



# **FHWA Operations Benefit/Cost Analysis Desk Reference Project**

**FDOT D2 TSM&O Workshop**

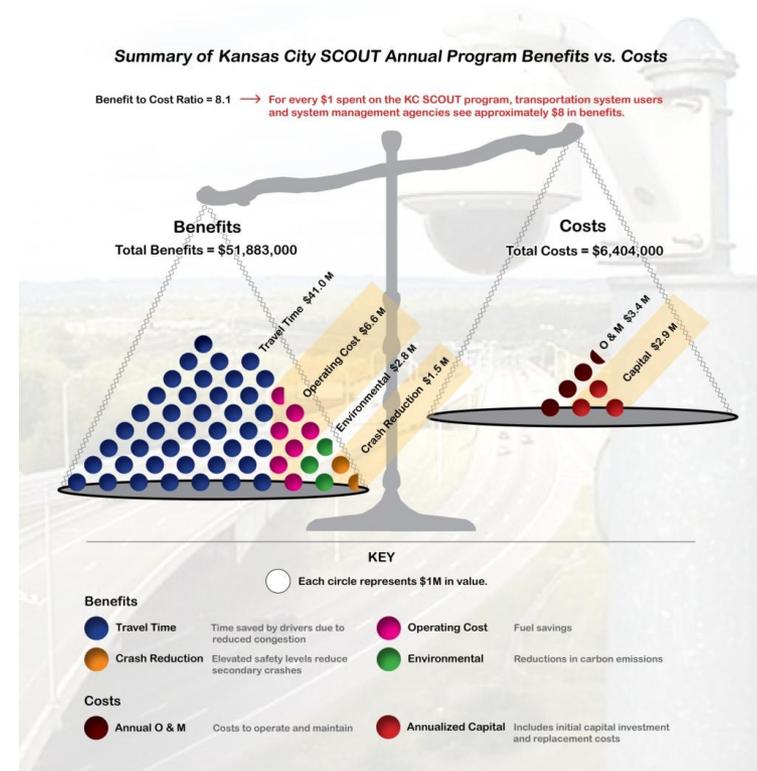
Anita Vandervalk, PE – Cambridge  
Systematics

# B/C Analysis Agenda

- **Project Need/Overview**
- **Why is B/C Analysis Important for Operations Planning?**
- **Real World Challenges of B/C for Operations**
- **Overview of Guidance in the Desk Reference**
- **Analysis Capabilities of the TOPS-BC Tool**

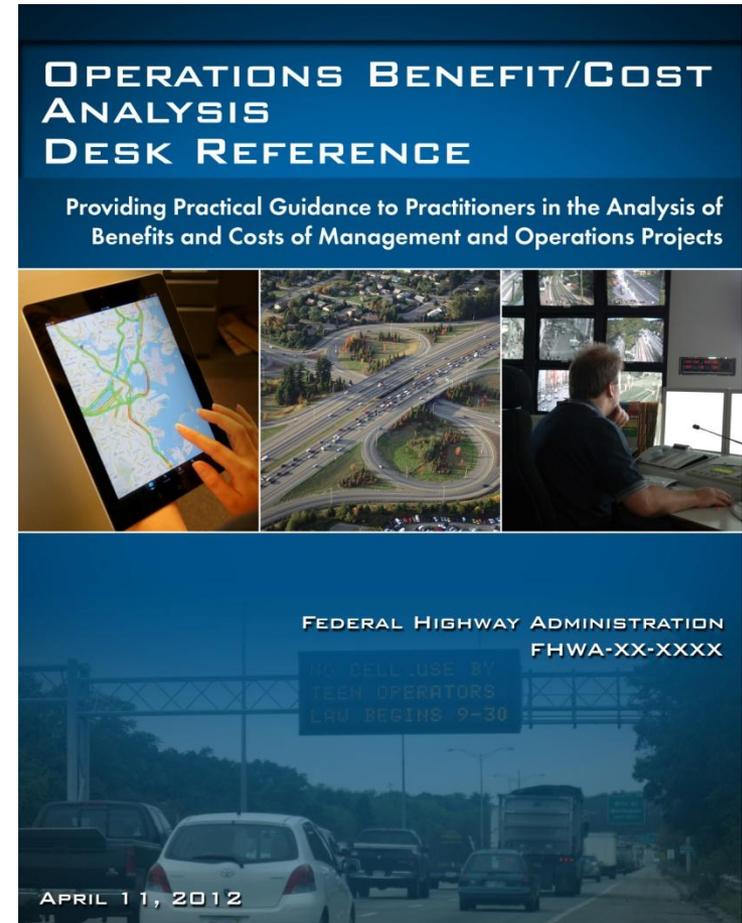
# Project Need

- Project was initiated by talking with practitioners about their real-world needs and challenges
- Operations personnel are increasingly being required to conduct B/C, yet many are unfamiliar with the process
- Many Operations strategies require unique analysis that may be taxing to even seasoned B/C analysts



# Project Outcomes

- **Desk Reference Document**
  - Provide comprehensive, one-stop-shopping for B/C information related to TSM&O (June 2012)
- **Companion Operations B/C Decision Support Tool**
  - TOPS-BC
- **Workshop/outreach Opportunities**



# Why B/C Analysis is important for Operations Planning

- **Provides a systematic process for calculating and comparing benefits and costs of a project for two purposes:**
  - **Determine if the investment is sound**
    - **Justification**
    - **Feasibility**
  - **Compare it with alternate projects**
    - **Prioritize different operational strategies**
    - **Compare operational strategies with traditional strategies**

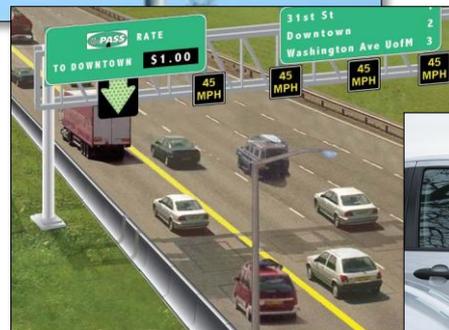
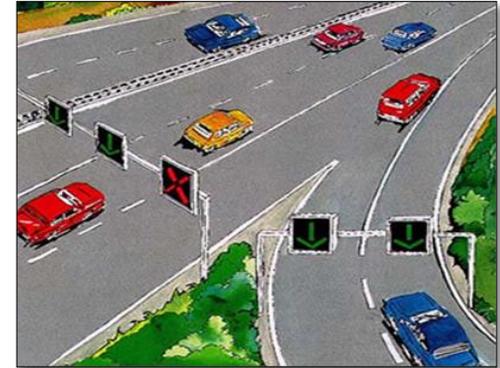
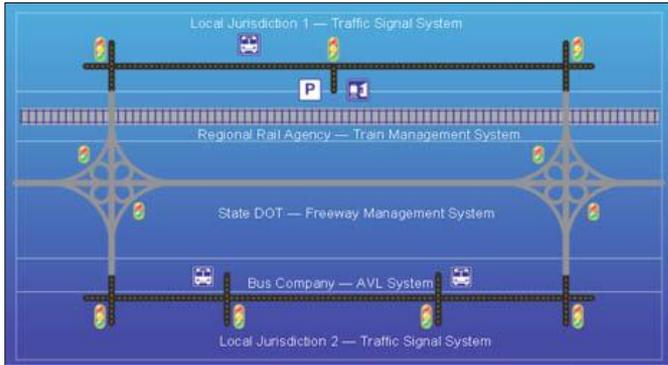
# B/C Analysis Supports Performance Based Planning



# Practitioners Facing Many Challenges

- **Challenges related to applying conventional B/C framework to Operations**
  - Current performance measures, available data, analysis tools and cost parameters are not sensitive to unique nature of Operations
- **Challenges related to M&O strategies themselves**
  - Limited data for new and emerging strategies
  - Assessing non-recurring conditions
  - Effect and value of traveler information
  - Assigning costs for backbone infrastructure
  - Analysis challenges of non-physical improvements

# Assessing the Synergistic Benefits of Integration

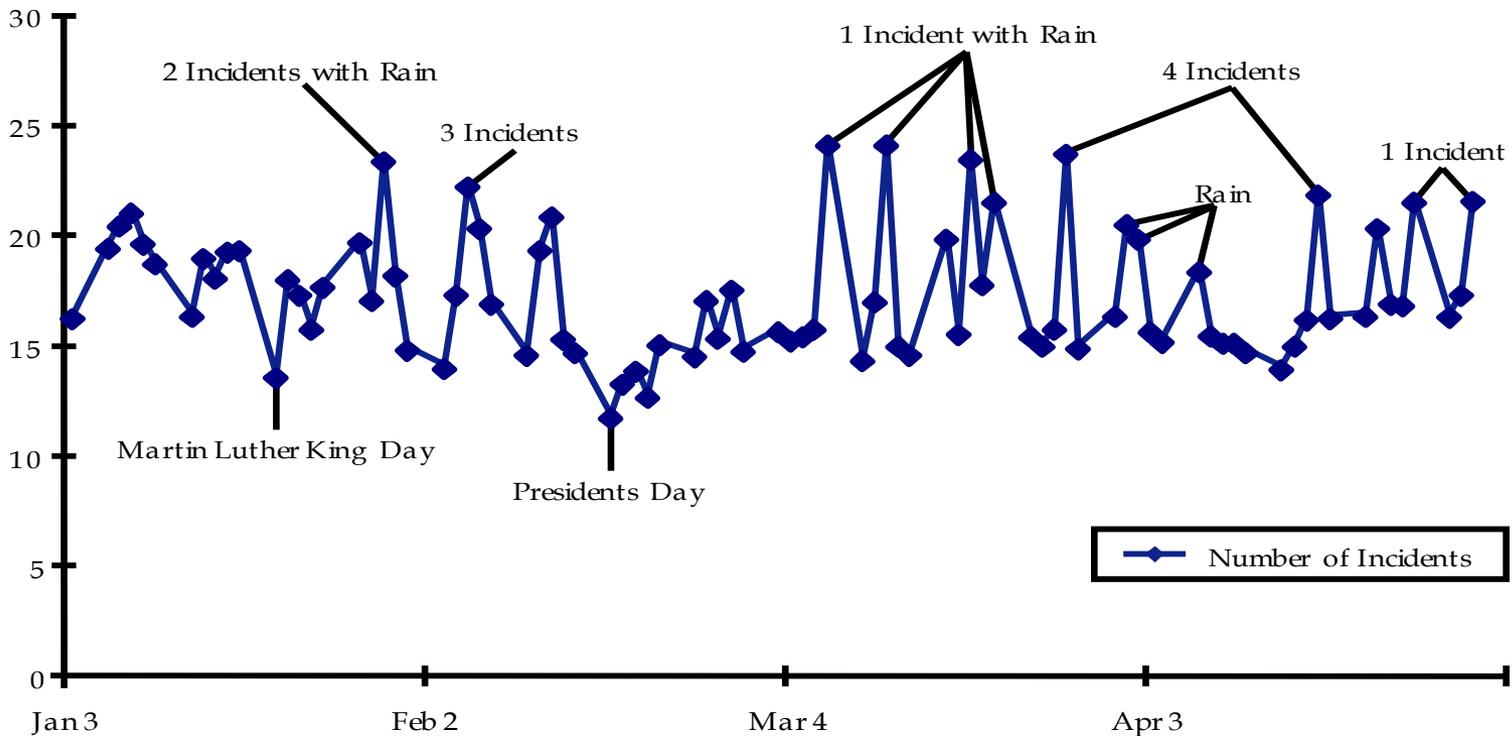


# Assessing Non-Typical Conditions

## Weekday Travel Times

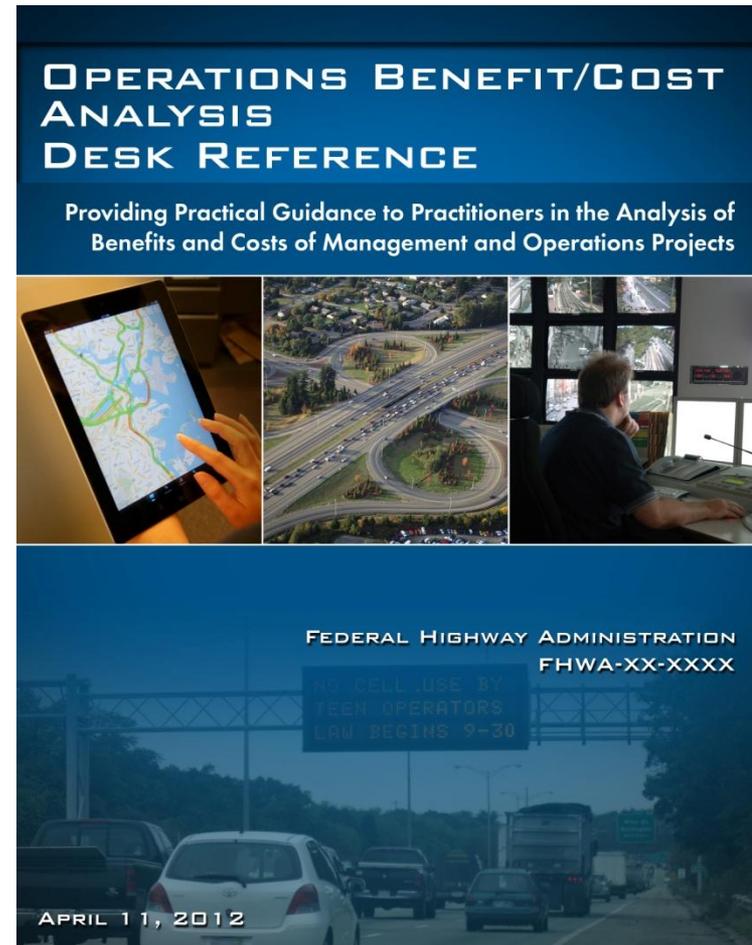
5:00-6:00 P.M., on State Route 520 Eastbound, Seattle, WA

Travel Time (in Minutes)



# Guidance Available in the Desk Reference Document

- **Report available in June 2012**
- **Document and other products have evolved as a result of outreach efforts**



# Guidance Available in the Desk Reference Document

- **B/C analysis primer information**
- **Definition of Ops strategies and likely impacts**
- **Available tools/methods and selection criteria**
- **Strategies for addressing identified challenges of B/C analysis for operations**
- **Methodologies for assessing travel time reliability**
- **Discussion of multi-scenario analysis methods**

# Desk Reference Outline

- Chapter 2, Overview of B/C Analysis for Operations** - Overview of B/C analysis, its role in the planning process, basic terminology and concepts, and identification of general challenges and limitations
- Chapter 3, Operations Strategies and Their Impacts** - Basic definitions of the types of TSM&O strategies covered in this project and maps strategies to their likely impacts/benefits
- Chapter 4, Existing B/C Tools and Methods** summarizes the capabilities with the strengths and limitations of many existing B/C tools and methods to aid practitioners in identifying appropriate situations
- Chapter 5, Conduct B/C Analysis for Operations** - More detailed, step-by-step guidance on how to successfully conduct B/C analysis for operations strategies, identify considerations that need to be made, and highlight challenges that may be encountered

# Typical Benefit and Costs

<b><u>User</u></b>	<b><u>Societal</u></b>	<b><u>Agency</u></b>
Travel time	Environmental/emissions	Efficiency
Travel time reliability	Health	Productivity
Safety	Mobility	
Vehicle operating costs	Productivity	(Costs)
Fuel costs	Security	
Comfort/convenience		
(Costs)		

# TSM&O Strategies Covered

TSM&O Strategy	Discussed in Desk Reference	TOPS-BC Analysis Capability
<b>Physical Strategies</b>		
Arterial Signal Coordination	●	●
Arterial Transit Signal Priority	●	●
Transit Automatic Vehicle Location	●	●
Ramp Metering	●	●
Incident Management	●	●
Pretrip Traveler Information	●	●
En-route Traveler Information	●	●
Work Zone Management	●	●
HOT Lanes	●	●
Speed Harmonization	●	
Hard Shoulder Running	●	●
Travel Demand Management	●	●

# TSM&O Strategies Covered (continued)

TSM&O Strategy	Discussed in Desk Reference	TOPS-BC Analysis Capability
<b>Supporting Strategies</b>		
Traffic Surveillance	●	\$
Traffic Management Centers	●	\$
Communications	●	\$
<b>Non-physical Strategies</b>		
Active Transportation and Demand Management (ATDM)	●	
System Integration	●	
Interagency Coordination	●	
Regional Concepts for Transportation Operations	●	

- **Requirements**
  - **Macro-driven spreadsheet environment**
  - **Designed to be intuitive to use**
  - **Default figures (based on real-world data) are documented and understandable**
  - **Formulas are reviewable**
  - **Easy maintenance and customization**
- **Four Key Capabilities...**

# TOPS-BC - Tool Options

## *What would you like to do today?*

1. Investigate the Range of Expected Values Associated with Various TSM&O Strategies
2. Map Different Benefit/Cost Methodologies to Your Organization's Needs
3. Estimate Lifecycle Costs of TSM&O Strategies
4. Conduct Simple Spreadsheet-Based Benefit/Cost Analysis for Selected TSM&O Strategies

# TOPS-BC:

## 1) 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

*Provides database and look-up function for the observed impacts of many TSM&O strategies*

**Data Source**

**Typical Range of Expected Impacts**

**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:

## 2) Select Methodology

*Guides users to appropriate analysis methodology based on their analysis needs*

### 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 accuracy 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?
  - Arterial Management Systems
    - Corridor Traffic Signal Coordination Strategies (Choose multiple)
      - Pre Set Timing
      - Traffic Actuated Timing
      - Centrally Controlled Timing
    - Traffic Signal Priority Strategies (Choose multiple)
      - Transit Priority
  - Freeway Management Systems
    - Ramp Metering Strategies (Choose multiple)
      - Pre Set Timing
      - Traffic Actuated Timing
      - Centrally Controlled Timing

#### Recommended:

##### Tools meeting ALL criteria

[TOPS-BC](#)  
[BCA.net](#)  
[CAL-BC](#)  
[EMFITS](#)  
[FITSEval](#)  
[HERS-ST](#)  
[IDAS](#)  
[MicroBENCOST](#)  
[Redbook Wizard](#)  
[SCRITS](#)  
[SPASM](#)  
[STEAM](#)  
[Travel Demand Model Methods](#)  
[Simulation Methods](#)

# TOPS-BC:

## 3) Estimate Lifecycle Costs

*Estimates life-cycle costs of many TSM&O strategies – Average Annual Costs and Stream of Costs over time*

FHWA Tool for Operations Benefit/Cost (TOPS-BC)				
Estimate Lifecycle Costs of TSM&O Strategies				
ESTIMATE AVERAGE ANNUAL COST				
Traveler Information - DMS				
	Useful Life	Capital / Replacement Costs (Total)	O&M Costs (Annual)	Annualized Costs
<b>Equipment</b>				
Equipment for Information Dissemination	5	\$ 7,500	\$ 375	\$ 1,875
Equipment for Information Dissemination	5	\$ 20,000	\$ 1,000	\$ 5,000
Integration	20	\$ 100,000	\$ 5,000	\$ 10,000
			\$ 100,000	\$ 100,000
<b>Infrastructure Cost</b>		<b>\$ 127,500</b>	<b>\$ 106,375</b>	<b>\$ 116,875</b>
<b>Incremental Deployment Equipment (Per Sign Location)</b>				
Communication Line	25	\$ 750	\$ 900	\$ 930
Variable Message Sign	25	\$ 92,500	\$ 4,400	\$ 8,100
Variable Message Sign Tower	25	\$ 125,000	\$ 275	\$ 5,275
<b>TOTAL Incremental Cost</b>		<b>\$ 218,250</b>	<b>\$ 5,575</b>	<b>\$ 14,305</b>
INPUT	Enter Number of Infrastructure Deployments		<input type="text" value="1"/>	\$ 116,875
INPUT	Enter Number of Incremental Deployments (# of Signs)		<input type="text" value="2"/>	\$ 28,610
INPUT	Enter Year of Deployment		<input type="text" value="2012"/>	
<b>Average Annual Cost</b>				<b>\$145,485</b>

# TOPS-BC:

## 4) 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	
INPUT	Average Vehicle Occupancy	1.2	
INPUT	% of Time Sign is Displaying Information	5%	
INPUT	Type of Information Being Displayed 1 = Comparative Travel Times 2 = Congestion Warning 3 = Alternative Route Recommendations	3	
	% of Drivers Passing the Sign that Act on the Information	10%	10%
	Average Time (Minutes) Saved by Drivers Acting on the Information		5.5
	Average Time (Minutes) Saved by Drivers Not Acting on the Information		0
	Average Hours of Vehicle Delay Saved Per Period		28
	Number of Periods Per Year	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	
	<b>Total Average Annual Modeled Travel Time Benefit</b>		<b>\$ 120,120</b>
	User Entered Benefit (Annual \$'s)		
	<b>TOTAL AVERAGE ANNUAL BENEFIT</b>		<b>\$ 120,120</b>
	Average Annual Equipment Deployment and Replacement Costs		\$ 60,000
	Average Annual Equipment Operations and Maintenance Costs	\$ 25,000	\$ 20,000
	<b>TOTAL AVERAGE ANNUAL COST</b>		<b>\$ 85,000</b>
	<b>Benefit Cost Ratio (Average Annual Benefits / Average Annual Costs)</b>		<b>1.41</b>
	<b>Annual Net Benefit (Average Annual Benefits - Average Annual Costs)</b>		<b>\$ 35,120</b>

Typical Range = 5%  
Typical Range = 2 m  
No Typical Range A

Assumes non-holid

Uses Value of Trav

From Lifecycle Cost Estimation Module

From Lifecycle Cost Estimation Module

*Sketch planning B/C framework provided for many TSM&O strategies. Users may enter data and estimate B/C directly or use as a framework to develop their own customized analysis.*

# For More Information

- **Please Contact:**
  - Jim Hunt – FHWA Office of Operations (jim.hunt@dot.gov)
  - Doug Sallman (dsallman@camsys.com)
  - Jennifer Strasser (jstrasser@camsys.com)
- **Interim Draft of the Desk Reference Document**
  - [http://www.camsys.com/kb\\_pubs\\_oper.htm](http://www.camsys.com/kb_pubs_oper.htm)
- **FHWA Planning for Operations Website**
  - <http://www.plan4operations.dot.gov>