TECHNICAL BRIEF #2

Benefit Cost Analysis
Transportation Systems Management and Operations

Providing Case Studies for Practitioners in the Use of Benefit-Cost Analysis for Management and Operations Projects and Strategies

This information brief is a continuation of the FHWA Office of Operations Transportation Systems Management and Operations Benefit-Cost Analysis technical briefing series. Earlier briefs were published in 2012 and are available online at: http://www.ops.fhwa.dot.gov/plan4ops/resources/brochures.htm.

Project Purpose

The Federal Highway Administration (FHWA) Office of Operations developed the Transportation Systems Management and Operations Benefit/Cost Analysis Compendium (TSM&O Compendium) and other resources to provide practitioners with practical guidance, tools, and information for conducting benefit-cost analyses (BCA) for a wide range of TSM&O strategies and projects. The TSM&O Compendium (for more information visit http://www.ops.fhwa.dot.gov/publications/fhwahop14032/fhwahop14032.pdf) offers 24 examples of TSM&O BCAs covering a wide range of TSM&O projects.

SOURCE: Federal Highway Administration

Project Need

Due to an increasingly competitive fiscal environment, State, regional, and local transportation planning organizations around the country are increasingly required to justify their programs and expenditures. TSM&O programs and strategies have not escaped this scrutiny, and practitioners and managers are routinely asked to rank their projects against traditional transportation expansion projects. In response to system operators' requirements to conduct these analyses, a number of initiatives have been undertaken in recent years at the national, State, and regional levels to develop enhanced analysis tools, methodologies, and information sources to support BCAs for many specific TSM&O projects and strategies. It often remains difficult, however, for practitioners to weed through the multiple information and guidance sources in order to understand and apply an appropriate methodology for meeting their specific analysis needs.

Other Federal Highway Administration Resources

FHWA provides several documents with answers to frequent BCA questions for a wide range of practitioners. Additionally, FHWA consistently offers activities that help transportation professionals in the conduct of BCA. These resources include:

- *Operations Benefit-Cost Analysis Desk Reference.*
- Transportation System Management and Operations Benefit-Cost Analysis Compendium.
- Road Weather Management Benefit-Cost Analysis Compendium.
- Information briefs on various aspects of TSM&O.
- Technical assistance during the use of TOPS-BC for Benefit-Cost Analysis.
- Preparatory Workshops on the application of Benefit-Cost Analysis for TSM&O Strategies.

Furthermore, some of these references are supported by a TSM&O benefit-cost decision support tool, called the Tool for Operations Benefit/Cost (TOPS-BC). This spreadsheet-based tool is designed to assist practitioners in conducting BCAs by providing several key capabilities, including:

- Investigating the expected range of impacts associated with previous deployments and analyses of many TSM&O strategies.
- Identifying appropriate tools and methodologies for conducting a BCA based on individual analysis needs.
- Estimating the life-cycle costs of various TSM&O strategies, including capital, replacement, and continuing operations and maintenance (O&M) costs.
- Conducting simple BCA for selected TSM&O strategies.

The TOPS-BC tool enables users to conduct BCAs for a wide range of strategies including:

Arterial Signal Coordination, Ramp Metering, Incident Management, Transit Priority, Work Zone Management Traveler Information, HOT Lanes, Variable Speed Control and Advanced Travel Demand Management.

Additional guidance is provided in TOPS-BC and the *Operations Benefit-Cost Analysis Desk Reference* covering:

Supporting strategies such as Traffic Surveillance, Traffic Management Centers and Communications as well as Non-physical strategies such as System Integration and Interagency Coordination.

The TOPS-BC spreadsheet tool was designed to support sketch-planning-level analyses, but is also suitable for in-depth planning studies.

The following section of this informational brief provides a closer look at one of the documents mentioned above, the FHWA TSM&O Compendium.

The Transportation System Management and Operations Benefit-Cost Analysis Compendium

The FHWA Office of Operations initiated this project in recognition that practitioners needed relevant and practical case studies demonstrating how to effectively conduct BCAs for a wide spectrum of transportation system management and operations strategies. The TSM&O Compendium (for more information visit http://www.ops.fhwa.dot.gov/publications/fhwahop14032/) provides practitioners with examples of BCAs for operations strategies and projects implemented by both State departments of transportation (DOT) as well as other transportation agencies across the country.

This body of work is part of a larger initiative in the Office of Operations referred to as Planning for Operations (P40). This initiative aims to better integrate planning and operations activities. Two previous products developed in the project are the Operations Benefit/Cost Analysis Desk Reference (http://www.ops.fhwa.dot.gov/publications/fhwahop12028/index.htm) and the Tool for Operations Benefit/Cost (TOPS-BC, http://www.ops.fhwa.dot.gov/plan4ops/topsbctool/index.htm).

Case Studies

The case studies contained in the TSM&O Compendium evaluate 24 TSM&O strategies and projects. Some are examples of actual analyses conducted throughout the country, others are based on real-world analyses but include some hypothetical elements, while still others represent realistic scenarios but are purely hypothetical. The following sections identify a few of these case studies.

Preset Arterial Signal Coordination Based on Data from Denver Regional Council of Governments

Since 1989, the Denver Regional Council of Governments' (DRCOG) Traffic Operations Program has partnered with the Colorado DOT and local governments to coordinate traffic signals on major roadways in the region. DRCOG designed the program to reduce traffic congestion and improve air quality (http://www.ops.fhwa.dot.gov/publications/fhwahop09046).

State DOTs, metropolitan planning organizations, and other local transportation agencies can use benefit-cost evaluations to determine whether to implement traffic signal timing programs and projects. Benefit-cost analyses can inform decision makers as to where the best locations to improve signal timing are and the most cost-effective alternatives to employ. Many pre-developed tools exist to help practitioners conduct benefit-cost evaluations. Users can also conduct BCAs using their own custom tools. TOPS-BC, is one option and has a function designed to aid users in identifying additional tools. In this case, TOPS-BC estimated that the project benefits exceed the costs by a ratio of 7:1.

Effectiveness of Arterial Management in Florida

Florida Department of Transportation (FDOT) District 4, in collaboration with Palm Beach County Traffic Engineering Department (PBC TED), initiated the "Living Lab" pilot project in 2012 to actively monitor, manage, and improve arterial operations along three major east-west corridors. The project costs included equipment and devices installed in the study area along with operations and maintenance costs. Several cost items were also provided by PBC TED such as transportation management center operators, incident management software, licensing for ATMS.now (an

advanced traffic management system), and an INRIX® data subscription. These costs were considered basic infrastructure costs because they are needed to operate the countywide traffic signal system regardless of the Living Lab project. Using the TOPS-BC spreadsheet tool, FDOT and PBC TED quantified costs and benefits and monetized each, including, travel time savings, crash reductions, and energy savings. The resulting benefit-cost ratio for this case study is 10:1.

Metropolitan Area Transportation Operations Coordination Program

The goal of the Washington, DC, Metropolitan Area Transportation Operations Coordination (MATOC) program is to facilitate real-time situational awareness of transportation operations during significant incidents in the National Capital Region. MATOC monitors, collects, analyzes, and coordinates information sharing among stakeholders regarding incidents of regional significance and actions taken by agencies involved in the response.

In 2010 the Metropolitan Washington Council of Governments (MWCOG) published an evaluation of the MATOC program, including a BCA. The BCA used a customized traffic model, incident data, and engineering procedures to estimate loss of roadway capacity, vehicular queuing, travel delay, and costs (i.e., emissions, fuel consumption, value of time) associated with a select number of regionally significant traffic incidents for the purpose of quantifying benefits attributable to MATOC. The benefit-cost ratio for this case is 10:1.

Minnesota Urban Partnership Agreement

In 2006, the U.S. Department of Transportation, in partnership with the Minnesota DOT (MnDOT), the city of Minneapolis, and several adjacent counties initiated a program to explore reducing congestion through the implementation of congestion pricing activities combined with necessary supporting elements. This program was instituted through the Urban Partnership Agreements (UPA) and the Congestion Reduction Demonstrations (CRD) programs. The projects under the Minnesota UPA focused on reducing traffic congestion in the I-35W corridor and in downtown Minneapolis and included 24 projects. A major focus was on reducing congestion on I-35W South. As a result, the BCA for Minnesota UPA focused on projects associated with I-35W South. The analysis included numerous individual projects that were combined into a single BCA. The benefit-cost ratio for the Minnesota UPA I-35W South project is 6:1 (for more information visit http://www.dot.state.mn.us/rtmc/reports/hov/20130419MnUPA_Evaluation_Final_Rpt.pdf).

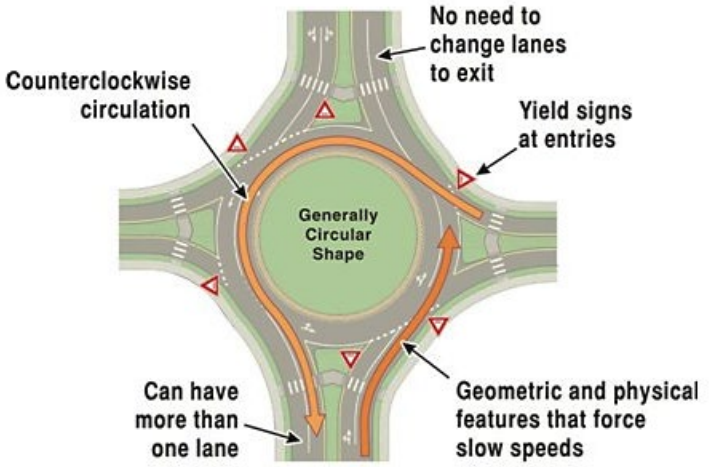
The Rural California / Oregon Advanced Trans-portation Systems Automated Wind Warning System

To address localized high crosswind challenges, the Oregon and California Departments of Transportation (ODOT and Caltrans, respectively) have used intelligent transportation system (ITS) installations to automatically alert motorists of dangerously windy conditions. These systems are called automated wind warning systems (AWWS). ODOT designed its AWWS to send warning messages to drivers at locations where they can either stop or wait until conditions have improved or opt to take an alternate route.

US Route 101 in Oregon is an important corridor for the movement of freight and tourists, so it is critical to keep this highway open. Therefore, the ODOT ITS Unit designed and deployed AWWS to reduce the number of road closures and improve efficiency. As part of this process, ODOT performed a BCA on these systems to evaluate their effectiveness in meeting their objectives. In order to provide comparable benefits and costs within the analysis, ODOT selected key measures of effectiveness (MOEs): safety (reduction in wind induced accident frequency and severity); efficiency (traveler awareness of these systems); customer satisfaction (traveler perception of the usefulness of these systems); reliability (traveler perception of the reliability of the system); productivity; and operational cost savings. The calculated benefit-cost ratio for this project ranges from 4:1 to 22:1.

Effectiveness of Roundabouts in Maryland

Modern roundabouts are a type of intersection characterized by their circular shape, yield control on entry, and geometric features that create a low-speed environment. Modern roundabouts provide a number of safety, operational, and other benefits when compared to other types of intersections. On projects that construct new or improved intersections, planners should examine the modern roundabout as an alternative. The figure 1 provides a diagram illustrating the key characteristics of a modern roundabout.



SOURCE: Maryland DOT

Figure 1. Illustration. Key characteristics of a modern roundabout.

This case study presents the results of an economic evaluation of roundabouts conducted by Maryland State Highway Administration's Traffic Safety Analysis Division, Office of Traffic & Safety. The calculations in the study are based on the anticipated accident experience expected to occur had no roundabouts been installed compared to the actual accident experience at the roundabout locations.

The analysis informs decision makers and allows others interested in this technology to make informed choices regarding the installation of such a system on roadways within their jurisdictions. The benefit-cost ratio for this project was estimated at 15:1.

Adaptive Traffic Signal Control

Adaptive signal control systems coordinate traffic signals across a signal network, adjusting the lengths of signal phases based on prevailing traffic conditions. This technology uses real-time data collected by system detectors to optimize signal timing for each intersection in the corridor. The use of real-time data means that signal timing along the corridor changes to accommodate traffic patterns throughout the day.

A State DOT commissioned the evaluation of an adaptive traffic signal control system on a principal arterial. The goal of the traffic signal control project was to reduce congestion, smooth traffic flows, improve travel times, maximize the benefits of signal timing, and potentially reduce crashes, which delay the need for more costly improvements such as adding capacity to the corridor.

Prior to and after the deployment, the study collected data on roadway performance to be able to compare the changes brought about by the deployment. The data collection revealed improvements in terms of travel time, fuel consumption, and side street delay. The benefit-cost ratio for this project is between 5:1 and 6:1.

Project Contacts

If you have any questions regarding the TSM&O Compendium on Benefit/Cost Analysis please visit http://www.ops.fhwa.dot.gov or contact:

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