STATEWIDE TSM&O STUDIES & IMPROVEMENT STRATEGIES

2017 FSITE & ITS FLORIDA ANNUAL MEETING
Agenda

- Background
- Maryland Statewide TSM&O
  - Methodology
  - Analysis
  - Hot Spot Identification
  - Evaluate Cause of Congestion
  - Identify Low Cost / Short Term Improvement Options
  - Evaluate Cost and Impacts
  - Benefit-Cost Analysis
- Greater Richmond Mobility Study
  - Methodology
  - Analysis
  - Evaluated Concepts
  - Installed Solutions
- US 29 Corridor TSM&O Project
- Summary
Statewide TSM&O Background

Mission:
“To establish and maintain a TSM&O program and implement supporting projects within MDOT/SHA improving mobility and reliability for all people goods through planned operations of transportation facilities”

Vision:
“Maximize mobility and reliable travel for people and goods within Maryland by efficient use of management and operations of transportation systems”

Goal 1.
Develop and implement a sustainable TSM&O program at SHA

Goal 2.
Improve travel time reliability for both people and freight

Goal 3.
Develop data- and performance-driven approaches to support TSM&O planning, programming, implementation and evaluation decisions

Goal 4.
Improve the travelling public’s experience on Maryland highways
Statewide TSM&O Background

- Statewide Mobility Program
- High Volume Corridor Focus
- Program IMPLEMENTABLE Projects
- Defensible to DOT "Higher Ups" and Politicians
Statewide TSM&O - Analysis

- Traffic Analysis
  - VISSIM
    - Corridor-wide
  - MOE’s include
    - Density
    - Speed
    - Delay and LOS
    - Travel Time

- Safety analysis
  - Surrogate Safety Assessment Model (SSAM)

- Cost Analysis
  - Benefit-Cost Tool
Statewide TSM&O - Hot Spot Identification

- Identify Hot Spots Statewide
- V/C Ratios plotted on GIS
- Performance Measures - RITIS Database
- Continually worst performing segments identified as Hot Spots
Statewide TSM&O- Hot Spot Identification

- Multiple factors including,
  - Inadequate accel lane length
  - Ramp terminal control
  - Recurrent safety concern
  - Lack of capacity
Statewide TSM&O- Identify Low Cost Short Term Improvement Options

- Proposed multiple low cost and short term improvement options
- Objective- “Do more with existing infrastructure”
- Options Evaluated:
  - Ramp Metering
  - Hard Shoulder Running
  - Auxiliary Lanes
  - Accel / Decel Lanes
Statewide TSM&O - Evaluate Cost and Impacts

- Cost estimation for all alternatives
- Significant environmental impacts considered
- Benefit-Cost Objective
  - Rate and prioritize multiple improvement options
  - Incorporate primary and secondary parameters
    - Primary - operation, safety, construction cost
    - Secondary - reliability, life cycle cost analysis, user cost
Benefit-Cost Analysis

Benefits
- Delay
- Fuel Cost
- Reliability
- Crash Savings

Costs
- Construction
- Engineering
- Right-of-way
- O&M
- Salvage Value
- Net Cost

Variables
- Annual Traffic Growth
- Annual Inflation Rate
- Annual Discount Rate
Benefit-Cost Analysis

- **Safety**
  - Crash types include
    - Fatal
    - Injury
    - PDO
    - Pedestrian Crashes

- **Reliability**
  - Travel Time
  - User Cost
Benefit-Cost Analysis

Tool Features

- Life Cycle Cost Analysis:
  - Future traffic growth
  - Inflation rates
  - Operation and maintenance costs

- Evaluating Multiple Alternatives:

  Implementation: Variety of infrastructure projects

Tool User Guide

Default Values

<table>
<thead>
<tr>
<th>Project</th>
<th>I-95/95 Baltimore Beltway Improvements - Southwest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Opening Year</td>
<td>2020</td>
</tr>
<tr>
<td>Project Life Span (Years)</td>
<td>20</td>
</tr>
<tr>
<td>Hours of AM and PM Peak</td>
<td>3</td>
</tr>
<tr>
<td>Heavy Vehicle Percentage</td>
<td>10</td>
</tr>
<tr>
<td>Annual Traffic Growth Factor (%)</td>
<td>1</td>
</tr>
<tr>
<td>Annual Growth in Heavy Vehicle Percentage</td>
<td>2.0</td>
</tr>
<tr>
<td>Working Days Per Year</td>
<td>250</td>
</tr>
<tr>
<td>Average Vehicle Occupancy</td>
<td>1.2</td>
</tr>
<tr>
<td>Auto Congestion Cost Per Hour ($)</td>
<td>25.68</td>
</tr>
<tr>
<td>Truck Congestion Cost Per Hour ($)</td>
<td>66.08</td>
</tr>
<tr>
<td>Reliability Ratio - Auto</td>
<td>0.75</td>
</tr>
<tr>
<td>Reliability Ratio - Heavy Vehicles</td>
<td>2.0</td>
</tr>
<tr>
<td>Annual Depreciation in Travel Time Reliability (%)</td>
<td>3</td>
</tr>
<tr>
<td>Fuel savings per hour of delay savings ($)</td>
<td>0.72</td>
</tr>
<tr>
<td>Salvage Value (%)</td>
<td>10.00%</td>
</tr>
<tr>
<td>Annual Inflation Rate (%)</td>
<td>2.30%</td>
</tr>
<tr>
<td>Annual Discount rate (%)</td>
<td>2.32%</td>
</tr>
</tbody>
</table>

Benefit-Cost Analysis

BENEFIT-COST ANALYSIS TOOL USER GUIDE

The Benefit-Cost analysis spreadsheet tool is designed for computing and comparing benefits and costs of a project, facilitating the decision-making process. This user guide includes instructions for using the tool including discussion of the methodologies involved in the computation of benefits and costs.

The following sections provide a detailed description of the different components of the spreadsheet.

Initial Input

This section allows the user to input basic project information and other related parameters. The general rule applicable throughout the spreadsheet is to fill out all the light blue cells, while all the light red cells are automated.

1. Project: Name/Description of project
2. Project Opening Year: The year project is open for traffic
3. Project Life Span: The total life span of the project [Default value: 20]
4. Hours of AM and PM Peak: The number of hours during AM and PM period where congested traffic conditions are expected [Default value: 3 Hour]
5. Heavy Vehicle Percentage (%): Percentage of heavy vehicles (Class 4 and above) within the project area
6. Annual Traffic Growth Factor (%): Anticipated growth factor [expressed as a percentage] per year within the project area
7. Working Days Per Year: Total number of working days per year [Default: 250]
8. Average Vehicle Occupancy: Average number of people per vehicle at a given time [Default: 1.2]
## Benefit-Cost Analysis

### How BCA was used?

<table>
<thead>
<tr>
<th>Concept #</th>
<th>Location</th>
<th>Concept Description</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1. MD 295 NB at MD 175</td>
<td>Convert MD 295 NB at MD 175 to partial signalized diamond interchange, and re-stripe MD 295 NB from 2 lanes to 3 lanes in this section. Ramps from MD 175 to MD 295 and Ramps to MD 295 NB from MD 175 will be signal controlled.</td>
<td><img src="table.png" alt="Table with analysis results" /></td>
</tr>
<tr>
<td>3A</td>
<td>3. Off-ramp from MD 295 SB to I-695 OL</td>
<td>a. Provide two-lane on-ramp with a choice lane on MD 295 SB, and merge the two-lane ramp to one-lane before joining I-695 OL. b. Remove the loop ramp from I-695 OL to MD 295 NB to reduce weaving, which is a low volume ramp with less 100 vph during both AM and PM peak periods.</td>
<td></td>
</tr>
<tr>
<td>3B</td>
<td>3. Off-ramp from MD 295 SB to I-695 OL</td>
<td>c. Remove the loop ramp from I-695 OL to MD 295 NB and add a new lane to I-695 OL.</td>
<td></td>
</tr>
<tr>
<td>3C</td>
<td></td>
<td>a. Extend the acceleration lane extend from 350 feet to 1400 feet b. Re-stripe the acceleration lane from 350 feet to 800 feet</td>
<td></td>
</tr>
<tr>
<td>4A</td>
<td></td>
<td>c. Implement ramp metering at On-ramp from Canine Rd to MD 295 NB.</td>
<td></td>
</tr>
</tbody>
</table>
Greater Richmond Mobility Study

- **Methodology**
  - Forecasting
  - Analysis
  - No Capacity Improvements

- **Regional Interstate System**
  - Focus on I-95 / I-64
  - How to shift traffic to Bypass
Greater Richmond Mobility Study

**Evaluated Concepts**
- Hard Shoulder Running
- Comparative Travel Times
- Queue Warning
- Variable Speed Limit / Speed Harmonization
- Ramp Metering / Dynamic Lane Merge
- Dynamic Speed Warning System
- Targeted Incident Management

**Existing ITS / Fiber Review**
- CCTV
- DMS
- Mainline Detection
- Lane Markings & Sign Upgrades
- Emergency Pull-Offs
- Queue Warning System
- Interchange Modifications
- Communications
- RWS
- Lighting Upgrades
- ITS Low Bridge Warning System

**Candidate Strategies**
- CCTV Camera Monitoring
- Moisture-High Water Detection
- Comparative Travel Times
- Adaptive Ramp Metering
- Interchange Modification
- Lane Control System
- Pavement, Lane Marking and Signing Enhancements
- Dynamic Curve Speed Warning System
- Dynamic Merge Control
- Targeted Incident Management

**Legend**
- CCTV Camera Monitoring
- Vehicle Detection
- Dynamic Message Sign
- Queue Warning System
- Supplemental CCTV Camera Coverage

**I-95 Corridor**
- CCTV
- DMS
- Mainline Detection

**I-64 Corridor**
- CCTV
- DMS
- Mainline Detection

**I-295 Corridor**
- CCTV
- DMS
- RWIS

**I-195 Corridor**
- CCTV
- DMS
Greater Richmond Mobility Study

I-95 Northbound Lane Configuration
Bryan Park Interchange Area

- Exit 83 Off-Ramp
- On-Ramp From
- Exit 79 Off-Ramp
- On-Ramp From
  - WEST
  - SOUTH

NB
US 29 Corridor TSM&O

- 7.5-mile Corridor in Central Virginia
- 17 Signals North of Charlottesville
- Directional Flow
- Three capacity projects:
  - Rio Road Intersection – Convert to Interchange
  - Widening of 2.2 miles at north of corridor
  - Berkmar Road Extension – parallel facility

- Adaptive Signal Control
  - Green Band Base Timings
  - Redundant Fiber Backbone
- Construction Conditions
US 29 Corridor TSM&O

Before Construction Conditions:

Average Annual Crashes (July 2012 – June 2015)

<table>
<thead>
<tr>
<th>Total Crashes</th>
<th>Injury Crashes</th>
<th>Severe Injury</th>
<th>Minor Injury</th>
<th>No Apparent Injury</th>
<th>No Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>20</td>
<td>1</td>
<td>25</td>
<td>7</td>
<td>146</td>
</tr>
</tbody>
</table>

Average Travel Time (April 9 – 10, 2014) (min:sec)

<table>
<thead>
<tr>
<th>Direction</th>
<th>Time Period</th>
<th>Average Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB</td>
<td>AM Peak</td>
<td>10:20</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>10:09</td>
</tr>
<tr>
<td></td>
<td>PM Peak</td>
<td>12:22</td>
</tr>
<tr>
<td>SB</td>
<td>AM Peak</td>
<td>11:41</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>11:01</td>
</tr>
<tr>
<td></td>
<td>PM Peak</td>
<td>12:14</td>
</tr>
</tbody>
</table>
After Construction Conditions:

July 2016 – June 2017 Crashes

<table>
<thead>
<tr>
<th>Total Crashes</th>
<th>Injury Crashes</th>
<th>Severe Injury</th>
<th>Minor Injury</th>
<th>No Apparent Injury</th>
<th>No Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>7</td>
<td>1</td>
<td>8</td>
<td>1</td>
<td>84</td>
</tr>
<tr>
<td>-46%</td>
<td>-65%</td>
<td>0%</td>
<td>-68%</td>
<td>-86%</td>
<td>-42%</td>
</tr>
</tbody>
</table>

Average Travel Time (August 9-10, 2017) (min:sec)

<table>
<thead>
<tr>
<th>Direction</th>
<th>Time Period</th>
<th>Average Travel Time</th>
<th>Travel Time Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>NB</td>
<td>AM Peak</td>
<td>8:08</td>
<td>-21%</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>8:31</td>
<td>-16%</td>
</tr>
<tr>
<td></td>
<td>PM Peak</td>
<td>9:59</td>
<td>-19%</td>
</tr>
<tr>
<td>SB</td>
<td>AM Peak</td>
<td>8:32</td>
<td>-27%</td>
</tr>
<tr>
<td></td>
<td>Midday</td>
<td>9:17</td>
<td>-16%</td>
</tr>
<tr>
<td></td>
<td>PM Peak</td>
<td>10:11</td>
<td>-17%</td>
</tr>
</tbody>
</table>
US 29 Corridor TSM&O

- After Construction Conditions:
  - Enhanced Travel Time Reliability
Programmatic TSM&O

- **Summary**
  - Meet the goals, vision and stakeholder desires of program
  - A lot of potential low-cost short-term improvement options
  - Utilize B-C analysis to obtain scope of costs
  - Evaluate traffic operations, safety, reliability and life cycle cost elements
  - Focus Statewide efforts on corridors which can relieve bottlenecks with greatest impact
  - Scoping down from Statewide to Regional allows for refined set of options to evaluate
  - Implementation on a corridor scale can alone provide substantial improvements
THANK YOU!

QUESTIONS?