  - **Red** cells provide default values that you can change if needed
    - Default base year (2020) and forecast year (2040) can be overridden.
  - **Blue** cells contain values calculated by the model
    - You can override the values in these cells if better data is available.
  - **Gray** cells indicate not to enter any data
    - Based on mode of model group.
Suggested Data Sources for Evaluations in Cal-B/C Corridor

**Model Data**
- Travel Demand Model (TDM)/Microsimulation Model/HCM Tool Outputs
- Caltrans Division of Traffic Operations, Traffic Census Program Traffic Volumes
- Federal Transit Administration (FTA) National Transit Database
- Caltrans Managed Lane Annual Report
- American Community Survey

**Traffic Collision and Safety Data**
- Caltrans Traffic Accident Surveillance and Analysis System (TASAS)
- California Highway Patrol (CHP) Statewide Integrated Traffic Records System (SWITRS)
- Other Sources (e.g., Transportation Research Board publications)
Suggested Data Sources for Evaluations in Cal-B/C Corridor (cont.)

Project Costing Data

- Project Study Report (PSR) or other documents
- Project Report (PR)
- Regional Transportation Improvement Program (RTIP)
- State Highway Operations and Protection Program (SHOPP)
- Caltrans Project Cost Website
- Federal Transit Administration (FTA) Capital cost database
Cal-B/C Data Entry – Project Information Worksheet

- Not all cells require data entry
- Cal-B/C Corridor data item headers indicate if data is required
- Use “Create Model” button
- Once you create the model (see modules 4 & 7), you can now do data entry
- Number of model groups represents the number of travel demand/microsimulation model output records to be input
- Model groups can be refined to represent various roadway/mode types (e.g., arterials, freeway general purpose/HOV lanes) and speed categories (e.g., speed bins, hourly, or peak period speeds)
Module 8b: Cal-B/C Corridor Data Input Overview

Cal-B/C Data Entry - Model Inputs Worksheet

- Required data:
  - Vehicle Miles Traveled (VMT) - refined by mode/facility/speed bin/time of day
  - Vehicle Hours Traveled (VHT) - using same model groups as for VMT
  - Average Vehicle Occupancy (AVO) - can come from model or other source
  - Percent Trucks – can come from model or other source
  - Number of trips – if a transit model group

DEFINITIONS OF MODEL GROUPS AND YEARS

MODEL DATA - YEAR 2020

MODEL DATA - YEAR 2040
• Fatal, Injury, Property Damage Only (PDO)

**DEFINITIONS OF SAFETY GROUPS AND YEARS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mode</th>
<th>Description</th>
<th>Fatal reduction factor</th>
<th>Injury reduction factor</th>
<th>PDO reduction factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Highway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAFETY DATA - YEAR 2020**

<table>
<thead>
<tr>
<th>Vehicle Miles</th>
<th>Fatal</th>
<th>Injury</th>
<th>PDO</th>
<th>Number of</th>
<th>Number of</th>
<th>Number of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**SAFETY DATA - YEAR 2040**

<table>
<thead>
<tr>
<th>Vehicle Miles</th>
<th>Fatal</th>
<th>Injury</th>
<th>PDO</th>
<th>Number of</th>
<th>Number of</th>
<th>Number of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Module 8b: Cal-B/C Corridor Data Input Overview

#### Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item

<table>
<thead>
<tr>
<th>Section Title</th>
<th>Data Input Item</th>
<th>To Find, Look at Cell</th>
<th>Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1A) Project Data</strong></td>
<td>Project Location</td>
<td>C12</td>
<td>Depends on proposed project</td>
</tr>
<tr>
<td></td>
<td>Project Timing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Current Year</td>
<td>D16</td>
<td>Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source</td>
</tr>
<tr>
<td></td>
<td>Year Construction Begins</td>
<td>D18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Year Project Opens</td>
<td>D20</td>
<td></td>
</tr>
<tr>
<td><strong>1B) Model Structure</strong></td>
<td>Number of Model Groups</td>
<td>M11</td>
<td>User-defined depending on proposed project. For example, could be based on roadway class (freeway, arterial), time of day (hourly, model period), speed bins (helps to better estimated emission benefits)</td>
</tr>
<tr>
<td></td>
<td>Number of Safety Groups</td>
<td>M12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Years</td>
<td>M13</td>
<td></td>
</tr>
<tr>
<td><strong>1C) Program Costs</strong></td>
<td>Direct Project Costs</td>
<td>W12:Y13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initial Project Costs (Support, R/W, Const.)</td>
<td>W12:Y13</td>
<td>Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source</td>
</tr>
<tr>
<td></td>
<td>Subsequent Costs (O&amp;M, Rehab)</td>
<td>Z12:AA13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mitigation</td>
<td>AB13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transit Agency Cost Savings</td>
<td>AC10</td>
<td></td>
</tr>
</tbody>
</table>
## Module 8b: Cal-B/C Corridor Data Input Overview

### Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item (cont.)

<table>
<thead>
<tr>
<th>Section Title</th>
<th>Data Input Item</th>
<th>To Find, Look at Cell</th>
<th>Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A) Definitions of Model Groups and Years</td>
<td>Select Mode</td>
<td>F10</td>
<td>User-defined, but needs to be data from Regional Travel Demand Model (specific output modes and formats requested from modelers)</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>G10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>I10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avg. Vehicle Occupancy (AVO)</td>
<td>M10</td>
<td>Regional Travel Demand Model, Caltrans Managed Lane Annual Report, U.S. Census American Community Survey, Field Data Collection</td>
</tr>
<tr>
<td></td>
<td>Percent Trucks</td>
<td>N10</td>
<td>Regional Travel Demand Model, Caltrans Traffic Census, Field Data Collection</td>
</tr>
<tr>
<td>2B) Average Profile for Diverted Trips/Induced Trips</td>
<td>For Trips Diverting from Highway to Transit</td>
<td>V10</td>
<td>Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor)</td>
</tr>
<tr>
<td></td>
<td>Average Speed in Year [Base Year]</td>
<td>V10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Trip Length in Year [Base Year]</td>
<td>W10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Speed in Year [Forecast Year]</td>
<td>X10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Trip Length in Year [Forecast Year]</td>
<td>Y10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Least Cost Alternative (for Induced Trips)</td>
<td>AA10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Speed in Year [Base Year]</td>
<td>AA10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Trip Length in Year [Base Year]</td>
<td>AB10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Speed in Year [Forecast Year]</td>
<td>AC10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Trip Length in Year [Forecast Year]</td>
<td>AD10</td>
<td></td>
</tr>
<tr>
<td>Data Input Item</td>
<td>To Find, Look at Cell</td>
<td>Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Number of Trips</td>
<td>F24 (Base Year), V24 (Future Year)</td>
<td>Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor); Project Initiation Document (PID)/Project Study Report (PSR)/Project Report (PR) or other source may also have transit trips</td>
<td></td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT)</td>
<td>G23 (Base Year), W23 (Future Year)</td>
<td>Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor)</td>
<td></td>
</tr>
<tr>
<td>Vehicle Hours Traveled (VHT) (Highway modes only)</td>
<td>H23 (Base Year), X23 (Future Year)</td>
<td>Regional Travel Demand Model (specific output modes and formats requested from modelers or post-processed before entry into Cal-B/C Corridor)</td>
<td></td>
</tr>
<tr>
<td>Passenger Miles Traveled (PMT) (Transit modes only)</td>
<td>I23 (Base Year), Y23 (Future Year)</td>
<td>Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection</td>
<td></td>
</tr>
<tr>
<td>Passenger Hours Traveled (PHT) (Transit modes only)</td>
<td>J23 (Base Year), Z23 (Future Year)</td>
<td>Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection</td>
<td></td>
</tr>
<tr>
<td>Out-of-Pocket Cost ($ per trip) (for tolls)</td>
<td>K23 (Base Year), AA23 (Future Year)</td>
<td>Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection</td>
<td></td>
</tr>
<tr>
<td>Speed (Calculated by Cal-B/C)</td>
<td>L26 (Base Year), AB26 (Future Year)</td>
<td>Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection</td>
<td></td>
</tr>
<tr>
<td>Average Vehicle Occupancy (AVO)</td>
<td>M23 (Base Year), AC23 (Future Year)</td>
<td>Regional Travel Demand Model, Managed Lane Annual Report, American Community Survey, Field Data Collection</td>
<td></td>
</tr>
<tr>
<td>Percent Trucks</td>
<td>N25 (Base Year), AD25 (Future Year)</td>
<td>Regional Travel Demand Model, Caltrans Traffic Census, Field Data Collection</td>
<td></td>
</tr>
</tbody>
</table>
### Suggested Data Sources for Cal-B/C Corridor Evaluations by Input Item (cont.)

<table>
<thead>
<tr>
<th>Section Title</th>
<th>Data Input Item</th>
<th>To Find, Look at Cell</th>
<th>Suggested Data Sources (for required input cells; or to update Cal-B/C estimates or default values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2E) Definitions of Safety Groups and Years</td>
<td>Select Mode</td>
<td>AL10</td>
<td>Depends on proposed project</td>
</tr>
<tr>
<td></td>
<td>Name</td>
<td>AM10</td>
<td>Depends on proposed project</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>AN10</td>
<td>Depends on proposed project</td>
</tr>
<tr>
<td></td>
<td>Fatal Reduction Factor</td>
<td>AQ10</td>
<td>Crash Modification Factors Clearinghouse</td>
</tr>
<tr>
<td></td>
<td>Injury Reduction Factor</td>
<td>AR10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDO Reduction Factor</td>
<td>AS10</td>
<td></td>
</tr>
<tr>
<td>2F) &amp;2G) Safety Data</td>
<td>Vehicle Miles Traveled (VMT)</td>
<td>AM23</td>
<td>Regional Travel Demand Model (Total VMT must equal total VMT in Sections 2C and 2D for build and no build scenarios)</td>
</tr>
<tr>
<td></td>
<td>Fatal Accident Rate Per MVM</td>
<td>AN23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Injury Accident Rate Per MVM</td>
<td>AO23</td>
<td>TASAS (Table B)/SWITRS</td>
</tr>
<tr>
<td></td>
<td>PDO Accident Rate Per MVM</td>
<td>AP23</td>
<td></td>
</tr>
</tbody>
</table>
Model Data
Travel Demand Model (TDM)

- There are multiple travel demand models, microsimulation models and HCM tools
- Main outputs needed from all tools include:
  - VMT
  - VHT
- Ideally, outputs are organized for input into Cal-B/C
- Can be organized by:
  - Facility type
  - Speed bin
  - Vehicle type
  - Time of Day
- Want Cal-B/C inputs to be reasonably refined to accurately reflect benefits
  - Especially emissions and vehicle operating cost benefits
Highway Capacity Manual (HCM) Tool

- There are multiple HCM tools, including HCS and FREEVAL.
- Primary outputs needed same as for TDM/micro-simulation:
  - VMT
  - VHT
- Organized by segment

Module 8b: Model Data

Input to Cal-B/C

Transposed/reorganized

Copy to Excel
Percent Truck Volume – Caltrans Traffic Census

- Model outputs sometimes may not have percent trucks
- Truck Traffic on California State Highways System
- Truck Traffic is classified by number of axles by location
- Locations remain fairly consistent over the years
- Data that can be used in Cal-B/C includes:
  - Truck Percent Total of Vehicles
- https://dot.ca.gov/programs/traffic-operations/census
Average Vehicle Occupancy (AVO) – Data Sources

- Models may not have AVO included in the outputs. Other sources include:
  
  o Caltrans Managed Lane Annual Report
    - Caltrans district offices prepare annual reports with statistics on managed facilities
      » Covers express lanes and high occupancy vehicle (HOV) lanes
    - Provides vehicle classification and occupancy counts during peak travel periods for managed lanes and adjacent general purpose lanes
    - Data that can be used in Cal-B/C Corridor includes:
      » Managed lane peak period and peak hour volumes
      » Average vehicle occupancy (AVO) statistics for managed lane and adjacent general purpose lane

  o American Community Survey

  o Field Data Collection
Traffic Collision Data
Module 8b: Traffic Collision Data

Traffic Accident Surveillance and Analysis System (TASAS) - Transportation Systems Network (TSN) Reports

- Highway inventory database which contains the current and historical collisions on the SHS
- Preferred source for SHS collision data
- Data/Reports only accessible through Caltrans Staff
- Data that can be used in Cal-B/C includes:
  - Total Accidents (Tot)
  - Fatal Accidents (Fat)
  - Injury Accidents (Inj)
  - Property Damage Only (PDO) Accidents (Tot – (Fat+Inj))
  - Accident Rate (per million vehicle-miles)
  - Percent Fatal Accidents (Pct Fat)

Statewide Integrated Traffic Records System (SWITRS)

- Collects and processes detailed data gathered from a collision scene by CHP and local law enforcement
- Account required to access detailed reports and data
- California collision data by location, date/time and type
- Used for collision data off the State Highway System (SHS) – TASAS should be used for SHS projects
- Downloadable but requires extensive data manipulation
- Data that can be used in Cal-B/C includes:
  - Total Accidents (Tot)
  - Fatal Accidents (Fat)
  - Injury Accidents (Inj)
  - Property Damage Only (PDO) Accidents
- https://iswitrs.chp.ca.gov/Reports/jsp/index.jsp
Crash Modifications Factors (CMF) Clearinghouse

- A searchable database of CMFs

- A CMF is used to compute the expected number of crashes after implementing a countermeasure

Find appropriate countermeasures and CMFs
- Collision type
- Roadway type
- Location
- Severity
- Time of Day
- Roadway Condition
Other Sources for Safety Data

- For percent reduction in transit accidents, other documentation and research can be utilized
Project Costing Data
Project Costs – Direct Initial Costs

- The level of detail for cost estimates depends on where the project is in the development process
  - Plans, Specifications and Estimate (PS&E), Project Report (PR), and Project Study Reports (PSR) provide detailed cost estimates
    - These costs typically include support costs (e.g., design), right of way (ROW or R/W), and construction costs (including contingency)
  - Regional Transportation Improvement Programs (RTIP)
  - Caltrans State Highway Operation and Protection Program (SHOPP)

Note: Remember to enter costs in thousands of dollars (1000$). Otherwise, you will not get a correct Benefit/Cost Ratio
Project Costs – Direct Initial Costs (cont.)

- Pre-planning stages are more difficult
  - Caltrans project cost database with rule-of-thumb cost guides
  - Cost-per-mile estimates are available
    - Costs per mile vary significantly depending on the location, region, and project type
    - Look for a similar completed project in the same region with known costs, then estimate the cost per mile for the similar type of improvements
    - If ROW impacts are likely, then a reserve amount should be included. Caltrans has rule-of-thumb ROW estimates available

Note: Remember to enter costs in thousands of dollars (1000$). Otherwise, you will not get a correct Benefit/Cost Ratio
Microsoft Access database that can be used to estimate order-of-magnitude cost for conceptual transit projects

- Uses the FTA Standard Cost Category (SCC) codes for comparisons among transit operators
- Contains “as-built” costs for 54 federally funded projects:
  - Bus rapid transit
  - Commuter rail
  - Light rail
  - Heavy rail
  - Trolley
Module 8b: Project Costing Data

Project Costs – Subsequent Costs

- Caltrans and regional agencies have estimates for maintenance and operating costs for various facilities
- Transit annual operating expenses can be estimated from NTD data tables
- Subsequent costs should be entered as a net increase or decrease from the No Build case
  - May be positive (e.g., increased cost due to a new lane being constructed)
  - May be negative (e.g., avoided maintenance or rehabilitation)
Project Costs – Mitigation Costs

- Mitigation costs (in thousands of dollars) include costs to protect communities and the environment from negative impacts
  - Include wetland and community preservation as well as sound walls to reduce highway or rail transit noise
- Plans, PS&E, PR, and PSR will provide mitigation cost estimates (with details found in the appendices)
- Often these costs can be included in the “construction” costs for a project and may not need to be entered into Cal-B/C as a separate costs
  - Soundwalls and environmental mitigations are examples of mitigations that are built into the cost of projects presented in PRs
- On-going mitigation costs that continue after the project construction is completed will be included in PRs
06

Conclusion
In this module, you learned…

- About potential data sources for data input and project costing for Cal-B/C Corridor
- How to get data from these sources
What’s Next?

- **Modules 9b** walks through an example project
  BCA analysis

- **Module 10** closes out the training and will
  summarize other resources to learn more about
  BCA