Cal-B/C Training Module 2
Overview of Cal-B/C Suite of Tools
About This Module
This module will...

- Introduce each tool in the Cal-B/C suite
- Include a brief history of the Cal-B/C tools
- Provide an overview of key features and components common in all Cal-B/C tools
- Help you determine which Cal-B/C tool is right for your project evaluation, based on the type of project and each tool’s strengths and limitations
Module 2: About This Module

The Previous Module…

- Module 1 provided a basic introduction on benefit-cost analysis (BCA) and a general overview of how to conduct a BCA
02 Introduction to Cal-B/C
Cal-B/C Tools

- Cal-B/C is a suite of Excel workbooks developed by Caltrans to provide decision-makers with the ability to assess the benefits and costs of transportation projects.
- Cal-B/C is continuously updated to ensure that it aligns with current transportation benefit-cost findings and practices.
- Cal-B/C consists of five modules:
  1. Cal-B/C Sketch
  2. Cal-B/C Corridor
  3. Cal-B/C Active Transportation (AT)
  4. Cal-B/C Park and Ride (PnR),
  5. Cal-B/C Intermodal Freight (IF)
- The Cal-B/C Sketch model is also periodically modified to comply with benefit-cost guidance from the U.S. Department of Transportation, so it can be used for federal grant applications.
History of Cal-B/C Sketch

- Initial tool was developed in mid-1990s to conduct investment analysis of the State Transportation Improvement Program (STIP)
- Cal-B/C provided sketch planning capabilities (in lieu of detailed planning analysis)
- Initial tool was updated several times and ultimately renamed the Cal-B/C Sketch model
- Framework has expanded over the years
  - Added a tool to post-process planning model data
  - Included new tools to cover projects that impact additional modes
History of Other Cal-B/C Tools

**Cal-B/C Corridor**
- Originally developed in 2009 to calculate benefits from micro-simulation or travel demand model data for corridor studies
- Recently updated to estimate accident cost savings and to allow data inputs for four modes for projects with multi-modal impacts

**Cal-B/C Active Transportation (AT)**
- Developed in 2017 from a first-generation AT model by Caltrans
- Refinements to the original model have been developed through a comprehensive literature review and in coordination with several organizations

**Cal-B/C Intermodal Freight (IF)**
- Designed in 2017 to provide economic benefit-cost analysis for a range of intermodal freight projects

**Cal-B/C Park and Ride (PnR)**
- Originally developed for Caltrans District 12 in 2013 to assess park and ride projects
- Incorporated into the Cal-B/C suite in 2019
Characteristics of All Cal-B/C Tools

- Each tool is set up as an interconnected, multi-sheet spreadsheet with formulas
- User will primarily use the 1) Project Information and the 2) Model Inputs worksheets for data entry
- Results are presented in the 3) Results worksheet and BCA metrics are comparable across Cal-B/C tools
- Analysis worksheets perform calculations automatically from project input data
- Simple, intuitive design (not a black box, complete documentation, color-coded inputs)
- Maintains consistency through a number of default values, assumptions, and lookup tables to standardize analysis
  - Common parameters (value of life, value of time, etc.)
  - Similar model assumptions (discount rates, 20-year planning horizon, etc.)
Overview of Cal-B/C Sketch

- Simple, sketch planning model
  - Allows for the evaluation of Highway Capacity Expansion, Highway Operational Improvements, Rail or Transit Capacity Expansion, and Transportation Management System (TMS) projects
  - In total, any one of 29 project types can be evaluated
  - Structure: 11 worksheets in total (including title page shown at right)

- Contains a number of default values and lookup tables to standardize analysis

- Estimates four categories of user benefits:
  - Travel time savings
  - Vehicle operating cost savings
  - Accident cost savings
  - Emission cost savings

- Estimates speeds from volumes (v/c ratios) when speed data is not available
Overview of Cal-B/C Corridor

- **Post-processor**, BCA tool for preparing economic analyses of highway and transit projects
  - Structure: 12 worksheets in total

- Estimates **four** categories of **user benefits**:
  - Travel time savings
  - Vehicle operating cost savings
  - Accident cost savings
  - Emission cost savings

- Flexible design that supports a **variety of input data**

- Estimates benefits using changes in vehicle-miles traveled (VMT) and vehicle-hours traveled (VHT) by mode from travel demand or micro-simulation models
Overview of Cal-B/C AT

- Part of larger effort to include bicycle and pedestrian modes in Cal-B/C suite
  - Structure: 16 worksheets in total
- Designed to meet Active Transportation Program (ATP) Guidelines
- Capable of evaluating infrastructure projects and non-infrastructure programs
- Flexible design that supports a variety of input data
- Estimates five categories of user benefits:
  - Journey Quality
  - Additional delay savings
  - Additional safety benefits
  - Health benefits
  - Emission cost savings
Overview of Cal-B/C PnR

- Originally developed for District 12 and updated for Cal-B/C suite to estimate benefits of park and ride lots
  - Structure: 10 worksheets in total
- Estimates five categories of user benefits:
  - Travel time savings
  - Vehicle operating cost savings
  - Accident cost savings
  - Emission cost savings
  - Residual value
- Calculates benefits for existing and new users
Overview of Cal-B/C IF

- Provides ability to conduct BCA for intermodal freight projects
  - Structure: 10 worksheets in total
- Estimates three benefits for bulk/break bulk and containerized shipments:
  - Shipper cost savings
  - Accident cost savings
  - Emission cost savings
- A unified approach to estimate project benefits, considering:
  - Full freight trip movements
  - Drayage
  - Transload operations
03

Key Features of Cal-B/C Tools
Worksheet Layout in Cal-B/C Tools

- Generally, all Cal-B/C tools have the following (or similar) worksheets:
  - Title page
  - Instructions
  - 1) Project Information
  - 2) Model Inputs
  - 3) Results
    - Benefit category estimations
    - Final Calculations
    - Parameters

Refer to Module 4a to 4e for more detail on spreadsheet layout and contents for each tool.
Cal-B/C Tools Are User Friendly

- Simple and easy to use in a spreadsheet format
- Each Cal-B/C tool is generally set up to follow a three-step process:
  1) Project Information
  2) Model Inputs
  3) Results
- Refer to Module 7 for a quick-start analysis guide using this three-step process
Module 2: Key Features of Cal-B/C Tools

Cal-B/C Tools Have Transparent Benefit Calculations

- Tools use formulas to automate calculations of costs, benefits, and BCA metrics
- Benefit estimation uses commonly accepted estimation methodologies
- Refer to Module 6 for more detail on cost and benefit estimation methods

Example: Cal-B/C PnR Analysis sheets
All Tools Use the Same Parameters

- Each tool includes a Parameters sheet with relevant default inputs
- Parameters and estimation methodology are consistent across the framework
- Every tool uses the same established data sources for the Parameters sheet

<table>
<thead>
<tr>
<th>Parameter Examples</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Vehicle Occupancy (AVO)</td>
<td>2010-2012 California Household Travel Survey (CHTS, 2012)</td>
</tr>
<tr>
<td>Average Hourly Wages</td>
<td>Bureau of Labor Statistics (BLS) OES</td>
</tr>
<tr>
<td>Value of Time Estimation</td>
<td>USDOT Department BCA Guidance &amp; California Department of Transportation TSI and Traffic Operations</td>
</tr>
<tr>
<td>Highway Operation Parameters</td>
<td>Highway Capacity Manual, NCHRP 387, PeMS data</td>
</tr>
<tr>
<td>Highway Emissions Factors</td>
<td>California Air Resources Board, EMFAC 2017</td>
</tr>
</tbody>
</table>

Refer to Module 5 for more detail on source information for assumptions and parameters
Module 2: Key Features of Cal-B/C Tools

Commonly Accepted Methodologies

- Tools generally use a 20-year life cycle
  - Cal-B/C Corridor allows the user to specify the lifecycle
- Costs and benefits are discounted for the future value of the dollar (discount rate set in Parameters worksheet)

**Example:** Cal-B/C PnR Project Cost and Vehicle Operating Cost Benefits tables

**Vehicle Operating Cost Benefits**

This sheet calculates changes in highway vehicle operating costs and out-of-pocket costs. Net changes in transit operating costs should be included as project costs.

**Formulas:**

- Vehicle-Miles Traveled = Distance Traveled × Average Veh/ Occupancy
- Fuel Consumption = Fuel Consumption × Fuel Price
- Operating Cost = Operating Cost × Project Cost

**New Transit Riders (switch from automobile to express bus)**

A table showing the annual number of users, total auto VMT, and benefits over a 10-year period, with costs calculated in both constant dollars (i.e., 2016 current dollars) and present value (i.e., discounted to current year).
Commonly Accepted Methodologies (cont’d)

- Benefit estimation for existing and new (induced) users are handled separately
  - Consumer surplus is estimated using the rule of half
- Estimation of every benefit category is consistent with the USDOT BCA Guidance for Discretionary Grant Programs
  - Each analysis sheet includes a summary of the methodology in formulas at the top of the sheet

Cal-B/C Sketch, Travel Time worksheet

Cal-B/C Corridor, excerpt from Consumer Surplus worksheet

Consumer Surplus Benefits

This sheet calculates consumer benefits associated with induced demand.

Formulas:

- \( \text{CS Benefit} = \text{Diff. in Travel Time} \times \text{Avg. Value of Time} \times \text{Diff. in Adj. Person Trips} \times 0.5 \)
Similar Results and Metrics in Cal-B/C Tools

- All Cal-B/C tools calculate the same metrics for project benefit evaluation
- These metrics are fully comparable between tools and projects
- Refer to Module 3 for more detail on results and metrics calculated in the Cal-B/C tools

Example: Cal-B/C Sketch Results sheet
Types of Projects Evaluated Using Cal-B/C Tools
Cal-B/C Sketch Can Evaluate…

**Highway Capacity Expansion Projects**
- General Highway
- HOV Lane Addition
- HOT Lane Addition
- Passing Lane
- Intersection
- Truck Only Lane
- Bypass
- Queuing
- Pavement

**Rail/Transit Capacity Expansion Projects**
- Passenger Rail
- Light-Rail (LRT)
- Bus
- Hwy-Rail Grade Crossing

**Highway Operational Improvement Projects**
- Auxiliary Lane
- Freeway Connector
- HOV Connector
- HOV Drop Ramp
- Off-Ramp Widening
- On-Ramp Widening
- HOV-2 to HOV-3 Conversion
- HOT Lane Conversion

**Transportation Management Systems (TMS)**
- Ramp Metering
- Ramp Metering Signal Coordination
- Incident Management
- Traveler Information
- Arterial Signal Management
- Transit Vehicle Location (AVL)
- Transit Vehicle Signal Priority
- Bus Rapid Transit (BRT)

**Methods**
- BPR Curve (v/c ratio)
- HCM/Weaving
- Multiple Roads/Macro
- TMS Master Plan
- Transit
- IDAS
- Queuing
- Other
Cal-B/C Corridor Can Evaluate…

- Any project with highway and/or transit components and detailed data:
  - Modeled in a travel demand model
  - Modeled in a micro-simulation model
  - Traffic by segment estimated using the Highway Capacity Manual (HCM) methods

- For example:
  - Highway Expansion projects (interchange improvements, capacity expansion, bypass construction, bridge reconstruction, etc.)
  - Transit projects (new or improved passenger rail, light rail, or bus systems)
Module 2: Types of Projects Evaluated Using Cal-B/C Tools

**Cal-B/C AT Can Evaluate…**

- Infrastructure & non-infrastructure projects for active transportation
  - Capital investments on facilities (upgraded or new, on- or off-road facilities), intersection or signal improvement, and other physical amenities
  - Educational, promotional and other initiatives to encourage ridership and safety
- Projects with bicycle and pedestrian traffic
- Projects with Safe Routes To School (SR2S) components: Encourage children walking or bicycling to school by improving safety

Source: [http://tinyurl.com/q8bhjss](http://tinyurl.com/q8bhjss)
Cal-B/C PnR Can Evaluate…

- Park and ride lot investments
  - New locations
  - Improved highway, transit, and/or bicycle access to park and ride lots
- Up to four user types
  - Existing and new transit riders
  - Existing and new carpoolers
- Up to three destinations for park and ride lot users
  - Macro-enabled to enter additional destinations
Module 2: Types of Projects Evaluated Using Cal-B/C Tools

Cal-B/C IF Can Evaluate…

- Modal Diversion and Freight Network Improvements
  - Rail Corridor Capacity Improvements
  - Truck Corridor Capacity Improvements
  - Projects Enabling Dedicated Freight Movements in Unit Trains
  - Loop Track Construction
  - Wye Construction/Extension
  - Rail Infrastructure Upgrades and Enhancements
  - Other Projects that Divert Freight Movements Between Truck and Rail

- Transload Operations and Terminal Efficiency Improvements
  - New Terminal Construction
  - Port/Terminal Capacity Improvements
  - New Port/Terminal Technology Implementation
Choosing the Best Tool for Your Project Evaluation
## Module 2: Choosing the Best Tool for your Project Evaluation

### Which Cal-B/C Tool is right for your project?

<table>
<thead>
<tr>
<th>Question</th>
<th>Sketch</th>
<th>Corridor</th>
<th>AT</th>
<th>PnR</th>
<th>IF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is your project at a preliminary planning phase?</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Are there few data points from which to estimate demand, costs, and benefits?</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Is there a completed travel demand study or traffic report?</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there data from a travel demand model or micro-simulation model available?</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the project impact multiple modes?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are there shifts in traffic from one mode to another?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is your project a highway, rail, or transit capacity expansion, or a highway operational improvement?</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is your project a transportation management system?</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the project impact bicycle and/or pedestrian traffic with infrastructure or non-infrastructure improvements?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Does the project have Safe Routes To School (SRTS) components?</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
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## Which Cal-B/C Tool is right for your project?

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<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Is there bicycle or pedestrian traffic data available?</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Does the project have Safe Routes To School (SRTS) components?</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the project involve a park and ride lot?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Is the project expected to promote increased usage of transit, carpool, and bus modes from a park and ride lot?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Does the project include modal diversion or freight network improvements?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Does the project include transload operations or terminal efficiency improvements?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Limitations of Cal-B/C
Limitations of Cal-B/C tools

- Cal-B/C tools are for benefit-cost analysis
  - They cannot estimate changes in demand, economic impacts, or other performance measures

- None of the Cal-B/C tools are equipped to assess:
  - Noise reduction
  - Projects on local streets and roads
  - Culverts

- Limitations of Cal-B/C Sketch
  - Analysis is limited to a set of applicable project types
    - e.g., cannot evaluate interchanges, complex projects, or combinations of projects
  - Sketch relies more heavily on rules-of-thumb and assumptions
    - e.g., Bureau of Public Roads formulas are used to estimate speeds from flows and capacities
    - Calculated speeds may not reflect actual roadway conditions
Module 2: Limitations of Cal-B/C

Limitations of Cal-B/C tools

- Limitations of Cal-B/C Corridor
  - Potentially requires post-processing of micro-simulation or travel demand model results to calculate VMT and VHT inputs
  - Requires data entry for number of trips
  - Requires more detailed safety data that may or may not be available

- Limitations of Cal-B/C AT
  - BCA for active transportation projects is evolving and Cal-B/C AT is a first-generation model
  - Data for AT projects, particularly forecast data, is difficult to obtain
  - The Non-Infrastructure Program component is evaluated through a multi-criteria analysis approach rather than BCA methods

- Limitations of Cal-B/C PnR
  - Requires information on typical destinations reached from the park-and-ride lot

- Limitations of Cal-B/C IF
  - Requires user to provide information on shipping costs and use of intermodal freight facilities
07 Evaluating Projects with Multiple Improvements
Projects with Multiple Improvements

- You can use more than one tool in the Cal-B/C suite to get a comprehensive estimate of a project’s benefits
- Benefits estimated from independent components of a project can be combined because results are fully comparable across tools
  - Lifecycle benefits can be added together (ensure this does not double-count benefits)
- Refer to Module 3 for more detail and instruction
Conclusion
In this module, you learned…

- A brief history of the Cal-B/C tools
- Key features common across all Cal-B/C tools
- The types of projects evaluated by each Cal-B/C tool
- How to determine which Cal-B/C tool is right for your project evaluation
What’s Next?

- Description of the results in the Cal-B/C tools
  - Module 3: Interpreting Cal-B/C Results
- Get more information on one Cal-B/C tool and how it works
  - Module 4a (Cal-B/C Sketch)
  - Module 4b (Cal-B/C Corridor)
  - Module 4c (Cal-B/C Active Transportation)
  - Module 4d (Cal-B/C Park & Ride)
  - Module 4e (Cal-B/C Intermodal Freight)

- Start an analysis!
  - Module 7: How to Start a Cal-B/C Analysis