Applying Analysis Tools in Planning for Operations

Presented by
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Federal Highway Administration

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Cambridge Systematics, Inc.

June 2013
Module 1 – Introductions and Agenda

**Agenda**

- **MORNING SESSION (8:00 a.m. – 12:30 p.m.)**
  - Module 1 – Introductions and Agenda
  - Module 2 – Objectives of the Workshop
  - Module 3 – Role of Analysis Tools in Planning for Operations
  - Module 4 – Current Methods and Tools in Use When Planning for Operations – Includes
  - BREAK
  - Module 4 – Continued

- **LUNCH (12:30 p.m. – 1:30 p.m.)**
Module 1 – Introductions and Agenda
Agenda (continued)

• AFTERNOON SESSION (1:30 p.m. – 4:30 p.m.)
  • SANDAG’s Transportation Modeling Forum
  • BREAK
  • Module 5 – Matching Transportation Planning Needs with Operational Analysis Tools and Methods
  • Module 6 – Situational Exercise
  • Module 7 - Workshop Closure

• FINISH around 4:30 p.m.
Module 1 – Introductions and Agenda

Introductions

- Welcome!

- Self Introductions
  - Name
  - Agency/Organization
  - Planning or Operations
  - Work Responsibilities
  - What are you hoping gain from this workshop?

- Logistics/Housekeeping
Module 2
Workshop Objectives
Module 2 – Workshop Objectives
Objectives and Expectations

- Promote the use of technical analysis tools for linking planning and operations by describing their benefits
- Provide participants with information and guidance on what tools are available, including their pros/cons
- Demonstrate and encourage innovation in the use of tools and methods
- Discuss current opportunities and challenges
Module 2 – Workshop Objectives
Metropolitan Planning in Context

Metropolitan Transportation Plan

- Safety
- Economic Vitality
- System Preservation
- Multimodal Connectivity
- Efficient System Management and Operation
- Environment, Energy, and Quality of Life
- Accessibility & Mobility
- Fiscal Constraint
- Air Quality Conformity +
- ADA Title VI, Environmental Justice
- Consultation with Federal, State & Tribal agencies
- Coordination with local elected officials
- Coordination with State and local transportation agencies
- Participation Plan
- Consistency with ITS architecture
- Congestion Management Process (CMP)*

* Required for TMAs
+ Required for nonattainment and maintenance areas
Module 2 – Workshop Objectives

Sources of Congestion

*It is estimated that non-recurring congestion is responsible for approximately 50 percent of delays in urban areas nationwide and operations strategies are often an appropriate mitigation measure.*
Module 2 – Workshop Objectives
Objectives-Driven, Performance-Based Approach

- Non-recurrent congestion approximately 50 percent of delay in urban areas
  - Goals, objectives, and performance measures need to reflect improving problems – non-recurrent congestion, safety, etc.

- Performance measures are means to implement SMART Objectives
  - Specific, Measurable, Agreed upon, Realistic, and Time bound operations objectives are key to moving forward

- Operational analysis needs to be embedded into the planning process
  - Agencies can more effectively prioritize investments to achieve agreed upon objectives
Operators and planners collaborate in developing and addressing short- and long-term system performance objectives that reflect regional values.

SMART Operations objectives selection is critical to both planning and operations:
- It can also be used to assess success of a completed project, future conditions, or further improvement strategies.

Invaluable to the decision makers and public:
- Operations will bring the ongoing operational perspective with considerations such as travel time, delay, safety, and reliability.
- Implemented performance measures demonstrate accomplishments.
Module 2 – Workshop Objectives
Objectives-Driven Approach

- Regional goals and motivation
- Operations objectives
- Systematic process to develop and select M&O strategies to meet objectives – Process encompassed by CMP
- Metropolitan transportation plan
- Transportation improvement program and other funding programs
- Implementation
Module 3
Role of Analysis Tools in Planning for Operations
Module 3 – Role of Analysis Tools

Observed Benefits

- Improved decision making
  - Informed planning/engineering decisions for operations
  - Mainstreaming operations into the planning process
  - Credibility
Module 3 – Role of Analysis Tools
Observed Benefits (continued)

- Evaluate multiple alternatives
  - Select the operations improvements or combination of improvements that best fit the region’s needs
  - Compare the relative benefits and costs
Intuitive presentation to stakeholders

- Provides data to support planning needs
- Provides benefit information that can be communicated to agency management, politicians, and the traveling public

Summary of Kansas City SCOUT Annual Program Benefits vs. Costs

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Total Benefits = $51,883,000</th>
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</thead>
<tbody>
<tr>
<td>Travel Time $411 M</td>
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<tr>
<td>Operating Cost $342 M</td>
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<tr>
<td>Environmental $3 M</td>
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<td>Crash Reduction $1.7 M</td>
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</table>

<table>
<thead>
<tr>
<th>Costs</th>
<th>Total Costs = $6,494,000</th>
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<tbody>
<tr>
<td>O&amp;M $54 M</td>
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<tr>
<td>Capital $35 M</td>
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</table>

KEY

- Each circle represents $1M in value.
Analyze alternatives to optimize transportation system

- Opportunity for experimentation without traffic disruption
- Possibility to test “what if” scenarios
Analysis tools and methods provide transportation practitioners with the ability to analyze ITS or operational strategies independently or in conjunction with other transportation investments.
By using analysis tools, planners can better inform elected officials, decision makers, and the public to make better decisions about transportation investments.
Module 3 – Role of Analysis Tools
What are Some Local Experiences?

Is your agency’s planning performance-based?

Is your Agency incorporating or considering modeling operations within the planning process? If so, what tools or methods are you using or planning to use?
Were your efforts successful?

How have you been challenged in using analysis tools in planning for operations?
Module 4
Current Methods and Tools in Use When Planning for Operations
Module 4 – Current Methods and Tools

Tool Categories

A. Sketch-planning tools
B. Travel demand models
C. Analytical/deterministic tools (HCM-based)
D. Traffic signal optimization tools
E. Simulation models
   - Macroscopic
   - Mesoscopic
   - Microscopic
F. Archived operations data

...Plus many hybrid approaches

Source: FHWA Traffic Analysis Toolbox Volume II, 2004
We’ll add three tool categories to our discussion today:

- Simple Prioritization Tools
- Multi-resolution Dynamic Traffic Assignment
- Work Zone Tools
Module 4: Comparison of Tool Capabilities

**Travel Demand Models**

- Detailed
- Analysis Sensitivity
- Order of Magnitude

- Archived Operations Data – Monitor, Evaluate, Data Source
- Simulation
- Signal Optimization Tools

- Sketch Planning
- Travel Demand Models
- Deterministic Tools
- Define Operational Strategies/Design

**Role in Planning Process**

- Preliminary Screening
- Alternatives Analysis
Module 4 – Current Methods and Tools

Module Format

- Tool Descriptions
  - Overview
  - Advantages
  - Disadvantages

- Real World Examples
Module 4
SIMPLE PRIORITIZATION TOOLS
Module 4: Comparison of Tool Capabilities

Archived Operations Data – Monitor, Evaluate, Data Source

Simulation

Signal Optimization Tools

Travel Demand Models

Deterministic Tools

Sketch Planning

Preliminary Screening

Alternatives Analysis

Define Operational Strategies/Design

Role in Planning Process
Module 4 – Current Methods and Tools
A. Simple Prioritization Tools

Advantages
- Simple / fast
- May be qualitative or minimally quantitative
- Allows for analysis resources to be targeted toward the most promising alternatives

Challenges
- Provides preliminary screening only
- Generally represents only the first step of the decision making process
Problem Statement

- Provide Statewide plan for ITS/Operations deployment
  - Where to deploy
  - Where NOT to deploy

- Integrate into traditional planning processes
  - Utilize current processes as much as possible
    » LRTP Corridors

- Complement versus compete with traditional infrastructure
## WisDOT Sketch Planning Demo

### Corridor Methodology

<table>
<thead>
<tr>
<th>Data Collection</th>
<th>Scoring</th>
<th>Technology Recommendations</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilizes traditional planning metrics that are readily available and updated frequently</td>
<td>Utilizes metrics and associated thresholds to score links statewide for their operations importance</td>
<td>Scores lead operations and technology solutions density recommendations</td>
<td>Process provides priority corridors for operations as well as deployment density recommendations for all corridors throughout the State</td>
</tr>
</tbody>
</table>

**Key Methodology Steps**

1. **Data Collection**
   - Meta Data
   - TOPS Weather Data
   - WisDOT Event Data

2. **Scoring**

3. **Technology Recommendations**

4. **Results**

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**WisDOT Operations Infrastructure Plan – Scoring Process**

**Deployment Scheduling Planning**

**WisDOT Sketch Planning Demo**

**Corridor Methodology**
Data Collection

- Criteria are chosen to reflect areas of Mobility, Safety, and Development Pressure
- Include impacts of severe weather and special events
Scoring

- Roadway links are scored based on Criteria
- Weights are applied to generate overall Deployment Density Class
Technology Recommendations

- Based on Deployment Density Class and Roadway Functional Class
- Are provided as a range of options

**Spectrum of Deployment Density**

*Urban Interstate/Expressway*

- **Baseline**
  - Mobile Probes
  - Negotiate for use of private or other public agency cameras

- **Low**
  - Supply cameras at specific locations based on data
  - Cameras no more than two miles spacing
  - Coordination with local PSAPs to identify closest resource
  - Incident management resources available on-demand for major incidents

- **Medium**
  - Detectors between interchanges
  - Trailblazer signs on freeway and alternate routes activated for emergency detours
  - Preplanned closure and detour plans

- **High**
  - Cameras at interchanges and site specific locations based on data
  - 100% camera coverage
  - Dedicated weekday service patrols

**Detection**

- Portable DMS and/or HAR for major incidents or closures
- Ramp Closure Gates
- Ramp metering in specific segments where cost-effective
- Fixed DMS and/or HAR at major interchanges/decision points
- Fixed DMS at major interchanges and every 5-10 miles along freeway – DMS report travel times to major decision points

**Surveillance**

- Reference markers
- Supply cameras at specific locations based on data
- Cameras no more than two miles spacing

**Incident Management**

- Coordination with local PSAPs to identify closest resource
- Preplanned closure and detour plans
- Incident management resources available on-demand for major incidents
- Trailblazer signs on freeway and alternate routes activated for emergency detours

**Traffic Flow Management**

- Portable DMS and/or HAR used for construction, major incidents and special events
- Pre-trip information (i.e., web-based or kiosk)
- Fixed DMS and/or HAR at major interchanges/decision points
- Ramp metering

**Traveler Information**

- Portable DMS and/or HAR used for construction, major incidents and special events
- Pre-trip information (i.e., web-based or kiosk)
- Fixed DMS and/or HAR at major interchanges/decision points
- Ramp metering

**Regional/Statewide**

- Portable DMS and/or HAR used for construction, major incidents and special events
- Pre-trip information (i.e., web-based or kiosk)
- Fixed DMS and/or HAR at major interchanges/decision points
- Ramp metering

511 – RWIS
Sample Roadway

1. Data are gathered for roadway links.

2. Links are scored to determine Deployment Density Class (DDC).

3. Technology recommendations are assigned based on DDC, functional class, and professional review.
Key Points

- All costs presented in 2007 dollars.
- Capital investments per year (blue bars) include multiple projects associated with the TOIP Corridors listed below.
- Larger scale corridor projects' cost were spread out over multiple years (max of three years).
- Costs associated with the STOC are not included in this estimate; but statewide initiatives such as 511 are included.
- Details on these costs, including assumptions, can be found in the WisDOT TOIP final report dated May 2008.

TOIP Corridors
Priority and Emerging Priority

A. Badger  H. Wild Goose
B. Capital  I. Peace Memorial
C. Fox Valley  J. Cornish Heritage
D. South Central  K. Titletown
E. Hiawatha  L. Southern Tier
F. Wisconsin River  M. Glacial Plains
G. Chippewa Valley

Staging of projects was driven by TOIP corridor prioritization process.

WisDOT Traffic Operations Infrastructure Plan
Deployment Cost Schedule
WisDOT Sketch Planning Demo
Agency Application/Conclusion

- ITS Sketch Plan results used in corridor planning process
- GIS Layer within the Sketch Plan tool was used in Long Range Plan updates
- ITS/Operations now included amongst traditional metrics
BREAK
Module 4
SKETCH PLANNING TOOLS
## Module 4 – Current Methods and Tools

### A. Sketch Planning Tools

<table>
<thead>
<tr>
<th>Transportation Planning Needs</th>
<th>Sketch Planning Tools</th>
<th>Travel Demand Forecasting Models</th>
<th>Deterministic Models</th>
<th>Traffic Signal Optimization Tools</th>
<th>Simulation</th>
<th>Archived Operations Data</th>
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</thead>
<tbody>
<tr>
<td>Needs Assessments/Deficiency Analysis</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<td>Preliminary Screening Assessments</td>
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<td>Alternatives Analysis</td>
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<td>Strategic ITS Planning</td>
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</tbody>
</table>
Module 4 – Current Methods and Tools

A. Sketch Planning Tools

- Provides quick order of magnitude estimates with minimal input data in support of preliminary screening assessments and high-level analysis

- Examples
  - Sketch
    - TOPS-BC
    - SCRITS
    - Cal B/C
    - Simple spreadsheets
  - Hybrid
    - IDAS
    - FITSEval
Module 4: Comparison of Tool Capabilities
Module 4 – Current Methods and Tools
A. Sketch Planning Tools (continued)

Advantages

- Low cost
- Fast analysis times
- Limited data requirements
- View of the “big picture”
- Typically not a black box

Challenges

- Limited in scope, robustness, and presentation capabilities
- Results constrained by quality of input data

Supports, but does not replace, project-level planning
FHWA Tool for Operations Planning Benefit/Cost Analysis (TOPS-BC)

- Spreadsheet based decision support tool
- Based on expressed needs of practitioners
- Anticipated distribution in 2013
TOPS-BC

Requirements

• Macro-driven spreadsheet environment
• Designed to be intuitive to use
• Default figures are documented and understandable
• Formulas are reviewable
• Easy maintenance and customization

Four key capabilities…
TOPS-BC

- Not intended to be a “one tool fits all” approach
- Provides opportunity to integrate data from more robust traffic analysis tools to assess benefits
- Provides a framework that users can customize to their own needs
TOPS-BC

- Provides research
  - Potential impacts of strategies
  - Available analysis methods
- Provides sketch-planning analysis
  - Lifecycle costs
  - Benefits estimation
TOPS-BC: Investigate Impacts

Investigate the Range of Impact Values Associated with Various TSM&O Strategies

Navigation Screen

Instructions: Please select the "TSM&O Strategy" and the "Impact Category" you are interested in from the list below. If sufficient data is available, a range of expected impacts will be shown below. Click on the hyperlink to be taken to a table displaying the datapoints comprising the range.

TSMO Strategy Selected:
- Freeway Management System : Ramp Metering : Pre-set Timing

Impact Category:
- Travel Time and Speed

Data Source

Noted Impacts

Expected travel time reductions range between 10% and 45%. Expected percent speed improvements between 10% and 55%. Expect delay reductions between 15% and 20%.
TOPS-BC: Estimate Lifecycle Costs

FHWA Tool for Operations Benefit/Cost (TOPS-BC)

Estimates lifecycle costs of many TSM&O strategies – Average Annual Costs and Stream of Costs over time

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Useful Life</th>
<th>Capital / Replacement Costs (Total)</th>
<th>O&amp;M Costs (Annual)</th>
<th>Annualized Costs</th>
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<tbody>
<tr>
<td>TMC Hardware for Information Dissemination</td>
<td>5</td>
<td>$7,500</td>
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<td>Basic Infrastructure Equipment</td>
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<td>Communication Line</td>
<td>25</td>
<td>$750</td>
<td>$900</td>
<td>$930</td>
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<td>Variable Message Sign</td>
<td>25</td>
<td>$92,500</td>
<td>$4,400</td>
<td>$8,100</td>
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<tr>
<td>Variable Message Sign Tower</td>
<td>25</td>
<td>$125,000</td>
<td>$275</td>
<td>$5,275</td>
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<tr>
<td>TOTAL Incremental Cost</td>
<td></td>
<td>$218,250</td>
<td>$5,575</td>
<td>$14,305</td>
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</table>

INPUT Enter Number of Infrastructure Deployments 1 $116,875

INPUT Enter Number of Incremental Deployments (# of Signs) 2 $28,610

INPUT Enter Year of Deployment 2012

Average Annual Cost $145,485
### TOPS-BC: Benefits Estimation

**FHWA Tool for Operations Benefit/Cost (TOPS-BC)**

Estimate Benefits of TSM&O Strategies

**Strategy: Dynamic Message Signs**

#### Notes:
- For additional information on this analysis method, please see Section X.X.X of the Desk Reference.
- For information on alternative methods for performing analysis of this strategy, please see Section X.X.X of the Desk Reference.

#### Primary Benefits Estimated by this Method:
- Travel Time Reliability

**Other Benefits that may be Considered:**
- Safety
- Customer Satisfaction
- Agency Efficiency
- Emissions
- Fuel Use

#### Impact | User Input | Default | Modeled
--- | --- | --- | ---
**INPUT**
Average Number of Vehicles Passing Sign Location(s) (per period) | 60,000 | 60,000 |
Average Vehicle Occupancy | 1.2 | 1.2 |
% of Time Sign is Displaying Information | 5% | 5% |
Type of Information Being Displayed | 3 | 3 |
1 = Comparative Travel Times
2 = Congestion Warning
3 = Alternative Route Recommendations
% of Drivers Passing the Sign that Act on the Information | 10% | 10% |
Average Time (Minutes) Saved by Drivers Acting on the Information | 5.5 | 5.5 |
Average Time (Minutes) Saved by Drivers Not Acting on the Information | 0 | 0 |
Average Hours of Vehicle Delay Saved Per Period | | 28 |
Number of Periods Per Year | 260 | 260 |
Average Hours of Vehicle Delay Saved per Year | 7,150 |
Average Hours of Person Delay Saved per Year | 8,580 |
$ Value of Person Hour (per hour) | $14.00 | $14.00 |
Total Average Annual Modeled Travel Time Benefit | $120,120 |
User Entered Benefit (Annual $') | | |
**TOTAL AVERAGE ANNUAL BENEFIT** | $120,120 |
Average Annual Equipment Deployment and Replacement Costs | $60,000 |
Average Annual Equipment Operations and Maintenance Costs | $25,000 | $20,000 |
**TOTAL AVERAGE ANNUAL COST** | $85,000 |
Benefit Cost Ratio (Average Annual Benefits / Average Annual Costs) | 1.41 |
Annual Net Benefit (Average Annual Benefits - Average Annual Costs) | $35,120 |
Additional Benefits Information

RITA ITS Benefits


The ITSUIPO Evaluation Program is hosting a workshop on "Emerging Needs and Opportunities in ITS Evaluation, Supporting New Directions in Research and Deployment - Exploring the Next Generation of Evaluation in ITS", at the Beckman Center in Irvine Ca. on September 20th, 2010.

For more information, view 2010 ITS Evaluation Workshop

Source: http://www.itsbenefits.its.dot.gov/
Module 4

TRAVEL DEMAND MODELS
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Module 4 – Current Methods and Tools

B. Travel Demand Models

- Estimate the regional traffic impact of changes in travel demand or system capacity

- Examples
  - **Travel Demand Models**
    - TRANPLAN
    - EMME/2
    - Cube
    - TransCAD
  - **Hybrid**
    - IDAS (post-processor)
    - FITSEval

Source: IDAS
Module 4: Comparison of Tool Capabilities

Role in Planning Process

Archived Operations Data – Monitor, Evaluate, Data Source

Sketch Planning

Travel Demand Models

Simulation

Signal Optimization Tools

Deterministic Tools

Order of Magnitude

Analysis Sensitivity

Detailed

Preliminary Screening

Alternatives Analysis

Define Operational Strategies/Design

Deterministic Tools

Signal Optimization Tools

Module 4: Comparison of Tool Capabilities
<table>
<thead>
<tr>
<th><strong>Advantages</strong></th>
<th><strong>Challenges</strong></th>
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</thead>
<tbody>
<tr>
<td>Validated models available for most metro areas</td>
<td>Limited ability to analyze operational strategies</td>
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<tr>
<td>Evaluation of the regional impacts</td>
<td>High initial costs</td>
</tr>
<tr>
<td>Consistent with current planning practices</td>
<td>Typical travel day does not capture incident, weather, work zones, and special event conditions</td>
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</tbody>
</table>
Module 4 – Current Methods and Tools
B. Travel Demand Models - IDAS

IDAS information: http://idas.camsys.com/
Module 4 – Current Methods and Tools

B. Travel Demand Models - IDAS DEMO

- ITS Deployment Analysis System
  
- Developed by FHWA (2000)

- Estimates the benefits and costs of ITS/operational deployments

- Functions as a post-processor to the regional travel demand model
IDAS Demo
Network View
# IDAS Demo

Sample Performance Summary by Facility Type

### Performance Summary

**Project:** Metro ITS Plan, ITS Option(s): Transit ATS

<table>
<thead>
<tr>
<th>By: Facility Type</th>
<th>Arterial</th>
<th>Centroid Connector</th>
<th>Expressway</th>
<th>Freeway</th>
<th>Ramp</th>
<th>Transit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle Miles of Travel</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Alternative</td>
<td>615,452</td>
<td>81,514</td>
<td>28,188</td>
<td>63,390</td>
<td>3.018</td>
<td></td>
<td>831,562</td>
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<tr>
<td>ITS Option</td>
<td>631,063</td>
<td>81,306</td>
<td>27,860</td>
<td>63,363</td>
<td>3.018</td>
<td></td>
<td>831,562</td>
</tr>
<tr>
<td>Difference (%)</td>
<td>-2,611 (-0.4%)</td>
<td>-209 (-0.3%)</td>
<td>-628 (-2.2%)</td>
<td>-36 (-0.1%)</td>
<td>-110.0%</td>
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<td>-3,262 (-0.4%)</td>
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<tr>
<td><strong>Vehicle Hours of Travel</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Control Alternative</td>
<td>25,979</td>
<td>5,420</td>
<td>726</td>
<td>1,974</td>
<td>224</td>
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<td>43,725</td>
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<tr>
<td>ITS Option</td>
<td>26,591</td>
<td>5,420</td>
<td>710</td>
<td>1,971</td>
<td>214</td>
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<td>43,405</td>
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<tr>
<td>Difference (%)</td>
<td>-207 (-0.8%)</td>
<td>-14 (-0.3%)</td>
<td>-17 (-2.0%)</td>
<td>-3 (-0.1%)</td>
<td>-9 (-4.2%)</td>
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<td>-300 (-0.6%)</td>
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<tr>
<td><strong>Average Speed</strong></td>
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<td></td>
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<td></td>
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<tr>
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<td>18.2</td>
<td>15.0</td>
<td>20.8</td>
<td>46.1</td>
<td>13.5</td>
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<td>10.9</td>
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<tr>
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<td>18.3</td>
<td>15.0</td>
<td>20.8</td>
<td>46.2</td>
<td>14.1</td>
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<td>11.1</td>
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<tr>
<td>Difference (%)</td>
<td>0.1 (0.4%)</td>
<td>0 (0.0%)</td>
<td>0 (0.1%)</td>
<td>0.1 (0.1%)</td>
<td>1 (4.0%)</td>
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<td>0 (0.4%)</td>
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<tr>
<td><strong>Person Hours of Travel</strong></td>
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<td>7,065</td>
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<tr>
<td>Difference (%)</td>
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<td>-22 (-2.3%)</td>
<td>-3 (-0.2%)</td>
<td>-12 (-4.2%)</td>
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<td>-429 (-0.8%)</td>
</tr>
<tr>
<td><strong>Number of Trips</strong></td>
<td></td>
<td></td>
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<tr>
<td>Control Alternative</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
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<tr>
<td>ITS Option</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td></td>
<td>$N/A$</td>
</tr>
<tr>
<td>Difference (%)</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
<td>$N/A$</td>
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<td>$N/A$</td>
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<tr>
<td><strong>Number of Fatality Accidents</strong></td>
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</tr>
<tr>
<td>Control Alternative</td>
<td>4.22E-03</td>
<td>1.960E-04</td>
<td>2.536E-04</td>
<td>4.76E-03</td>
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<td>4.10E-03</td>
<td>1.910E-04</td>
<td>2.524E-04</td>
<td>4.74E-03</td>
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<td>4.74E-03</td>
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<tr>
<td>Difference (%)</td>
<td>1.57E-05 (-0.4%)</td>
<td>1.42E-05 (-2.2%)</td>
<td>1.45E-07 (-0.1%)</td>
<td>1.00E-05 (-0.4%)</td>
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<td></td>
<td>1.00E-05 (-0.4%)</td>
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<tr>
<td><strong>Number of Injury Accidents</strong></td>
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<tr>
<td>Control Alternative</td>
<td>1.00E+00</td>
<td>4.432E-02</td>
<td>4.591E-02</td>
<td>1.12E+00</td>
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<td></td>
<td>1.12E+00</td>
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<tr>
<td>ITS Option</td>
<td>1.02E+00</td>
<td>4.306E-02</td>
<td>4.570E-02</td>
<td>1.11E+00</td>
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<td></td>
<td>1.11E+00</td>
</tr>
<tr>
<td>Difference (%)</td>
<td>2.55E-03 (-0.4%)</td>
<td>1.86E-04 (-2.2%)</td>
<td>1.51E-04 (-0.31%)</td>
<td>1.09E-03 (-0.4%)</td>
<td></td>
<td></td>
<td>1.09E-03 (-0.4%)</td>
</tr>
<tr>
<td><strong>Number of PDO Accidents</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Control Alternative</td>
<td>1.38E+00</td>
<td>6.186E-02</td>
<td>7.573E-02</td>
<td>1.57E+00</td>
<td></td>
<td></td>
<td>1.57E+00</td>
</tr>
</tbody>
</table>

*Note: Data does not include cold-start amounts*
IDAS Demo
Real World Example – Kansas City

- KC SCOUT program operates the freeway management systems in the bi-state region
- Program needed to prove its worth in order to compete for scarce funding resources
- IDAS was used to estimate benefits of expanding the KC SCOUT system
IDAS Demo
Real World Example – Kansas City

Summary of Kansas City SCOUT Annual Program Benefits vs. Costs

Benefit to Cost Ratio = 8.1 → For every $1 spent on the KC SCOUT program, transportation system users and system management agencies see approximately $8 in benefits.

Benefits
Total Benefits = $51,883,000

- Travel Time $41.0 M
- Operating Cost $5.6 M
- Environmental $2.9 M
- Crash Reduction $1.5 M

Costs
Total Costs = $6,404,000

- O & M $2.4 M
- Capital $2.9 M

KEY
Each circle represents $1M in value.

Benefits
- Travel Time
- Crash Reduction

Costs
- Annual O & M
- Annualized Capital

Time saved by drivers due to reduced congestion
Elevated safety levels reduce secondary crashes
Costs to operate and maintain
Includes initial capital investment and replacement costs

Fuel savings
Reductions in carbon emissions
IDAS Demo
Innovative Use of IDAS in Planning for Operations

- Virginia DOT
  - Used a spreadsheet version of IDAS to assess statewide ITS benefits and costs

- Wisconsin DOT
  - Applied IDAS methodologies to a statewide network using HPMS volumes

- Seattle Puget Sound Regional Council (PSRC)
  - Used IDAS to identify the likely speed/capacity changes for packages of ITS deployed on representative corridors

- Missouri and Kansas DOT
  - Used IDAS to generate cost estimates without a statewide model

- Florida DOT
  - Incorporated methodologies similar to IDAS as part of a customized analysis tool (FITSEVAL) that works directly with the State’s common travel demand models

- Michigan DOT
  - Evaluation of a Temporary ITS for a Work Zone: Reconstruction of I-496 in Lansing, MI
## Module 4 – Current Methods and Tools
### C. Analytical/Deterministic Tools

<table>
<thead>
<tr>
<th>Transportation Planning Needs</th>
<th>Sketch Planning Tools</th>
<th>Travel Demand Forecasting Models</th>
<th>Deterministic Models</th>
<th>Traffic Signal Optimization Tools</th>
<th>Simulation</th>
<th>Archived Operations Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs Assessments/Deficiency Analysis</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Preliminary Screening Assessments</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Alternatives Analysis</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Strategic ITS Planning</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Project Scoring/Ranking/Prioritizing</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Corridor and Environmental Analysis</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Planning for Nonrecurring Congestion</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Performance Monitoring</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
<tr>
<td>Evaluations of Deployed Projects</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td>•</td>
</tr>
</tbody>
</table>
Module 4 – Current Methods and Tools
C. Analytical/Deterministic Tool

- Analyze the performance (capacity, density, speed, delay, and queuing) for small segments of the transportation system based on *Highway Capacity Manual (HCM)* methods

- Examples
  - Highway Capacity Software (HCS)
  - Traffix
Module 4: Comparison of Tool Capabilities

Archived Operations Data – Monitor, Evaluate, Data Source

Detailed

Archived Operations Data – Monitor, Evaluate, Data Source

Simulation

Signal Optimization Tools

Travel Demand Models

Sketch Planning

Deterministic Tools

Preliminary Screening

Alternatives Analysis

Define Operational Strategies/Design

Role in Planning Process

Analysis Sensitivity

Order of Magnitude

Deterministic Tools

Sketch Planning

Travel Demand Models

Simulation

Signal Optimization Tools
Module 4 – Current Methods and Tools
C. Analytical/Deterministic Tool (continued)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Quickly predict impacts for an isolated area</td>
<td>- Limited ability to analyze broader network impacts</td>
</tr>
<tr>
<td>- Widely accepted</td>
<td>- Limited performance measures</td>
</tr>
</tbody>
</table>
Preview of 2010 HCM Service Volume Tables
The absolute shrinking of the HCM

Down to 3 pages!
2010 HCM Generalized Service Volume Tables
Based on Florida DOT Service Volume Tables

- **Generalized Tables**
  - Rough estimate of capacity and LOS

- **LOSPLAN Software**
  - Good determination of capacity and LOS
2010 HCM Service Volume Tables

The Tables

...provide estimates of maximum service volumes for various types of road facilities

...represent average roadway conditions for an area; not representative of any single roadway

...allow analysts to quickly and easily compare volumes to estimate LOS
### 2010 HCM Service Volume Tables

#### Freeways

**Table 1** Generalized Annual Average Daily Volumes for Florida's Urbanized Areas

<table>
<thead>
<tr>
<th>State Signaled Arterials</th>
<th>Class I (0.0 to 1.59 signalized intersections per mile)</th>
<th>Class II (2.0 to 4.98 signalized intersections per mile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanes</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>44,500</td>
<td>63,800</td>
</tr>
<tr>
<td>6</td>
<td>67,200</td>
<td>95,400</td>
</tr>
<tr>
<td>8</td>
<td>91,000</td>
<td>128,000</td>
</tr>
<tr>
<td>10</td>
<td>113,700</td>
<td>161,600</td>
</tr>
<tr>
<td>12</td>
<td>155,200</td>
<td>213,000</td>
</tr>
</tbody>
</table>

**Freeway Adjustments**

- Auxiliary Lanes: +20,000
- Ramp Metering: +5%
- Oversaturated Conditions*: -10% of E

---

*Note: Although presented as a standard, these values should be used as guidelines. The data and design components should be adjusted based on specific traffic conditions and flow rates.*

---

*Source: Florida Department of Transportation, Planning Office, Office of Traffic Engineering.*
## 2010 HCM Service Volume Tables
### State Signalized Arterials

**Table 1: Generalized Annual Average Daily Volumes for Florida’s Urbanized Areas**

<table>
<thead>
<tr>
<th>Class I (&gt;0.00 to 1.99 signalized intersections per mile)</th>
<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanes</td>
<td>Median</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>2</td>
<td>Undivided</td>
<td>9,600</td>
<td>15,400</td>
<td>16,500</td>
<td>***</td>
</tr>
<tr>
<td>4</td>
<td>Divided</td>
<td>29,300</td>
<td>35,500</td>
<td>36,700</td>
<td>***</td>
</tr>
<tr>
<td>6</td>
<td>Divided</td>
<td>45,000</td>
<td>53,700</td>
<td>55,300</td>
<td>***</td>
</tr>
<tr>
<td>8</td>
<td>Divided</td>
<td>60,800</td>
<td>71,800</td>
<td>73,800</td>
<td>***</td>
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</table>

<table>
<thead>
<tr>
<th>Class II (2.00 to 4.50 signalized intersections per mile)</th>
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<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lanes</td>
<td>Median</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>2</td>
<td>Undivided</td>
<td>**</td>
<td>10,500</td>
<td>15,200</td>
<td>16,200</td>
</tr>
<tr>
<td>4</td>
<td>Divided</td>
<td>**</td>
<td>25,000</td>
<td>33,200</td>
<td>35,100</td>
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<tr>
<td>6</td>
<td>Divided</td>
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<td>39,000</td>
<td>50,300</td>
<td>53,100</td>
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<tr>
<td>8</td>
<td>Divided</td>
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<td>53,100</td>
<td>67,300</td>
<td>70,900</td>
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</table>

<table>
<thead>
<tr>
<th>Class III/IV (more than 4.5 signalized intersections per mile)</th>
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<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
<th>🚗</th>
</tr>
</thead>
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<td>D</td>
<td>E</td>
</tr>
<tr>
<td>2</td>
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<td>**</td>
<td>5,100</td>
<td>11,900</td>
<td>14,900</td>
</tr>
<tr>
<td>4</td>
<td>Divided</td>
<td>**</td>
<td>12,600</td>
<td>28,200</td>
<td>31,900</td>
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<tr>
<td>6</td>
<td>Divided</td>
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<td>19,700</td>
<td>43,700</td>
<td>48,200</td>
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<tr>
<td>8</td>
<td>Divided</td>
<td>**</td>
<td>27,000</td>
<td>59,500</td>
<td>64,700</td>
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</table>

*Note: Classes are based primarily on signalized intersection spacing.*

(Adapted from page 74 of the 2010 Highway Capacity Manual)
## HCM Methods for Active Transportation and Demand Management (ATDM)

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<thead>
<tr>
<th>Capacity Reduction</th>
<th>5% Demand</th>
<th>20% Demand</th>
<th>50% Demand</th>
<th>80% Demand</th>
<th>95% Demand</th>
<th>Row Totals</th>
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<tbody>
<tr>
<td>No Incidents, Good Weather</td>
<td>0%</td>
<td>6.04%</td>
<td>15.10%</td>
<td>18.12%</td>
<td>15.10%</td>
<td>6.04%</td>
</tr>
<tr>
<td>Single Lane Closure, Good Weather</td>
<td>42%</td>
<td>2.16%</td>
<td>5.40%</td>
<td>6.48%</td>
<td>5.40%</td>
<td>2.16%</td>
</tr>
<tr>
<td>Dual+ Lane Closure, Good Weather</td>
<td>75%</td>
<td>0.07%</td>
<td>0.19%</td>
<td>0.22%</td>
<td>0.19%</td>
<td>0.07%</td>
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<tr>
<td>No Incidents, Bad Weather</td>
<td>7%</td>
<td>1.26%</td>
<td>3.15%</td>
<td>3.78%</td>
<td>3.15%</td>
<td>1.26%</td>
</tr>
<tr>
<td>Single Lane Closure, Bad Weather</td>
<td>49%</td>
<td>0.45%</td>
<td>1.13%</td>
<td>1.35%</td>
<td>1.13%</td>
<td>0.45%</td>
</tr>
<tr>
<td>Dual+ Lane Closure, Bad Weather</td>
<td>82%</td>
<td>0.02%</td>
<td>0.04%</td>
<td>0.05%</td>
<td>0.04%</td>
<td>0.02%</td>
</tr>
<tr>
<td>Column Totals</td>
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<td>25.00%</td>
<td>30.00%</td>
<td>25.00%</td>
<td>10.00%</td>
<td>100.00%</td>
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Module 4
TRAFFIC SIGNAL OPTIMIZATION TOOLS
Module 4 – Current Methods and Tools

D. Traffic Signal Optimization Tools

<table>
<thead>
<tr>
<th>Transportation Planning Needs</th>
<th>Operational Analysis Tools/Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sketch Planning Tools</td>
</tr>
<tr>
<td>Needs Assessments/Deficiency Analysis</td>
<td>◆</td>
</tr>
<tr>
<td>Preliminary Screening Assessments</td>
<td>◆</td>
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<tr>
<td>Alternatives Analysis</td>
<td>◆</td>
</tr>
<tr>
<td>Strategic ITS Planning</td>
<td>◆</td>
</tr>
<tr>
<td>Project Scoring/Ranking/Prioritizing</td>
<td>◆</td>
</tr>
<tr>
<td>Corridor and Environmental Analysis</td>
<td>◆</td>
</tr>
<tr>
<td>Planning for Nonrecurring Congestion</td>
<td>◆</td>
</tr>
<tr>
<td>Performance Monitoring</td>
<td></td>
</tr>
<tr>
<td>Evaluations of Deployed Projects</td>
<td>◆</td>
</tr>
</tbody>
</table>
Module 4 – Current Methods and Tools
D. Traffic Signal Optimization Tools

- Analyze delay and identify optimum signal phasing and timing plans for isolated intersections or small signal systems

- Examples
  - PASSER
  - TRANSYT-7F
  - Synchro
Module 4: Comparison of Tool Capabilities

Archived Operations Data – Monitor, Evaluate, Data Source

Simulation

Signal Optimization Tools

Travel Demand Models

Deterministic Tools

Sketch Planning

Preliminary Screening

Alternatives Analysis

Define Operational Strategies/Design

Role in Planning Process

Analysis Sensitivity

Order of Magnitude

Detailed

79
## Module 4 – Current Methods and Tools
### D. Traffic Signal Optimization Tools (continued)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Effective tool for testing plans prior to field implementation</td>
<td>- Calibration process can be time consuming</td>
</tr>
<tr>
<td>- Proven operational benefits</td>
<td></td>
</tr>
</tbody>
</table>
### Module 4 – Current Methods and Tools

#### E. Simulation Tools

<table>
<thead>
<tr>
<th>Transportation Planning Needs</th>
<th>Sketch Planning Tools</th>
<th>Travel Demand Forecasting Models</th>
<th>Deterministic Models</th>
<th>Traffic Signal Optimization Tools</th>
<th>Simulation</th>
<th>Archived Operations Data</th>
</tr>
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Module 4: Comparison of Tool Capabilities

- **Archived Operations Data** – Monitor, Evaluate, Data Source
- **Simulation**
- **Signal Optimization Tools**
- **Travel Demand Models**
- **Deterministic Tools**
- **Sketch Planning**
- **Operational Strategies/Design**

**Analysis Sensitivity**

- **Detailed**

**Order of Magnitude**

- **Preliminary Screening**
- **Alternatives Analysis**
- **Role in Planning Process**

**Deterministic Tools**

**Sketch Planning**

**Travel Demand Models**

**Archived Operations Data – Monitor, Evaluate, Data Source**

**Signal Optimization Tools**
Module 4 – Current Methods and Tools

E. Simulation Tools

- **Macroscopic**
  - Simulates average flow, speed, and density on a segment-by-segment basis
  - Examples: FREQ, PASSER, Transyt-7F, VISTA

- **Mesoscopic**
  - Simulates individual vehicles based on average segment speed and density
  - Examples: DYNASMART-P, DynusT, DynaMIT-P, TransModeler, TRANSIMS, Aimsun, Dynameq

- **Microscopic**
  - Simulates detailed movement of individual vehicles throughout the network
  - Examples: CORSIM, Paramics, VISSIM, Aimsun, TransModeler
E. Simulation Tools (continued)
Module 4 – Current Methods and Tools
E. Simulation Tools (continued)

Advantages

- Detailed results, particularly microsimulation and select macrosimulation tools
- Can use dynamic procedures for evaluating incidents and real-time diversion patterns
- Visual presentation opportunities
- Reuse for future analyses

Challenges

- Demanding data and computing requirements, particularly microsimulation
- Resource requirements may limit network size and number of analysis scenarios
- Calibration may be time consuming for larger, more complex, or congested networks
Module 4 – Current Methods and Tools

E. Simulation Tools – Simulation DEMO
Simulation Demo
Port of Entry (POE) Simulation

- Review and assess traffic operations at all Ports of Entry (POE) in El Paso, Texas

POEs simulated
- Bridge of the Americas (BOTA)
- Ysleta-Zaragoza

Objective
- Evaluate the impacts of potential improvements

Modeling software
- VISSIM
Ysleta-Zaragoza POE
Base vs. Fully Staff All Existing Inbound Booths

- **Year:** 2015

- **Time Period:** 8 a.m. – 8 p.m.

- **Base Scenario:** Do-nothing (booth staffing plan same as 2010)
  - Only 50% to 75% of the 12 auto booths are open
  - Only 50% to 63% of the 8 truck booths are open

- **Fully Staff All Existing Inbound Booths:** Open all inbound booths coming into the U.S. (autos & trucks)
  - Open all 12 auto booths
  - Open all 8 truck booths
Ysleta-Zaragoza POE
Use of Simulation to Demonstrate Impacts

2015 Base Scenario (Do-Nothing)

2015 Model with All Inbound Booths Open (Coming into the U.S.)
Simulation Demo
Additional Output Examples

<table>
<thead>
<tr>
<th>Segment</th>
<th>2008 Existing</th>
<th>2030 No Build</th>
<th>2030 8+4</th>
<th>2030 10+4</th>
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<td>SR-76 MISSION</td>
<td>3:00 4:00</td>
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<td>3:00 5:00</td>
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<tr>
<td>CANNON RD</td>
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<td>PALOMAR AIRPORT RD</td>
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<td>POINSETTIA LN</td>
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<td>LA COSTA AVE</td>
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<td>LOMAS SANTA FE DR</td>
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<td>N/O GENESEE AVE</td>
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<tr>
<td>LA JOLLA VILLAGE</td>
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</tbody>
</table>

Colors indicate speed limits: 30 mph, 45 mph, 60 mph.
Module 4

DYNAMIC TRAFFIC ASSIGNMENT
Dynamic Traffic Assignment

What is DTA?

- May be incorporated into macroscopic, mesoscopic and/or microscopic simulation models

- Often involves a combination of model types representing Multi-Resolution Modeling (MRM)

- Simulated vehicles can change start times, choose alternative routes, or even change modes based on congestion and other information during the analysis period

- Unlike static simulation, DTA can be used to simulate the impact of incidents
Dynamic Traffic Assignment

Background

- Emerging as a practical tool for numerous planning and operational applications

- Well suited for evaluating operational strategies that are likely to induce a temporal or spatial pattern shift of traffic among different roadway facilities at a corridor and network-wide level

- Allows for more realistic estimation of travel behavior from various demand/supply changes and interactions
  - Suitable for analyses involving incidents, construction zones, ATDM strategies, ICM strategies, ITS, managed lanes, congestion pricing, etc.
Dynamic Traffic Assignment
Advantages and Challenges

**Advantages**
- Same as simulation
- More realistic in estimating traveler response and therefore operations
- Wider range of strategies can be more accurately tested

**Challenges**
- Same as simulation
- Can be more resource intensive
- Requires skill sets of both demand modeling and simulation modeling
Dynamic Traffic Assignment
Integrated Corridor Management (ICM)

- Coordinated, multimodal cross-network operations within a corridor
- Demonstrates how proven and emerging technologies can strongly link separate transportation networks and more efficiently use of existing network assets
- Better information and more choices for travelers
- Integrates strategies and technology to more efficiently move people and goods
- Toolbox of policies, strategies, requirements and methodologies to advance operations
Dynamic Traffic Assignment
Integrated Corridor Management (ICM)

Analysis, Modeling, and Simulation (AMS) Methodology

- Revised Trip Tables
- Refined Travel Times

Enhanced Performance Measures
- VMT/VHT/PMT/PHT
- Travel Time/Queues
- Throughput/Delay
- Environment
- Safety

Benefit Valuation

Outputs
- Benefit/Cost Analysis
- Sensitivity Analysis
- Ranking of ICM Alternatives

User Selection of ICM Strategies

Cost of Implementing ICM Strategies
Dynamic Traffic Assignment
ICM and Nonrecurrent Sources of Congestion

Key ICM Impacts May Be Lost If Only “Normal” Conditions are Considered

Source: Wunderlich, K., et al., Seattle 2020 Case Study, PRUEVIIN Methodology, Mitretek Systems. This document is available at the FHWA Electronic Data Library (http://www.itsdocs.fhwa.dot.gov/)
Dynamic Traffic Assignment
ICM Analysis is a Continuous Process

Performance Measurement

Comprehensive Situational Awareness

Archived Data

Substantive Alternatives Analysis

Modeling and Simulation

Trusted Models
Dynamic Traffic Assignment
ICM Variations in Operating Conditions

I-394 ICM Corridor
Incident Severity vs. Demand
AM Peak Period Only 6am-9am

Incident Clearance Time

Minimal Impact to Traffic
Moderate Impact to Traffic
Severe Impact to Traffic
Dynamic Traffic Assignment
San Diego ICM: Annual Benefit by Performance Measure

ICM Benefits
Without Incidents

ICM Benefits
With Incidents

Arterial Freeway Total

Arterial Freeway Total
Module 4
WORK ZONE TRAFFIC ANALYSIS
Module 4 – Current Methods and Tools

Work Zone Traffic Analysis (WZTA)

- WZTA is a process of analyzing the Work Zone traffic impacts and related impact mitigation strategies

- Encompasses all tool types
  - Sketch planning and travel demand models are most commonly used in the planning phase
  - Simulation models are also well suited

- Examples specific to Work Zones: QuickZone, QUEWZ, CA4PRS, NetZone
Why analyze work zones in early planning stages?

- Work Zones are part of the non-recurrent congestion category for which operations mitigation strategies are effective.
- To capture all the benefits during project selection, consider the benefits of investing in operations strategies during the construction phase.
- Operations strategies in place during construction can be left in place as part of the overall project.
- Assess how the impacts of different projects affect one another and determine the optimal timing of project initiation to best fit the region’s needs.
- Identify the likely corridors that would be used as alternative routes, which in turn may need congestion mitigation.
Module 4 – Current Methods and Tools

QuickZone Sample Inputs

- Geometry data
- Demand data
- Start date
- Duration
- Detour options
- Yearly capacity change
Module 4 – Current Methods and Tools
QuickZone Adjustable Parameters

- Number of lanes
- Capacity
- Free-flow speed
- Jam density
Module 4 – Current Methods and Tools
QuickZone Sample Output – Delay Comparisons

Change in Delay from Base Case

Phases with the highest delay values:

- Phase 2
- Phase 3
- Phase 1

Time of Day

Delay Vehicile-Hour/Hour

0 500 1000 1500 2000 2500 3000 3500

Sun-C00 Sun-06:00 Sun-12:00 Mon-06:00 Mon-12:00 Mon-18:00 Tue-06:00 Tue-12:00 Tue-18:00 Wed-06:00 Wed-12:00 Wed-18:00 Thu-06:00 Thu-12:00 Thu-18:00 Fri-06:00 Fri-12:00 Fri-18:00 Sat-06:00 Sat-12:00 Sat-18:00 Sun-06:00
Module 4 – Current Methods and Tools
Work Zone Alternatives Analysis Case Study

- Determine optimal project sequencing using existing mesoscopic model
  - Scenario 1.1 – Construction project on Loop 375
  - Scenario 1.2 – Construction project on I-10
  - Scenario 2.0 – Conduct both projects concurrently

Project sequence options:
- Option 1: Conduct one construction project at a time:
  ✓ Scenario 1.1: Loop 375 construction
  ✓ Scenario 1.2: I-10 construction
- Option 2: Conduct both construction projects simultaneously.
Module 4 – Current Methods and Tools
Work Zone Alternatives Analysis Case Study

- Time and duration of congestion on freeway links

![chart showing time and duration of congestion on freeway links]
Module 4
ARCHIVED OPERATIONS DATA
## Module 4 – Integrating Planning and Operations

### Archived Operations Data

<table>
<thead>
<tr>
<th>Transportation Planning Needs</th>
<th>Sketch Planning Tools</th>
<th>Travel Demand Forecasting Models</th>
<th>Deterministic Models</th>
<th>Traffic Signal Optimization Tools</th>
<th>Simulation</th>
<th>Archived Operations Data</th>
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Module 4 – Current Methods and Tools
Archived Operations Data

Sources
- Surveillance equipment on freeways
- Probe vehicles
- Cell phone tracking
- Toll tags
- Third-party providers
- Aerial photography
- Incident management videos

Data types
- Travel times
- Volumes
- Lane occupancies
Module 4: Comparison of Tool Capabilities

Archived Operations Data – Monitor, Evaluate, Data Source

Sketch Planning

Travel Demand Models

Deterministic Tools

Simulation

Signal Optimization Tools

Role in Planning Process
Common Uses by Planning Agencies

- Supply model inputs
  - Archives can provide link level speeds (free-flow and congested) and capacities

- Calibrate/validate ops and planning models
  - To check assigned volumes against collected volumes
  - Speed data sometimes used to check generated speeds from traffic assignment process

- Report congestion performance trends
  - Evaluate strategy effectiveness
  - Report existing conditions
Module 4 – Current Methods and Tools

Archived Operations Data (continued)

- Miscellaneous Known Uses
  - Expanded hourly count coverage
  - Diurnal distribution of traffic
  - Event-related traffic patterns
  - Weather impacts
  - Dynamic OD refinement
  - Measuring variances in traffic flows
## Module 4 – Current Methods and Tools
### Archived Operations Data (continued)

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Challenges</th>
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<tbody>
<tr>
<td>• Quick data collection</td>
<td>• Limited availability of quality data</td>
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<tr>
<td>• Current/up-to-date data</td>
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<tr>
<td>• Provides detailed response to public officials based on real-world data</td>
<td>• Too much data to choose from, need method to pick representative data</td>
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<td>• Interagency data sharing</td>
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<tr>
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<td>• Data quality</td>
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<td>• Staff resources, tool availability, and training</td>
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Module 4 – Current Methods and Tools
Archived Operations Data (continued)
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Archived Operations Data (continued)
Module 4 – Current Methods and Tools
Archived Operations Data (continued)
Las Vegas RTC FAST (MPO) Archive System

http://rtcsnv.com/mpo/fast/dashboard.cfm
Las Vegas RTC FAST (MPO) Archive System

![Image of Freeway Travel Times Interactive Dashboard](image-url)
Las Vegas RTC FAST (MPO) Archive System
Las Vegas RTC FAST (MPO) Archive System
Las Vegas RTC FAST (MPO) Archive System
LUNCH BREAK
Afternoon Agenda

- AFTERNOON SESSION (1:30 p.m. – 4:30 p.m.)
  - SANDAG’s Transportation Modeling Forum
  - BREAK
  - Module 5 – Matching Transportation Planning Needs with Operational Analysis Tools and Methods
  - Module 6 – Situational Exercise
  - Module 7 - Workshop Closure

- FINISH around 4:30 p.m.
Fireside Chat

- SANDAG’s Transportation Modeling Forum
Module 5
Matching Transportation Planning Needs with Operational Analysis Tools and Methods
There is no one analytical tool that can do everything or solve every problem

Method or tool should be consistent with planning objectives and matched with budget and resource requirements

- Using a too-sophisticated tool results in poor use of resources
  - Use of a complex and time-consuming microsimulation for a preliminary screening of scenarios
- Using a too basic tool results in inaccurate or unreliable results
  - Use of a travel demand model for determining ramp metering rate
# Module 5 – Matching Planning Needs With Tools

## General Characteristics of Each Tool Category

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130
## Module 5 – Matching Planning Needs With Tools

### Summary of Benefits and Challenges

<table>
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<th>Tool/Methods</th>
<th>Advantages</th>
<th>Challenges</th>
</tr>
</thead>
</table>
| Sketch Planning Tools                     | • Low cost  
• Fast analysis times  
• Limited data requirements  
• View of the “big picture”                                                                                                                   | • Limited in scope, robustness, and presentation capabilities                                         |
| Travel Demand Forecasting Models          | • Validated models available for most metro areas  
• Evaluation of the regional impacts  
• Consistent with current planning practices                                                                                               | • Limited ability to analyze operational strategies  
• Typically does not capture non-recurring delay                                                   |
| Deterministic Models                      | • Quickly predict impacts for an isolated area  
• Widely accepted                                                                                                                             | • Limited ability to analyze broader network impacts  
• Limited performance measures                                                                  |
| Traffic Signal Optimization Tools         | • Effective tool for testing plans prior to field implementation  
• Proven operational benefits                                                                                                                 | • Calibration process can be time consuming                                                       |
**Module 5 – Matching Planning Needs With Tools**  
**Summary of Benefits and Challenges (continued)**

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<tr>
<td><strong>Operations-Oriented Performance Measures/Metrics</strong></td>
<td>• Provides detailed response to public officials based on real-world data</td>
<td>• Limited availability of quality data</td>
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<tr>
<td></td>
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<td>• Difficult to fuse different types of data</td>
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</tbody>
</table>
Module 5 – Matching Planning Needs With Tools

Tool Selection Process

- How is it done at your agency?

- Why?

- FHWA Traffic Analysis Toolbox can help guide your analysis tool selection
Module 5 – Matching Planning Needs With Tools
Tool Selection Process (continued)

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<tr>
<th>1</th>
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<tbody>
<tr>
<td>Geographic Scope</td>
<td>Facility Type</td>
<td>Travel Mode</td>
<td>Management Strategy</td>
<td>Traveler Response</td>
<td>Performance Measures</td>
<td>Tool/Cost-Effectiveness</td>
</tr>
</tbody>
</table>

**What is your study area?**

**Which facility types do you want to include?**

**Which travel modes do you want to include?**

**Which management strategies should be analyzed?**

**Which traveler responses should be analyzed?**

**What performance measures are needed?**

**At what analysis cost?**

**Analysis Context:**
Planning, Design, or Operations/Construction

Source: FHWA Traffic Analysis Toolbox Volume II, 2004
Module 5 – Matching Planning Needs With Tools

Tool Selection Process (continued)

### Analysis Context:
Planning, Design, or Operations/Construction

#### Geographic Scope
- Isolated Location
- Segment
- Corridor/Small Network
- Region

#### Facility Type
- Isolated Intersection
- Roundabout
- Arterial
- Highway
- Freeway
- HOV Lane
- HOV Bypass Lane
- Ramp
- Auxiliary Lane
- Reversible Lane
- Truck Lane
- Bus Lane
- Toll Plaza
- Light Rail

#### Travel Mode
- SOV
- HOV (2, 3, 3+)
- Bus
- Rail
- Truck
- Motorcycle
- Bicycle
- Pedestrian

#### Management Strategy
- Fwy Mgmt
- Arterial Intersections
- Arterial Mgmt
- Incident Mgmt
- Emerg Mgmt
- Work Zone
- Special Event
- APTS
- ATIS
- Electronic Payment
- RRX
- CVO
- AVCSS
- Weather Mgmt
- TDM

#### Traveler Response
- Route Diversion
  - Pre-Trip
  - En-Route
- Mode Shift
- Departure Time Choice
- Destination Change
- Induced/Foregone Demand

#### Performance Measures
- LOS
- Speed
- Travel Time
- Volume
- Travel Distance
- Ridership
- AVO
- v/c Ratio
- Density
- VMT/PMT
- VHT/PHT
- Delay
- Queue Length
- # Stops
- Crashes/Duration
- TT Reliability
- Emissions/Fuel
- Noise
- Mode Split
- Benefit/Cost

#### Tool/Cost-Effectiveness
- Tool Capital Cost
- Effort (Cost/Training)
- Ease of Use
- Popular/Well-Trusted
- Hardware Requirements
- Data Requirements
- Run Time
- Post-Processing
- Documentation
- User Support
- Key Parameters
- User Definable
- Default Values
- Integration
Table 4. Relevance of traffic analysis tool categories with respect to travel mode.

<table>
<thead>
<tr>
<th>Travel Mode</th>
<th>Sketch Planning</th>
<th>Travel Demand Models</th>
<th>Analytical/Deterministic Tools (HCM-Based)</th>
<th>Traffic Optimization</th>
<th>Macroscopic Simulation</th>
<th>Mesoscopic Simulation</th>
<th>Microscopic Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOV</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>HOV</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Bus</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Rail</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Truck</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Bicycle</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Notes:
- ● Specific context is generally addressed by the corresponding analytical tool/methodology.
- ○ Some of the analytical tools/methodologies address the specific context and some do not.
- ○ The particular analytical tool/methodology does not generally address the specific context.

Source: Traffic Analysis Toolbox Volume II
TOPS-BC can also assist in selecting appropriate benefit/cost methodologies.
Module 5 – Matching Planning Needs With Tools

FHWA Tool for Operations Benefit/Cost (TOPS-BC)

Guidance on Appropriate Benefit/Cost Methods

**Instructions:** Please indicate the needs of your analysis associated with the following criteria then press “GO”. A list of appropriate methodologies will be displayed to the right and will change in response to your answers to the input analysis criteria.

### INPUT CRITERIA

1. **What is the geographic scope of the analysis? (Select 1)**
   - Do not care
   - Statewide
   - Regional
   - Corridor
   - Isolated Location
   - Other

2. **What is the desired level of confidence of the analysis results? (Select 1)**
   - Do not care
   - High (extremely accurate)
   - Medium
   - Low (order of magnitude)

3. **What TSM&O strategy(ies) do you want to analyze? (Choose Multiple)**
   - Do not care
   - Arterial Corridor Traffic Signal Coordination Strategies
   - Traffic Signal Priority Strategies
   - Ramp Metering Strategies
   - Traffic Incident Management Systems
   - Transit AVL and Automated Scheduling
   - Pre-Trip Traveler Information
   - En-Route Traveler Information
   - Active Traffic Demand and Management
   - Work Zone Management
   - Travel Demand Management - Employer Based
   - Supporting Systems (Surveillance, TMC, Communications)

4. **What are the key measures of effectiveness you are interested in generating? (Choose multiple)**

### Suggested Methodologies:

<table>
<thead>
<tr>
<th>Recommended:</th>
<th>Also Consider:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tools meeting ALL criteria</strong></td>
<td></td>
</tr>
<tr>
<td>TOPS-BC</td>
<td></td>
</tr>
<tr>
<td>BCA.net</td>
<td></td>
</tr>
<tr>
<td>CAL-BC</td>
<td></td>
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<tr>
<td>EMFITS</td>
<td></td>
</tr>
<tr>
<td>FITSEval</td>
<td></td>
</tr>
<tr>
<td>HERS-ST</td>
<td></td>
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<tr>
<td>IDAS</td>
<td></td>
</tr>
<tr>
<td>MicroBENCOST</td>
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<tr>
<td>Redbook Wizard</td>
<td></td>
</tr>
<tr>
<td>SCRITS</td>
<td></td>
</tr>
<tr>
<td>SPASM</td>
<td></td>
</tr>
<tr>
<td>STEAM</td>
<td></td>
</tr>
<tr>
<td>Travel Demand Model Methods</td>
<td></td>
</tr>
<tr>
<td>Simulation Methods</td>
<td></td>
</tr>
</tbody>
</table>
Module 5 – Matching Planning Needs With Tools

Investment Requirements

- Most tools and performance analysis focus on benefits

- But for operations, Operations and Maintenance (O&M) cost is a critical component
  - A tool to identify and validate costs would be valuable
  - Operations investments require capital and ongoing operational and maintenance costs

- Few tools include costs or perform benefit-cost analysis

- Accurately estimating and allocating life-cycle costs upfront helps ensure that transportation goals can be achieved
Need to better understand benefits of using operations data and using them as part of planning

Few established procedures on regional-scale analyses

Important analysis gaps still remain (i.e., incidents, construction, weather, special events, etc.)

No tool can account for all travel modes and programs (i.e., HOT lanes, ramp metering, BRT, etc.)

Need to better understand how operational strategies impact travel decisions
Most tools lack ability to measure sustainability, livability, health measures, etc.
  - e.g., emissions analysis

Need for guidance on how these tools and methods can be used more effectively

Not all tools fit neatly into these general categories
  - Some tools may combine capabilities of several different categories
    - Example: IDAS is a hybrid between a sketch planning tool and a travel demand model
BREAK
Module 6
Situational Exercise Scenarios
What’s My Line
Rules of the Game

- Each agency starts with a set budget
- You will be presented with five different scenarios
- Each group will be asked to select what they feel is the most appropriate tool for the job
  - Refer back to earlier Workshop Session materials for details on each tool
- Guidelines for relative costs of the different tools will be provided
  - Costs are subject to change
  - Selecting a tool once can either help or hurt later on
- It’s a game, so relax
Scenario Background

- Sunnydale, USA
- Population 500,000
- Transportation network
  - Two interstates plus beltway
  - Bus transit
  - County arterial system
- Six municipalities
- Existing travel demand model available
- Roadway network equipped with surveillance (loops and cameras)
Scenario - I

- New regional priority to explore new, innovative ways of generating revenue while alleviating congestion

- The region has underutilized HOV lanes that may be converted into HOT lanes

- State DOT and the region’s MPO jointly funded a multi-corridor study to assess the feasibility of HOT lane deployment

- Internal two-year study being done in preparation for the update to the Long Range plan
HOT Lanes Overview

- Tolled lanes alongside existing highway lanes

- Buses, HOV-2, and emergency vehicles will have free access to HOT lanes

- Drivers with fewer than two occupants can choose to pay to access the lanes

- Toll amount changes according to traffic conditions

- Designs will incorporate the latest tolling technologies
Study Context

The Study’s scope

- Mainly concerned about reduction in delays
- Revenues not a focus of this initial effort
- Winning support of the public and local agencies

Expecting controversy and scrutiny, the DOT and MPO Executive Directors want to make sure that the study is done as carefully as possible.
### Scenario Summary

- **Regional HOT Lane Study**

<table>
<thead>
<tr>
<th>Politics</th>
<th>Timeliness</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>Med/High</td>
</tr>
</tbody>
</table>
What’s the best tool?
Costs

- Sketch-planning tools
- Travel demand models
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models
- Archived operations data
Scenario – II (6 months after study starts)

- The Governor is running for reelection
  - Wants to include transportation as part of his agenda as he approaches election

- Early results of the study show I-90 is the most appropriate corridor for HOT lanes
  - Wants to accelerate the study for the I-90 corridor
  - Wants high-level results in two months
I-90 Study Area Characteristics

- 25 miles long
  - 4 general purpose lanes
  - 2 HOV lanes
  - 4 interchanges

- ITS deployments
  - CCTV
  - DMS
  - Fiber optics

- Passes through 3 jurisdictions
Scenario Summary

- Regional HOT Lane Study
  - Politics: Low
  - Timeliness: Low
  - Accuracy: Med/High

- I-90 Corridor Focus
  - Politics: High
  - Timeliness: High
  - Accuracy: Low/Med
What’s the best tool?
Costs

- Sketch-planning tools
- Travel demand models
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models
- Archived operations data
Scenario- III (9 months after study starts)

- Three municipalities around the region fear that HOT lanes will force more traffic onto their parallel arterials

- They are insisting arterials be included in the study’s scope

- They want the study to keep to the original timeline
Scenario Summary

- Regional HOT Lane Study  
  Politics: Low  
  Timeliness: Low  
  Accuracy: Med/High

- I-90 Corridor Focus  
  Politics: High  
  Timeliness: High  
  Accuracy: Low/Med

- Parallel Arterial Focus  
  Politics: Medium  
  Timeliness: Medium  
  Accuracy: Medium
What’s the best tool?
Costs

- Sketch-planning tools
- Travel demand models
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models
- Archived operations data
Scenario IV (13 months after start)

- New State DOT director has an operations focus
- Is concerned that HOT lanes will be perceived as just Lexus lanes
- Wants to study installing ramp meters as an alternative
- However, regional municipalities are concerned meters will affect their arterials
- Must complete as part of normal project timeline
Scenario Summary

- Regional HOT Lane Study
  - Politics: Low
  - Timeliness: Low
  - Accuracy: Med/High

- I-90 Corridor Focus
  - Politics: High
  - Timeliness: High
  - Accuracy: Low/Med

- Parallel Arterial Focus
  - Politics: Medium
  - Timeliness: Medium
  - Accuracy: Medium

- Ramp Meter Add-on
  - Politics: Medium
  - Timeliness: Medium
  - Accuracy: High
What’s the best tool?
Costs

- Sketch-planning tools
- Travel demand models
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models
- Archived operations data
Scenario V

- HOT project has concluded
- Ramp meters were installed along the I-90 corridor
- Director is requesting an evaluation of the ramp meters to determine the benefits
## Scenario Summary

<table>
<thead>
<tr>
<th>Focus Area</th>
<th>Politics</th>
<th>Timeliness</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional HOT Lane Study</td>
<td>Low</td>
<td>Low</td>
<td>Med/High</td>
</tr>
<tr>
<td>I-90 Corridor Focus</td>
<td>High</td>
<td>High</td>
<td>Low/Med</td>
</tr>
<tr>
<td>Parallel Arterial Focus</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Ramp Meter Add-on</td>
<td>Medium</td>
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<td>High</td>
</tr>
<tr>
<td>Ramp Meter Evaluation</td>
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<td>Medium</td>
</tr>
</tbody>
</table>
What’s the best tool?
Costs

- Sketch-planning tools
- Travel demand models
- Analytical/deterministic tools
- Traffic signal optimization tools
- Simulation models
- Archived operations data
What We Have Learned

- Many factors/trade-offs to consider
- Often more than one tool appropriate for the task
- Decisions made today impact what can be done tomorrow
- Sometimes the cheapest solution is not the best – and vice versa
- Borrowing capabilities from multiple tools is sometimes the best solution
Module 7
Workshop Closure
Overview of analysis tools benefits

- Improved decision making
- Evaluate multiple alternatives
- Present alternatives to optimize transportation system performance
- Optimize transportation system performance through operational strategies

Analysis tools are important components in linking planning and operations

Linking the two fields, using *appropriate* tools, methods, and performance measures can bring great benefits
Module 7 – Workshop Closure
Final Thoughts

Was the material presented in this workshop useful?

What did you find most useful?

Where would you like to see more emphasis?
After hearing about the case studies, would you be more likely to employ these innovative methods?

What aspect of any innovative methods did you find potentially valuable?

Are there any shortcomings that might serve as a barrier to your use of analysis tools to plan for operations?
For More Information Contact

- Visit FHWA’s Web Site on Planning for Operations
  [http://www.plan4operations.dot.gov](http://www.plan4operations.dot.gov)
  - Applying Analysis Tools in Planning for Operations Brochure and Case Studies
    » [http://www.plan4operations.dot.gov/casestudies/analysis.htm](http://www.plan4operations.dot.gov/casestudies/analysis.htm)
  - Traffic Analysis Toolbox

- Contact
  - Doug Laird, FHWA-Operations
    [Douglas.Laird@dot.gov](mailto:Douglas.Laird@dot.gov)
  - Egan Smith, FHWA-Planning
    [Egan.Smith@dot.gov, 202-366-6072](mailto:Egan.Smith@dot.gov, 202-366-6072)
Questions or Comments?