Advancing Metropolitan Planning for Operations

The Building Blocks of a Model Transportation Plan Incorporating Operations

A Desk Reference

U.S. Department of Transportation
Federal Highway Administration
Federal Transit Administration

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16. Abstract

This publication is a resource designed to enable transportation planners and their planning partners to build a transportation plan that includes operations objectives, performance measures, and strategies that are relevant to their region, that reflect the community's values and constraints, and that move the region in a direction of improved mobility and safety. It offers practitioners a menu of options for incorporating operations into their plans through an organized collection of sample operations objectives and performance measures. It also features excerpts from a model metropolitan transportation plan, illustrating the results of an objectives-driven, performance-based approach to planning for operations.

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Dear Colleague,

The Federal Highway Administration's (FHWA) Office of Planning, Environment, and Realty, Office of Operations, the Federal Transit Administration's (FTA) Office of Planning and Environment, along with professionals in the planning and operations communities nationwide, are pleased to present three significant new products that work together to advance an outcomes-driven, performance-based approach in the area of Planning for Operations. These three products, "Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach – A Guidebook," "Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference," and "Statewide Opportunities for Integrating Operations, Safety, and Multimodal Planning: A Reference Manual" have been developed to act as a companion package of documents and reflect the strong continuing collaboration among FHWA, FTA, and professionals in the planning and operations communities nationwide.

The Advancing Planning for Operations Guidebook provides an approach focused on operations outcomes that metropolitan area transportation planners and operators can utilize to advance performance-driven regional thinking for metropolitan areas. This Guidebook utilizes requirements for the Congestion Management Process (CMP) and Management and Operations that are contained in the Federal legislation, "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" (SAFETEA-LU).

The Model Transportation Plan Desk Reference is intended to be a "toolbox" document that provides to planners and operators types of possible operations objectives, with associated performance measures, data needs, and strategies, that a metropolitan area can utilize as a starting point towards advancing Planning for Operations in their area. In addition to providing types of operations objectives to advance, the document includes an illustrative plan to visually show "how the pieces fit together," incorporating outcomes-driven operations into the metropolitan planning process. This document was developed in close collaboration with a number of metropolitan planning organizations (MPOs) from across the country and it is intended to be an easily accessible reference document.

The Statewide Opportunities Reference Manual is designed to assist managers and staff within State DOTs to integrate their functions and to partner with other agencies, such as metropolitan planning organizations (MPOs), transit agencies, and local jurisdictions to more effectively integrate operations, safety, and planning. Specifically, this manual is designed as a "how to" reference that provides practical information on implementing these opportunities, and case

study examples with "toolkits" to help get started. This document also expands the focus of integration to include planning, operations, and safety in a multimodal context. This document was developed working closely with the support of a number of State DOT organizations, as well as AASHTO, to create a product that is intended to be a readily accessible resource document for promoting this Statewide collaboration.

Each of these three documents can be viewed electronically by visiting our U.S. DOT website on Planning for Operations at "http://www.plan4operations.dot.gov." On this website one can also find additional associated resources for advancing an outcomes-driven, performance-based approach as part of the Planning for Operations program.

We look forward to receiving your feedback, reactions, and experiences in implementing this concept and utilizing these resources. Please direct any comments, questions, and suggestions to any of the following members of our staff:

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Sincerely yours,

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Contents

Acronyms

CMF	Crash Modification Factor
CMP	Congestion Management Process
DOT	Department of Transportation
ETC	Electronic Toll Collector
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ITS	Intelligent Transportation System
HOT	High Occupancy/Toll
HOV	High Occupancy Vehicle
HSM	Highway Safety Manual: 1st Edition
LOS	Level of Service
M&O	Management and Operations
MPO	Metropolitan Planning Organization
MTP	Metropolitan Transportation Plan
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users
SOV	Single Occupancy Vehicle
SMART	Specific, Measurable, Agreed, Realistic, Time-Bound
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TSM&O	Transportation Systems Management and Operations
TTI	Travel Time Index
VMT	Vehicle Miles Travelled

Executive Summary

Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations - A Desk Reference is a resource designed to enable transportation planners and their planning partners to build a transportation plan that includes operations objectives, performance measures, and strategies that are relevant to their region, that reflect the community's values and constraints, and that move the region in a direction of improved mobility and safety. It offers practitioners a menu of options for incorporating operations into their plans through an organized collection of sample operations objectives and performance measures. It also features excerpts from a model metropolitan transportation plan, illustrating the results of an objectives-driven, performance-based approach to planning for operations. Succinct commentary on the excerpts ensures a clear understanding of the benefits and applications of each element presented.

This reference is a companion to the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) resource, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*.[1] The guidebook introduces the objectives-driven, performance-based approach to planning for operations and how to use this approach while this desk reference supplies the reader with tangible examples of operations objectives and associated performance measures that can be tailored for a specific region or pulled directly into a metropolitan transportation plan (MTP). The resources are provided to assist metropolitan planning organizations (MPOs) and their planning partners in addressing the Federal requirements to include "operational and management strategies to improve the performance of existing transportation facilities" in the MTP and "promote efficient system management and operation."[2] The collection of operations objectives and the model plan excerpts can be used to inspire discussion among operations planning partners as they work to develop their own operations objectives and a plan that reflects this approach.

This is not a document that needs to be read from cover to cover for the full benefit. The reader is encouraged to use the table of contents and reference tables in Section 3.2 to locate information of interest. **Section 1, Introduction**, and **Section 2, Developing Operations Objectives**, offer background to the desk reference and the objectives-driven, performance-based approach. These sections are helpful in orienting the reader to the information found in the remainder of the document.

Section 3, Menu of Operations Objectives, is for the reader interested in creating operations objectives and performance measures to be included in the MTP or other planning documents. This section contains cross-reference tables to locate operations objectives related to a specific interest. Following the table is a collection of information sheets that hold operations objectives and their associated performance measures, data needs, management and operations (M&O) strategies, and a sampling of safety benefits. The information sheets are organized according to desired system performance outcomes (e.g., efficiency, reliability, quality) and operations areas (e.g., arterial management, work zones, incident and emergency management). Each sheet gives one or more operations objectives focused on a specific topic, such as "System Efficiency: Extent of Congestion." Performance measures needed to assess progress toward those objectives are given along with a list of anticipated data needs. Potential data resources or necessary partners are listed as well as a short description of M&O strategies that may be considered in achieving the objectives. Finally, safety benefits that result from achieving the operations objectives may be described.

Readers are encouraged to consult **Section 4, Model Metropolitan Transportation Plan**, when developing or updating a plan. This model reflects the use of an objectives-driven, performance-based approach to planning for operations and its effects on the content and focus of the MTP. Sections of a plan offer an illustration of how a plan incorporates this approach while acknowledging that no single format will fit all regions. Excerpts of this plan have been tailored for three levels of operations planning: basic, advancing, and comprehensive. This will allow readers from a range of regions to find useful examples.

Finally, **Section 5, References and Resources**, gives the readers a list of other sources on which to rely for additional information or assistance.

[1] U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*, Publication No. FHWA-HOP-10-026, http://www.plan4operations.dot.gov/.

[2] "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)," Section 6001(i), 2005.

Desk Reference User's Guide

This desk reference is meant to assist you, the reader, in cultivating an objectives-driven, performance-based approach to planning for operations in your region. This quick user's guide will help you in accomplishing your goals as you turn to this desk reference.

The desk reference is organized into five sections:

Section 1

Introduction: Provides a quick overview of the objectives-driven, performance-based approach to planning for operations.

Section 2

Developing Operations Objectives: Gives the fundamentals of developing operations objectives, a cornerstone of the objectives-driven, performance-based approach.

Section 3

Menu of Operations Objectives: Offers the reader numerous examples of operations objectives and their associated performance measures, data needs, and other related information. The operations objectives are displayed in reference tables and on one- to two-page "fact sheets." The objectives are organized in the following categories:

- System Efficiency
- System Reliability
- System Options
- Arterial Management
- Emergency/Incident Management
- Freeway Management
- Freight Management
- Special Event Management
- Transit Operations and Management
- Travel Demand Management
- Travel Weather Management
- Traveler Information
- Work Zone Management

Section 4

Model Metropolitan Transportation Plan: Provides excerpts from a model metropolitan transportation plan (MTP) to illustrate what operations-related elements of a plan could look like when developed with an objectives-driven, performance-based approach.

Section 5

References and Resources: Lists other sources on which to rely for additional information or assistance.

The remainder of the user's guide will lead you to specific sections of the desk reference based on your purpose for going to this tool. On the next page are a list of reasons for going to the desk reference and descriptions of how to use the tool based on those reasons.

Purpose for Going to the Desk Reference	Recommended Actions
Answer the question "What is an objectives-driven, performance-based approach?"	Read Section 1.2.
Get ideas for operations objectives to be included in the MTP (or supporting operations planning documents).	Go to Objectives Summary Table on page 19. This table lists all operations objectives found in the fact sheets.
Find an operations objective for a specific operations area such as traveler information.	Go to Cross-Reference Table on page 14. Look for a column heading matching the operations area of interest and look up the fact sheets corresponding to that operations area.
Find operations objectives for a specific mode such as transit.	Go to Cross-Reference Table on page 14. Look for a column heading matching the mode of interest and look up the fact sheets corresponding to that operations area.
Learn what performance measures and data would be needed to track an operations objective.	Find the operations objective in Objectives Summary Table on page 19 and then go to the fact sheet containing the operations objective.
Find potential M&O strategies to help improve transportation system efficiency, reliability, or options.	Examine the M&O strategies listed on fact sheets in the category of system efficiency, reliability, or options. Refer to Cross-Reference Table on page 14 and look for operations objective fact sheets that correspond to the system outcome category of interest.
See an example of how to shape the operations-related portions of the MTP to incorporate selected operations objectives and performance measures.	Read Section 4 to see excerpts of a model plan incorporating operations objectives.

1.0 Introduction

1.1 Planning for Operations in the Metropolitan Transportation Plan

As concern grows about the overall performance of our transportation system, metropolitan planning organizations (MPOs) around the country increasingly see operational improvements as serving an important role in addressing regional transportation challenges. In most urban areas, traffic congestion now occurs more frequently throughout the day and on more roadways than in the past. Funding for major new highway and transit capacity projects is limited, and the time it takes to plan and construct new infrastructure means that it can be years or decades to realize their effects. At the same time, much of the traffic delay on roadways is caused by incidents, weather conditions, special events, and other factors that require more immediate solutions and are not solved solely through transportation infrastructure. Effective transportation solutions are needed to remain competitive in a global economy, address climate change, and meet transportation system user expectations. The public is increasingly calling for greater government transparency, travel options, and information to make travel decisions.

Transportation system management and operations (M&O) strategies are designed to optimize the performance of the transportation system. They allow for a more immediate response to traveler concerns than capacity projects offer while improving the reliability, security, and safety of the multimodal transportation system. While operations strategies focus primarily on improving system efficiency, reliability, and options, these strategies often have important safety benefits as well. For instance, improving operations through better work zone management, weather information, and traveler information can help to reduce crashes and improve safety. Since incidents are a major source of non-recurring delay, strategies to improve system operations can include safety strategies that reduce crashes.

Traditionally, the metropolitan transportation planning process has not focused significant attention on transportation operations. Given the challenges facing the transportation system, the availability of new technologies, and public expectations, planning for operations is increasingly being recognized as an important element of the metropolitan transportation planning process. Moreover, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) specifically requires that metropolitan transportation plans (MTP) include "operational and management strategies to improve the performance of existing transportation facilities to relieve vehicular congestion and maximize the safety and mobility of people and goods."[3] Addressing these challenges requires a new way of doing business — a strategic and informed approach to planning for operations.

1.2 An Objectives-Driven, Performance-Based Approach

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) promote the use of an objectives-driven, performance-based approach to planning for operations as an effective way to integrate operations in the MTP. The resource, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*[4] describes a recommended approach for shifting from a project-based approach focused on addressing problems to an objectives-driven, performance-based approach. The recommended approach focuses on working toward desired system performance outcomes rather than just responding to problems. This approach recognizes that what is measured matters in decisionmaking, and setting specific, measurable performance objectives will facilitate incorporating operations strategies into the MTP. An objectives-driven, performance-based approach, therefore, is recommended as a means to meet Federal transportation planning requirements for including "operational and management strategies to improve the performance of existing transportation facilities" in the MTP and promoting "efficient system management and operation."[5]

A key element of this approach is developing operations objectives that state what a region plans to achieve regarding the operational performance of the transportation system. Operations objectives are included in the MTP and guide incorporating operations into the plan and transportation improvement program (TIP). These objectives provide specific, measurable, agreed-upon statements of system performance that can be tracked on the regional level and inform cyclical investment decisions.

[3] "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)," Section 6001(i), 2005.

[4] U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*, Publication No. FHWA-HOP-10-026, http://www.plan4operations.dot.gov/.

[5] "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)," Section 6001(i), 2005.

A plan developed using an objectives-driven, performance-based approach for operations provides a direct connection between operations objectives and project selection. The objectives may relate to issues such as recurring and non-recurring congestion, access to traveler information, emergency response time, incident management coordination, and transit operations, among others.

An objectives-driven, performance-based approach to planning for operations within a metropolitan area includes the elements in the following list, conducted in collaboration among planners, transportation providers, operators, and other stakeholders.

- Regional Goals. Establish one or more goals that focus on efficiently managing and operating the transportation system (in response to Federal requirements).
- Operations Objectives. Develop operations objectives — specific, measurable statements of performance — to include in the MTP that will lead to accomplishing the goal or goals.
- Performance Measures. Using a systematic approach, develop performance measures, analyze transportation performance issues, and recommend M&O strategies.
- M&O Strategies. Select M&O strategies within fiscal constraints to meet operations objectives for inclusion in the MTP and TIP.
- Investment and Implementation. Implement strategies, including program investments, collaborative activities, and projects.
- Monitoring and Evaluation. Monitor and evaluate the effectiveness of implemented strategies and track progress toward meeting operations objectives.

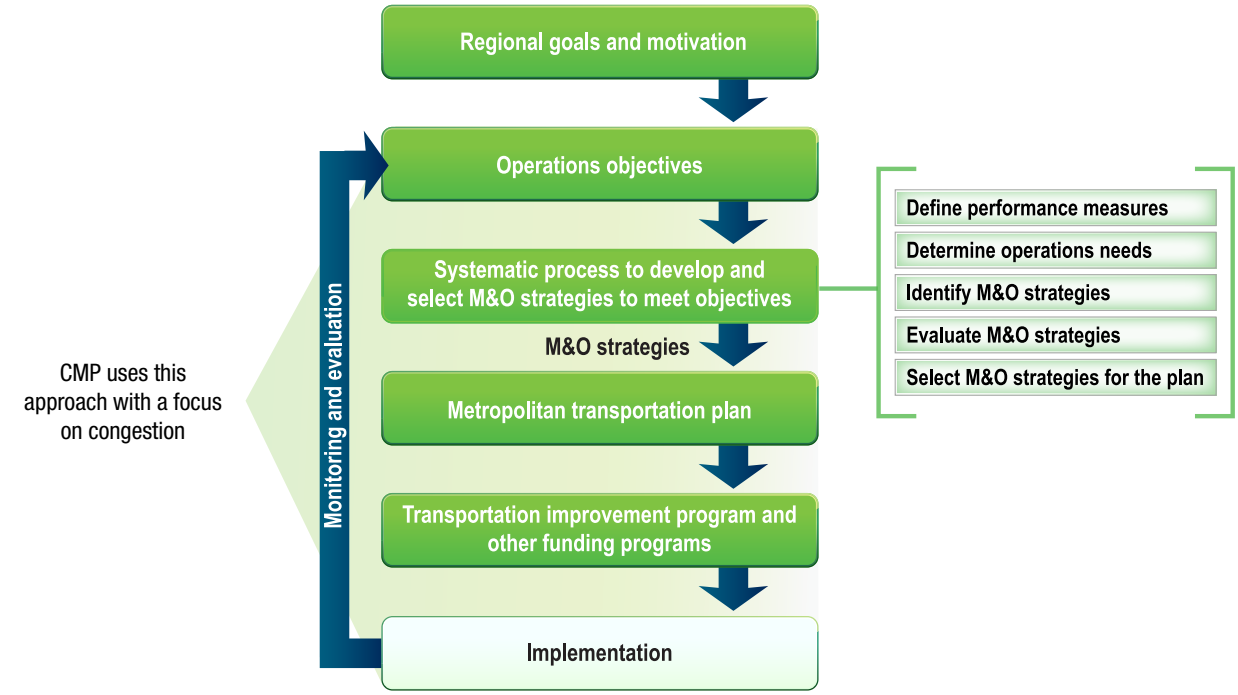
1.3 Getting Started with the Approach

Using an objectives-driven, performance-based approach to plan for operations can seem daunting to MPOs that are just beginning to incorporate operations into their planning process. Taking small steps toward building this approach can help make it accessible.

Engage Operating Agencies in Your Region

A first step in the approach is simply to bring together operating agency managers to begin a dialogue about improving system performance in the region. Operating agencies are typically already at the MPO table and involved in the transportation planning process. However, it is important to engage day-to-day operating agency managers from a systems operations perspective and not simply as advocates for capital projects. Developing an interagency committee that focuses on improving regional management and operations that meets regularly has been an effective technique used by several MPOs to engage operators in addressing regional operations. MPOs can use this forum to determine system performance priorities in the region, operations objectives, data availability, and funding opportunities.

Figure 1. An Objectives-Driven, Performance-Based Approach to Planning for Operations



Raise Visibility and Support of Operations among Decisionmakers in the Region

In preparing decisionmakers to commit to operations objectives, it is necessary to first raise their awareness of both system performance issues in the region and the value of operational improvements. In some regions, this has been done through presentations to the MPO board and managing operating agency management. Other regions have used fliers and brochures to highlight the benefits that operational improvements bring at a relatively low cost and in a short timeframe.

Develop One or More Goals that Focus on the Desired Operational Performance of the Transportation System

Establish one or more goals that focus on efficiently managing and operating the transportation system to be included in the MTP. The goals provide a basis for developing the operations objectives and should reflect input from operators in the region. A goal is a broad statement that describes a desired end state. In the metropolitan transportation planning process, goals stem from the values inherent in the region's vision. The goals may be created during the development or update of the MTP or in anticipation of the next update cycle.

Develop a Small Number of Simple Operations Objectives

Based on the identified operations goals, work with operators in the region to develop a small number of operations objectives that accurately reflect what the region would like to achieve and that stakeholders believe can be achieved within a certain timeframe. These operations objectives may start out as vague and then grow in specificity as the iterative process to define and refine the operations objectives advances. As the operations objectives become more precise, performance measures should be selected to provide adequate information to planners, operators, and decisionmakers on progress toward achieving the identified objectives. Throughout this process, it is vital that the agencies necessary for achieving the objectives be committed to realizing them.

Forming the Operations Objectives

- Initially focus on what to improve, such as delay or clearance time. Developing an objective around an important issue in the region — something that decisionmakers and the public care deeply about — will aid in getting buy-in and commitment to the objective.
- Select the area and time of focus, such as regionally significant arterials during peak hours.
- Identify what data is currently being collected in the region and may be available for tracking the objectives. Based on this information, make the operations objectives more specific and link them to performance measures.
- As fiscal constraints are applied while developing the MTP or as resources available from other sources become known, revisit the operations objectives to ensure feasibility.
- Collect baseline data for performance measures. Performance targets can be introduced into the operations objectives or adjusted with an understanding of baseline performance.

Use Operations Objectives to Identify and Select M&O Strategies for MTP and TIP

Once operations objectives have been decided upon, it is vital that they be used to influence the selection of projects and programs. In collaboration with operators in the region, M&O strategies should be identified and fully defined within the MTP that help to achieve the operations objectives. In selecting projects for funding, the ability to contribute to achieving the operations objectives should be included as a significant prioritization factor. The capability of the MPO to determine the impact of projects on the operations objectives may begin at a rudimentary level and become more comprehensive over time as the MPO improves its data resources and analytical tools.[6]

Collect Data on Selected Performance Measures to Monitor and Report Progress toward Objectives

Based on resource availability among the MPO and the collaborating operating agencies, a regular schedule for collecting data on each performance measure should be established. The difficulty of this element depends on the selection of operations objectives. Monitoring system performance should be sufficient to detect progress toward the region's operations objectives. Both to inform collaborating partners and decisionmakers as well as to maintain their interest, the results of the performance monitoring should be regularly reported, whether as a simple memo distributed to the participating agencies and MPO board or a glossy, full-color publication for the public. This information should be used to adjust investments or operations objectives that are no longer appropriate or beneficial.

[6] See Federal Highway Administration, "Applying Analysis Tools in Planning for Operations," (draft brochure) for more information.

1.4 Purpose of the Desk Reference

This desk reference is designed as a practical resource for MPOs and their partners — including State departments of transportation (DOT), transit agencies, and local governments — to advance operations in the metropolitan transportation planning process. It recognizes the wide diversity of MPOs in terms of size, growth, and congestion issues. Consequently, it is designed with flexibility in mind. The information contained in this document should help support efforts in small, medium, and large regions to incorporate operations objectives suitable to their unique circumstances and needs in their MTPs. This document should be used as a companion to the guidebook, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*. The guidebook describes how to use the objectives-driven, performance-based approach to integrate operations into the metropolitan planning process. This desk reference gives practitioners tangible examples of operations objectives that can be drawn from, in whole or in part, to develop MTPs. Additionally, the desk reference contains excerpts from a fictitious model plan showing how an MTP would incorporate operations using operations objectives and performance measures.

This desk reference contains the following sections:

Section 1, Introduction. An overview of the objectives-driven, performance-based approach is provided in this section. It also features ideas for getting started with implementing the approach for regions that are just beginning to incorporate operations into their metropolitan planning process.

Section 2, Developing Operations Objectives. This section provides a brief background on characteristics of operations objectives and provides a hierarchy for considering and developing operations objectives that might be included in an MTP.

Section 3, Menu of Operations Objectives. This section provides a set of sample operations objectives and associated performance measures and data needs organized by desired system outcomes and management and operations area. Reference tables are available in the beginning of the section to allow readers to find operations objectives based on their particular interest. Following the tables, are one- to two-page information sheets (fact sheets) that group together similar objectives under each category. The sheets contain sample operations objectives, performance measures, data required, and sample M&O strategies that may be considered to meet the objectives. In addition, any known safety benefits that may be realized by reaching the operations objectives on the sheet are highlighted.

Section 4, Model Transportation Plan. This section of the desk reference provides examples from a model metropolitan transportation plan that illustrate the integration of operations using the objectives-driven, performance-based approach. Examples of applying the approach from a basic, advancing, and comprehensive level are given to provide readers with a stronger understanding of how the approach may affect their MTPs.

Section 5, References and Resources. The document ends with information on additional references and resources to help in advancing operations in the metropolitan transportation planning process.

2.0 Developing Operations Objectives

Operations objectives and their associated performance measures are the focal point for integrating operations into the planning process. They are contained in the MTP and guide the discussion about operations in the region. While goals relate to the overall vision or desired end-result, operations objectives are specific and measurable. Unlike goals, progress toward an operations objective and its achievement can be evaluated with performance measures.

Regional goals reflect the region's values and vision for the future, and operations objectives should be developed to support one or more regional goals. This ensures that projects developed based on operations objectives are responding to the explicit values and overall goals for the region. Operations objectives describe what needs to occur to accomplish a regional goal. The operations objectives state what a region plans to achieve concerning the operational performance of the transportation system and help to determine what strategies and investments to include in the MTP.

Operations objectives typically place a focus on issues of congestion, reliability, safety and security, incident management, and work zone management, among other issues. Operations objectives aim to "optimize the performance of existing [and planned] infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system."[7]

2.1 Outcome-Based and Activity-Based Operations Objectives

The operations objectives contained in Section 3 range from objectives that focus on high-level outcomes, such as system reliability, to objectives that focus on low-level operations activities, such as signal timing. Operations objectives span a continuum between outcome-oriented (higher order) to activity-oriented (lower order) objectives. While there is not a strict boundary between the two primary orientations, most fit within one label or the other.

Given that the fundamental purpose of M&O strategies is to improve the transportation system, operations objectives that guide operations throughout the plan are preferably described in terms of those system performance outcomes experienced by users. Aspects of system performance experienced by the user include travel times, travel time reliability, and access to traveler information. The public cares about these measures, and, in many regions, data may be available to develop specific outcome-based operations objectives. Regions also may develop operations objectives that are activity-based and support desired system performance outcomes. Planners may find that the activity-based objectives are more appropriate for guiding the development of specific sections of the MTP or for use in supporting documents such as the regional concept for transportation operations. All lower level, activity-oriented operations objectives should support an existing outcome-oriented operations objective, providing a simple check to make sure that operations activities are performed in pursuit of a system performance outcome.

By establishing one or more activity-based objectives for each outcome-based objective, planners and operators further define how each outcome-based objective can be accomplished. Planners and operators can develop specific M&O strategies or actions to support the objectives and, in turn, the goals by examining how the activity-based objectives can be accomplished.

2.2 Characteristics of Operations Objectives

By creating specific, measurable objectives for operations, regions can use these operations objectives for making investment decisions as well as tracking progress.

An operations objective should have the SMART characteristics defined below:

- **Specific.** The objective provides sufficient specificity (e.g., decrease travel time delay) to guide formulating viable approaches to achieving the objective without dictating the approach.
- **Measurable.** The objective facilitates quantitative evaluation (e.g., by 10 percent), saying how many or how much should be accomplished. Tracking progress against the objective enables an assessment of the effectiveness of an action or set of actions.
- **Agreed.** Planners, operators, and relevant planning participants come to a consensus on a common objective. This is most effective when the planning process involves a wide range of stakeholders to facilitate regional collaboration and coordination.

[7] Excerpted from the definition of transportation systems management and operations (TSM&O) in the SAFETEA-LU Technical Corrections Act of 2008 that amended Section 101(a) of Title 23 U.S.C.

- **Realistic.** The objective can reasonably be accomplished within the limitations of resources and other demands. The objective may require substantial coordination, collaboration, and investment to achieve. Because determining the realism of the objective cannot occur until after strategies and costs are defined, the objective may need to be adjusted to be achievable.
- **Time-Bound.** The objective identifies a timeframe within which it will be achieved (e.g., within 5 years).

By selecting a performance target as part of the operations objective, regions make decisions knowing the degree of improvement they are striving for rather than just the direction of improvement. For example, the objective of "decrease travel time delay" conveys direction ("decrease") but does not indicate the desired degree of improvement. The objective "decrease travel time delay by 10 percent within 5 years" gives the region a specific and measurable target to reach.

It is common for metropolitan transportation plans to have more general objectives relating to the performance of the transportation system, such as, "Relieve congestion on the freeway and arterial systems in the region." This example objective provides the direction—to relieve congestion—but does not express to what degree it must be relieved to be met.

To make this objective SMART, it must define congestion in measurable terms. One measure used for congestion is the travel time index that compares travel during peak periods to travel at free flow or the posted speed limit. In addition, the objective needs a performance target for the region, such as a 0.10-point reduction in the index. The objective also must establish the timeframe in which it must be accomplished. Establishing a realistic objective and reaching agreement on it must be done within the context of the region and the participating organizations. Using the SMART characteristics as a guide, the general operations objective, "Relieve congestion on the freeway and arterial systems in the region" can be transformed into a SMART objective: "Reduce the regional average travel time index on freeways and arterials in the region by 0.10 points within 10 years."

Incorporating SMART operations objectives into the MTP provides the opportunity for decisionmakers to invest in near-term, relatively low-cost operations strategies that provide immediate improvements to the transportation system. These can complement longer-term improvement strategies that may require time to study and fund. Thus, it would be appropriate for an operations objective to have a timeframe that is shorter than the horizon year of the MTP. The cyclical updates required of these plans provide the logical opportunities to determine if adjustments are needed to the timeframe or degree of the objective and help determine whether different or additional actions are appropriate.

2.3 Scope of Operations Objectives

An operations objective is the product of many decisions. As mentioned in the previous section, those who draft the objective must decide on what they want to improve or maintain, the direction of that improvement (e.g., increase), the degree of improvement desired (e.g., by 25 percent), and the timeframe for reaching the objective (e.g., within 10 years).

In determining what to improve, several dimensions often come into consideration. These dimensions determine the scope of the operations objective. One or more of the following dimensions may need to be addressed while developing or refining the objective. In using the menu of objectives in the next section, the dimensions of the objective can be tailored to specific needs of the region.

- **Area.** This dimension defines the spatial aspect of the objective. What is the geographic area of focus? Does the objective aim to make improvements for the entire region, urban centers, corridors, freight-significant highways, work zones near major activity centers in the region, or another area?
- **Time.** What are the time periods of interest for operational improvements? Is there a focus on peak periods, off-peak periods, weekdays, during certain events, or other times? Frequently, operations objectives aim to make improvements during all time periods.
- **Mode and Facility Type.** Is the objective mode-neutral or does it target one or more specific modes such as walking, bicycling, public transit, or facility types such as highways/arterials, rails, or local connectors?
- **User Type.** Is there a particular transportation system user type that is the focus of this operations objective? Does the objective center on freight companies, single-occupancy vehicle drivers, transit-only travelers, or others?

While defining operations objectives, developers must consider how best to measure progress toward the objective because this impacts how the objective is stated and, subsequently, the improvements that are made. This process includes considerations such as whether the improvements are measured per person, per vehicle, per facility, or for the total population. Does the region want to improve the average performance or make strides toward reducing the worst performance? These are strategic decisions that must be made when developing operations objectives.

In the menu of objectives in Section 3, the scope of the objective can be adjusted along these dimensions to fit a region's specific needs.

2.4 Connecting Operations Objectives

Using the structure of a tree to develop operations objectives and ensure that the supporting connections exist is a common technique in strategic planning and systems analysis. The method of developing an objectives tree is more fully described in other resources,[8] but an example can be found in Figure 2, which illustrates the parts of an objectives tree. For the sake of brevity, the operations objectives are not written as full SMART objectives in the figure.

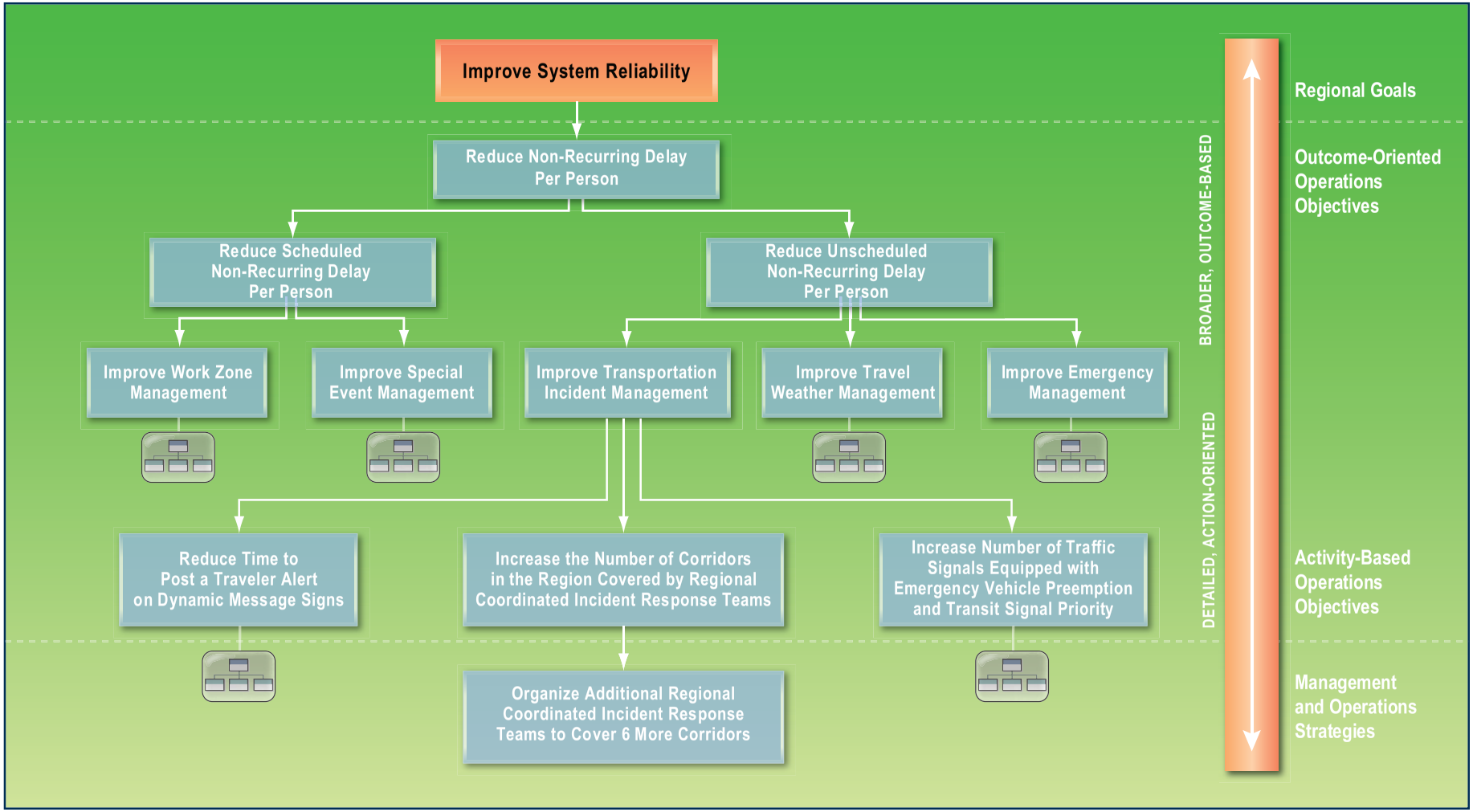
The objectives tree concept can be put to use in developing a logical set of operations objectives and in understanding the necessary connections between goals, operations objectives, and management and operations strategies. An objective tree illustrates the logical hierarchy that exists between outcome-based objectives and activity-based objectives. It can be used to connect regional goals to objectives and objectives to M&O strategies. It is also helpful in thinking through the interactions between operations objectives.

An objectives tree begins with a broad goal or high-order objective relating to the performance of the transportation system. This objective answers the question, "What do we ultimately want to achieve?" Examples may focus on improved system reliability, efficiency, system options, or high service quality. In the example shown in Figure 2, the tree begins with the broad goal, "Improve system reliability." Based on that goal, the higher-order, outcome-based objective, "Reduce nonrecurring delay" was formed. This is how the region aims to achieve its goal of improving system reliability. From this high-order objective, the developers form more specific and detailed operations objectives that answer the question, "How can this objective be accomplished?" These detailed or lower order objectives are then linked to the higher order objective. This process is repeated for each goal or high-order objective until the developers reach the point where the lower order operations objectives can be acted upon. These are typically activity-oriented operations objectives that can be readily addressed through one or more M&O strategies. Lower order operations objectives connected to a higher operations objective answer the question of how that higher objective can be accomplished. Similarly, the higher operations objective answers the question of why the lower objective should be accomplished. M&O strategies can be placed below each of the lowest objectives in the tree to indicate which strategies are needed to accomplish those objectives. In Figure 2, the M&O strategy of "Organize additional regional coordinated incident response teams to cover six more corridors" stems from one of the activity-based objectives.

Regions can select which operations objectives in the objectives tree are most important to be included in the MTP or other planning documents. Outcome-oriented objectives such as those that may be near the top of an objectives tree are used to guide the operations elements of the entire plan. Activity-based objectives are used in specific sections to guide the development of M&O strategies.

[8] See J. Gibson and W. Scherer, (W. Gibson, ed.), How to Do Systems Analysis, "Chapter 3: Goal Development," (Hoboken, NJ: Wiley & Sons, 2007).

Figure 2. Example of an Objectives Tree



2.5 Using Objectives to Identify and Select M&O Strategies

Operations objectives are used within the regional transportation planning process to help select strategies that will be included in the MTP and corresponding TIP. This occurs through a systematic process in which objectives lead to performance measures, data collection and analysis, and identification and prioritization of strategies. Each of the sample objectives in Section 3 identifies sample performance measures; anticipated data needs, data resources, and partners; and M&O strategies to consider.[9]

Specifically, developing operations objectives leads to performance measures that can be used to assess and track regional system performance. These regional performance measures can be tracked and forecasted under various plan scenarios. By identifying specific and measurable performance outcomes, operations objectives also can lead to developing performance measures at a micro level, such as to determine the performance of corridors, road segments, intersections, or transit routes. For instance, while an operations objective might include a specific target for regional delay, different thresholds can be used to define unacceptable delay within the region based on location (e.g., urban or suburban), facility type (e.g., freeway, high-occupancy vehicle [HOV] lane, transit route, arterial), and time period (e.g., peak commute periods, periods of special events).

Data are needed to use performance measures. Consequently, collecting data for performance measures is a key step in the planning process. Limitations in data are often a concern in selecting performance measures, particularly since MPOs typically are not responsible for operating the transportation system. However, many types of data currently are being collected by MPOs (e.g., census data on journeys to work, population, traffic counts, travel times). A wealth of data is being collected by transportation system operators, such as transit agencies, State DOTs, local transportation agencies, and toll authorities. It particular, intelligent transportation systems (ITS), such as toll tag readers, video detector systems, and traffic management systems, offer the opportunity for more detailed data to be used in planning, enabling analysis of issues such as variations in travel speeds. MPOs can team with agencies to collect and use the data.

An analysis of system- and corridor-level deficiencies (e.g., problems in specific parts of the region and corridors, times of year, or types of trips) and financial constraints should be used to help identify and select specific M&O strategies to include in the MTP and TIP. The assessment should consider cost-effectiveness in meeting operations objectives along with co-benefits, such as improved safety, and ability to support other regional goals. Analysis tools, such as sketch planning tools, travel demand forecasting model post-processors, and simulation modeling may be used to help forecast system deficiencies and analyze the potential benefits of operations strategies.

It is important to recognize that M&O strategies may be implemented as individual programs or projects, such as a regional incident management system, traveler information system, or transit smart card. They also can be implemented as part of transportation preservation projects, safety projects, or capacity improvements. For instance, as part of any new highway expansion, it may be useful to consider the role of transportation pricing, HOV lanes, flexible design to accommodate concurrent flows of traffic, or demand management programs.

[9] The specific strategies to be included within a plan should be based on analysis of the conditions in each metropolitan area.

3.0 Menu of Operations Objectives

3.1 Menu Structure and Definitions

The objectives in the menu have been organized into two main areas: system outcomes and transportation systems management and operations (TSM&O) areas.

Operations objectives in the area of system outcomes tend to be high-level, cross-cutting, and outcome-oriented as opposed to activity-based. They are typically mode-neutral. The three categories describing system outcomes were chosen based on three major attributes that users of the transportation system expect.

The operations objectives under the TSM&O areas are generally focused on one operational aspect of the system such as arterial management. They include both outcome-based objectives (e.g., reduce delay on arterials) and activity-based objectives (e.g., reduce time between incident verification and posting traveler alert). Operations objectives within the TSM&O areas support the achievement of one or more high-level objectives for system outcomes such as efficiency, reliability, or options.

The operations objectives under system outcomes have been subdivided into these three categories:

- System Efficiency
- System Reliability
- System Options

Under the TSM&O areas, the operations objectives have been subdivided into the following ten categories:

- Arterial Management
- Emergency/Incident Management
- Freeway Management
- Freight Management
- Special Event Management
- Transit Operations and Management
- Travel Demand Management
- Travel Weather Management
- Traveler Information
- Work Zone Management

The following provides the definition used in this desk reference for each of the categories, as well as information regarding what types of objectives are referenced under each section.

System Efficiency. Efficiency is defined as maximizing the benefits of the transportation system to the user while minimizing user costs. Costs to consider include additional travel time, monetary costs, travel distance, and fuel consumption. Operations objectives in the category of efficiency focus on minimizing costs and managing several aspects to congestion: extent, duration, and intensity. The sample objective categories cover:

- Extent of Congestion
- Duration of Congestion
- Intensity of Congestion
- Travel Time
- Delay
- Energy Consumption
- Cost of Congestion
- Vehicle Miles of Travel
- Trip Connectivity

System Reliability. A reliable transportation system can be defined as one that provides the users with a consistent and predictable travel time. While reliability could be expanded beyond travel time to cost, comfort, route, and mode availability, those aspects are more appropriately handled in other sections of the menu. Categories of operations objectives in this section include:

- Non-Recurring Delay
- Travel Time Buffer Index
- Planning Time Index
- Travel Time 95th/90th Percentile
- Variability
- Transit On-time Performance

System Options. System options refers to the user's ability to select a mode of travel from among many that are available to make a trip within a given timeframe, for a specific purpose, and/or via a certain route. Availability and utilization of multimodal options, such as transit, ridesharing, bicycling, and walking can be important components of a regional strategy to reduce traffic congestion and improve the operation of the transportation system. The sample objective categories cover:

- Mode Share
- Transit Use
- Transit Compared to Auto Travel Time

- Bicycle and Pedestrian Accessibility and Efficiency
- Modal Options for Individuals with Disabilities

Arterial Management. Arterial management is the management of arterial facilities in a manner that provides users with a safe, efficient, and reliable trip. The sample objective categories cover:

- Delay
- Access Management
- Reliability
- Traffic Monitoring and Data Collection
- Traffic Signal Management

Emergency / Incident Management. Emergency management is designed to provide users with a safe and efficient transportation system during an emergency situation. Incident management is defined as verifying, responding to, and clearing traffic incidents in a manner that provides transportation system users with the least disruption. The sample objective categories cover:

- Incident Duration
- Person Hours of Delay
- Evacuation Times
- Customer Satisfaction
- Traveler Information
- Inter-Agency Coordination
- Training
- Use of Technology

Freeway Management. Freeway management is the implementation of policies, strategies, and technologies to improve freeway performance. The over-riding objectives of freeway management programs include minimizing congestion (and its side effects), improving safety, and enhancing overall mobility. The sample objective categories cover:

- Efficiency
- Reliability
- Managed Lanes
- HOV Lanes
- Pricing and Tolling
- Ramp Management
- Transportation Management Centers

Freight Management. Freight management is the effective management of the system for freight transportation. The goal of freight transportation is to move goods safely, efficiently, and reliably throughout the region. This may range from satisfying the customer (e.g., freight shippers, receivers, and carriers) to actual travel time on the system. The sample objective categories cover:

- Customer Satisfaction
- Travel Time Delay
- Travel Time Reliability
- Border-Crossing
- Intermodal Facilities
- Detours and Routing

Special Event Management. Special event management provides users with a safe and efficiently managed transportation system during a planned special event. The sample objective categories cover:

- Entry/Exit Travel Times
- Mode Shift from Single Occupancy Vehicle (SOV)
- Traveler Information
- Parking Management
- Multi-Agency Coordination and Training
- Use of Technology

Transit Operations and Management. Transit operations and management is the operation and management of the transit system in a safe and efficient manner. The sample objective categories cover:

- Service Directness
- Loading Standards
- Traveler Information
- Customer Service/Safety
- Line-Haul Transit
- Transit Signal Priority
- Automated Fare Collection
- Park-and-Ride Support

Travel Demand Management. Travel demand management is defined as providing users with effective travel choices to shift or reduce the demand for travel in congested conditions. Travel demand management oversees two types of travel: commute travel and travel associated with tourism, emergencies, special events, shopping, etc. The objective categories in the menu cover:

- Auto Commuter Trip Reduction Programs
- Commuter Shuttle Service
- Carpool/Vanpool
- Walking/Bicycling
- Parking Management
- Marketing

Travel Weather Management. Travel weather management focuses on providing users with a safe and efficient transportation system during and after weather events. The sample objective categories cover:

- Clearing Time
- Detours for Impacted Roadways
- Disseminating Information
- Road Weather Information System Coverage
- Signal Timing Plans

Traveler Information. Traveler information is designed to provide transportation system users with the information they need to choose the safest and most efficient mode and route of travel. The sample objective categories cover:

- Information Dissemination
- Trip Planning Tools
- Data Collection and Sharing on Travel Conditions
- Customer Satisfaction

Work Zone Management. Work zone management involves organizing and operating areas impacted by road or rail construction to minimize traffic delays, maintain safety for workers as well as travelers, and accomplish the work efficiently.[10] The sample objective categories cover:

- Travel Time Delay
- Extent of Congestion
- Travel Time Reliability
- Construction Coordination
- Traveler Information
- Customer Satisfaction

[10] U.S. Department of Transportation, FHWA Work Zone Mobility and Safety Program, http://www.ops.fhwa.dot.gov/wz/.

3.2 Reference Tables

The operations objectives have been summarized in two table formats so users may quickly and efficiently find operations objectives of interest. The first, a cross-reference table, summarizes all the objective categories in the far left column while distinguishing different attributes that may be associated with each category, as summarized in the top row of the table. Each category listed in the left column of the table represents a single fact sheet. The purpose of the cross-reference table is to summarize where one fact sheet's objectives may overlap with another fact sheet's objectives. This allows users to quickly find outcome- and activity-based objectives related to their area of interest without having to read the entire menu section. For example, objectives related to System Efficiency are applicable to a majority of the individual TSM&O areas, so users are recommended not only to look under System Efficiency but also to review the TSM&O categories that are cross-referenced. In addition, many MPOs have staff that focus on specific modes; therefore, the table has efficiently summarized objectives by mode. Only fact sheet categories are summarized in the cross-reference table. Specific objectives are listed in the second summary table described below.

The second table, the objectives summary table, serves as a table of contents for the objectives listed within each fact sheet. The second table allows readers to quickly view what sample objectives are listed within the menu without needing to look through all fact sheets. This table is valuable for staff that 1) need to briefly share with other staff the menu of the objectives for MTP development or 2) often reference the document's menu for specific objectives.

3.2.1 Cross-Reference Table

Objective Fact Sheet Category, Title, and Page Number	System Benefits to Users			Modes Potentially Affected by Objective Being Considered						TSM&O Areas Potentially Used to Achieve Objectives									
	Efficiency	Reliability	Options	Auto	Transit	Freight	Pedestrian/Bicycle	Vanpool/Carpool	Ferry	Arterial	Emergency/ Incident	Freeway	Freight	Special Event	Transit	Travel Demand	Travel Weather	Traveler Information	Work Zone
System Efficiency																			
Extent of Congestion 37				X	X	X		X		X		X	X		X	X		X	
Duration of Congestion 38				X	X	X		X		X		X	X		X	X		X	
Intensity of Congestion 39				X	X	X		X	X	X		X	X		X	X		X	
Travel Time 40				X	X	X	X	X	X	X		X	X		X	X		X	
Delay 41				X	X	X	X	X	X	X		X	X		X	X		X	
Energy Consumption 42				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Cost of Congestion 43				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vehicle Miles of Travel 44				X	X		X	X	X	X		X			X	X		X	
Trip Connectivity 45					X		X	X	X	X		X			X	X			
System Reliability																			
Non-recurring Delay 46				X	X	X	X	X	X	X	X	X		X	X		X	X	X
Travel Time Buffer Index 47				X	X	X	X	X	X		X			X	X		X	X	X
Planning Time Index 48				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Travel Time 95th/90th Percentile 49				X	X	X	X	X	X		X			X	X		X	X	X
Variability 50				X	X	X	X	X	X	X	X	X		X	X		X	X	X
Transit On-Time Performance 51					X				X	X	X	X		X	X		X		X
System Options																			
Mode Share 52					X		X	X	X	X		X			X	X		X	
Transit Use 53					X		X	X	X	X		X			X	X		X	
Travel Time- Transit Compared to Auto 54					X				X	X		X			X	X			X
Bicycle and Pedestrian Accessibility and Efficiency 55							X			X						X			
Modal Options for Individuals with Disabilities 56							X			X						X			

Objective Fact Sheet Category, Title, and Page Number	System Benefits to Users			Modes Potentially Affected by Objective Being Considered						TSM&O Areas Potentially Used to Achieve Objectives									
	Efficiency	Reliability	Options	Auto	Transit	Freight	Pedestrian/Bicycle	Vanpool/Carpool	Ferry	Arterial	Emergency/ Incident	Freeway	Freight	Special Event	Transit	Travel Demand	Travel Weather	Traveler Information	Work Zone
Arterial Management																			
Delay 57	X	X		X	X	X	X	X		X									
Access Management 58	X			X	X	X	X	X		X									
Reliability 59		X		X	X	X		X		X	X								
Traffic Monitoring & Data Collection 60	X	X		X	X	X	X	X		X			X		X			X	
Traffic Signal Management 61	X	X		X	X	X	X	X		X									
Emergency/Incident Management																			
Incident Duration 63	X	X	X	X	X	X	X	X	X	X	X	X			X			X	
Person Hours of Delay 65	X	X		X	X	X	X	X	X	X	X	X			X			X	
Evacuation Times 66	X	X		X	X		X	X	X	X	X	X			X			X	
Customer Satisfaction 67		X		X	X	X	X	X	X		X							X	
Traveler Information 68		X	X	X	X	X	X	X	X	X	X	X			X			X	
Inter-Agency Coordination 69		X		X	X	X	X	X	X		X							X	
Training 71		X		X	X	X	X	X	X		X							X	
Use of Technology 72	X	X	X	X	X	X	X	X	X	X	X	X	X		X			X	
Freeway Management																			
Efficiency 73	X			X	X	X		X				X	X		X				
Reliability 74	X	X		X	X	X		X				X	X		X				
Managed Lanes 75	X	X		X	X	X		X				X	X		X		X		
HOV Lanes 76	X	X		X	X	X		X				X	X		X		X		
Pricing and Tolling 77	X	X		X	X	X		X				X	X		X		X		
Ramp Management 78	X			X	X	X		X				X	X		X				
Transportation Management Centers 79	X	X								X	X	X	X	X	X		X	X	X

Objective Fact Sheet Category, Title, and Page Number	System Benefits to Users			Modes Potentially Affected by Objective Being Considered						TSM&O Areas Potentially Used to Achieve Objectives									
	Efficiency	Reliability	Options	Auto	Transit	Freight	Pedestrian/Bicycle	Vanpool/Carpool	Ferry	Arterial	Emergency/ Incident	Freeway	Freight	Special Event	Transit	Travel Demand	Travel Weather	Traveler Information	Work Zone
Freight Management																			
Customer Satisfaction 80	X	X				X				X	X	X	X	X			X	X	X
Travel Time Delay 81	X	X				X				X	X	X	X	X		X	X	X	X
Travel Time Reliability 82		X				X				X	X	X	X	X			X	X	X
Border-Crossing 83	X					X							X					X	
Intermodal Facilities 84	X					X							X					X	
Detours and Routing 85		X				X							X						
Special Event Management																			
Entry/Exit Travel Times 86	X	X		X	X		X	X	X	X		X		X		X		X	
Mode Shift from Single Occupancy Vehicles (SOV) 87		X	X	X	X	X	X	X	X			X		X	X			X	
Traveler Information 88		X	X	X	X	X	X	X	X	X		X	X	X		X		X	
Parking Management 89			X	X				X						X					
Multi-Agency Coordination and Training 90		X		X	X	X	X	X	X					X					
Use of Technology 91	X	X	X	X	X	X	X	X	X	X				X	X	X		X	
Transit Operations and Management																			
Service Directness 92	X		X		X										X				
Loading Standards 93			X		X				X						X				
Traveler Information 94	X	X			X				X	X		X			X	X			
Customer Service/Safety 95	X	X			X										X				
Line-Haul Transit 96	X		X		X				X	X		X			X				
Transit Signal Priority 97	X		X		X					X		X			X				
Automated Fare Collection 98	X				X				X			X			X				
Park-and-Ride Support 99			X		X			X							X	X			

Objective Fact Sheet Category, Title, and Page Number	System Benefits to Users			Modes Potentially Affected by Objective Being Considered						TSM&O Areas Potentially Used to Achieve Objectives									
	Efficiency	Reliability	Options	Auto	Transit	Freight	Pedestrian/Bicycle	Vanpool/Carpool	Ferry	Arterial	Emergency/ Incident	Freeway	Freight	Special Event	Transit	Travel Demand	Travel Weather	Traveler Information	Work Zone
Travel Demand Management																			
Auto Commuter Trip Reduction Programs 100	X		X		X		X	X	X						X	X		X	
Commuter Shuttle Service 101	X		X		X			X	X						X	X			
Carpool/Vanpool 102	X		X					X								X			
Walking/Bicycling 103			X				X									X			
Parking Management 104			X	X	X			X	X							X			
Marketing 106	X		X		X		X	X	X						X	X		X	
Travel Weather Management																			
Clearing Time 107	X	X		X	X	X	X	X	X	X		X			X		X	X	
Detours for Impacted Roadways 108		X	X	X	X	X		X		X		X					X	X	
Disseminating Information 109		X	X	X	X	X	X	X	X	X		X	X		X		X	X	
Road Weather Information System Coverage 110		X		X	X	X	X	X	X	X		X	X		X		X	X	
Signal Timing Plans 111		X		X	X	X		X		X		X	X		X		X		
Traveler Information																			
Information Dissemination 112	X	X	X	X	X	X	X	X	X						X			X	
Trip Planning Tools 113	X	X	X	X	X	X	X	X	X						X	X		X	
Data Collection & Sharing on Travel Conditions 114	X	X	X	X	X	X	X	X	X	X		X			X			X	
Customer Satisfaction 115	X	X		X	X	X	X	X	X									X	

Objective Fact Sheet Category, Title, and Page Number	System Benefits to Users			Modes Potentially Affected by Objective Being Considered						TSM&O Areas Potentially Used to Achieve Objectives									
	Efficiency	Reliability	Options	Auto	Transit	Freight	Pedestrian/Bicycle	Vanpool/Carpool	Ferry	Arterial	Emergency/ Incident	Freeway	Freight	Special Event	Transit	Travel Demand	Travel Weather	Traveler Information	Work Zone
Work Zone Management																			
Travel Time Delay 116	X	X		X	X	X	X	X	X	X		X			X			X	X
Extent of Congestion 117	X	X		X	X	X	X	X	X	X		X			X			X	X
Travel Time Reliability 118	X	X		X	X	X	X	X	X	X		X			X			X	X
Construction Coordination 119	X	X	X	X	X	X	X	X		X		X	X		X				X
Traveler Information 120	X	X	X	X	X	X	X	X		X		X	X		X			X	X
Customer Satisfaction 121	X	X		X	X	X	X	X	X	X		X			X			X	X

3.2.2 Objectives Summary Table

System Efficiency	
Fact Sheet Title/Page Number	**Operations Objective**
Extent of Congestion / 37	• Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y. • Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate). • Reduce the share of major intersections operating at LOS Z by X percent by year Y.
Duration of Congestion / 38	• Reduce the daily hours of recurring congestion on major freeways from X to Y by year Z. • Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion by X percent by year Y.
Intensity of Congestion (Travel Time Index) / 39	• Reduce the regional average travel time index by X percent per year.
Travel Time / 40	• Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through year Y. • Improve average travel time during peak periods by X percent by year Y.
Delay / 41	• Reduce hours of delay per capita by X percent by year Y. • Reduce hours of delay per driver by X percent by year Y.
Energy Consumption / 42	• Reduce total energy consumption per capita for transportation by X percent by year Y. • Reduce total fuel consumption per capita for transportation by X percent by year Y. • Reduce excess fuel consumed due to congestion by X percent by 2020.
Cost of Congestion / 43	• Reduce the annual monetary cost of congestion per capita for the next Y years by X percentage each year.
Vehicle Miles Travel / 44	• Reduce vehicle miles traveled per capita by X percent by year Y.
Trip Connectivity / 45	• Reduce door-to-door trip time by X percent by year Y. • Reduce cost of transfer fees paid by X percent by year Y.

System Reliability

Fact Sheet Title/Page Number	Operations Objective
Non-Recurring Delay /46	• Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by: ▪ (Option 1) scheduled events, work zones, or system maintenance by X hours in Y years. ▪ (Option 2) unscheduled disruptions to travel by X hours in Y years. ▪ (Option 3) all transient events such as traffic incidents, special events, and work zones by X hours in Y years.
Travel Time Buffer Index / 47	• Decrease the buffer index for (specific travel routes) by X percent over the next Y years. • Decrease the average buffer index for (multiple routes or trips) by X percent over Y years. • Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.
Planning Time Index / 48	• Reduce the average planning time index for (specific routes in region) by X (no units) over the next Y years. • Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.
Travel Time 95th/90th Percentile / 49	• Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years. • Reduce the 90th (or 95th) percentile travel time for each route selected by X percent over Y years.
Variability / 50	• Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.
Transit On-time Performance / 51	• Improve average on-time performance for specified transit routes/ facilities by X percent within Y years.

System Options

Fact Sheet Title/Page Number	Operations Objective
Mode Share / 52	• Reduce per capita single occupancy vehicle commute trip rate by X percent in Y years. • Increase alternative (non-SOV) mode share for all trips by X percent within the next Y years. • Increase active (bicycle/pedestrian) mode share by X percent by year Y. • Reduce SOV vehicle trips by X percent through travel demand management strategies (e.g., employer or residential rideshare) by year Y. • Achieve X percent alternative (non-SOV) mode share in transit station communities (or other areas) by year Y.
Transit Use / 53	• Increase transit mode share by X percent by year Y. • Increase transit mode share by X percent by year Y during peak periods. • Increase average transit load factor by X percent by year Y. • Increase passenger miles traveled per capita on transit by X percent by year Y.
Travel Time—Transit Compared to Auto / 54	• Reduce the travel time differential between transit and auto during peak periods by X percent per year for Y years. • Maintain a travel time differential between transit and auto during peak periods of X percent for Y years. • Improve average transit travel time compared to auto in major corridors by X minutes per year for Y years.
Bicycle and Pedestrian Accessibility and Efficiency / 55	• Decrease average delay for pedestrians and bicyclists on primary ped/bike routes by X percent in Y years. • Increase the share of roadways with bicycle lanes to X by year Y. • Increase system completeness for bicyclists and pedestrians by X percent within Y years. • Increase the number of intersections with pedestrian features (countdown pedestrian signal heads, painted crosswalks, etc.) to X percent by year Y. • Increase average pedestrian (or bicyclist) comfort level by X points in Y years.
Modal Options for Individuals with Disabilities / 56	• Increase the percent of intersections with ADA (Americans with Disabilities Act) provisions to X percent by year Y. • Increase the availability of transit to individuals with disabilities by X percent by year Y. • Increase the percent of transit stops with ADA (Americans with Disabilities Act) provisions to X percent by year Y.

Arterial Management

Fact Sheet Title/Page Number	Operations Objective
Delay /57	• Decrease the seconds of control delay per vehicle on arterial roads by X percent in Y years. (Control delay is defined as the portion of the total delay attributed to traffic signal operation for signalized intersections.) • Increase the miles of arterials in the region operating at level of service (LOS) Z by X percent in Y years.
Access Management / 58	• Maintain a distance of X feet between intersections on major arterials in the region for the next Y years. • Reduce driveway access by X percent on major arterials for all new developments for the next Y years.
Reliability / 59	• Reduce buffer index on arterials during peak and off-peak periods by X percent in Y years. • Reduce delay associated with incidents on arterials by X percent by year Y. [See section on System Reliability for additional information on Buffer Index, planning index, and other measures]
Traffic Monitoring and Data Collection / 60	• Number of field data collection studies performed every Y and X years on major and minor signalized arterials, respectively. • X percent of intersections in the region are equipped and operating with traffic signals that enable real-time monitoring and management of traffic flows by year Y. • X percent of major and minor arterials are equipped with and operating with arterial link traffic data detection stations (or appropriate technology) per Z distance by year Y. • X percent of major and minor arterials are equipped with and operating with closed circuit television (CCTV) cameras per Z distance by year Y.
Traffic Signal Management / 61	• Maintain a program of evaluating X percent of signals for retiming every Y years. • Increase the number of intersections running in a coordinated, closed-loop, or adaptive system by X percent in Y years. • Special timing plans are available for use during freeway incidents, roadway construction activities, or other special events for X miles of arterials in the region by year Y. • Crash data for all arterials in the region is reviewed every X years to determine if signal adjustments can be made to address a safety issue.

Emergency/Incident Management

Fact Sheet Title/Page Number	Operations Objective
Incident Duration / 63	Discovery and Verification Time • Reduce mean incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies) by X percent over Y years (i.e., through "Motorist Assist" roving patrol programs, reduction of inaccurate verifications, etc.). Notification and Response Time • Reduce mean time for needed responders to arrive on-scene after notification by X percent over Y years. Time to Clear Incident and Resume Traffic Flow • Reduce mean incident clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and the time the last responder has left the scene.) • Reduce mean roadway clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and restoration of lanes to full operational status.) • Reduce mean time of incident duration (from awareness of incident to resumed traffic flow) on transit services and arterial and expressway facilities by X percent in Y years.
Person Hours of Delay / 65	• Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y years.
Evacuation Times / 66	• Reduce the per capita time to evacuate Z persons in the region by X percent over Y years.
Customer Satisfaction / 67	• Increase customer satisfaction with the region's incident management by X percent over Y years.
Traveler Information / 68	• Reduce time between incident/emergency verification and posting a traveler alert to traveler information outlets (e.g., variable message signs, agency website, 511 system) by X minutes in Y years. • Increase number of repeat visitors to traveler information website (or 511 system) by X percent in Y years. • Reduce the time between recovery from incident and removal of traveler alerts for that incident.

Emergency/Incident Management

Fact Sheet Title/Page Number	Operations Objective
Inter-Agency Coordination / 69	• Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years. • Increase the number of corridors in the region covered by regional coordinated incident response teams by X percent in Y years. • Hold at least X multi-agency after-action review meetings each year with attendance from at least Y percent of the agencies involved in the response to an incident. • At least X percent of transportation operating agencies have a plan in place for a representative to be at the local or State Emergency Operations Center (EOC) to coordinate strategic activities and response planning for transportation during emergencies by year Y.
Training / 71	• Conduct X joint training exercises among operators and emergency responders in the region by year Y. • By Y (year), X percent of staff in region with incident management responsibilities will have completed the National Incident Management System (NIMS) Training and at least X percent of transportation responders in the region are familiar with the incident command structure (ICS).
Use of Technology / 72	• Increase number of ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident and emergency detection/response by X in Y years. • Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response by X percent in Y years. • Increase number of traffic signals equipped with emergency vehicle preemption by X percent in Y years.

Freeway Management

Fact Sheet Title/Page Number	Operations Objective
Efficiency / 73	• Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system. • Reduce the share of freeway miles at level of service (LOS) X by Y by year Z. [See section on efficiency-related objectives for others that apply to freeways]
Reliability / 74	• Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years. • Reduce delay associated with incidents on the freeway system by X percent by year Y. [See section on system reliability for additional information on buffer index, planning index, and other measures]
Managed Lanes / 75	• Increase the miles of managed lanes in the region from X to Y by year Z. • Provide options for reliable travel times for certain types of travel (e.g., transit, carpool, truck, etc.) on at least X percent of the freeway network by year Y. • Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate at no less than X mph during their hours of operation. • Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate with a volume of at least X vehicles per hour. • Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) carry a throughput of at least Y persons per hour.
HOV Lanes / 76	• Increase the number of HOV lane miles from X to Y by year Z. • Provide options for reliable travel times for carpools and transit on at least X percent of the freeway network by year Y. • Ensure that all HOV lanes operate at no less than X mph during their hours of operation. • Ensure that all HOV lanes operate with a volume of at least X vehicles per hour. • Ensure that all HOV lanes carry a throughput of at least Y persons per hour. • Increase the average vehicle occupancy rate in HOV lanes to X by year Y. • Increase the compliance rate for HOV lanes to X percent by year Y.

Freeway Management

Fact Sheet Title/Page Number	Operations Objective
Pricing and Tolling / 77	• Increase the percentage of users carrying electronic toll collection (ETC) transponders by X percent by year Y. • Increase the share of toll roadways and bridges that are using variable pricing (e.g., congestion pricing) to X percent by year Y. • Increase the share of freeways that are priced to X percent by year Y.
Ramp Management / 78	• Increase the percent of freeway interchanges operating at LOS Z or higher during peak periods by X percent by year Y. • Reduce the number of congestion-inducing incidents occurring at freeway ramps by X percent by year Y. • Increase the number freeway ramps currently metered by X percent by year Y.
Transportation Management Centers / 79	• Increase the level of transportation management center (TMC) field hardware (cameras, variable message signs, electronic toll tag readers, ITS applications, etc.) by X percent by year Y. • Increase the hours of TMC operation and level of staffing done by X percent by year Y. • Increase the percent of regional transportation system monitored by the TMC for real-time performance by X percentage points.

Freight Management

Fact Sheet Title/Page Number	Operations Objective
Customer Satisfaction / 80	• Increase ratings for customer satisfaction with freight mobility in the region among shippers, receivers, and carriers by X percent in Y years.
Travel Time Delay / 81	• Increase the mobility index (defined below) by X percent in Y years. • Decrease the annual average travel time index for freight by X points in Y years. • Decrease point-to-point travel times on selected freight-significant highways by Y minutes within Y years. • Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways by X percent in Y years.
Travel Time Reliability / 82	• Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years. (See System Reliability for additional information on buffer index.)
Border Crossing / 83	• Decrease average crossing times at international borders by X minutes for each border in the region over Y years. • Increase the use of electronic credentialing to X percent of weigh stations and border crossings by year Y.
Intermodal Facilities / 84	• Reduce the frequency of delays per month at intermodal facilities by X percent in Y years. • Reduce the average duration of delays per month at intermodal facilities by X percent in Y years.
Detours and Routing / 85	• X percent of freeway and major arterial detours can accommodate commercial vehicles by year Y. • Provide freight operators with traveler alerts and alternate routes in the case of incidents, special events, weather, construction, and severe congestion at choke points on X percent of freight-significant routes by year Y.

Special Event Management

Fact Sheet Title/Page Number	Operations Objective
Entry/Exit Travel Times / 86	• Reduce average travel time into and out of the event by X percent in Y years. • Reduce average time to clear event's exiting queue by X percent in Y years. • Reduce non-special event VMT in the event area during events by X percent in Y years. • Reduce buffer time index for travelers to multiple similar special events by X percent in Y years.
Mode Shift from Single Occupancy Vehicles / 87	• Decrease the percent of special event attendees traveling to the event in single-occupancy vehicles by X percent in Y years. • Increase the percent of special event attendees using park & ride lots by X percent in Y years. • Increase the percent of special events with dedicated shuttle service by X percent in Y years.
Traveler Information / 88	• Increase the methods of effectively disseminating special event information to travelers by X percent in Y years (e.g., media releases, highway advisory radio, dynamic message signs, commercial AM and FM radio). • Increase the percentage of planned special events (with attendance above Z) with information on anticipated and actual travel conditions being disseminated to the traveling public at least X hours prior to the event.
Parking Management / 89	• Increase the number of special events that use shared parking facilities (e.g., parking lots of nearby businesses or organizations) by X percent in Y years. • Increase the use of flexible pricing mechanisms near special event locations on X percent of parking spaces in Y years. • Increase on-street parking restrictions on X percent of widely used routes during special events in Y years. • Decrease the time spent clearing special event venue parking lots of vehicles by X percent in Y years following each event.

Special Event Management

Fact Sheet Title/Page Number	Operations Objective
Multi-Agency Coordination and Training / 90	• Increase the percentage of special event stakeholder agencies participating in a regional event management team to X percent by year Y. • Increase the number of agencies with special event management responsibilities that use interoperable communications by X percent in Y years. • Increase the percentage of special events that include a pre-event and post-event briefing by X percent in Y years. • Increase the number of special event-related exercises performed among stakeholders by X percent in Y years.
Use of Technology / 91	• Increase the percent of major special events using ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) to detect and manage special event entry/exit bottlenecks and incidents by X percent in Y years. • Implement special event traffic signal timing plans at X percent of major special events each year beginning in year Y.

Transit Operations and Management

Fact Sheet Title/Page Number	Operations Objective
Service Directness / 92	• At least X percent of trips can be made with no more than Y transfers. • Scheduled transfer times between routes should be no longer than X minutes.
Loading Standards / 93	• Load factors for (route type) routes at each route's busiest point should not exceed X on any vehicle (or on the average vehicle) during peak/off-peak periods. • Passenger loads on (route type) routes at each route's busiest point should not exceed X passengers on any vehicle (or on average) during the hour during peak/off-peak periods • No more than X standees should be present at each route's busiest point on any vehicle (or on the average vehicle) during peak/off-peak periods. • No passenger will have to stand for more than X minutes during their journey.
Traveler Information / 94	• Equip X shelters/platforms with real-time arrival displays annually. • Increase the number of web-based trip planner requests each year by X percent. • All stops have up-to-date schedule information available within X days of schedule changes. • Transit traveler information is available in the region via 511 web and phone service by year Y. • Install Wi-Fi service on X number of routes annually.
Customer Service/Safety / 95	• Decrease by X percent on an annual basis the number of complaints per 1,000 boarding passengers. • Increase the number of closed circuit television (CCTV) cameras installed by X percent in Y years on platforms, park-n-ride lots, vehicles, and other transit facilities. • Increase customer service and personal safety ratings by X percent within Y years. • Decrease the number of reported personal safety incidents by X percent within Y years.
Line-Haul Transit / 96	• Improve average travel speeds by X percent for specified line-haul transit routes every Y years. • Improve average on-time performance for specified line-haul transit routes by X percent annually. • Provide line-haul transit travel times equal to or less than average auto travel times on same corridors/parallel corridors for X number of routes over Y years.

Transit Operations and Management

Fact Sheet Title/Page Number	Operations Objective
Transit Signal Priority / 97	• Increase implementation of transit signal priority strategies on X number of routes (or X number of intersections) over the next Y years. • Decrease system-wide signal delay on transit routes by X percent per year. • Decrease delay by X percent per year by increasing the use of queue jumping and automated vehicle location.
Automated Fare Collection / 98	• Implement an automated fare collection system in Y years for X percent of transit providers in the region. • Integrate X additional modes/services into an automated fare collection system by Y years. • Increase use of system by X percent per year. • Increase by X percentage points, every Y years, the percent of transfers performed with automated fare cards.
Park-and-Ride Support / 99	• Increase traveler awareness of park-and-ride lots by X percent within Y years. • Increase pedestrian and bicycle access to park-and-ride lots by X percent within Y years. • Increase the number of automobile and bicycle spaces by X percent within Y years for lots currently experiencing X percent utilization.

Travel Demand Management

Fact Sheet Title/Page Number	Operations Objective
Auto Commuter Trip Reduction Programs / 100	• Increase the percent of major employers (employers with a number of employees greater than Z at least Z employees) actively participating in transportation demand management programs by X percent within Y years. • Reduce commuter vehicle miles traveled (VMT) per regional job by X percent in Y years.
Commuter Shuttle Service / 101	• Annually promote shuttle service between X major activity centers and major destinations that are not already accommodated within 1/4 mile by other transit services.
Carpool/Vanpool / 102	• Increase the number of carpools by X percent over the next Y years. • Increase use of vanpools by X percent over the next Y years. • Provide carpool/vanpool matching and ridesharing information resources and services by year Y. • Reduce trips per year in region by X percent through carpools/vanpools. • Create and share regional carpool/vanpool database with Z number of employers per year.
Walking/Bicycling / 103	• Increase the number of travelers commuting via walking and/or bicycling by X percent over Y years. • Annually update bicycle/pedestrian map for accuracy. • Increase the number of available tools for travelers that incorporate a bicycle/pedestrian component by X percent by year Y.
Parking Management / 104	• Implement shared parking for X communities every Y years. • Implement parking pricing for X communities every Y years. • Install parking meters along X corridors by year Y in the urban core/transit supportive areas. • Increase the number of residents/commuters receiving information on parking pricing and availability within Y years. • Increase park-and-ride lot capacity by X percent over Y years. • Biannually increase preferred parking spaces for carpool/vanpool participants within downtown, at special events, and among major employers by X percent within Y years.
Marketing / 106	• Develop and provide travel option services to X identified communities and audiences within Y years. • Construct visitor information centers in X communities by year Y. • Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.) by year Y. • Develop and enhance (e.g., through ease of navigation techniques) X number of web-based traveler information tools.

Travel Weather Management

Fact Sheet Title/Page Number	Operations Objective
Clearing Time / 107	• Reduce average time to complete clearing (choose mode, hierarchy of facilities, or subarea of region) of weather-related debris on (interstates, freeways, expressways, all roads, main tracks, and main sidewalks, etc.) after weather impact by X percent in Y years. • Reduce average time to complete clearing (interstates, freeways, expressways, all roads, main tracks, and main sidewalks) of weather-related debris after weather impact by X percent in Y years.
Detours for Impacted Roadways / 108	• Increase by X percent of significant travel routes covered by weather-related diversion plans by year Y. • Increase the percent of agencies that have adopted multi-agency weather-related transportation operations plans and that are involved in transportation operations during weather events to X percent by year Y.
Disseminating Information / 109	• Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.
Road Weather Information System Coverage / 110	• Increase the percent of major road network (or transit network or regional bicycle network) covered by weather sensors or a road weather information system (RWIS) by X percent in Y years as defined by an RWIS station within Z miles.
Signal Timing Plans / 111	• Special timing plans are available for use during inclement weather conditions for X miles of arterials in the region by year Y.

Traveler Information

Fact Sheet Title/Page Number	Operations Objective
Information Dissemination / 112	• Increase number of 511 calls per year by X percent in Y years. • Increase number of visitors to traveler information website per year by X percent in Y years. • Increase number of users of notifications for traveler information (e.g., e-mail, text message) by X percent in Y years. • Increase number of Web 2.0 (e.g., Twitter, Facebook) followers by X percent in Y months. • Increase the accuracy and completeness of traveler information posted (on variable message signs, websites, and/or web 2.0 technologies) by reducing the number of incomplete and inaccurate reports by X percent in Y years.
Trip Planning Tools / 113	• Enhance regional multimodal trip planning tools to X data sources by year Y. • Increase the ease of use of trip planning tools by X percent by year Y. • Increase the number of uses of multimodal trip planning tools by X percent by year Y.
Data Collection and Sharing on Travel Conditions / 114	• Increase the percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. to X percent by Y year. • Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region to X percent by Y year. • Increase the percent of modes in the region that share their traveler information with other modes in the region to 100 percent by Y year.
Customer Satisfaction / 115	• Increase customer satisfaction ratings for the timeliness, accuracy, and usefulness of traveler information in the region by W, X, and Z percent, respectively, over Y years.

Work Zone Management

Fact Sheet Title/Page Number	Operations Objective
Travel Time Delay / 116	• Reduce the person hours (or vehicle hours) of total delay associated with work zones by X percent over Y years. • Increase the rate of on-time completion of construction projects to X percent within Y years. • Increase the percent of construction projects that employ night/off-peak work zones by X percent in Y years.
Extent of Congestion / 117	• Reduce the percent of vehicles traveling through work zone that are queued by X percent in Y years. • Reduce the average and maximum length of queues, when present, by X percent over Y years. • Reduce the average time duration (in minutes) of queue length greater than some threshold (e.g., 0.5 mile) by X percent in Y years.
Travel Time Reliability / 118	• Reduce vehicle-hours of total delay in work zones caused by incidents (e.g., traffic crashes within or near the work zone).
Construction Coordination / 119	• Increase the number of capital projects reviewed for regional construction coordination by X percent in Y years. • Decrease the number of work zones on parallel routes/along the same corridor by X percent in Y years. • Establish a work zone management system within X years to facilitate coordination of work zones in the region.
Traveler Information / 120	• Provide traveler information regarding work zones using variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years. • Provide travelers with information on multimodal alternatives to avoid work zones for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years. • Provide work zone information (for upcoming and ongoing construction projects) to all impacted businesses, or tenants of business centers, with X employees or more by year Y.
Customer Satisfaction / 121	• Increase customer satisfaction with region's work zone management by X percent over Y years.

3.3 Fact Sheets

This section contains fact sheets for the following categories (defined in Section 3.1):

1. System Efficiency
2. System Reliability
3. System Options
4. Arterial Management
5. Emergency/Incident Management
6. Freeway Management
7. Freight Management
8. Special Event Management
9. Transit Operations and Management
10. Travel Demand Management
11. Travel Weather Management
12. Traveler Information
13. Work Zone Management

Each fact sheet contains the following information:

- Category title
- General description
- Operations objectives
- Performance measures
- Anticipated data needs
- Data resources and partners
- M&O strategies to consider
- Safety-related impacts

Safety Background Information

Three sources were researched to identify statistically sound, agreed-upon safety impact information. The three sources referenced for this desk reference were:

- Transportation Research Board, National Cooperative Highway Research Program, NCHRP 17-36: *Production of the First Edition Highway Safety Manual* (HSM).
- U.S. Department of Transportation, FHWA, *Desktop Reference for Crash Reduction Factors*, September 2008. Publication Number FHWA-SA-08-011. Available at: http://safety.fhwa.dot.gov/tools/crf/desk_ref_sept2008/.
- Transportation Research Board, National Cooperative Highway Research Program (NCHRP), Report 500, Volumes 1 – 17, *Guidance for Implementation of the AASHTO Strategic Highway Safety Plan*, 2003-2005. Available at http://safety.transportation.org/guides.aspx.

The related safety impacts cited in this document are select examples, and do not constitute a comprehensive overview and listing. Example M&O strategies within the three sources were only selected for those actions which produced a sound trend or a specific crash modification factor. Crash modification factors and associated error estimates are sited when available in the safety-related impacts section of the fact sheets. A crash modification factor (CMF) is a multiplicative factor used to compute the expected number of crashes after implementing a given treatment (countermeasure) at a specific site. For example, an intersection is experiencing 100 angle crashes per year. If an agency applies a countermeasure that has a crash modification factor of 0.80 for angle crashes, then the agency can expect to see 80 angle crashes per year following the implementation of the countermeasure (100 x 0.80 = 80). Most crash modification factors are stated with standard errors. The standard error can be used to estimate the confidence interval of the crash modification factor. To estimate the range of the potential change in crash frequency with a 95th percentile confidence interval, multiply the standard error by two and add and subtract this value to/from the crash modification factor. So if a crash modification factor of 0.80 has a standard error of 0.1, the range of the crash modification factor is 0.60 (0.80 – 2x0.10) to 1.0 (0.80 + 2x0.10). This means that an agency can be 95% confident that the treatment will result in up to a 40 percent reduction in crashes.[11]

[11] For more information on crash modification factors and standard error, see the FHWA crash modification factor Clearinghouse 2009, at http://www.cmfclearinghouse.org.

System Efficiency: Extent of Congestion 3.3.1

General Description

The intent of these objectives is to manage the proportion of the transportation system that experiences recurring congestion (the spatial extent of congestion). Common expressions of recurring congestion are volume-to-capacity (V/C) ratio and level of service (LOS), which is measured in terms of travel speed or delay.

Operations Objectives	• **Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y.** • **Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate).** • **Reduce the share of major intersections operating at LOS Z by X percent by year Y.**
Performance Measures	• Percent of lane-miles (or rail) operating at LOS F or V/C > 1.0 • Percent of intersections operating at LOS F or V/C > 1.0 • Rate of increase in facility miles operating at LOS F or V/C > 1.0 • Population growth rate.
Anticipated Data Needs	• Hourly volume data (e.g., traffic counts); inventory of facilities (number of lanes, presence/frequency of signals/intersections, etc.); calculations or estimates of capacity. • Population, average vehicle control delay.
Data Resources and Partners	• Annual count programs, planning studies, engineering studies, and traffic impact studies. • GIS or other database of system inventory. • State DOTs, transit agencies, MPOs, regional planning councils, highway districts, cities, counties, and traffic management centers.
M&O Strategies to Consider	Strategies designed to reduce recurring congestion, such as traffic signal coordination and travel demand strategies that encourage shifts in travel mode, time, or route.
Safety-related Impacts	Select examples of M&O strategies associated with recurring congestion and their safety impacts include: • Convert a four-leg intersection into two T-intersections: The crash modification factor for this treatment is between 0.75 and 1.35 depending on the crash severity and distribution of traffic entering the intersection. *Source: HSM, First Edition.* • Install turn and bypass lanes: The crash modification factor for this treatment is between 0.95 and 0.47 depending on the crash severity and crash type. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.* **Note**: The existing number of crashes is multiplied by the crash modification factor to determine the expected number of crashes following implementation of a treatment.

System Efficiency: Duration of Congestion

General Description

These objectives focus on managing the duration of recurring congestion (roadway or intersection) on the transportation system. The duration of recurring congestion represents the length of time that a facility is congested. Common expressions of recurring congestion are volume-to-capacity (V/C) ratio and level of service (LOS), which is measured in terms of travel speed or delay.

Operations Objectives	• **Reduce the daily hours of recurring congestion on major freeways from X to Y by year Z.** • **Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion by X percent by year Y.**
Performance Measures	• Hours per day at LOS F or V/C > 1.0 (or other threshold).
Anticipated Data Needs	• Hourly traffic volume data (e.g., traffic counts); inventory of facilities (number of lanes, presence/frequency of signals/intersections, etc.); calculations or estimates of capacity.
Data Resources and Partners	• ITS data (continuous traffic counters), traffic count programs, studies. • GIS or other database of system inventory. • State DOTs, regional planning councils, MPOs, highway districts, cities, counties, and traffic management centers.
M&O Strategies to Consider	Strategies designed to reduce recurring congestion, such as traffic signal coordination; travel demand strategies that encourage shifts in travel mode, time, or route; and congestion pricing strategies that encourage shifts to off-peak periods.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Remove unwarranted signals: The safety impact for this countermeasure is the potential for decreasing frequency of collisions. Targets for this action are signalized intersections where traffic volumes and safety records do not warrant a traffic signal. This action also includes potential to eliminate excessive delay and disobedience of traffic signal and decrease use of inappropriate routes to avoid signal. Right angle crashes may increase after removal. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").* • Modify access point density: The safety impact of reducing the number of access points is the potential reduction in both injury and non-injury crash frequency as well as angle and sideswipe collisions at intersections and mid-block areas. *Source: HSM, First Edition.*

System Efficiency: Intensity of Congestion (Travel Time Index)

General Description

This objective focuses on managing the intensity of traffic congestion experienced by the traveling public. Congestion is measured using a travel time index, which compares travel conditions in the peak period to travel conditions during free-flow or posted speed limit conditions. For instance, a travel time index of 1.30 indicates that travel typically takes 30 percent longer in the peak period than during the off-peak period. The objectives focus on the actual experience of travelers and can be multimodal if transit travel time is included in the measure.

Operations Objectives	• **Reduce the regional average travel time index by X percent per year.**
Performance Measures	• Travel time index (the average travel time during the peak period, using congested speeds, divided by the off-peak period travel time, using posted or free-flow speeds).
Anticipated Data Needs	• Travel speed data during peak and off-peak periods across a network of facilities (freeways, highways, arterials, light-rail tranist, BRT, bus routes, etc.).
Data Resources and Partners	• ITS data (continuous measurements of traffic speed), speed studies. • State DOTs, regional planning councils, MPOs, highway districts, cities, counties, and traffic management centers.
M&O Strategies to Consider	Strategies designed to reduce recurring peak period congestion, such as traffic signal coordination; and travel demand strategies that encourage shifts in travel mode, time, or route. If the objective includes transit, strategies could include transit signal priority.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Remove unwarranted signals: The safety impact for this countermeasure is the potential for decreasing the frequency of collisions. Targets for this action are signalized intersections where traffic volumes and safety records do not warrant a traffic signal. This action also includes the potential to eliminate excessive delay and disobedience of traffic signals and decrease the use of inappropriate routes to avoid signals. Right angle crashes may increase after removal. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").*

System Efficiency: Travel Time

General Description

These objectives focus on reducing travel time experienced by travelers. Travel time is a measure of the average time spent in travel, reflecting both travel speeds and distances. Total travel time is calculated as the sum of individual segment time multiplied by the number of people experiencing that time. The objectives can be multimodal if they account for transit travel time.

Operations Objectives	• **Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through year Y.** • **Improve average travel time during peak periods by X percent by year Y.**
Performance Measures	• Average commute trip travel time (minutes). • Average travel time during peak periods (minutes).
Anticipated Data Needs	• Peak period and free flow travel time or speeds. • Person travel along links (e.g., vehicle volume multiplied by vehicle occupancy). • Trip length.
Data Resources and Partners	• Providers of travel data, including speeds and volumes, such as State DOTs, cities, counties, and traffic management centers. • Transit agencies, which can provide transit travel time or speed data and passenger counts.
M&O Strategies to Consider	Strategies designed to reduce recurring peak period congestion, such as traffic signal coordination, and travel demand strategies that encourage shifts in travel mode, time, or route. If the objective includes transit, strategies could include transit signal priority.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Accident Ahead" warning signs: The crash modification factor for this treatment is 0.56 with a standard error of 0.2. Therefore the range of the crash modification factor is 0.96 to 0.16. *Source: HSM, First Edition.* • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore, the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes, the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* **Note**: The existing number of crashes is multiplied by the crash modification factor to determine the expected number of crashes following implementation of a treatment.

System Efficiency: Delay

General Description

These objectives focus on reducing the delay in travel experienced by travelers. Delay is a measure of "excess travel time" caused by congestion (i.e., in comparison to free flow time or relative to the posted speed limit). Traffic delay per capita measures are more mode neutral than traffic delay per driver or per vehicle measures (i.e., focuses on the experiences of the entire population, not just drivers).

Operations Objectives	• **Reduce hours of delay per capita by X percent by year Y.** • **Reduce hours of delay per driver by X percent by year Y.**
Performance Measures	• Hours of delay per capita or per driver.
Anticipated Data Needs	• Peak period and free-flow travel time or speeds. • Person travel along links (e.g., vehicle volume multiplied by vehicle occupancy).
Data Resources and Partners	• Providers of travel data, including speeds and volumes, such as State DOTs, cities, counties, and traffic management centers. • Transit agencies, which can provide transit travel time or speed data and passenger counts.
M&O Strategies to Consider	Strategies designed to reduce recurring peak-period congestion, such as traffic signal coordination, and travel demand strategies that encourage shifts in travel mode, time, or route. If the objective includes transit, strategies could include transit signal priority.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Accident Ahead" warning signs: The crash modification factor for this treatment is 0.56 with a standard error of 0.2. Therefore the range of the crash modification factor is 0.96 to 0.16. *Source: HSM, First Edition.* • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore, the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* • Convert exclusive leading protected to exclusive lagging: The crash modification factor for this treatment is 0.85 with a standard error of 0.19 for all crashes. Therefore, the range of the crash modification factor is 1.23 to 0.47. For left-turn crashes the crash modification factor is 0.51 with a standard error of 0.54. Therefore, the range of the crash modification factor is 1.59 to 0.0. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.* **Note**: The existing number of crashes is multiplied by the crash modification factor to determine the expected number of crashes following implementation of a treatment.

System Efficiency: Energy Consumption

General Description

These objectives focus on reducing total energy consumed for purposes of transportation. Energy consumption reflects both the amount of travel and fuel efficiency. "Excess" energy consumption specifically focuses on the excess fuel consumed due to congestion (i.e., in comparison to free-flow conditions). Objectives that address total energy consumption may more effectively account for energy savings of increasing bicycling, walking, and transit, compared to measures that focus solely on excess fuel consumption associated with traffic congestion.

Operations Objectives	• **Reduce total energy consumption per capita for transportation by X percent by year Y.** • **Reduce total fuel consumption per capita for transportation by X percent by year Y.** • **Reduce excess fuel consumed due to congestion by X percent by 2020.**
Performance Measures	• Total energy consumed per capita for transportation. • Total fuel consumed per capita for transportation. • Excess fuel consumed (total or per capita).
Anticipated Data Needs	• Regional population, vehicle miles traveled, and average vehicle fuel economy, or regional fuel sales data. • Transit vehicle energy use and ridership. • Hours of excess delay and fuel economy associated with delay.
Data Resources and Partners	• Partners include State taxation, economic development, vital records, and transit agencies, and transportation departments. Fuel sales associations can provide data on total fuel sold. • Excess fuel requires regional measures of total delay, which typically come from partners such as State and local DOTs, ITS managers, or traffic management center operators.
M&O Strategies to Consider	Strategies designed to reduce congestion and single occupancy vehicle trips, such as traffic signal coordination and incident management; travel demand strategies that encourage shifts in travel mode, time, or route; and congestion pricing strategies that encourage shifts to off-peak periods.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Signal coordination: The potential safety impacts from implementing these strategies include decreasing intersection crash rates, reducing rear-end conflicts, and reducing crashes during permitted turning movements at signalized intersections. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").*

System Efficiency: Cost of Congestion

General Description

These objectives focus on reducing the annual monetary cost of congestion, which can be measured based on wasted time and fuel, increased vehicle operating costs, increased accidents, and costs of pollution.

Operations Objectives	• **Reduce the annual monetary cost of congestion per capita for the next Y years by X percent each year.**
Performance Measures	• Cost (in dollars) of congestion or delay per capita.
Anticipated Data Needs	• Peak period and free-flow travel time or speeds. • Traveler volumes, auto/transit occupancy (by link, if determining delay for a sub-network). • Costs per delay time (i.e., all of the cost components including wasted time, fuel, vehicle operating costs, pollution, and incidents).
Data Resources and Partners	• Providers of travel data, including speeds and volumes, such as State DOTs, cities, counties, and traffic management centers. • Transit agencies that can provide transit travel time or speed data and passenger counts. • Can utilize a benefit-cost analysis tool, such as STEAM.[12]
M&O Strategies to Consider	Strategies designed to reduce peak period congestion as well as unexpected delay, such as traffic signal coordination and traffic incident management; and travel demand strategies that encourage shifts in travel mode, time, or route. If the objective includes transit, strategies could include transit signal priority.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

[12] For more information go to the U.S. Department of Transportation, Surface Transportation Efficiency Analysis Model (STEAM) page: http://www.fhwa.dot.gov/steam.

System Efficiency: Vehicle Miles Travel

General Description

The intent of this objective is to reduce the amount of vehicle miles traveled (VMT) by users of the transportation system. Comparisons of performance are best facilitated by associating the VMT with the population that generates them (per capita).

Operations Objectives	• **Reduce vehicle miles traveled per capita by X percent by year Y.**
Performance Measures	• Average VMT per capita per day, per week, or per year.
Anticipated Data Needs	• Traffic volumes by facility and segment. • System inventory that provides lane-miles of facilities, by segment. • VMT may be estimated based on travel monitoring programs (e.g., the Highway Performance Monitoring System). • Survey data, such as the Nationwide Household Travel Survey or local surveys may also be used to address VMT and trip lengths for different types of trips.
Data Resources and Partners	• Providers of system inventory information and traffic data, such as State and local DOTs.
M&O Strategies to Consider	M&O strategies that focus on managing travel demand through trip elimination (e.g., telecommuting), trip chaining (e.g., combining trips to reduce trip lengths), mode shifts (e.g., shifts from driving alone to transit, bicycling, and walking), increasing vehicle occupancy, as well as land-use strategies. Transit strategies that make transit trips faster and more reliable likely will also encourage shifts from driving to transit.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Efficiency: Trip Connectivity

General Description

The intent of these objectives is to improve the efficiency of intra- and intermodal connectivity on trips taken by the traveling public in terms of providing an alternative to the single occupancy vehicle trip. Optimization of trip connectivity is indicated by cost and travel time.

Operations Objectives	• **Reduce door-to-door trip time by X percent by year Y.** • **Reduce cost of transfer fees paid by X percent by year Y.**
Performance Measures	• Average door-to-door trip time. • Average cost of transfers.
Anticipated Data Needs	• Survey data of traveler behavior including average door-to-door trip time. • Transfer cost data from transit providers.
Data Resources and Partners	• Agencies conducting traveler behavior surveys, such as transit agencies, MPOs, and State and local DOTs. • Transit agencies for transfer data.
M&O Strategies to Consider	Strategies include those designed to improve trip connectivity focus on the end-user: the traveling public. Transfers of trips should be minimized and fare payments should be seamless.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Reliability: Non-Recurring Delay 3.3.2

General Description

This set of objectives aims at decreasing non-recurring delay—travel time delay caused by transient events as opposed to delay caused by geometric limitations or a lack of capacity. These objectives focus on non-recurring delay due to scheduled disruptions and unscheduled disruptions to travel.

Operations Objectives	• **Reduce total person hours of delay (or travel-time delay per capita) by time period (peak, off-peak) caused by:**
	  · **(Option 1) scheduled events, work zones, or system maintenance by X hours in Y years.**
	  · **(Option 2) unscheduled disruptions to travel X hours in Y years.**
	  · **(Option 3) all transient events such as traffic incidents, special events, and work zones X hours in Y years.**

Performance Measures	• Travel time delay per capita during scheduled and/or unscheduled disruptions to travel.
	• Total person hours of delay during (or travel time delay per capita) during
	  · (Option 1) scheduled events, work zones, or system maintenance by X hours in Y years.
	  · (Option 2) unscheduled disruptions to travel X hours in Y years.
	  · (Option 3) all transient events such as traffic incidents, special events, and work zones X hours in Y years.

Anticipated Data Needs	• Travel time by person or vehicle during transient events such as traffic incidents, special events, and work zones.
Data Resources and Partners	• Travel time data during transient events may be difficult to collect, particularly during unscheduled events such as incidents and severe weather. Public safety organizations are likely needed to assist in identifying the locations and times of traffic incidents. Road and track maintenance staff will be needed to identify upcoming work. Data on travel times during unscheduled events may need to be extracted after collection from ongoing travel-time data based on the time and location of events. The National Weather Service may also need to be involved in identifying times and locations of severe weather that may have impacted travel.
M&O Strategies to Consider	Strategies to reduce non-recurring delay include those that focus on reducing the delay caused by incidents, work zones, special events, and other transient events that affect traffic flow.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Reliability: Travel Time Buffer Index

General Description

Objectives in the area of travel time reliability aim to reduce the variability in travel time so that transportation system users experience a consistent and predictable trip time. Unexpected delay is reduced for people and goods. This sheet focuses on the buffer time index, which reflects the amount of extra time that travelers need to add to their average travel time to account for non-recurring delay.

Operations Objectives

- **Decrease the buffer index for (specific travel routes) by X percent over the next Y years.**
- **Decrease the average buffer index for (multiple routes or trips) by X percent over Y years.**
- **Reduce the average buffer time needed to arrive on-time for 95 percent of trips on (specified routes) by X minutes over Y years.**

Performance Measures[13]

- The buffer index represents the extra time (buffer) most travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time.

$$\text{Buffer Index (\%)} = \frac{\text{95th percentile travel time (minutes)} - \text{average travel time (minutes)}}{\text{average travel time (minutes)}}$$

- Average buffer index or buffer time can be calculated using miles traveled as a weighting factor.
- Buffer time = 95th percentile travel time (min) – average travel time (min).

Anticipated Data Needs

- Travel time by segment of the transportation system that is of interest.

Data Resources and Partners

- Travel time estimates can be calculated using probe vehicles, continuous point-based detectors, periodic special studies, or simulation.[14] Partners may include State and local DOTs, transit agencies, highway districts, tolling authorities, and other agencies responsible for managing, operating, or coordinating transportation facilities and services.

M&O Strategies to Consider

Strategies for increasing travel time reliability are those activities that aim to improve non-recurring delay such as traffic incident management, work zone management, or special events management.

Safety-related Impacts

Direct safety impacts not identified within referenced safety documents.

FACT SHEETS

[13] U.S. Department of Transportation, FHWA, *Monitoring Urban Freeways in 2003: Current Conditions and Trends from Archived Operations Data*, FHWA-HOP-05-018 (Washington, DC: December 2004). http://mobility.tamu.edu/mmp/FHWA-HOP-05-018/data.stm. Accessed on October 20, 2009.

[14] U.S. Department of Transportation, FHWA, *Travel Time Reliability: Making It There On Time, All The Time*, December 2005. http://www.ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm. Accessed on October 20, 2009.

System Reliability: Planning Time Index

General Description

Objectives in the area of travel time reliability aim to reduce the variability in travel time so that transportation system users experience a consistent and predictable trip time. Unexpected delay is reduced for people and goods. This sheet focuses on the planning time index. This reflects the amount of extra time that travelers need to add to free-flow (or posted speed limit) travel time in order to arrive on-time in almost all situations. The planning time index takes into account both recurring and non-recurring sources of delay.

Operations Objectives

- **Reduce the average planning time index for (specific routes in region) by X points over the next Y years.**
- **Reduce the average planning time for (specific routes in region) by X minutes over the next Y years.**

Performance Measures

- The planning time index represents the time that must be added to travel time at free-flow speeds or the posted speed limit to ensure on time arrivals for 95 percent of the trips.

$$\text{Planning time Index} = \frac{\text{95th percentile travel time (minutes)}}{\text{Travel time at free flow speed or posted speed limit (minutes)}}$$

- Planning time = 95th percentile travel time (minutes) – Travel time at free-flow speed or posted speed limit.
- Average planning time index or planning time can be computed using a weighted average over person miles traveled.

Anticipated Data Needs

- Travel time.

Data Resources and Partners

- Travel time estimates can be calculated using probe vehicles, continuous point-based detectors, periodic special studies, or simulation.[15]

M&O Strategies to Consider

Those that aim to reduce both recurring and non-recurring delay: HOV/HOT lanes, ramp metering, single occupancy vehicles, transit, traffic incident management, work zone management, special events management.

Safety-related Impacts

Direct safety impacts not identified within referenced safety documents.

FACT SHEETS

[15] U.S. Department of Transportation, FHWA, *Travel Time Reliability: Making It There On Time, All The Time*, December 2005. http://www.ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm. Accessed on October 20, 2009.

System Reliability: Travel Time 90th/95th Percentile

General Description

These objectives focus on reducing the 90th or 95th percentile travel time for one or more routes or trips in the region. The 90th or 95th percentile travel time represents one of the worst travel times for that route or trip because it indicates that 90 – 95 percent of travel times for that route are shorter than the 90th or 95th percentile travel time.

Operations Objectives	• **Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region) by X minutes in Y years.** • **Reduce the 90th (or 95th) percentile travel times for each route selected by X percent over Y years.**
Performance Measures	• 95th or 90th percentile travel times for selected routes.
Anticipated Data Needs	• Travel time.
Data Resources and Partners	• Travel time estimates can be calculated using probe vehicles, continuous point-based detectors, periodic special studies, or simulation.[16]
M&O Strategies to Consider	Travel times that are in the top 5 to 10 percent of duration for a given route are likely caused by significant, non-recurring events such as major traffic incidents, system maintenance failures, severe weather, and work zones that significantly reduce available capacity. Strategies to consider would be those that work to prevent the more extreme events or reduce the impact to travelers through traveler information.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

[16] U.S. Department of Transportation, FHWA, *Travel Time Reliability: Making It There On Time, All The Time,* December 2005. http://www.ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm. Accessed on October 20, 2009.

System Reliability: Variability

General Description

Objectives in this section focus on improving travel time reliability by trying to reduce the variability of travel time.

Operations Objectives	• **Reduce the variability of travel time on specified routes by X percent during peak and off-peak periods by year Y.**
Performance Measures	• Variance of travel time. Variance is the sum of the squared deviations from the mean. This can also be calculated as the standard deviation of travel time. Standard deviation is the square root of variance.
Anticipated Data Needs	• Travel time.
Data Resources and Partners	• Travel time estimates can be calculated using probe vehicles, continuous point-based detectors, periodic special studies, or simulation.[17] Travel time may be collected by the owner of the facility such as the State DOT or city/county DOT.
M&O Strategies to Consider	Strategies for reducing variance in travel time include those activities that aim to reduce delay caused by transient events such as incidents, work zones, special events, etc.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

[17] U.S. Department of Transportation, FHWA, *Travel Time Reliability: Making It There On Time, All The Time*, December 2005. http://www.ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm. Accessed on October 20, 2009.

System Reliability: Transit On-Time Performance

General Description

These objectives focus on travel time reliability for transit users as measured by on-time performance. There is often a tolerance interval for on-time performance such that if a transit vehicle arrives at a stop within X minutes of scheduled arrival and does not depart from that stop more than Y minutes after scheduled departure time, it is considered on-time.

Operations Objectives	• **Improve average on-time performance for specified transit routes/facilities by X percent within Y years.**
Performance Measures	• On-time performance of transit.
Anticipated Data Needs	• Arrival and departure times (if different) from a select number of stops on transit facilities of interest.
Data Resources and Partners	• The data would primarily come from transit operators.
M&O Strategies to Consider	Improvements to transit on-time performance may be achieved through reducing recurring and non-recurring delay on transit routes by implementing transit signal preemption, designated lanes for transit, and electronic fare collection.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Options: Mode Share 3.3.3

General Description

These objectives seek to increase the share of modes used other than the single occupancy vehicle to improve the overall efficiency of the transportation system.

Operations Objectives	• **Reduce per capita single occupancy vehicle commute trip rate by X percent in Y years.** • **Increase alternative (non-single occupancy vehicle) mode share for all trips by X percent within the next Y years.** • **Increase active (bicycle/pedestrian) mode share by X percent by year Y.** • **Reduce single occupancy vehicle vehicle trips by X percent through travel demand management strategies (e.g., employer or residential rideshare) by year Y.** • **Achieve X percent alternative (non-single occupancy vehicle) mode share in transit station communities (or other areas) by year Y.**
Performance Measures	• Single occupancy vehicle commute trips per capita. • Share of employees walking, biking, telecommuting, carpooling/vanpooling, riding transit, driving alone. • Share of trips by each mode of travel. • Percent of all trips made using alternative modes in transit station communities.
Anticipated Data Needs	• Survey data, such as the Census Journey to Work Survey or other mode share surveys. • Employer surveys of employee commuting patterns. • Household surveys of travel behaviors including mode choice, frequency of trip making, and vehicle occupancy.
Data Resources and Partners	• Employers, transportation management associations, travel demand management programs, transit agencies, State and local DOTs, commuters, non-auto advocacy groups, and research firms.
M&O Strategies to Consider	M&O strategies to encourage the use of other modes include travel demand management strategies, parking management, and congestion pricing strategies.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Options: Transit Use

General Description

The primary intent of these objectives is to increase the use of transit for trips taken or transit mode share so as to reduce single occupancy vehicle use and improve overall system efficiency; they may also address the efficiency of transit services in terms of the number of occupied seats per bus or train.

Operations Objectives	• **Increase transit mode share by X percent by year Y.** • **Increase transit mode share by X percent by year Y during peak periods.** • **Increase average transit load factor by X percent by year Y.** • **Increase passenger miles traveled per capita on transit by X percent by year Y.**
Performance Measures	• Percent of all trips made by transit. • Percent of all peak-period trips made by transit. • Number of riders on transit units per trip. • Number of passenger miles traveled per capita.
Anticipated Data Needs	• Travel behavior survey data. • Public transit system data (e.g. number of tickets purchased, number of trips made, passenger travel data for trip length).
Data Resources and Partners	• Survey participants and local transit providers.
M&O Strategies to Consider	M&O strategies to increase the use of transit over single occupancy vehicle travel include marketing, rider incentive programs, electronic fare card systems, increased transit travel time efficiency and reliability, and ease of use.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

System Options: Travel Time – Transit Compared to Auto

General Description

These objectives focus on improving the travel time (or speed) of public transit in comparison to average auto travel times (or speeds). The objective is designed to advance efficient transit operations and make transit more competitive with the auto to persuade system users to use transit as opposed to single occupancy vehicles.

Operations Objectives	• **Reduce the travel time differential between transit and auto during peak periods by X percent per year for Y years.** • **Maintain a travel time differential between transit and auto during peak periods of X percent for Y years.** • **Improve average transit travel time compared to auto in major corridors by X minutes per year for Y years.**
Performance Measures	• Transit to auto travel time differential for a given period (daily, hourly, or peak hours), on a given portion of the system (system wide, by facility type, or by corridor).
Anticipated Data Needs	• Transit travel time performance, average auto speeds or auto travel times.
Data Resources and Partners	• Transit on-time performance records, measured travel speeds on key facilities; probes in traffic streams, and permanent traffic recorders that collect speed data. • State and local DOTs, transit agencies, traffic management centers, ITS operators.
M&O Strategies to Consider	Strategies designed to increase transit speeds, such as bus rapid transit, HOV lanes that buses can use, queue jump lanes at signalized intersections, and transit signal priority.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install shoulder bus lanes: The crash modification factor for this treatment is between 0.92 and 0.14 depending on crash severity and crash type. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.* **Note**: The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

System Options: Bicycle and Pedestrian Accessibility and Efficiency

General Description

The objectives in this section focus on improving the accessibility and efficiency of bicycle and pedestrian modes to offer travelers feasible and attractive travel options.

Operations Objectives	• **Decrease average delay for pedestrians and bicyclists on primary ped/bike routes by X percent in Y years.** • **Increase the share of roadways with bicycle lanes to X by year Y.** • **Increase system completeness for bicyclists and pedestrians by X percent within Y years.** • **Increase the number of intersections with pedestrian features (countdown pedestrian signal heads, painted crosswalks, etc.) to X percent by year Y.** • **Increase average pedestrian (or bicyclist) comfort level by X points in Y years.**
Performance Measures	• Average delay for pedestrians and bicyclists on primary ped/bike routes. • Percent of roadways with bicycle and pedestrian facilities. • The percentage of intersections with pedestrian features. • Average pedestrian (or bicyclist) comfort level as measured by survey.
Anticipated Data Needs	• Wait time for pedestrians and bicyclists at intersections or path blockages. • An inventory of bicycle and pedestrian facilities. • Survey information on pedestrian (or bicyclist) comfort level.
Data Resources and Partners	• State and local DOTs, counties, cities, highway districts.
M&O Strategies to Consider	Pedestrian countdown signals, bicycle lanes, signage, crossing signals where bicycles cross major roadways.
Safety-related Impacts	Select examples of associated M&O strategies, and their safety impacts include: • Provide a sidewalk or shoulder: The safety impact is a potential reduction in collisions with pedestrians. *Source: HSM, First Edition.* • Install raised pedestrian crosswalks: The safety impact is a potential to reduce vehicle operating speeds *Source: HSM, First Edition.* • Re-stripe roadway to provide bicycle lane: The safety impact is no evidence of increased conflicts between curb lane vehicles and bicycles. *Source: HSM, First Edition.*

System Options:
Modal Options for Individuals with Disabilities

General Description

The objectives in this sheet focus on increasing modal options for individuals with disabilities.

Operations Objectives	• **Increase the percent of intersections with ADA (Americans with Disabilities Act) provisions to X percent by year Y.** • **Increase the availability of transit to individuals with disabilities by X percent by year Y.** • **Increase the percent of transit stops with ADA provisions to X percent by year Y.**
Performance Measures	• The percent of intersections with ADA provisions. • The percent of individuals with disabilities that can access transit. • The percent of transit stops with ADA provisions.
Anticipated Data Needs	• The number of intersection with and without ADA provisions. • The number of individuals with disabilities that can access transit. • The number of transit stops with and without ADA provisions.
Data Resources and Partners	• State and local DOTs, transit agencies.
M&O Strategies to Consider	Planning, programming, and constructing ADA improvements at intersections. Expanding paratransit service and purchasing transit vehicles with low-floor boarding capabilities and other accommodations for individuals with disabilities.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Arterial Management: Delay 3.3.4

General Description

These objectives seek to address delay experienced on arterials. Arterial roads primarily serve through traffic and provide access to abutting properties as a secondary function.

Operations Objectives	• **Decrease the seconds of control delay per vehicle on arterial roads by X percent in Y years. (Control delay is defined as the portion of the total delay attributed to traffic signal operation for signalized intersections).** • **Increase the miles of arterials in the region operating at level of service (LOS) Z by X percent in Y years.**
Performance Measures	• Control delay seconds per vehicle. • Percent of arterial miles in region operating at LOS Z.
Anticipated Data Needs	• Travel times on arterials near traffic signals. • Speed, volume/capacity or other measures of level of service.
Data Resources and Partners	• Partner agencies that operate and maintain arterials in the region.
M&O Strategies to Consider	M&O strategies designed to address the management of traffic on arterial roads typically include a blend of outreach, guidance, training, and research to advance four major types of strategies: traffic signal improvements, advanced traffic signal control, traffic monitoring, and access management.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Modify access point density: The safety impact of reducing the number of access points is the potential reduction in injury and non-injury crash frequency, as well as angle and sideswipe collisions at intersections and mid-block areas. *Source: HSM, First Edition.* • Remove unwarranted signals: The safety impact of this treatment is the potential for decreasing the frequency of collisions. Targets for this action are signalized intersections where traffic volumes and safety records do not warrant a traffic signal. This action also includes the potential to eliminate excessive delay and disobedience to traffic signals and decreases the use of inappropriate routes to avoid signals. Right angle crashes may increase after signal removal. *Source: NCHRP 500 Volume 12 (effectiveness categorized as"proven").* • Provide a right-turn lane: The crash modification factor (crash modification factor) for this treatment for all crashes at stop-controlled intersections is a 0.86 with a standard error of 0.06. Therefore the range of the crash modification factor is 0.98 to 0.74. Relating to all crashes at signalized intersections, the crash modification factor for this treatment is 0.96 with a standard error of 0.02. Therefore the range of the crash modification factor is 1.00 to 0.92. **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Arterial Management: Access Management

General Description

These objectives seek to address access management issues experienced on arterials to improve the flow of traffic, reduce crashes, and reduce congestion.

Operations Objectives	• **Maintain a distance of X feet between intersections on major arterials in the region for the next Y years.** • **Reduce driveway access by X percent on major arterials for all new developments for the next Y years.**
Performance Measures	• Distance between intersections on major arterials in the region. • Percent driveway access on major arterials for new developments.
Anticipated Data Needs	• Distance between intersections. • Driveway access for new developments on major arterials.
Data Resources and Partners	• Partner agencies that approve new developments, and operate and maintain arterials in the region.
M&O Strategies to Consider	M&O strategies designed to address access management on arterials can be outlined in an access management plan and include access spacing, driveway spacing, dedicated left- and right-turn lanes, roundabouts, two-way left-turn lanes, and non-traversable, raised medians.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Modify access point density: The safety impact of reducing the number of access points is a potential reduction in both injury and non-injury crash frequency as well as angle and sideswipe collisions at intersections and mid-block areas. *Source: HSM, First Edition.*

Arterial Management: Reliability

General Description

These objectives aim to reduce the variability in travel time on arterials so that users experience a more consistent and predictable trip time.

Operations Objectives	• **Reduce buffer index on arterials during peak and off-peak periods by X percent in Y years.** • **Reduce delay associated with incidents on arterials by X percent by year Y.** **[See section on System Reliability for additional information on buffer index, planning index, and other measures.]**
Performance Measures	• The buffer index (represents the extra time ("buffer") travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time). • Hours of delay associated with incidents.
Anticipated Data Needs	• Travel time (daily figures, to calculate 95 percentile travel time). • Crash data.
Data Resources and Partners	• Providers of travel data on freeways, including State DOTs or transportation management centers.
M&O Strategies to Consider	Strategies include traffic incident management, work zone management, special events management, and traveler information.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore, the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes, the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* **Note**: The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Arterial Management: Traffic Monitoring and Data Collection

General Description

These objectives focus on developing or improving traffic monitoring and data collection on arterials that is necessary for managing arterials through signalization or traveler information.

Operations Objectives	• **Field data collection is conducted either through floating car studies or other methods at least once every Y years on major signalized arterials and X years on minor signalized arterials.** • **X percent of intersections in the region are equipped and operating with traffic signals that enable real-time monitoring and management of traffic flows by year Y.** • **X percent of major and minor arterials are equipped and operating with arterial link traffic data detection stations (or appropriate technology) per Z distance by year Y.** • **X percent of major and minor arterials are equipped and operating with closed circuit television (CCTV) cameras per Z distance by year Y.**
Performance Measures	• Number of field data collection studies performed every Y and X years on major and minor signalized arterials, respectively. • Percent of intersections in the region equipped and operating with traffic signals that enable real-time monitoring and management of traffic flows. • Percent of major and minor arterials equipped and operating with arterial link traffic data detection stations (or appropriate technology) per Z distance. • Percent of major and minor arterials equipped and operating with closed circuit television (CCTV) cameras per Z distance.
Anticipated Data Needs	• Number of field studies performed on signalized arterials. • Traffic signal capabilities inventory. • Arterial link traffic data detection station inventory. • CCTV camera inventory.
Data Resources and Partners	• Partner agencies that operate traffic signals in the region.
M&O Strategies to Consider	M&O strategies directly follow from the objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Arterial Management: Traffic Signal Management

General Description

These objectives improve the management of traffic signal systems through advanced technology, increased reviews, and planning.

Operations Objectives[18]	• **Maintain a program of evaluating X percent of signals for retiming every Y years.** • **Increase the number of intersections running in a coordinated, closed-loop, or adaptive system by X percent in Y years.** • **Special timing plans are available for use during freeway incidents, roadway construction activities, or other special events for X miles of arterials in the region by year Y.** • **Crash data for all arterials in the region is reviewed every X years to determine if signal adjustments can be made to address a safety issue.**
Performance Measures	• Number of traffic signals evaluated for retiming. • Number of intersections running in a coordinated, closed-loop, or adaptive system. • Number of miles of arterials that have at least one special timing plan for incidents, construction, or events. • Number of years between reviews of crash data on all arterials for possible signal timing impacts.
Anticipated Data Needs	• Reports from operating agencies on signal retiming, signal capabilities, special timing plans, and crash data reviews.
Data Resources and Partners	• Partner agencies that operate arterials in the region and police departments that maintain traffic crash records.
M&O Strategies to Consider	M&O strategies directly follow from the objectives.

[18] Some operations objectives have been derived from the *2007 National Traffic Signal Report Card - Technical Report* by the National Transportation Operations Coalition.

Safety-related Impacts

Select examples of associated M&O strategies and their safety impacts include:

- Convert exclusive leading protected to exclusive lagging: The crash modification factor for this treatment is 0.85 with a standard error of 0.19 for all crashes. Therefore, the range of the crash modification factor is 1.23 to 0.47. For left-turn crashes, the crash modification factor is 0.51 with a standard error of 0.54. Therefore, the range of the crash modification factor is 1.59 to 0.0. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.*
  Note: The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.
- Provide actuated control: The safety impact is apparent reduction in some crash types. *Source: HSM, First Edition.*
- Signal coordination: The safety impact includes the potential for decreasing intersection crash rates, rear-end conflicts, and crashes during permitted turning movements at signalized intersections. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").*

Emergency/Incident Management: Incident Duration 3.3.5

General Description

This set of objectives focuses on reducing the duration of incidents on the transportation system. Three different categories are covered: Discovery and verification time, notification and response time, and clearance time. Verification includes determining the incident location and gathering sufficient information to enable an appropriate response.[19]

Operations Objectives	**Discovery and Verification Time** • **Reduce mean incident notification time (defined as the time between the first agency's awareness of an incident and the time to notify needed response agencies) by X percent over Y years (i.e., through "Motorist Assist" roving patrol programs, reduction of inaccurate verifications, etc.).** **Notification and Response Time** • **Reduce mean time for needed responders to arrive on-scene after notification by X percent over Y years.** **Time to Clear Incident and Resume Traffic Flow** • **Reduce mean incident clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and the time the last responder has left the scene.)** • **Reduce mean roadway clearance time per incident by X percent over Y years. (Defined as the time between awareness of an incident and restoration of lanes to full operational status.)** • **Reduce mean time of incident duration (from awareness of incident to resumed traffic flow) on transit services and arterial and expressway facilities by X percent in Y years.**
Performance Measures	• Average incident notification time of necessary response agencies. • Mean time for needed responders to arrive on-scene after notification. • Mean incident clearance time per incident. • Mean roadway clearance time per incident. • Mean time of incident duration.
Anticipated Data Needs	• For each incident of interest in the region, incident notification time and on-scene arrival time. • Data needed for these measures include the time of the awareness of an incident and one or more of the following pieces of data: the time the last responder left the scene, the time when all lanes were re-opened, and the time when traffic returned to full operational status.

[19] See http://www.transportation.org/sites/ntimc/docs/Anatomy%20of%20a%20Traffic%20Incident.pdf for information on the stages of traffic incident management.

Data Resources and Partners	• Data would need to be tracked by the incident responders or operators at a traffic management center or emergency operations center with access to video of the scene. The partners needed for these measures would be all incident responders willing to support the objectives.
M&O Strategies to Consider	M&O strategies to consider in improving detection and verification of incidents include enhancing inter-agency voice and data communications systems, expanding the use of roving patrols, and CCTV cameras.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Employ emergency vehicle preemption: The safety impact is the potential for decreasing response times. Reviews of systems in several cities show a decrease in response times ranging from 14 to 50 percent. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").* • Install emergency vehicle preemption systems: The crash modification factor for this treatment is 0.30 for all crashes. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.* Note: The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Emergency/Incident Management: Person Hours of Delay

General Description

The intent is to reduce person hours of delay due to traffic incidents.

Operations Objectives	• **Reduce the person hours (or vehicle hours) of total delay associated with traffic incidents by X percent over Y years.**
Performance Measures	• Person hours (or vehicle hours) of delay associated with traffic incidents.
Anticipated Data Needs	• Total travel time in person hours (or vehicle hours) of travel impacted by incidents. • Total travel time in person hours (or vehicle hours) of travel during free flow conditions.
Data Resources and Partners	• Due to the unpredictable nature of traffic incidents, travel time may need to be collected, stored, and then analyzed after incident times and locations are obtained. Partners needed include public safety agencies and departments of transportation.
M&O Strategies to Consider	Regions can reduce travel time delay due to incidents by shortening incident clearance time and providing travelers with information to avoid the incident area.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Accident Ahead" warning signs: The crash modification factor for this treatment is 0.56 with a standard error of 0.2. Therefore the range of the crash modification factor is 0.96 to 0.16. *Source: HSM, First Edition.* • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore, the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes, the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Emergency/Incident Management: Evacuation Times

General Description

This objective provides a focus on the safety and efficiency of emergency evacuation via surface transportation. The objective emphasizes per capita time to evacuate and allows for evaluation of large and small events involving large and small geographic areas and/or numbers of people.

Operations Objectives	• **Reduce the per capita time to evacuate Z persons in the region by X percent over Y years.**
Performance Measures	• Per capita time to evacuate.
Anticipated Data Needs	• Time to evacuate region (or subarea).
Data Resources and Partners	• Data would likely need to be collected by emergency command staff and involve communication and coordination with field staff from all agencies involved with the evacuation. • Emergency responders, police, fire, public safety, U.S. Transportation Security Administration, local and State DOTs, and public officials.
M&O Strategies to Consider	M&O strategies for improving evacuation time in an emergency situation include interagency coordination and communication, responder training, and traffic engineering strategies (e.g., contraflow lanes).
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Employ emergency vehicle preemption: The safety impact for this technology is the potential for decreasing response times. Reviews of systems in several cities show a decrease in response times ranging from 14 to 50 percent. *Source: NCHRP 500 Volume 12 (effectiveness categorized as "proven").*

Emergency/Incident Management: Customer Satisfaction

General Description

The intent is to improve customer satisfaction with incident management in the region.

Operations Objectives	• **Increase customer satisfaction with the region's incident management by X percent over Y years.**
Performance Measures	• Percentage of customers satisfied with region's incident management practices.
Anticipated Data Needs	• Customer satisfaction surveys.
Data Resources and Partners	• This data would be gathered through surveys among transportation system users that had been using the system during the time of an incident.
M&O Strategies to Consider	M&O strategies to consider for improving customer satisfaction with TIM include extensive traveler information during incidents and reducing the duration of the incident.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Emergency/Incident Management: Traveler Information

General Description

This section contains objectives that focus on providing travelers with accurate, timely, and actionable information about incidents and emergencies.

Operations Objectives	• **Reduce time between incident/emergency verification and posting a traveler alert to traveler information outlets (e.g., variable message signs, agency website, 511 system) by X minutes in Y years.** • **Increase number of repeat visitors to traveler information website (or 511 system) by X percent in Y years.** • **Reduce the time between recovery from incident and removal of traveler alerts for that incident.**
Performance Measures	• Time to alert motorists of an incident/emergency. • Number of repeat visitors to traveler information website (or 511 system). • Time between recovery from incident and removal of traveler alerts.
Anticipated Data Needs	• Data needed for these measures include the time of incident verification and variable message sign (VMS) posting, 511 entry, traveler information website log of the number of visitors, and the time of transportation system recovery and travel alert removal.
Data Resources and Partners	• Data on the time of incident recovery could be collected by TMC operators with video of incident scene or through continuous collection of traffic speeds. Partners would need to include agencies that manage traveler information websites, VMS, and emergency operations centers. Public safety partners may be needed for information on incident verification time.
M&O Strategies to Consider	M&O strategies to consider include training on disseminating traveler information on incidents as well as deploying and managing VMS and websites.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Accident Ahead" warning signs: The crash modification factor for this treatment is 0.56 with a standard error of 0.2. Therefore, the range of the crash modification factor is 0.96 to 0.16. *Source: HSM, First Edition.* • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore ,the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes, the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Emergency/Incident Management: Inter-Agency Coordination

General Description

This section contains objectives that focus on increasing coordination and communication between agencies with responsibilities for traffic incident management.

Operations Objectives	• **Increase percentage of incident management agencies in the region that (participate in a multi-modal information exchange network, use interoperable voice communications, participate in a regional coordinated incident response team, etc.) by X percent in Y years.** • **Increase the number of corridors in the region covered by regional coordinated incident response teams by X percent in Y years.** • **Hold at least X multi-agency after-action review meetings each year with attendance from at least Y percent of the agencies involved in the response to an incident.** • **At least X percent of transportation operating agencies have a plan in place for a representative to be at the local or State Emergency Operations Center (EOC) to coordinate strategic activities and response planning for transportation during emergencies by year Y.**
Performance Measures	• Percentage of incident management agencies in region participating in multi-modal information exchange network. • Number of agencies in the region with interoperable voice communications. • Number of participating agencies in a regional coordinated incident response team. • Number of TIM corridors in the region covered by regional coordinated incident response teams. • Number of multi-agency after-action reviews per year. • Percentage of responding agencies participating in after-action review. • X percent of transportation operating agencies that have a plan in place for a representative to be at the local (city or county) EOC or State EOC to coordinate strategic activities and response planning for transportation during emergencies.
Anticipated Data Needs	• Data needed for these measures include the number of agencies participating in a regional incident management program or activity, the number of corridors covered by a regional incident management team, and the number of after-action reviews held. Also needed is the number of transportation operating agencies in the region and the number that have a plan in place for a representative to be at an EOC.

Data Resources and Partners	• This data can be collected by observation of emergency/incident management programs or asking TIM and other emergency management agencies to self-report.
M&O Strategies to Consider	The M&O strategies to consider are inherent in these objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Emergency/Incident Management: Training

General Description

This section contains objectives that focus on training incident management staff.

Operations Objectives	• **Conduct X joint training exercises among operators and emergency responders in the region by year Y.** • **By Y (year), X percent of staff in region with incident management responsibilities will have completed the National Incident Management System (NIMS) Training and at least X percent of transportation responders in the region are familiar with the incident command structure (ICS).**
Performance Measures	• Number of joint training exercises conducted among operators and emergency responders. • Percent of staff having completed NIMS training and percent of transportation responders familiar with ICS.
Anticipated Data Needs	• The number of joint training exercises conducted in the region among operators and emergency responders • The number of staff within each agency in the region that have incident management responsibilities as well as the number of staff that have completed the NIMS training. • The number of transportation responder staff in the region familiar with ICS.
Data Resources and Partners	• A simple count of incident management staff and those that completed NIMS training would need to be collected from each TIM agency in the region. A survey or self-assessment could be used on a regional level for ICS familiarity.
M&O Strategies to Consider	M&O strategies to consider would include making the NIMS training widely available to all relevant staff in the region.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Emergency/Incident Management: Use of Technology

General Description

This section contains objectives that focus on deploying technology needed to support traffic incident management.

Operations Objectives	• **Increase number of ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident and emergency detection/response by X in Y years.** • **Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/ response by X percent in Y years.** • **Increase number of traffic signals equipped with emergency vehicle preemption by X percent in Y years.**
Performance Measures	• Number of ITS-related assets in use for incident detection. • Number of regional roadway miles covered by ITS-related assets in use for incident detection. • Number of traffic signals equipped with emergency vehicle preemption.
Anticipated Data Needs	• The data needed for technology deployment objectives is simply a count of the assets deployed for TIM.
Data Resources and Partners	• Only data needed is a count of technology deployed.
M&O Strategies to Consider	The M&O strategies to consider are inherent in the objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freeway Management: Efficiency 3.3.6

General Description

These objectives seek to address the overall efficiency of the freeway system, and address issues such as delay experience on freeways and the extent, duration, and intensity of congestion.

Operations Objectives	• **Reduce the number of person hours (or vehicle hours) of delay experienced by travelers on the freeway system.** • **Reduce the share of freeway miles at level of service (LOS) X by Y by year Z. [See section on Efficiency-related objectives for others that apply to freeways]**
Performance Measures	• Hours of delay (vehicle-hours or person-hours). • Hours of delay per capita or driver. • Miles at LOS or V/C > 1.0 (or other threshold).
Anticipated Data Needs	• Peak period and free flow travel time or speeds. • Person travel along links (e.g., vehicle volume multiplied by vehicle occupancy).
Data Resources and Partners	• Providers of travel data on freeways, including State DOTs or transportation management centers.
M&O Strategies to Consider	Strategies include managed lanes, ramp management, use of shoulder lanes during peak periods, traveler information, and other strategies to improve freeway throughput and manage demand and traffic flow.
Safety-related Impacts	Select examples of associated M&O strategies, and their safety impacts include: • Install changeable "Accident Ahead" warning signs: The crash modification factor for this treatment is 0.56 with a standard error of 0.2. Therefore, the range of the crash modification factor is 0.96 to 0.16. *Source: HSM, First Edition.* • Install changeable fog warning signs: Safety impact includes the potential for a reduction in crashes during fog conditions on freeways. *Source: HSM, First Edition.* **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Freeway Management: Reliability

General Description

These objectives aim to reduce the variability in travel time on the freeway system so that users experience a more consistent and predictable trip time.

Operations Objectives	• **Reduce buffer index on the freeway system during peak and off-peak periods by X percent in Y years.** • **Reduce delay associated with incidents on the freeway system by X percent by year Y. [See section on System Reliability for additional information on buffer index, planning index, and other measures.]**
Performance Measures	• The buffer index (represents the extra time ("buffer") travelers add to their average travel time when planning trips in order to arrive on-time 95 percent of the time). • Hours of delay associated with incidents.
Anticipated Data Needs	• Travel time (daily figures, to calculate 95 percentile travel time). • Crash data.
Data Resources and Partners	• Providers of travel data on freeways, including State DOTs or transportation management centers.
M&O Strategies to Consider	Strategies include managed lanes, incident management, work zone management, special events management, and traveler information.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore the range of the crash modification factor is 1.04 to 0.64. For rear-end non injury crashes the crash modification factor is 0.84 with a standard error of 0.2. Therefore the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition.* **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Freeway Management: Managed Lanes

General Description

The objectives in this category focus on increasing the availability of or improving the operation of managed lanes. Managed lanes are intended to keep traffic flowing through techniques such as time-of-day restrictions, vehicle type restrictions (e.g., high occupancy vehicle (HOV) lanes and truck-only toll ways), and/or pricing (charging motorists for access, e.g., high occupancy toll (HOT) lanes).

Operations Objectives	• **Increase the miles of managed lanes in the region from X to Y by year Z.** • **Provide options for reliable travel times for certain types of travel (e.g., transit, carpools, trucks, etc.) on at least X percent of the freeway network by year Y.** • **Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate at no less than X mph during their hours of operation.** • **Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) operate with a volume of at least X vehicles per hour.** • **Ensure that all managed lanes (e.g., HOV lanes, HOT lanes) carry a throughput of at least Y persons per hour.**
Performance Measures	• Miles of managed lanes. • Share of freeway network with managed lanes (by class of traveler). • Average speeds in managed lanes. • Vehicle volumes in managed lanes. • Passenger volumes in managed lanes.
Anticipated Data Needs	• System information (e.g., miles of managed lanes). • Speed and/or volume data from ITS systems, transponders, etc.
Data Resources and Partners	• Providers of travel data, including State DOTs, transit agencies, cities, counties, or transportation management centers.
M&O Strategies to Consider	M&O strategies designed to offer time savings to various classes of road users could include truck only lanes, high occupancy vehicle (HOV) lanes, and high occupancy toll (HOT lanes), and could be established as contraflow or reversible lanes.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install shoulder bus lanes: The crash modification factor for this treatment is between 0.92 and 0.14 depending on crash severity and crash type. *Source: FHWA Desktop Reference for Crash Reduction Factors, 2008.* **Note:** The existing number of crashes is multiplied by the crash modification factor to determine the number of crashes following implementation of a treatment.

Freeway Management: HOV Lanes

General Description

The objectives in this category focus on increasing the availability of or improving the operation of high occupancy vehicle (HOV) lanes. HOV lanes are intended to provide a faster and more reliable travel time for carpools, vanpools, and buses, thereby encouraging higher levels of ridesharing and transit use.

Operations Objectives	• **Increase the number of HOV lane miles from X to Y by year Z.** • **Provide options for reliable travel times for carpools and transit on at least X percent of the freeway network by year Y.** • **Ensure that all HOV lanes operate at no less than X mph during their hours of operation.** • **Ensure that all HOV lanes operate with a volume of at least X vehicles per hour.** • **Ensure that all HOV lanes carry a throughput of at least Y persons per hour.** • **Increase the average vehicle occupancy rate in HOV lanes to X by year Y.** • **Increase the compliance rate for HOV lanes to X percent by year Y.**
Performance Measures	• Total number of HOV lane miles in a region. • Share of freeway network with HOV lanes. • Minimum and average speeds in HOV lanes. • Vehicle volume and persons per hour per lane. • Percent of vehicles violating HOV restrictions.
Anticipated Data Needs	• System information (e.g., miles of managed lanes). • Speed and/or volume data from ITS systems, transponders, speed studies, etc. • Vehicle violation data from law enforcement.
Data Resources and Partners	• Providers of travel data, such as State DOTs, cities, counties, or transportation management centers. • Law enforcement, which may provide information on HOV violations recorded.
M&O Strategies to Consider	M&O strategies to consider include identification of under-performing HOV lanes, consideration of peak-hour operation only, HOV bypass lanes at ramp meters, and access to park-and-ride facilities that provide a location for individuals to transfer from single occupant vehicles to a high-occupancy mode of travel.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freeway Management: Pricing and Tolling

General Description

The objectives in this section focus on use of pricing to manage demand, such as by charging a premium to users who want to drive during peak periods.

Operations Objectives	• **Increase the percentage of users carrying electronic toll collection (ETC) transponders by X percent by year Y.** • **Increase the share of toll roadways and bridges that are using variable pricing (e.g., congestion pricing) to X percent by year Y.** • **Increase the share of freeways that are priced to X percent by year Y.**
Performance Measures	• Percentage of drivers with ETC transponders. • Share of toll roads and bridges using variable pricing. • Lane miles that are priced.
Anticipated Data Needs	• Total number of users (annually) with ETC transponders. • System information (e.g., miles of priced facilities).
Data Resources and Partners	• Providers of travel data, such as State DOTs, cities, counties, or transportation management centers.
M&O Strategies to Consider	M&O strategies to consider include dynamic/congestion pricing, electronic toll collection, and automated enforcement.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freeway Management: Ramp Management

General Description

The objectives in this section focus on the application of control devices, such as traffic signals, signing, and gates, to regulate the number of vehicles entering or leaving the freeway in order to achieve operational objectives.

Operations Objectives	• **Increase the percent of freeway interchanges operating at LOS Z or higher during peak periods by X percent by year Y.** • **Reduce the number of congestion-inducing incidents occurring at freeway ramps by X percent by year Y.** • **Increase the number freeway ramps currently metered by X percent by year Y.**
Performance Measures	• Percent of interchanges operating at LOS Z or above during peak periods (per year). • Total number of congestion-inducing incidents at freeway interchanges during peak period (per year). • Total number of ramp meters (by year of installation).
Anticipated Data Needs	• Traffic volume and level of service data (e.g., traffic counts) at selected interchanges. • Total number of congestion-related incidents at selected interchanges. • Number of freeway ramp meters and year of installation.
Data Resources and Partners	• Providers of travel data, including traffic volumes and incidents, such as State DOTs, cities, counties, and transportation management centers.
M&O Strategies to Consider	Ramp management strategies typically encompass ramp metering, ramp closure, special use treatments (e.g., HOV, special events, etc.), and ramp terminal treatments.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freeway Management: Transportation Management Centers

General Description

The objectives in this section focus on monitoring the operation of the freeway system and initiating control strategies that effect changes in the operation of the network.

Operations Objectives	• **Increase the level of transportation management center (TMC) field hardware (cameras, variable message signs, electronic toll tag readers, ITS applications, etc.) by X percent by year Y.** • **Increase the hours of TMC operation and level of staffing by X percent by year Y.** • **Increase the percent of regional transportation system monitored by the TMC for real-time performance.**
Performance Measures	• Total amount of TMC equipment. • Number of hours of TMC operation and number of staff serving the TMC. • Percent of regional transportation system monitored by the TMC for real-time performance.
Anticipated Data Needs	• TMC operational data (e.g., level of performance monitoring, number of events managed, level of services provided to aid motorists, etc.).
Data Resources and Partners	• Transportation management center and transportation agency partners.
M&O Strategies to Consider	Strategies include managing the operation of the transportation system by communicating travel condition information, making necessary modifications to traffic and transit control systems, and directing response activities.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freight Management: Customer Satisfaction 3.3.7

General Description

The intent of this objective is to improve freight shippers', receivers', and carriers' satisfaction with freight mobility in the region.

Operations Objectives	• **Increase ratings for customer satisfaction with freight mobility in the region among shippers, receivers, and carriers by X percent in Y years.**
Performance Measures	• Percentage of customers satisfied with region's freight management practices.
Anticipated Data Needs	• Customer satisfaction surveys.
Data Resources and Partners	• This data would be gathered through surveys among users and providers of the region's freight-related transportation system.
M&O Strategies to Consider	M&O strategies to consider for improving customer satisfaction with freight management include infrastructure and technology improvements. Additional strategies include providing rest areas and services for long-haul truckers.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freight Management: Travel Time Delay

General Description

The objectives in this section focus on reducing travel-time delay for regional freight transportation.

Operations Objectives	• **Increase the mobility index (defined below) by X percent in Y years.** • **Decrease the annual average travel time index for freight by X points in Y years.** • **Decrease point-to-point travel times on selected freight-significant highways by Y minutes within Y years.** • **Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways by X percent in Y years.**
Performance Measures	• Mobility index for system users defined as [Ton-miles of travel] / [Vehicle-miles of travel * Average speed].[20] • Travel time index: ratio of observed average travel time to free-flow travel time. • Point-to-point travel times on selected freight-significant highways. • Hours of delay per 1,000 vehicle miles on selected freight-significant highways.
Anticipated Data Needs	• Ton-miles of travel for freight, vehicles-miles of travel for freight, and average speed (can be derived from travel time, if necessary). • Observed travel time and free-flow travel time. • Point-to-point travel time on selected freight-significant facilities. • Average travel time and traffic volumes on selected freight-significant facilities.
Data Resources and Partners	• Data would need to be collected by agencies responsible for operation of the roadways and/or freight operators responsible for operation of the vehicles (e.g., trucks, trains). • State and local DOTs, freight carriers.
M&O Strategies to Consider	Regions can reduce travel time delay for freight by increasing traveler information across the region, weigh-in-motion weigh stations, travel demand management programs, and freight-only lanes.
Safety-related Impacts	Select example of associated M&O strategies, and its safety impacts include: • Modify access point density: The safety impact of reducing the number of access points is potential reduction in injury and non-injury crash frequency, as well as angle and sideswipe collisions at intersections and mid-block areas. *Source: HSM, First Edition.*

[20] Transportation Research Board, NCHRP, *NCHRP Report 606: Forecasting Statewide Freight Toolkit*, (Washington, DC: 2008). Available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_606.pdf, last accessed February 25, 2010.

Freight Management: Travel Time Reliability

General Description

Objectives in the area of travel-time reliability for freight aim to reduce the variability in travel time so that users experience a consistent and predictable trip time for the movement of goods on the surface transportation system.

Operations Objectives

- **Reduce buffer index on regional freight routes during peak and off-peak periods by X percent in Y years.**
  [See System Reliability for additional information on buffer index.]

Performance Measures[21]

Buffer index on regional freight routes during peak and off-peak period.

The buffer index represents the extra time (buffer) freight travelers add to their average travel time when planning trips. This is the extra time between the average travel time and near-worst case travel time (95th percentile), whereas the planning time index represents the extra time between the free-flow travel time and the near-worst case travel time (95th percentile). The buffer index is stated as a percentage of the average travel time.

$$\text{Buffer Index (\%)} = \frac{\text{95th percentile travel time (minutes)} - \text{average travel time (minutes)}}{\text{average travel time (minutes)}}$$

Anticipated Data Needs

- Travel time during peak and off-peak periods on freight routes.

Data Resources and Partners

- Travel time estimates directly calculated from continuous probe vehicle data, estimates from continuous point-based detector data, data collected in periodic special studies, or estimation created through simulation.[22]

M&O Strategies to Consider

Strategies to consider include traveler information, road weather management practices, quick clearance of incidents, truck-only lanes and truck-only toll facilities.

Safety-related Impacts

Select examples of associated M&O strategies and their safety impacts include:

- Modify access point density: The safety impact of reducing the number of access points is potential reduction in injury and non-injury crash frequency, as well as angle and sideswipe collisions at intersections and mid-block areas. *Source: HSM, First Edition.*

[21] U.S. Department of Transportation, FHWA, *Monitoring Urban Freeways in 2003: Current Conditions and Trends* from Archived Operations Data. Texas Transportation Institute: December 2004. http://mobility.tamu.edu/mmp/FHWA-HOP-05-018/data.stm

[22] U.S. Department of Transportation, FHWA, *Travel Time Reliability: Making It There On Time, All The Time*, December 2005. http://www.ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm. Accessed on October 20, 2009.

Freight Management: Border Crossing

General Description

The intent of this objective is to reduce travel time delay at international border crossings for freight transportation in the region.

Operations Objectives	• **Decrease average crossing times at international borders by X minutes for each border in the region over Y years.** • **Increase the use of electronic credentialing to X percent of weigh stations and border crossings by year Y.**
Performance Measures	• Average border crossing time for freight at international borders per year. • Percent of weigh stations and border crossings in the region that use electronic credentialing.
Anticipated Data Needs	• Time between freight vehicle entering border area to the time freight vehicle exits border area. • Count of weigh stations and border crossings using electronic credentialing.
Data Resources and Partners	• Potential data resources are trucking companies that use trucks equipped with AVL. Potential partners include the U.S. Customs Service and other agencies operating at the border.
M&O Strategies to Consider	M&O strategies to consider include the use of commercial vehicle information systems and networks (CVISN) and traveler information to alert commercial vehicle drivers of delays at borders and possible alternatives. Additional strategies include installation, maintenance, and training in the use of electronic credentialing and dynamic pricing.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freight Management: Intermodal Facilities

General Description

The intent is to reduce the frequency and duration of delays at intermodal facilities where goods can transfer between modes.

Operations Objectives	• **Reduce the frequency of delays per month at intermodal facilities by X percent in Y years.** • **Reduce the average duration of delays per month at intermodal facilities by X percent in Y years.**
Performance Measures	• Frequency of delays per month at intermodal facilities where a delay is defined as an addition of Z minutes to free flow conditions. • Average duration of delays per month at intermodal facilities.
Anticipated Data Needs	• Travel time of goods through intermodal facilities in the region.
Data Resources and Partners	• Freight carriers and port authorities would be potential sources of data and partners in measuring performance.
M&O Strategies to Consider	Strategies include on-site weight-in-motion facilities at intermodal hubs, automated inspection technology, pre-sorting of containers by complexity of inspection, and other logistical actions.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Freight Management: Detours and Routing

General Description

The intent is to reduce the impact on freight when detours and re-routing is necessary due to incidents, emergencies, events, construction, weather, or choke points.

Operations Objectives	• **X percent of freeway and major arterial detours can accommodate commercial vehicles by year Y.** • **Provide freight operators with traveler alerts and alternate routes in the case of incidents, special events, weather, construction, and severe congestion at choke points on X percent of freight-significant routes by year Y.**
Performance Measures	• Percent of detours of freeways and major arterials that can accommodate commercial vehicles. • Percent of freight-significant routes where traveler alerts and alternate route information is provided in the case of incidents, special events, weather, construction, and severe congestion at choke points.
Anticipated Data Needs	• Number of detours accommodating commercial vehicles. • Freight traveler information coverage.
Data Resources and Partners	• State DOTs, local DOTs, freight carriers, port authorities would be potential sources of data and partners in measuring performance.
M&O Strategies to Consider	Strategies include detection of incidents/congestion and dissemination of traveler alerts and detours. Strategies also include developing region-wide map of potential freight detours.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Entry/Exit Travel Times 3.3.8

General Description

The objectives in this category focus on reducing the travel time for entering and exiting a special event. This section includes related objectives such as customer satisfaction of event management, event clearance, and the reliability of travel time to events.

Operations Objectives	• **Reduce average travel time into and out of the event by X percent in Y years.** • **Reduce average time to clear event's exiting queue by X percent in Y years.** • **Reduce non-special event VMT in the event area during events by X percent in Y years.** • **Reduce buffer time index for travelers to multiple similar special events by X percent in Y years.**
Performance Measures	• Average travel time to selected special events from a set of locations in the area over a year. • Average travel time away from selected special events to a set of locations over a year. • Average time to clear event's exiting queue by year per event. • Non-special event VMT in the event area during events over a year. • Buffer time index for travelers to multiple similar special events.
Anticipated Data Needs	• Travel time to and from a set of special events. • Time to clear an event's exiting queue in terms of vehicles as well as people exiting via transit, walking, or biking. • Vehicle miles traveled for vehicles not associated with special event.
Data Resources and Partners	• Example methods of obtaining travel times include probes in the traffic stream (MAC reader technology, AVL technology on transit vehicles, CCTV surveillance, etc.), speed sensors and segment lengths, and intercept surveys of arriving event patrons. • Non-special event VMT would likely be recorded for key facilities providing access to the event. Facility operators (DOTs, transit agencies, etc.) would collect counts at key locations that allow differentiation between event and non-event traffic. • Agencies that may be involved in collecting data would include highway, arterial, and transit facility operators, signal system operators, public safety officials, parking authorities, and special event management staff.
M&O Strategies to Consider	Travel demand management strategies such as efforts in encouraging transit, car pooling, biking, walking, and other non-single occupancy vehicle modes of transportation, provide ways to improve entry and exit travel times to events. Other strategies include creating a special event signalization or special event management plan, traffic/parking management staff training, traveler information, and route management for event and non-event traffic.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Mode Shift from Single Occupancy Vehicle

General Description

The intent is to minimize the use of single-occupancy vehicles by special event attendees by encouraging the use of other modes.

Operations Objectives	• **Decrease the percent of special event attendees traveling to the event in single-occupancy vehicles by X percent in Y years.** • **Increase the percent of special event attendees using park & ride lots by X percent in Y years.** • **Increase the percent of special events with dedicated shuttle service by X percent in Y years.**
Performance Measures	• Percent of special event attendees using single occupancy vehicles each year for selected events. • Percent of special event attendees utilizing park & ride lots each year for selected events. • Percent of special events with dedicated shuttle service for selected events during a 1-year period.
Anticipated Data Needs	• Number of special event attendees and number of single occupancy vehicles arriving at event. • Number of special event attendees and number of attendees using park & ride lots for a sample of events. • Number of special events in region and number of events with dedicated shuttle service.
Data Resources and Partners	• The data resources needed include counts at special events for single occupancy vehicles and the number of people using park & ride lots. Estimates for park & ride lots could be developed though automatic passenger counters (or manual counts) on park & ride lot shuttles. • Special event managers and park & ride operators would be the key partners for these objectives.
M&O Strategies to Consider	Strategies include park and ride lots, shuttle service, restricting parking availability, and pricing as well as locating special events at sites that are accessible to transit, walking, and biking.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Traveler Information

General Description

The objectives in this sheet focus on the use of traveler information to manage the movement of people and goods into and out of special events safely and efficiently.

Operations Objectives	• **Increase the methods of effectively disseminating special event information to travelers by X percent in Y years (e.g., media releases, highway advisory radio, dynamic message signs, commercial AM and FM radio).** • **Increase the percentage of planned special events (with attendance above Z) with information on anticipated and actual travel conditions being disseminated to the traveling public at least X hours prior to the event.**
Performance Measures	• Number of effective methods to disseminate special event information to travelers. • Percent of special events with expected attendance over Z that traveler information is disseminated at least X hours prior to the event.
Anticipated Data Needs	• A count of the available traveler information dissemination channels. • A count of major special events with and without the dissemination of traveler information ahead of the event.
Data Resources and Partners	• Data could be collected through surveys of special event management agencies on methods used for information dissemination and the use of traveler information at major events.
M&O Strategies to Consider	Strategies include the range of communication techniques to support traveler information for special events as well as creating a special event signalization plan or a special event management plan with components on disseminating traveler information.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Parking Management

General Description

The objectives in this sheet focus on the use of parking management during special events to encourage a more efficient use of existing parking facilities and to improve the quality of service for users.

Operations Objectives	• **Increase the number of special events that use shared parking facilities (e.g., parking lots of nearby businesses or organizations) by X percent in Y years.** • **Increase the use of flexible pricing mechanisms near special event locations on X percent of parking spaces in Y years.** • **Increase on-street parking restrictions on X percent of widely used routes during special events in Y years.** • **Decrease the time spent clearing special event venue parking lots of vehicles by X percent in Y years following each event.**
Performance Measures	• Number of special events that use shared parking facilities. • Percent of parking spaces near special event locations that use flexible pricing mechanisms. • Percent of routes widely used during planned special events with on-street parking restrictions. • Percent decrease in time to clear parking lots.
Anticipated Data Needs	• A count of special events using shared use parking facilities • Count of parking spaces near special event locations with and without flexible pricing mechanisms. • Determination of the most widely used routes during special events and count of those routes with on-street parking restrictions. • Time to clear special event parking lots following each special event.
Data Resources and Partners	• Staff time or technology would be needed to count the number of available parking spaces, assess widely used commuter routes during special events, and record clearance time for parking lots after events.
M&O Strategies to Consider	Strategies include shared parking with nearby facilities, priced parking, transportation demand management, and park and ride. These strategies could be outlined within a special event management plan.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Multi-Agency Coordination and Training

General Description

This section contains objectives that focus on efforts to improve multi-agency collaboration and training for special event management.

Operations Objectives	• **Increase the percentage of special event stakeholder agencies participating in a regional event management team to X percent by year Y.** • **Increase the number of agencies with special event management responsibilities that use interoperable communications by X percent in Y years.** • **Increase the percentage of special events that include a pre-event and post-event briefing by X percent in Y years.** • **Increase the number of special event-related exercises performed among stakeholders by X percent in Y years.**
Performance Measures	• Percent of stakeholder agencies participating agencies in a regional special event management team. • Number of agencies special event management responsibilities using interoperable communications. • Percent of special events that include a pre-event and post-event briefing. • Number of special event-related exercises performed among stakeholders.
Anticipated Data Needs	• The number of special event management stakeholder agencies and, of them, the number that participate each year in a regional event management team. • A count of special events with pre- and post-event briefings, number of special event-related exercises, and number of special event management agencies using interoperable communication systems.
Data Resources and Partners	• The data for these objectives would need to come from the agencies involved in special event management. It could be gathered through phone calls or surveys of these agencies.
M&O Strategies to Consider	M&O strategies to consider include developing a special event management plan with components on multi-agency coordination and training efforts.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Special Event Management: Use of Technology

General Description

The objective in this section focuses on deploying and using technology to improve special event management.

Operations Objectives	• **Increase the percent of major special events using ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) to detect and manage special event entry/exit bottlenecks and incidents by X percent in Y years.** • **Implement special event traffic signal timing plans at X percent of major special events each year beginning in year Y.**
Performance Measures	• Percent of special events using ITS-related assets to detect and manage incidents/ bottlenecks at entry/exit routes of the events. • Percent of major special events each year in which a special event traffic signal timing plan was implemented.
Anticipated Data Needs	• Number of special events in the region and number of special events with ITS assets used for detecting/managing bottlenecks and incidents at entry/exit routes of events. • Number of major special events where signal timing plans were and were not implemented.
Data Resources and Partners	• Data for this measure would need to come from special event managers who would potentially use ITS for monitoring travel and disseminating information. • State and local DOTs, ITS operators, emergency responders, and special event managers who would need to coordinate event planning, routing, and information dissemination.
M&O Strategies to Consider	Strategies include ITS deployment to support special event management, developing a special event signalization plan or special event management plan that identifies areas of the system that could benefit from technology improvements to coordinate special events, special event management planning and coordination among regional partners, monitoring and response to special event-related incidents, post-event debriefs, and implementation improvements.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Convert exclusive leading protected to exclusive lagging: The crash modification factor for this treatment is 0.85 with a standard error of 0.19 for all crashes. Therefore, the range of the crash modification factor is 1.23 to 0.47. For left-turn crashes, the crash modification factor is 0.51 with a standard error of 0.54. Therefore, the range of the crash modification factor is 1.59 to 0.0. *FHWA Desktop Reference for Crash Reduction Factors, 2008.* **Note:** A crash modification factor is multiplied by the existing number of crashes to determine the number of crashes following the implementation of a treatment.

Transit Operations and Management: Service Directness 3.3.9

General Description

This sheet contains objectives on improving transit service with limiting the number and time of transfers.

Operations Objectives	• **At least X percent of trips can be made with no more than Y transfers.** • **Scheduled transfer times between routes should be no longer than X minutes.**
Performance Measures	• Percent of trips with no more than Y transfers. • Scheduled transfer times between routes.
Anticipated Data Needs	• Transit trip origin and destination data is needed. • Scheduled arrival and departure times at transfer points between routes.
Data Resources and Partners	• The data resources will likely come from transit schedules and transit rider surveys for origin and destinations.
M&O Strategies to Consider	M&O strategies to minimize the number of transfers rely on the determination of transit trip characteristics, which allows transit routes to be adjusted to reduce the number of transfers.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Loading Standards

General Description

This sheet contains objectives on improving transit loading standards.

Operations Objectives	• **Load factors for (route type) routes at each route's busiest point should not exceed X on any vehicle (or on the average vehicle) during peak/off-peak periods.** • **Passenger loads on (route type) routes at each route's busiest point should not exceed X passengers on any vehicle (or on average) during the hour during peak/off-peak periods** • **No more than X standees should be present at each route's busiest point on any vehicle (or on the average vehicle) during peak/off-peak periods.** • **No passenger will have to stand for more than X minutes during their journey.**
Performance Measures	• Load factor. • Maximum passenger loads. • Maximum standees. • Duration of standee time.
Anticipated Data Needs	• Transit ridership data is required. • Passenger standing time.
Data Resources and Partners	• The transit agency is the key partner for these objectives.
M&O Strategies to Consider	M&O strategies include strategic infrastructure improvements to match with the busiest points along transit routes.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Traveler Information

General Description

This sheet contains objectives on improving passenger shelters/platforms and amenities.

Operations Objectives	• **Equip X shelters/platforms with real-time arrival displays annually.** • **Increase the number of web-based trip planner requests each year by X percent.** • **All stops have up-to-date schedule information available within X days of schedule changes.** • **Transit traveler information is available in the region via 511 web and phone service by year Y.** • **Install Wi-Fi service on X number of routes annually.**
Performance Measures	• Number of shelters/platforms equipped with real-time arrival displays per year. • Number of web-based trip planner requests per year. • Percent of stops with up-to-date schedule information available within X days of schedule changes. • Availability of transit traveler information on 511 web and phone service. • The number of routes in which Wi-Fi service was installed.
Anticipated Data Needs	• Count of shelters/platforms with arrival displays. • Web page usage statistics for trip planning requests. • Count of stops with up-to-date schedule information (within a specified timeframe). • Inclusion of transit traveler information on 511 services. • Count of routes in which Wi-Fi service was installed per year.
Data Resources and Partners	• The transit agency is the key partner for this objective.
M&O Strategies to Consider	M&O strategies are inherent in the objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Customer Service/Safety

General Description

The objectives in this section focus on improving transit customer service, improving personal safety (e.g. reducing crime on transit vehicles that affects customer perceptions of safety), and improving security related to reducing vandalism and graffiti in a region.

Operations Objectives	• **Decrease by X percent on an annual basis the number of complaints per 1,000 boarding passengers.** • **Increase the number of closed circuit television (CCTV) cameras installed by X percent in Y years on platforms, park-n-ride lots, vehicles, and other transit facilities.** • **Increase customer service and personal safety ratings by X percent within Y years.** • **Decrease the number of personal safety incidents by X percent within Y years.**
Performance Measures	• Complaint rate. • Number of CCTV cameras on platforms, park-n-ride lots, vehicles, and other transit facilities. • Personal safety and customer service ratings. • Number of reported personal safety incidents.
Anticipated Data Needs	• Count of complaints made by customers to transit agencies and number of total transit boardings by agency. • Count of CCTV cameras on transit property. • Customer satisfaction survey evaluating safety and customer service. • Transit boardings. • Reported number of safety incidents.
Data Resources and Partners	• This data would be provided by the transit agencies in the region.
M&O Strategies to Consider	M&O strategies to improve customer service and safety could involve additional police/security staff around transit stations, improved staff/security training, better information about vehicle arrivals, and more frequent cleaning of transit vehicles and facilities.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Line-Haul Transit

General Description

The objectives in this section focus on improving line-haul transit service in a region.

Operations Objectives	• **Improve average travel speeds by X percent for specified line-haul transit routes every Y years.** • **Improve average on-time performance for specified line-haul transit routes by X percent annually.** • **Provide line-haul transit travel times equal to or less than average auto travel times on same corridors/parallel corridors for X number of routes over Y years.**
Performance Measures	• Average line-haul transit travel speeds for specified line-haul transit routes. • Average line-haul transit on-time performance for specified line-haul transit routes. • Number of line-haul transit routes operating with travel times equal to or less than average auto travel times on same corridors/parallel corridors.
Anticipated Data Needs	• Travel speeds of transit vehicles for specified line-haul transit routes. • Percent of on-time arrivals/departures for specified line-haul transit routes. • Average travel time for transit vehicles on specified line-haul transit routes and average auto travel time for same corridor or parallel corridor.
Data Resources and Partners	• This data would be provided by the transit agencies and the MPO in the region.
M&O Strategies to Consider	M&O strategies to improve line-haul transit service could include making improvements to existing infrastructure (stations/platforms, exclusive bus lanes, etc.), vehicles, fare collection systems, and scheduling.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Transit Signal Priority

General Description

The objectives in this section focus on implementation of transit signal priority systems to improve transit performance and reliability in a region.

Operations Objectives	• **Increase implementation of transit signal priority strategies on X number of routes (or X number of intersections) over the next Y years.** • **Decrease system-wide signal delay on transit routes by X percent per year.** • **Decrease delay by X percent per year by increasing the use of queue jumping and automated vehicle location.**
Performance Measures	• Number of transit routes/intersections equipped with transit signal priority capability. • System-wide signalized stop delay on transit routes. • Travel time delay on routes with queue jumping and automated vehicle location in use.
Anticipated Data Needs	• Count of transit routes/intersections with transit signal priority capabilities. • AVL data with location and travel time delay. • Signal operations/green time reports.
Data Resources and Partners	• This data would be provided by the transit agencies and traffic signal operating agencies in the region.
M&O Strategies to Consider	M&O strategies to increase transit signal priority implementation could involve identification and prioritization of routes or transit corridors that are candidates for implementing transit signal priority systems. Another strategy may include collaboration with the traffic management agency to leverage transit signal priority implementation with traffic signal system upgrades.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Automated Fare Collection

General Description

The objectives in this section focus on implementing and integrating automated fare collection in a region.

Operations Objectives	• **Implement an automated fare collection system in Y years for X percent of transit providers in the region.** • **Integrate X additional modes/services into automated fare collection system by Y years.** • **Increase use of system by X percent per year.** • **Increase by X percentage points, every Y years, the percent of transfers performed with automated fare cards.**
Performance Measures	• Percent of transit providers using the region's automated fare collection system. • Number of additional modes/service integrated into the fare collection system. • Percent of fares collected using automated fare collection. • Percent of total transfers performed with automated fare cards.
Anticipated Data Needs	• Number of transit providers and additional modes/services implementing automated fare collection system. • Farebox data – number of fares collected through automated system. • Number of transfers performed using automated fare card.
Data Resources and Partners	• This data would be provided by the transit agencies in the region.
M&O Strategies to Consider	M&O strategies to increase implementation and utilization of automated fare collection could involve integrating the system across multiple modes or services, implementing a consistent system with other connecting transit services, and implementing a marketing campaign to increase awareness and utilization.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Transit Operations and Management: Park-and-Ride Support

General Description

The objectives in this section focus on improving knowledge of, and support for, park-and-ride lot connections to transit service in a region.

Operations Objectives	• **Increase traveler awareness of park-and-ride lots by X percent within Y years.** • **Increase pedestrian and bicycle access to park-and-ride lots by X percent within Y years.** • **Increase the number of automobile and bicycle spaces by X percent within Y years for lots currently experiencing X percent utilization.**
Performance Measures	• Number of users aware of park-and-ride lots in their region. • Percent of park-and-ride areas with pedestrian and bicycle access. • Number of auto/bicycle spaces at the park-and-ride lots.
Anticipated Data Needs	• Customer survey measuring knowledge of regional park and ride lots. • Number of secure bicycle storage areas. • Number of bicycle routes. • Number of crosswalks. • Number of park-and-ride lots meeting ADA standards. • Parking utilization studies for bicycle and auto spaces.
Data Resources and Partners	• Data would need to be collected by transit agencies to determine amenities of the park-and-ride lots. • Partners needed include departments of transportation, intermodal facility operators, and transit agencies to coordinate the expansion of park-and-ride lots, bicycle, and pedestrian facilities.
M&O Strategies to Consider	Strategies to consider include those that make park-and-ride lots easier to use with technologies such as electronic payment systems and park and ride space finders. Additionally, strategies that increase transit use would also increase park-and-ride lot use.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Demand Management: Auto Commuter Trip Reduction Programs 3.3.10

General Description

The objectives in this sheet focus on commuter trip reduction programs for employers.

Operations Objectives	• **Increase the percentage of major employers (employers with at least Z employees) actively participating in transportation demand management programs by X percent within Y years.** • **Reduce commuter vehicle miles traveled (VMT) per regional job by X percent in Y years.**
Performance Measures	• Percent of major employers with active TDM programs. • Commuter VMT per regional employee.
Anticipated Data Needs	• Number of major employers with and without active TDM programs. • Number of regional employees and total commute VMT.
Data Resources and Partners	• Department of Labor, Transportation Management Associations, Business Licensing Bureaus. • Travel behavior surveys for commute mode choice, US Census Bureau.
M&O Strategies to Consider	M&O strategies include guaranteed ride home program; commuter financial incentives (parking cash out and transit allowances); alternative scheduling (flextime and compressed work weeks); telework; bicycle parking and changing facilities at major employer locations; worksite amenities such as on-site childcare, restaurants, and shops to reduce the need to drive for errands; company travel reimbursement policies for bicycle or transit mileage for business trips; company vehicles to eliminate the need for employees to drive to work in order to have their cars for business travel; proximate commuting, which allows employees to shift to worksites that are closest to their home (for employers who have multiple work locations, such as banks and other large organizations); worksite locations that reflect location-efficient development principles; and employer strategies to encourage bicycling and walking, including safe and secure storage for bicycles and shower and locker facilities.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Demand Management: Commuter Shuttle Service

General Description

The objective in this sheet focuses on promoting commuter shuttle services.

Operations Objectives	• **Annually promote shuttle service between X major activity centers and major destinations that are not already accommodated within 1/4 mile by other transit services.**
Performance Measures	• Percent of residents in region receiving marketing material on shuttle service opportunities.
Anticipated Data Needs	• Shuttle service and transit route maps. • Count of residents in applicable areas receiving shuttle marketing materials.
Data Resources and Partners	• Employers, transportation management associations, travel demand management programs, transit agencies, and State and local DOTs.
M&O Strategies to Consider	The M&O strategy is inherent in the objective.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Demand Management: Carpool/Vanpool

General Description

The objectives in this sheet focus on carpool and vanpool travel.

Operations Objectives	• **Increase the number of carpools by X percent over the next Y years.** • **Increase use of vanpools by X percent over the next Y years.** • **Provide carpool/vanpool matching and ridesharing information services by year Y.** • **Reduce trips per year in region by X percent through carpools/vanpools.** • **Create and share regional carpool/vanpool database with Z number of employers per year.**
Performance Measures	• Share of household trips by each mode of travel. • Number of trips in region. • Availability of carpool/vanpool matching and ridesharing information services. • Number of employers with access to regional carpool/vanpool database.
Anticipated Data Needs	• Mode share and total trips in region. • Count of employers with access to regional carpool/vanpool database.
Data Resources and Partners	• Survey data, such as the Census Journey to Work Survey or other mode share surveys. • Employer surveys of employee commuting patterns. • Household surveys of travel behaviors including mode choice, frequency of trip making and vehicle occupancy. • Partners include employers, transportation management associations, travel demand management programs, transit agencies, State and local DOTs, Commuters, non-auto advocacy groups, and research firms.
M&O Strategies to Consider	The M&O strategy is inherent in the objective.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Demand Management: Walking/Bicycling

General Description

The objectives in this sheet focus on walking and bicycling incentives.

Operations Objectives	• **Increase the number of travelers commuting via walking and/or bicycling by X percent over Y years.** • **Annually update bicycle/pedestrian map for accuracy.** • **Increase the number of available tools for travelers that incorporate a bicycle/pedestrian component by X percent by year Y.**
Performance Measures	• Number of travelers commuting via walking and/or bicycling. • Number of months since the last update of the bicycle/pedestrian map. • Number of traveler tools with a bicycle/pedestrian component.
Anticipated Data Needs	• Count of commuters walking and/or bicycling. • Date of bicycle/pedestrian map update. • Count of traveler tools with a bicycle/pedestrian component.
Data Resources and Partners	• Employers, transportation management associations, travel demand management programs, transit agencies, and State and local DOTs. • Commuters, non-auto advocacy groups, research firms.
M&O Strategies to Consider	The M&O strategies are inherent in the objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Demand Management: Parking Management

General Description

The objectives in this sheet focus on managing parking in support of managing travel demand.

Operations Objectives	• **Implement shared parking for X communities every Y years.** • **Implement parking pricing for X communities every Y years.** • **Install parking meters along X corridors by year Y in the urban core/transit supportive areas.** • **Increase the number of residents/commuters receiving information on parking pricing and availability within Y years.** • **Increase park-and-ride lot capacity by X percent over Y years.** • **Biannually increase preferred parking spaces for carpool/vanpool participants within downtown, at special events, and among major employers by X percent within Y years.**
Performance Measures	• Number of communities with shared parking. • Number of communities with priced parking stalls. • Number of corridors in urban core/transit supportive areas with parking meters. • Number of residents/commuters receiving information on parking pricing and availability. • Capacity of park & ride lots. • Number of preferred parking spaces for carpool/vanpool participants.
Anticipated Data Needs	• Count of communities with shared parking and priced parking stalls. • Count of corridors with parking meters. • Count of residents/commuters exposed to parking information. • Park-and-ride lot capacity data. • Count of preferred parking spaces.
Data Resources and Partners	• Employers, county/city staff, transit agencies, and special event managers.

M&O Strategies to Consider

M&O strategies are inherent in the objectives.

Safety-related Impacts

Select examples of associated M&O strategies and their safety impacts include:

- Prohibit on-street parking: The crash modification factor for this treatment is 0.58 with a standard error of 0.08 for all crashes. Therefore, the range of the crash modification factor is 0.74 to 0.42. For injury crashes, the crash modification factor is 0.78 with a standard error of 0.05. Therefore the range of the crash modification factor is 0.88 to 0.68. *Source: HSM, First Edition.*
- Convert free to regulated parking: The crash modification factor for this treatment is 0.94 with a standard error of 0.08 for injury crashes. Therefore, the range of the crash modification factor is 1.10 to 0.78. For non-injury crashes, the crash modification factor is 0.81 with a standard error of 0.05. Therefore the range of the crash modification factor is 0.91 to 0.71. *Source: HSM, First Edition.*
- Implement time-limited parking restrictions: The crash modification factor for this treatment is 0.89 with a standard error of 0.06 for all crashes. Therefore, the range of the crash modification factor is 1.01 to 0.77. For parking-related crashes, the crash modification factor is 0.21 with a standard error of 0.09. Therefore the range of the crash modification factor is 0.39 to 0.03. *Source: HSM, First Edition.*
  Note: A crash modification factor is multiplied by the existing number of crashes to determine the number of crashes following the implementation of a treatment.

Travel Demand Management: Marketing

General Description

The objectives in this sheet focus on using marketing and communications to manage demand for travel.

Operations Objectives	• **Develop and provide travel option services to X identified communities and audiences within Y years.** • **Construct visitor information centers in X communities by year Y.** • **Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.) by year Y.** • **Develop and enhance (e.g., through ease of navigation techniques) X number of web-based traveler information tools.**
Performance Measures	• Number of communities receiving travel option services. • Number of communities in which visitor information centers are constructed. • Implementation of transportation access guide. • Number of web-based traveler information tools developed or enhanced.
Anticipated Data Needs	• Count of communities with travel option services and visitor information centers. • Count of web-based traveler information tools.
Data Resources and Partners	• Employers, transportation management associations, travel demand management programs, transit agencies, and State and local DOTs.
M&O Strategies to Consider	M&O strategies are inherent in objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Weather Management: Clearance Time (Weather-Related Debris) 3.3.11

General Description

The intent is to improve the time needed to clear the transportation system of weather-related debris (fallen limbs and trees, snow and ice, power lines and poles, etc.) so that safe and efficient travel can resume.

Operations Objectives	• **Reduce average time to complete clearing (mode, hierarchy of facilities, or subarea of region) of weather-related debris after weather impact by X percent in Y years.** • **Reduce average time to complete clearing (interstates, freeways, expressways, all roads, main tracks, and main sidewalks) of weather-related debris after weather impact by X percent in Y years.**
Performance Measures	• Average time to clear selected surface transportation facilities of weather-related debris after weather impact.
Anticipated Data Needs	• The data needed for this objective would be the time in which the transportation facility surface has been impacted by the debris and the time required to clear selected facilities and restore them to full operation.
Data Resources and Partners	• Data needed for this performance measure would come from road or rail weather sensors, observations from meteorologists, or road maintenance staff on the roads. Data on the time to clear would need to be obtained from road maintenance managers and staff.
M&O Strategies to Consider	M&O strategies to consider in the quick clearance of roads impacted by weather would include pre-positioned debris removal vehicles, collaboration with weather forecasting services, dissemination of weather information to travelers, and preventative techniques such as spreading de-icing material prior to storm.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Raise standards for winter maintenance: The crash modification factor for this treatment is 0.89 with a standard error of 0.02 for all crashes. Therefore, the range of the crash modification factor is 0.93 to 0.85. For non-injury crashes, the crash modification factor is 0.73 with a standard error of 0.02. Therefore, the range of the crash modification factor is 0.77 to 0.69. *Source: HSM, First Edition.* **Note**: A crash modification factor is multiplied by the existing number of crashes to determine the number of crashes following the implementation of a treatment. • Raise the state of preparedness for winter maintenance: Appears to have no effect on crash frequency. *Source: HSM, First Edition*. • Apply preventive chemical anti-icing during entire winter season: The safety impact is potential reduction in injury crashes. *Source: HSM, First Edition.*

Travel Weather Management: Detours for Impacted Roadways

General Description

This category addresses making improvements in helping travelers avoid sections of roadway that are dangerous and would cause them substantial delay.

Operations Objectives	• **Increase by X percent the number of significant travel routes covered by weather-related diversion plans by year Y.** • **Increase the percent of agencies that have adopted multi-agency weather-related transportation operations plans and that are involved in transportation operations during weather events to X percent by year Y.**
Performance Measures	• Percent of significant travel routes covered by weather-related diversion plans. • Percent of agencies involved in transportation operations during weather events that have adopted multi-agency, weather-related transportation operations plans.
Anticipated Data Needs	• Number of weather-related division plans. • Total number of agencies involved in transportation operations during weather events and the number of those agencies that have adopted multi-agency diversion plans.
Data Resources and Partners	• Partners needed for collecting data would be the operators (including public safety) of the impacted roads and owners of the diversion plans.
M&O Strategies to Consider	Successfully developing plans for alternate routes during weather events requires significant preparations and collaboration between jurisdictions and modes.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Weather Management: Disseminating Information

General Description

The objectives in this category focus on getting relevant information to travelers as soon as possible regarding the impact of weather on travel in the region.

Operations Objectives	• **Reduce time to alert travelers of travel weather impacts (using variable message signs, 511, road weather information systems, public information broadcasts, the agency's website, Web 2.0 technologies, etc.) by X (time period or percent) in Y years.**
Performance Measures	• Time from beginning of weather event to posting of traveler information on (variable message signs, 511, Road Weather Information Systems, public information broadcasts etc.). • Time from beginning of weather event to posting of traveler information on agency website.
Anticipated Data Needs	• Data required for these performance measures include the time of the start of a weather event and the time in which information is given to the traveler by various methods (variable message signs, 511, road weather information systems, public information broadcasts, agency website).
Data Resources and Partners	• Partners needed to collect this data would include those with information on the timing and trajectory of weather events such as the National Weather Service, transportation agencies (DOTs, transit agencies, ports, etc.), and broadcasters that disseminate traveler information using different technologies.
M&O Strategies to Consider	M&O strategies include variable message signs on key corridors, 511 systems, road weather information systems, agency websites, and communication links with broadcasters.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Install changeable fog warnings signs: The safety impact is the potential for a reduction in crashes during fog conditions on freeways. *Source: HSM, First Edition.*

Travel Weather Management: Road Weather Information System Coverage

General Description

The intent is to increase coverage of the road system with weather sensors and communications systems. This approach can be applied to the transit system and has the potential for application to regional bicycle facilities.

Operations Objectives	• **Increase the percent of major road network (or transit network or regional bicycle network) covered by weather sensors or a road weather information system (RWIS) by X percent in Y years as defined by an RWIS station within Z miles.**
Performance Measures	• Percent of major road (transit or bicycle) network within Z miles of an RWIS station.
Anticipated Data Needs	• Data needed for this performance measure would be the deployment locations of each RWIS station in the region and location and length of major road (transit or bicycle) network.
Data Resources and Partners	• Partners needed for this data would be the agencies responsible for deployment of the RWIS stations and those responsible for maintaining an inventory of the roadway (transit or bicycle) network. This information is often stored in GIS or other mapping database, in a central data repository for sharing with all public agencies and public broadcasting groups involved with weather information dissemination.
M&O Strategies to Consider	Strategies include maintaining and sharing current information on the extent of the system (roadway, transit, bicycle), the location of weather sensors, the sharing of weather data, the installation of additional sensors, and the sharing of operational actions related to a weather event.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Travel Weather Management: Signal Timing Plans

General Description

The intent is to improve the management of traffic signal systems during inclement weather conditions.

Operations Objectives	• **Special timing plans are available for use during inclement weather conditions for X miles of arterials in the region by year Y.**
Performance Measures	• Number of miles of arterials that have at least one special timing plan for inclement weather events.
Anticipated Data Needs	• Reports from operating agencies on signal retiming, signal capabilities, and special timing plans.
Data Resources and Partners	• Partner agencies that operate arterials in the region.
M&O Strategies to Consider	M&O strategies directly flow from the objectives.
Safety-related Impacts	No known safety benefit.

Traveler Information: Information Dissemination 3.3.12

General Description

This sheet contains objectives for improving the delivery of traveler information to the public, businesses, and other users of the transportation system.

Operations Objectives	• **Increase number of 511 calls per year by X percent in Y years.** • **Increase number of visitors to traveler information website per year by X percent in Y years.** • **Increase number of users of notifications for traveler information (e.g., e-mail, text message) by X percent in Y years.** • **Increase number of Web 2.0 (e.g., Twitter, Facebook) followers by X percent in Y months.** • **Increase the accuracy and completeness of traveler information posted (on variable message signs, websites, and/or web 2.0 technologies) by reducing the number of incomplete and inaccurate reports by X percent in Y years.**
Performance Measures	• Number of 511 calls per year. • Number of visitors to traveler information website per year. • Number of users of notifications for traveler information (e.g., e-mail, text message) per year. • Number of Web 2.0 (e.g., Twitter, Facebook) followers. • Number of complaints received from system users about inaccurate or missing information.
Anticipated Data Needs	• Data for these performance measures would be a count of users for the traveler information dissemination channels. • Number of customer complaints regarding incomplete or inaccurate traveler information.
Data Resources and Partners	• This data would be gathered through call logs, website logs, and other systems that record information on its access history or membership.
M&O Strategies to Consider	M&O strategies to improve information dissemination include polling target audiences to determine the more effective ways to reach them with information and providing accurate, timely, and useful information.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Traveler Information: Trip Planning Tools

General Description

The objectives in this section focus on promoting system awareness among users so they have direct knowledge and awareness of current and forecasted system operating and safety conditions, route choices, and mode choices.

Operations Objectives	• **Enhance regional multimodal trip planning tools to X data sources by year Y.** • **Increase the ease of use of trip planning tools by X percent by year Y.** • **Increase the number of uses of multimodal trip planning tools by X percent by year Y.**
Performance Measures	• The number of data sources providing information for multi-modal trip planning tools. • Trip planning tools ease of use rating. • Number of uses of trip planning tools.
Anticipated Data Needs	• Identification of all multimodal trip planning tools and their data sources. • Trip planning tool ease-of-use rating obtained by customer survey. • Number of uses of trip planning tools.
Data Resources and Partners	• All operating agencies within the region.
M&O Strategies to Consider	M&O strategy is inherent in objective.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Traveler Information: Data Collection and Sharing on Travel Conditions

General Description

This sheet contains objectives on improving the detection of travel conditions by operators and sharing traveler information between jurisdictions and modes.

Operations Objectives	• **Increase the percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. to X percent by Y year.** • **Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region to X percent by Y year.** • **Increase the percent of modes in the region that share their traveler information with other modes in the region to 100 percent by Y year.**
Performance Measures	• Percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. • Percent of transportation facilities whose owners share their traveler information with other agencies in the region. • Percent of modes in the region that share their traveler information with other modes.
Anticipated Data Needs	• Number of miles of roads or rails that are covered by remote detection. • Number of the transportation facilities in the region. • Count of jurisdictions sharing traveler information with other agencies in the region. • Count of modes in the region sharing traveler information with other modes.
Data Resources and Partners	• The data for these performance measures would come from querying each of the transportation facility owners/operators in the region on their detection systems and information sharing practices.
M&O Strategies to Consider	The M&O strategies to consider are inherent in the objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Traveler Information: Customer Satisfaction

General Description

The objective in this sheet focuses on improving customer satisfaction with the timeliness, accuracy, and usefulness of traveler information in the region.

Operations Objectives	• **Increase customer satisfaction rating of the timeliness, accuracy, and usefulness of traveler information in the region by W, X, and Z percent, respectively, over Y years.**
Performance Measures	• Customer satisfaction ratings of timeliness, accuracy, and usefulness of traveler information.
Anticipated Data Needs	• Customer ratings of traveler information per year.
Data Resources and Partners	• This data would be gathered through surveys among the public and businesses that use the transportation system to move goods and deliver services.
M&O Strategies to Consider	M&O strategies to improve customer satisfaction with traveler information include increasing the detection of travel conditions, improving multi-agency, multi-modal sharing of travel data, and relying on convenient, accessible means of information distribution such as cell phones and websites.
Safety-related Impacts	Select examples of associated M&O strategies, and their safety impacts include: • Install changeable "Queue Ahead" warning signs: The crash modification factor for this treatment is 0.84 with a standard error of 0.1 for rear-end injury crashes. Therefore, the range of the crash modification factor is 1.04 to 0.64. For rear-end non-injury crashes, the crash modification factor is 0.84 with a standard error of 0.2. Therefore, the range of the crash modification factor is 1.24 to 0.44. *Source: HSM, First Edition*. **Note:** A crash modification factor is multiplied by the existing number of crashes to determine the number of crashes following the implementation of a treatment.

Work Zone Management: Travel Time Delay 3.3.13

General Description

The objectives in this section focus on reducing travel time delay for travelers within work zones in the region.

Operations Objectives	• **Reduce the person hours (or vehicle hours) of total delay associated with work zones by X percent over Y years.** • **Increase the rate of on-time completion of construction projects to X percent within Y years.** • **Increase the percentage of construction projects that employ night/ off-peak work zones by X percent in Y years.**
Performance Measures	• Person hours (or vehicle hours) of delay associated with work zones. • Percent of construction projects completed on-time according to established schedule. • Percent of construction project employing night /off-peak work zones.
Anticipated Data Needs	• Total travel time in person hours (or vehicle hours) of travel impacted by work zones. • Traffic volume in select work zones. • Travel times in select work zones. • Length of work zones. • Number of constructions projects employing night/ off-peak work zones. • Number of construction projects completed on time. • Total travel time in person hours (or vehicle hours) of travel during free-flow conditions. • Similar data (volume, times, length) of work zones during non-work time periods.
Data Resources and Partners	• Data would need to be collected by agencies responsible for maintanance and operation of the roadways. • Partners needed include public safety, departments of transportation, contractors, and utility companies.
M&O Strategies to Consider	Regions can reduce travel time delay in work zones by shortening lane closure time (particularly during high-traffic hours) and providing travelers with ahead-of-time and real-time information to avoid the work zone.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Work Zone Management: Extent of Congestion

General Description

The objectives in this section focus on reducing the extent of congestion for travelers within work zones in the region.

Operations Objectives	• **Reduce the percentage of vehicles traveling through work zones that are queued by X percent in Y years.** • **Reduce the average and maximum length of queues, when present, by X percent over Y years.** • **Reduce the average time duration (in minutes) of queue length greater than some threshold (e.g., 0.5 mile) by X percent in Y years.**
Performance Measures	• Percentage of vehicles experiencing queuing in work zones. • Length of average and maximum queues in work zones. • Average duration in minutes of queue length greater than X miles.
Anticipated Data Needs	• Number of vehicles traveling through work zones. • Number of vehicles traveling through work zones experiencing queuing. • Average and maximum length of work zones. • Duration of queue length greater than X miles.
Data Resources and Partners	• Data would need to be collected by agencies responsible for operation of the roadways. • Partners needed include public safety, departments of transportation, contractors, and utility companies.
M&O Strategies to Consider	Regions can reduce the extent of congestion in work zones by shortening lane closure time (particularly during high-traffic hours) and providing travelers with advance notice and real-time information to avoid the work zone.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Use crossover closure: There is a potential negative safety impact of using this strategy: there is an increased likelihood of severe crashes and head-on collisions. *Source: HSM, First Edition.* • Use single lane closure: There is a potential negative safety impact of using this strategy: there is an increased likelihood in all crash types, particularly fixed object crashes. *Source: HSM, First Edition.*

Work Zone Management: Travel Time Reliability

General Description

Objectives in the area of travel time reliability in work zones aim to reduce the variability in travel time so that transportation system users experience a consistent and predictable trip time.

Operations Objectives	• **Reduce vehicle-hours of total delay in work zones caused by incidents (e.g., traffic crashes within or near the work zone).**
Performance Measures	• Vehicle-hours of delay due to incidents related to work zones.
Anticipated Data Needs	• Traffic volume through work zones. • Hours of incident-related delay in work zones.
Data Resources and Partners	• Data would need to be collected by agencies responsible for operation of the roadways. • Partners needed include public safety, departments of transportation, contractors, and utility companies.
M&O Strategies to Consider	Regions can improve travel time reliability in work zones by shortening lane closure time (particularly during high-traffic hours) and providing travelers with advance notice and real-time information to avoid the work zone. Proper temporary traffic control devices and practices minimize the opportunity for crashes, and therefore shortening the incident-related delay in work zones.
Safety-related Impacts	A select example of an associated M&O strategies, and its safety impacts include: • Use dynamic message signs in work zones: The safety impact is potential speed reduction in congested flow conditions, but not during uncongested flow. *Source: NCHRP 500 Volume 17.*

Work Zone Management: Construction Coordination

General Description

Objectives in the area of construction coordination in work zones aim to reduce the potential overlap in construction projects so that transportation system users are not burdened with significant increases in travel time due to multiple construction projects along the same or parallel routes or corridors.

Operations Objectives	• **Increase the number of capital projects reviewed for regional construction coordination by X percent in Y years.** • **Decrease the number of work zones on parallel routes/along the same corridor by X percent in Y years.** • **Establish a work zone management system within X years to facilitate coordination of work zones in the region.**
Performance Measures	• Percent of capital projects whose project schedules have been reviewed. • Percent of work zones on parallel routes/along the same corridor. • Presence of an established work zone management system.
Anticipated Data Needs	• Capital projects submitted for review. • Capital project anticipated and actual schedules. • Map of work zones along area maps.
Data Resources and Partners	• Data would need to be collected by agencies responsible for maintenance and operation of the roadways. • Partners needed include public safety, departments of transportation, contractors, and utility companies.
M&O Strategies to Consider	M&O strategies are implied in the operations objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Work Zone Management: Traveler Information

General Description

Objectives in the area of traveler information for work zones aim to inform transportation system users of ongoing work zones along routes and corridors in order to reduce the impacts of travel-time delay on travelers.

Operations Objectives	• **Provide traveler information regarding work zones using variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.** • **Provide travelers with information on multimodal alternatives to avoid work zones for at least X percent of work zones on major arterials, freeways, and transit routes over the next Y years.** • **Provide work zone information (for upcoming and ongoing construction projects) to all impacted businesses or tenants of business centers with X employees or more by year Y.**
Performance Measures	• Percent of work zones on major arterials, freeways, and transit routes for which traveler information is available via variable message signs (VMS), 511, traveler information websites, and/or Web 2.0 technologies. • Percent of work zones on major arterials, freeways, and transit routes for which information on multimodal alternatives to avoid work zones is available to travelers. • Number of impacted businesses or tenants of business centers of X employees or more receiving work zone information (for upcoming and ongoing construction projects).
Anticipated Data Needs	• Availability of traveler information for work zones (including multimodal travel alternatives).
Data Resources and Partners	• Data would need to be collected by agencies responsible for the maintenance and operation of roads and transit routes.
M&O Strategies to Consider	M&O strategies are implied in the operations objectives.
Safety-related Impacts	Direct safety impacts not identified within referenced safety documents.

Work Zone Management: Customer Satisfaction

General Description

The objectives in this section focus on improving customer satisfaction with work zone management in the region.

Operations Objectives	• **Increase customer satisfaction with region's work zone management by X percent over Y years.**
Performance Measures	• Percentage of customers satisfied with region's work zone management practices.
Anticipated Data Needs	• Customer satisfaction surveys.
Data Resources and Partners	• This data would be gathered through surveys among transportation system users who had used the system while an active work zone was in place.
M&O Strategies to Consider	M&O strategies to consider when looking to improve customer satisfaction with work zones include extensive traveler information in advance of the work zone and minimizing the effect on travelers during periods when work zones are active.
Safety-related Impacts	Select examples of associated M&O strategies and their safety impacts include: • Use dynamic message signs in work zones: The safety impact is potential speed reduction in congested flow conditions, but not during uncongested flow. *Source: NCHRP 500 Volume 17.*

4.0 Model Metropolitan Transportation Plan

4.1 One Size Does Not Fit All

The purpose of this section is to provide a sample (or model) metropolitan transportation plan (MTP) that illustrates the effect of applying the objectives-driven, performance-based approach (simply, "the approach") for operations. The approach complements or enhances the metropolitan transportation planning process, rather than replacing it. The model plan is neither a real nor a complete document; it is an assembly of excerpts intended to provide insight to the benefit derived from applying the approach, with an emphasis on operations.

Each metropolitan planning organization (MPO) operates in a unique circumstance with varying State land-use laws, regional congestion and air quality issues, staffing and funding constraints, extent of multiple-agency collaboration, and commonality of vision, making a single model plan impractical. Fortunately, all MPOs take similar steps in the MTP development process to address these unique circumstances: goals lead to objectives, objectives lead to evaluation criteria (or performance measures), performance measures inform the selection of programs and projects, and funding facilitates the feasibility and timing of implementation. Thus, it is possible to illustrate the effect of applying the approach through model plan excerpts that follow these steps. To uncover how the approach is integrated into the process, the sample is outlined as transparently as possible using a systematic approach similar to the steps in a congestion management process (for more information on the systematic approach, refer to *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*.[23]

Currently, some MPOs are making significant strides toward integrating operations into their MTPs, while others have only begun to consider operations. MPOs have found that a number of factors affect their ability to fully incorporate operations using operations objectives and performance measures. These factors include revenue and cost, data availability, staff capabilities and resources, and partnerships.

These factors influence the level at which an MPO can integrate operations. Because of this, the model plan represents different levels at which operations may be incorporated by covering basic, advancing, and comprehensive levels of integration. Many MPOs may be limited to a basic level of integration, but should find value from considering ways to advance their operations effort over time. Even MPOs that are comprehensive in their integration of operations into the planning approach should find value in reviewing the model plan and the examples offered at each level.

4.2 Model Plan Overview

Purpose

The intent of this section is not to dictate how MPOs should organize, format, or prepare their plan. Instead, the model plan illustrates how the approach affects who is involved in the planning process, how operations can help achieve regional outcomes (goals), and the value derived from applying measurable objectives to the decisionmaking and implementation phases of the planning process. Section 4.3 includes excerpts drawn from two chapters of the model plan: "Goals and Objectives" and "System Management and Operations." In addition to these two sample chapters, the example MTP table of contents illustrates how the two sample chapters fit into the entire MTP framework.

Excerpt Description and Framework

Excerpts from key chapters of the model plan demonstrate the effect of integrating operations into that component of the overall plan. The primary text in the excerpts addresses an MPO that is functioning at an advanced planning for operations level (not basic or comprehensive). However, recognizing that MPOs throughout the country function at different levels, call-out boxes within the excerpts provide scaled examples to reflect the ability or intent to implement a basic, advancing, or comprehensive operations approach.

Excerpts from key chapters illustrate the approach application as if it were an authentic MTP section. They enable the reader to understand what is included in the excerpt (the content), how the approach/process was prepared, and why it was prepared (i.e., its importance). Graphics and tables are included in the excerpts to best explain and visualize the approach application. In addition, qualifying text in text boxes describe to the reader the details about the excerpt. Because MTPs do not include the technical details on how the MPO reached its final decisions, the text boxes enable the reader to understand how an MTP gets from the beginning to the end in the approach application. Setup and closing text provided in certain sections of the sample chapters lets the reader know that a new excerpt is beginning and what its purpose is or, conversely, lets a reader know that an excerpt has ended.

[23] U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration, *Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach - A Guidebook*, Publication No. FHWA-HOP-10-026, available at: http://www.plan4operations.dot.gov/.

4.3 Model Plan Excerpts

*The following excerpt shows an example MTP table of contents. The chapters highlighted in **darker text** will be provided as excerpts in the following sections.*

Metropolitan Transportation Plan Table of Contents

*The following sample chapter, "**Goals and Objectives**," is intended to show the reader how the approach is incorporated in the early stage of the MTP development process where goals and outcome-based objectives are identified. Goals and objectives that emphasize operational characteristics are of particular interest in this chapter and are highlighted in red. Excerpts for the balance of the model plan flow directly from these highlighted goals and objectives.*

*Text in the excerpt is color-coded. **Grey** text is provided for context, establishing the topic discussed in the MTP chapter. **Black** text illustrates the results of the MPO having applied the objectives-driven, performance-based approach for operations during the MTP development process.*

Chapter 2 — Goals and Objectives

Regional Goals

The Region has established a clear vision and is now prepared to construct goals and objectives that guide actions to achieve the vision. Coupled with the regional vision, the MPO's mission is empowered by Federal and State authorization and fueled by the partnerships of public agencies and private stakeholders in the region. Therefore, the following goals listed reflect the union of vision, mission, authorization, and partnership.

Goal 1: Provide an efficient and reliable transportation system
Goal 2: Support planned economic growth
Goal 3: Encourage vital communities and efficient land uses
Goal 4: Preserve and secure the transportation system
Goal 5: Reduce environmental impacts
Goal 6: Promote human health and safety
Goal 7: Expand affordable, effective transportation choices
Goal 8: Provide effective communications to inform travel decisions

This set of regional goals derives from carefully considering the plans and goals of each partner responsible for planning, delivering, operating, and maintaining the regional transportation system and ensuring the safety and security of the traveling public. The MTP will present an integrated approach to achieving the regional goals in close coordination with the unique goals of each regional partner.

Goals 1, 7, and 8 have strong connections to the SAFETEA-LU planning factor of promoting efficient system management and operations. This planning factor serves as the foundation for integrating operations into the MTP process.

MODEL PLAN

Coordination of Regional Activities

Achieving these goals requires a great many activities to be undertaken by a number of public agencies, private owners and operators, and not-for-profit associations, subsequently referred to as the regional partners. The regional partners have considered their various activities and grouped them into categories for ease of communication and coordination. Table 1 summarizes the four activity categories and the regional goals they support. This simple tool provides substantial guidance for considering the impact any one set of activities has on the effort to attain the regional goals. To that end, the entire MTP is organized around these categories.

This set of regional goals derives from carefully considering the plans and goals of each partner responsible for planning, delivering, operating, and maintaining the regional transportation system and ensuring the safety and security of the traveling public. The MTP will present an integrated approach to achieving the regional goals in close coordination with the unique goals of each regional partner.

Activity Category	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5	Goal 6	Goal 7	Goal 8
System Preservation and Maintenance	X	X		X		X		X
System Management and Operations	X		X		X	X	X	X
System Integration	X	X	X		X	X		X
System Expansion	X	X			X		X	X

Regional Objectives

Regional objectives reflect commitments by the regional partners to achieving the regional goals. Regional stakeholders declared sustainability as the core of the regional vision and the MPO board has emphasized efficiency as an overarching strategy to reach the vision. Goal 1, *Provide an efficient and reliable transportation system*, captures this strategy and all five activity categories support it. Thus, all regional partners can contribute to improving system efficiency and creating a more sustainable region.

Various technical and policy committees of the MPO, in close coordination with the regional partners, worked to develop a broad set of objectives that relate directly to the transportation system outcomes expressed in the regional goals. The objectives development process included direct input from transportation providers, operators, users, and policy makers. Listed below is a resulting set of regional objectives specific to each regional goal.

A small number of outcome-based operations objectives provide the foundation for fully integrating operations with the MTP process. Decisionmakers and staff are able to trace plans and actions back to these objectives and the goals they support.

Goal 1
Provide an efficient and reliable transportation system
Objective 1.1 — Efficiency
Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years.
Objective 1.2 — Reliability
Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.

Goal 1 Provide an efficient and reliable transportation system

Objective 1.1 addresses efficiency, while Objective 1.2 addresses reliability. These are defining characteristics of the multimodal transportation system and, as noted above, cut across all categories of activities (as summarized in Table 1) undertaken by the MPO and its regional partners. Both objectives focus on peak-period conditions in an effort to deal directly with the adverse impacts of recurring and nonrecurring delays during the most congested conditions.

Goal 2: Support planned economic growth

Goal 3: Encourage vital communities and efficient land uses

Goal 4: Preserve and secure the transportation system

Goal 5: Reduce environmental impacts

Goal 6: Promote human health and safety

Recognizing that MPOs incorporating operations into MTPs function at variable levels, multiple objective examples are shown. Scaled examples reflect the ability or intent to implement a basic, advancing, and comprehensive operations approach.

Examples for Outcome-Based Objectives at Different Capability Levels for Goal 1 — Efficiency and Reliability

Objective	Basic Capabilities	Advancing Capabilities	Comprehensive Capabilities
1.1	Reduce vehicle miles traveled per capita by 10 percent in 10 years and 25 percent in 20 years.	Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years.	Improve the average travel time per person during peak periods for all major modes by 20 percent within 10 years and maintain at that level for the remaining 10 years.
1.2	Reduce delay on major arterials by 3 percent per year.	Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	Reduce the variability of travel time per person during peak periods for all major modes by 15 percent within 10 years and 25 percent within 20 years.

To see related performance measures and data needs for the varying levels, please refer to the relevant fact sheets for the objectives identified in the table above.

Goal 7 Expand affordable, effective transportation choices

The regional partners have concluded that providing affordable, effective transportation options is critical to ensuring the quality of life and economic vitality expected by citizens and employers. The intent of Goal 7 is to provide a range of choices that fit the context of the area (neighborhoods, centers, districts, and corridors) and serve the needs of users traveling within and between these areas. In addition, it is understood that the perceived cost and a multitude of other factors that relate to the quality or effectiveness of the trip often influence the choice of transportation options. Among these factors are safety, security, reliability, accessibility, duration, comfort, and convenience. The following objectives work in combination to achieve this goal.

Goal 7
Expand affordable and effective transportation choices
Objective 7.1 — Choices
Increase non-single occupancy vehicle (SOV) mode share for all trips by 20 percent every 5 years.
Objective 7.2 — Effectiveness
Reduce the auto-to-transit travel time differential on major corridors by 15 percent over 5 years and maintain for the subsequent 10 years.

The primary objectives that serve Goals 2 through 6 are not likely to have operations as a central feature. Therefore, the model plan does not attempt to demonstrate such a connection. Nonetheless, operations can serve a supporting role in achieving these goals. For example, efficiencies provided to the transportation system through improved operations are understood to support economic growth, evoke a sense of vitality, reduce emissions, promote human health, and improve safety.

Examples for Outcome-Based Objectives at Different Capability Levels for Goal 7 — Choices

Objective	Basic Capabilities	Advancing Capabilities	Comprehensive Capabilities
7.1	Reduce per capita SOV commute trip rate by 5 percent every 5 years.	Increase non-SOV mode share for all trips by 20 percent every 5 years.	Achieve a 50 percent non-SOV mode share in transit station communities by 2025.
7.2	Improve non-SOV travel times by 25 percent over the next 10 years.	Reduce the auto-to-transit travel-time differential on major corridors by 15 percent over 5 years and maintain for the subsequent 10 years.	Reduce the travel time differential between transit and auto during peak periods by 5 percent per year for 10 years and maintain thereafter.

To see related performance measures and data needs for the varying levels, please refer to the relevant fact sheets for the objectives identified in the table above.

Goal 8 Provide effective communications to inform travel decisions

The effectiveness of the transportation system can be linked directly to the quality and extent of information that is available to users of the system, which in turn depends upon communications by transportation providers. There is broad regional support for continually improving and expanding effective communications to support the achievement of all other regional goals and the complementary plans of public agencies, service providers, emergency responders, and other regional partners. Equally important is the support the MPO and all regional partners can provide to transportation users as they decide whether, when, how, and by what route to travel. Objective 8.1 identifies regional outcomes for effective communications among all regional partners and to all users of the regional transportation system, respectively.

Goal 8
Provide effective communications to inform travel decisions
Objective 8.1 — Communication
Expand the capability to provide real-time travel condition information by 3 percent per year.

Examples for Outcome-Based Objectives at Different Capability Levels for Goal 8 — Communication

Objective	Basic Capabilities	Advancing Capabilities	Comprehensive Capabilities
8.1	Increase the availability of traveler information regarding alternative travel options during system disruptions by 25 percent in 5 years.	Expand the capability to provide real-time travel condition information by 3 percent per year.	At least 95 percent of travelers by 2025 are aware of significant delays, hazardous travel conditions, and alternative routes in time to affect travel decisions.

To see related performance measures and data needs for the varying levels, please refer to the relevant fact sheets for the objectives identified in the table above.

If this were a full MTP example, the following chapters would be detailed and incorporated into the plan per the table of contents. Not being operations related, these chapters will not be shown as excerpts in this sample plan.

Chapter 3 — Financial Snapshot

Chapter 4 — System Preservation and Maintenance

*The following sample chapter, "**System Management and Operations**," is intended to show the reader how the approach is incorporated in the planning for operations stage of the MTP development process. During this process, specific strategies are selected to move the region in the direction of achieving the desired outcomes and goals from a system operations perspective. Because this entire chapter focuses on operations, text coloring is not used.*

Chapter 5 — System Management and Operations

Management and Operations Overview

Regional Operations History

To incorporate the approach, an understanding of the starting point is necessary. In this example, the history of operations in the region has been established.

The regional system management and operations chapter is a critical element of the regional MTP that we developed in cooperation with our Regional Technical Operations Task Force (RTOTF), which consists of traffic, transit, and emergency management operators in the region. It is based on a number of previous planning efforts, including the following:

- Our Region's Intelligent Transportation Systems (ITS) Master Plan
- Our Region's Congestion Management Process
- DOT's Regional Operations Plan (ROP)
- DOT's ITS Investment Strategy: 10-Year Program
- Our Region's ITS Regional Architecture.

The ITS Master Plan was the first major effort focusing solely on ITS technology that formulated a regional policy among transportation operations personnel. This MTP update takes a broader view, placing greater emphasis on planning and coordination as well as emerging ITS technologies. With regional operations as a critical element for the success of our system, this MTP will ensure that funding is a priority for this area of transportation.

This chapter of the MTP consists of six major components. The Management and Operations Overview provides the context and motivation for management and operations in the region. Operations Goals reviews operations-oriented goals that were established in Chapter 2 of the MTP. Operations Objectives and Performance Measures outlines the specific operational outcomes we hope to achieve as a region, with the identification of performance measures and data needs. M&O Strategies and Implementation establishes the solutions the region will implement to best achieve our desired operational outcomes and how they may be implemented (including financial considerations). Monitoring described an ongoing effort to regularly monitor progress toward the operations objectives, report the results, and evaluate activities for reaching those objectives. Programs, Partners, and Responsibilities presents ongoing programs, the partners in the program, and their respective responsibilities to ensure accountability.

Regional Operations Purpose

Transportation operations is not simply moving people and goods; it applies a combination of technology, robust planning, improved preparedness, and extensive interagency and intra-agency coordination, as follows:

The following text is an excerpt from the Delaware Valley Regional Planning Commission's Transportation Operations Master Plan.[24] This gives a comprehensive overview regarding the strategic importance of operations planning. This information helps paint the picture on the different elements of a successful, objectives-driven, performance-based approach. See http://www.dvrpc.org/operations/Masterplan.htm *to access the complete plan.*

- Technology Technology is the backbone of transportation operations. It utilizes advanced technologies: computers, communications, electronics, and control systems to improve the efficiency and safety of the surface transportation system. Real-time surveillance systems monitor transportation facilities identifying unusual conditions that need immediate action, whether it is a bus running behind schedule or a crash on the Schuylkill Expressway. Technology enables transportation operations centers to impart accurate up-to-date travel information to the public, or to adjust traffic signal timings to handle a surge of traffic from a closed expressway. It enables first responders to overcome interoperability communication issues among themselves and with transportation personnel. Deploying technology also saves agencies money by automating functions like highway toll and transit fare collection.
- Planning When an incident temporarily closes a highway or disrupts transit service, it is already too late to plan a response. Detour routes, traffic control points, signing, and potential response resources should be identified in advance. Agency and personnel roles and responsibilities also have to be pre-defined.
- Preparedness This involves conducting training courses and table top exercises so that personnel can be fully prepared to respond to a highway or transit incident. It also involves pre-deploying traffic management equipment so that portable VMS or accident investigation equipment for emergency responders will arrive in a timely manner, and not have to be transported across the region. Emergency service patrols offer immediate on-scene resources to mitigate minor incidents and provide traffic support in larger ones.
- Coordination Operationally, the region is very fragmented, with three departments of transportation, three state police departments, multiple toll authorities and transit agencies, and hundreds of local police and fire departments. Institutional coordination, whether at the scene of an incident, between transportation operations centers, or across jurisdictions or modes, is a major undertaking. Incident command structures must be established, and situational information disseminated. On-going coordination is required to make sure everything runs smoothly, and to correct problems that periodically occur.

...

Transportation operations has unique funding and implementation requirements. While Intelligent Transportation Systems (ITS) projects are like other major transportation capital investments, in that they can be funded through the region's Transportation Improvement Program (TIP); they are unlike highway projects in that there is substantial maintenance and operations costs associated with them. Hardware, software, and communication devices have to be continually maintained and updated to remain consistent with the latest IT technology standards. Ultimately, operations and maintenance (O&M) costs can exceed the initial capital investment.

Many transportation operations initiatives are programmatic, for example funding service contracts, vehicles and equipment, and training programs. In many instances, non-traditional transportation stakeholders like police or fire departments will be the primary beneficiary of these programs. How to fund these types of programs, whether to use federal transportation monies, state funds, toll monies, or even Department of Homeland Security funding, is unclear. As transportation agencies evolve from a design-build culture to an operations culture, decisions on how to fund, operate, and maintain these types of programs need to be resolved.

[24] Delaware Valley Regional Planning Commission's *Transportation Operations Master Plan* (July 2009). Available at http://www.dvrpc.org/operations/Masterplan.htm

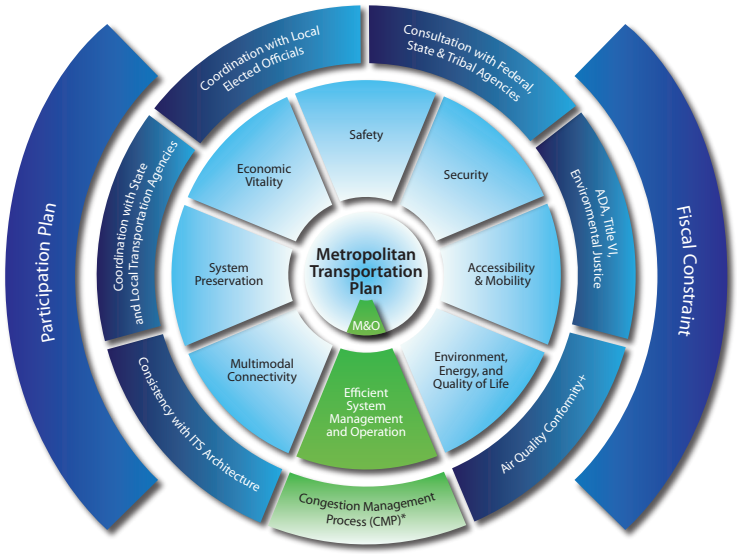
Operations in the MTP Framework

All the transportation elements within this plan were prepared in coordination with one another. System management and operations, as shown in Figure 1, is one of eight strategic factors our region must plan for as required by the Federal government.

Partners and Process

This MTP was prepared under the framework of an objectives-driven, performance-based approach. From start to finish, multiple agencies within our region collaborated to produce a coordinated plan with a set of agreed-upon strategies selected to achieve our desired goals and objectives. The regional partners, committees, and task forces that helped produce the outcomes identified within include the following:

Figure 3. M&O and CMP in the Context of Metropolitan Transportation Planning Requirements



* Required for TMAs
\+ Required for nonattainment and maintenance areas

- MTP Steering Committee. The MTP Steering Committee is a regional group focused on ensuring the coordination and collaboration across disciplines and agencies throughout our region. This group is charged with ensuring that the final adopted MTP is an agreed to, consistent, comprehensive, and objective plan.
- Regional Technical Operations Task Force (RTOTF). This committee was formed to ensure the technical accuracy and soundness in the planning for the regional operations process. The committee consists of traffic, transit, and emergency management operations. Meeting monthly throughout the process, this group helped prepare an agreed to, objective plan to meet our region's goals. The task force has the following subtask forces:
  - Transit Management and Operations Subtask Force
  - Incident Management Subtask Force
  - Work Zone Subtask Force
  - Arterial Management Subtask Force.

Committees, task forces, sub-committees, and subtask forces are essential to developing an objectives-driven, performance-based approach plan. By coordinating and collaborating, these groups will build the plan on technically sound procedures that are realistic and feasible for the specific region the MTP is being prepared for. Having these committees and task forces also creates a sense of trust for decisionmakers that the strategies being considered are the most appropriate ones.

The RTOTF went through a rigorous process throughout the development of the operations plan, including testing, refining, and revising the objectives, performance measures, strategies, and monitoring techniques to match our region's desired outcomes (while keeping in mind current limitations such as revenue and data sources). This was an iterative process that the regional partners undertook to produce a set of defensible, objective, transparent, agreed-upon regional M&O strategies.

Goal 1 Provide an Efficient and Reliable Transportation System.
Goal 7 Expand Affordable, Effective Transportation Choices.
Goal 8 Provide Effective Communications to Inform Travel Decisions.

Operations Goals

As summarized in Chapter 2, the Region has established eight goals to direct and guide how our region plans its transportation system, three of which directly influence the operations of the network. The main themes of the goals include Efficiency and Reliability, Communications, and Choices. The Region derived this set of regional goals from careful consideration of the plans and goals of each partner responsible for planning, delivering, operating, and maintaining the regional transportation system and ensuring the safety and security of the traveling public. The remaining sections within this chapter will present an integrated approach to achieving the regional goals in close coordination with the unique goals of each regional partner. Achieving these goals requires a number of public agencies, private owners and operators, and not-for-profit associations undertaking many activities.

Operations Objectives and Performance Measures

Regional operations objectives reflect commitments, by one or more of the regional partners, for achieving the regional goals. Regional stakeholders declared sustainability as the core of the regional vision and the MPO board has emphasized efficiency, reliability, options, and communication as the overarching strategies to reach the vision.

For the remainder of this example plan excerpt, only Goal 1, Provide an Efficient and Reliable Transportation System, will be shown with the application of the objectives-driven performance-based approach; however, if this were a full plan example, all three goals would be carried throughout the entire chapter.

Various technical and policy committees of the MPO, in close coordination with the regional partners, worked to develop a broad set of objectives that relate directly to the transportation system outcomes expressed in the regional goals. The objectives development process included direct input from transportation providers, operators, users, and policy makers. The following sections summarize the resulting set of regional objectives specific to each regional goal.

Through the process of identifying and evaluating congestion areas in our region, the objectives became more refined and specific.

A small number of outcome-based operations objectives provide the foundation for fully integrating operations with the MTP process. Decisionmakers and staff are able to trace plans and actions back to these objectives and the goals they support.

Outcome-Based Objectives

The RTOTF has identified outcome-based objectives for each operations-related goal. Each objective is specific and measurable to ensure that progress may be tracked over time. In addition, each objective was tested and refined to select realistic and achievable targets and timelines.

To achieve Goal 1, the regional partners created outcome-based objectives for both efficiency and reliability.

Goal 1
Provide an Efficient and Reliable Transportation System.
Objective 1.1 — Efficiency
Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years..
Objective 1.2 — Reliability
Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.

Efficiency
To address efficiency specifically, the RTOTF identified an objective focused on improving travel time during peak periods. Peak-period travel time has been significantly affected during the past 5 years because of significant growth. The region has chosen an aggressive objective to reverse this historical trend. Peak period travel has a tremendous effect on our economy, bringing people to and from destinations. Based on historical data and projections, the region believes that a 20 percent improvement in travel time during the next 10 years is an achievable target and timeline. Subsequent to the 10-year timeline, the region has assumed that maintaining the improvement is the most feasible and practical.

Reliability
To address reliability specifically, the RTOTF identified an objective focused on reducing the variability of travel time during peak periods at varying levels during the next 25 years. Although it is expected that population and employment growth will be occurring throughout the northeastern and southwestern portions of our region, the system needs to perform consistently for users to plan their travel appropriately. As efficiency improves over time, the region projects that the variability in travel time will diminish. Based on historical data and projections, the region believes that a 15 percent reduction in variability within 10 years and 25 percent within 20 years is an achievable target and timeline.

Examples for Outcome-Based Objectives at Different Capability Levels for Goal 1 — Efficiency and Reliability (from Chapter 2)

Objective	Basic Capabilities	Advancing Capabilities	Comprehensive Capabilities
1.1	Reduce vehicle miles traveled per capita by 10 percent in 10 years and 25 percent in 20 years.	Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years.	Improve the average travel time per person during peak periods for all major modes by 20 percent within 10 years and maintain at that level for the remaining 10 years.
1.2	Reduce delay on major arterials by 3 percent per year.	Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	Reduce the variability of travel time per person during peak periods for all major modes by 15 percent within 10 years and 25 percent within 20 years.

The remainder of this section would give an overview of how and why the additional outcome-based objectives were developed for Goal 7 and Goal 8.

Performance Measures and Data Needs[25]

The RTOTF collectively identified the following associated performance measures and data needs for each outcome-based objective identified under Goals 1, 7, and 8. It established performance measures to identify and evaluate recurring and nonrecurring congestion. It evaluated potential performance measures, weighing their strengths and weaknesses in terms of their applicability to the unique characteristics of the planning area. These measures will enable the region to track and see that it is meeting our regional goals and objectives.

In our region, the individual cities and counties currently undertake data collection efforts. They collect traffic volume and crash data consistently and comprehensively across the region. They are collecting ITS-related data currently on all principal arterial roadways in the region and 65 percent of major arterial roadways. Through the MTP update process, the region continues to update the data collection efforts through new technology while maintaining consistency. Additional coverage also is sought throughout the region. When possible, the RTOTF will continue using existing data sources. Currently, the statewide annual reporting system is a higher-level analysis source. In addition to that report, the region references congested corridor studies being conducted routinely throughout the region each year. These data sources help the RTOTF identify and prioritize areas within the region where the best progress can be made through operation-related strategies.

Objective	Performance Measure	Data Needs
Objective 1.1 Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years.	• Average travel time per day during peak periods (minutes)	• Peak period and free-flow travel time or speeds Person travel along links (e.g., vehicle volume X vehicle occupancy)
Objective 1.2 Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	• Variance in travel time	• Travel time

[25] Text under the Performance Measures and Data Needs section was derived from the Metroplan Orlando *2030 Long Range Transportation Plan*, "Technical Document #5: Congestion Management Process." Their document gives a comprehensive overview of performance measure identification and selection. See http://www.metroplanorlando.com/site/lrtp/reports.asp to access the complete technical document.

The remainder of this section would give a summary of the performance measures and data needs for Goal 7 and Goal 8.

Activity-Based Objectives

Our region has identified eight activity-based objectives for the areas of reliability, efficiency, choices, and communications. The RTOTF and subtask forces tested and refined the objectives to create a system of measures and activities that will achieve our ultimate goals. Below is an overview of the activities.

Objective 1.1 — Efficiency Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the subsequent 10 years.
Objective 1.1.1 Evaluate and retime 95 percent of the traffic signals in the region (if needed) at least once every 3 years.
Objective 1.1.2 Implement a single, region-wide automated fare collection system within 5 years that enables transit users to pay electronically for transit fare on all transit services with the same card.
Objective 1.2 — Reliability Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.
Objective 1.2.1 Reduce the mean clearance time per incident by 25 percent in 5 years. (Clearance time defined as the time between awareness of an incident and restoration of lanes to full operational status.)
Objective 1.2.2 Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.

Efficiency
The RTOTF identified two activity-based objectives related to the efficiency outcome. They agreed unanimously on the two identified activities as realistic and achievable given the ongoing activities throughout the region related to traffic signal retiming programs and automated fare collection visions. With the achievement of these two objectives, the target of travel-time improvements by 20 percent may be achieved.

Reliability
The RTOTF identified two activity-based objectives related to the reliability outcome. They agreed unanimously on the two identified activities as realistic and achievable given the ongoing activities throughout the region related to incident management programs and work zone management discussions. With the achievement of these two objectives, the target of reducing travel time variability by 15 percent and 25 percent may be achieved.

Examples for Outcome-Based Objectives at Different Capability Levels
for Goal 1 — Efficiency and Reliability (from Chapter 2)

Objective	Basic Capabilities	Advancing Capabilities	Comprehensive Capabilities
1.1.1	Increase the number of intersections running in a coordinated, closed-loop, or adaptive system by 10 percent in 5 years and 15 percent in 10 years.	Evaluate and retime 95 percent of the traffic signals in the region (if needed) at least once every 3 years.	Special timing plans are available for use during freeway incidents, roadway construction activities, or other special events for 55 percent of arterial miles in the region in 5 years and updated annually for the subsequent 10 years.
1.1.2	Within 5 years, at least 75 percent of transit trips can be made with no more than two transfers.	Implement a single, region-wide automated fare collection system within 5 years that enables transit users to pay electronically for transit fare on all transit services with the same card.	Increase the routes meeting performance targets by 5 percent annually.
1.2.1	Increase percentage of incidents initially discovered and verified by Motorist Assist roving patrols by 10 percent in 5 years.	Reduce the mean clearance time per incident by 25 percent in 5 years.	Reduce the person hours (or vehicle hours) of delay associated with traffic incidents by 15 percent within 10 years and 20 percent the subsequent 10 years.
1.2.2	Reduce the percentage of vehicles traveling through work zones that are queued by 5 percent in 5 years.	Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.	Reduce the average time duration (in minutes) of queue length greater than 0.5 miles by 15 percent in 10 years.

To see related performance measures and data needs for the varying levels, please refer to the relevant fact sheets for the objectives identified in the table above.

The remainder of this section would give an overview of how and why the additional activity-based objectives were developed for Goal 7 and Goal 8.

Performance Measures and Data Needs

Similar to the process described for outcome-based objectives, the regional partners collectively identified the following associated performance measures and data needs for each activity-based objective. Performance measures were established to identify and evaluate recurring and nonrecurring congestion. Many potential performance measures were evaluated, weighing their strengths and weaknesses in terms of their applicability to the unique characteristics of the planning area. These measures will enable the region to track and see that our regional goals and objectives are being met. The RTOTF strategically chose performance measures that would solely depend on existing data. A very minor set of performance measures will require additional data collection procedures.

Objective	Performance Measure	Data Needs
Objective 1.1.1 Evaluate and retime 95 percent of the traffic signals in the region are at least once every 3 years.	• Number of traffic signals retimed	• Reports from operating agencies on signal retiming, signal capabilities, special timing plans, and crash data reviews
Objective 1.1.2 Implement a single, region-wide automated fare collection system within 5 years that allows transit users to pay electronically for transit fare on all transit services with the same card.	• Percentage of fares using automated fare collection	• Farebox data
Objective 1.2.1 Reduce the mean clearance time per incident by 25 percent in 5 years.	• Mean incident clearance time per incident	• The time of incident awareness and one or more of the following pieces of data: the time the last responder left the scene, the time when all lanes were reopened, the time when traffic returned to normal flow
Objective 1.2.2 Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.	• Percentage of vehicles experiencing queuing in work zones • Length of average and maximum queues in work zones • Average duration in minutes of queue length greater than X miles	• Number of vehicles traveling through work zones • Number of vehicles traveling through work zones experiencing queuing • Average and maximum length of work zones • Duration of queue length greater than X miles

If this were a complete MTP, the remainder of this section would give a summary of the performance measures and data needs for goals 7 and 8.

M&O Strategies and Implementation

To meet the region's goals and associated objectives, management and operations strategies were identified for implementation. The strategies identified cut across multiple modes, agencies, and geographic locations in the region. The intent is that, with these identified strategies implemented, the region's targets and timelines may be achieved through close coordination, collaboration, and technical excellence. Performance measures associated with each objective have been used to ensure that the selected strategies and improvements result in the quantitative benefits within each objective.

Improvement and Cost Feasibility[26]

For the selection of appropriate improvement strategies, cost is a major contributing factor. Cost is typically one of the main factors as to whether or not strategies are feasible. Other factors also affecting feasibility that the RTOTF considered include the availability of right-of-way, technology infrastructure, environmental constraints, social constraints, and others.

Types of M&O Strategies

The following categories of strategies, or combinations of strategies, were considered for each area:

- Demand management measures, including growth management and congestion pricing.
- Traffic operational improvements.
- Public transportation improvements.
- ITS technologies as related to the regional ITS architecture.
- Where necessary, additional system capacity.

Based on specific characteristics of each congested area in the region, the anticipated strategy benefits, project viability, cost, and potential funding sources available, the RTOTF selected the following set of strategies relating to each objective.

[26] Text under the Improvement and Cost Feasibility as well as the Types of M&O Strategies sections is derived from the Metroplan *Orlando 2030 Long Range Transportation Plan*, "Technical Document #5: Congestion Management Process." See http://www.metroplanorlando.com/site/lrtp/reports.asp to access the complete technical document.

	Objectives	Strategies	Priority
Provide an Efficient and Reliable Transportation System	**Objective 1.1 — Efficiency** Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the remaining 10 years.	Implement and finance the following programs annually in the TIP: Arterial Management and Transit Management and Operations.	High
	Objective 1.1.1 — Arterial Management Evaluate and retime 95 percent of the traffic signals in the region (if needed) at least once every 3 years.	Implement program and finances for signal retiming every 3 years.	Medium
	Objective 1.1.2 — Transit M&O Implement a single region-wide automated fare collection system within 5 years that allows transit users to pay electronically for transit fare on all transit services with the same card.	• Involve integrating the system across multiple modes or services. • Implement a consistent system with other connecting transit services. • Implement a marketing campaign to increase awareness and use.	High
	Objective 1.2 — Reliability Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	Implement and finance the following programs annually in the TIP: Incident Management and Work Zone Management.	High
	Objective 1.2.1 — Incident Management Reduce the mean clearance time per incident by 25 percent in 5 years.	• Responder training. • Quick clearance laws. • Towing agreements . • Traveler information to reduce delay during incidents.	High
	Objective 1.2.2 — Work Zone Management Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.	• Shorten lane closure time (particularly during high-traffic hours). • Provide travelers with advance notice and real-time information to avoid the work zone.	Medium

If this were a complete MTP, the remainder of this section would give a summary of the strategies and their priority levels for Goal 7 and Goal 8.

Monitoring

With adoption of this MTP, it is the region's obligation to monitor and track progress of our system's efficiency, reliability, communications, and choices. The RTOTF has reached consensus on its specific targets and timelines and the MTP Steering Committee is committed to working together to ensure that our region moves forward economically. This monitoring effort will occur annually with results documented in our region's Annual Performance Monitoring report. Through the development of this MTP update, transit operators, traffic operators, and emergency incident responders have committed to collecting, summarizing, and analyzing the generated data needed to indicate if targets have been achieved. As time progresses and monitoring is performed, the RTOTF will assess the need for adjustments to the initial set of specific objectives and strategies. This intermittent assessment of the performance of implemented strategies represents the shift from a project-based solution solving process to an outcome-based solution process.

Programs, Partners, and Responsibilities

Management and operations strategies identified herein will be included in the TIP or in the funding programs of partnering agencies. This step is critical to ensure that funding mechanisms are in place for the regional operations component of our transportation system. Currently, management- and operations-related improvement strategies in our MTP have been allocated $2 million per year.

A set of four programs have been identified to ensure our region's objectives may be achieved. Two of the programs, incident management and arterial management, were established under the last MTP update. Two new programs, transit management and operations and work zone management, were created under this MTP update to assist us in making our system successful.

	Outcome-Based Objectives	Performance Measures	Activity-Based Objectives	Performance Measures	Strategies
Provide an Efficient and Reliable Transportation System	Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the remaining 10 years.	Average peak-period travel time per day (minutes)	Evaluate and retime 95 percent of the traffic signals in the region (if needed) at least once every 3 years.	Number of traffic signals retimed	Implement program and finances for signal retiming every 3 years
			Implement a single region-wide automated fare collection system within 5 years that allows transit users to pay electronically for transit fare on all transit services with the same card.	Percentage of fares using automated fare collection	Involve integrating the system across multiple modes or services Implement a consistent system with other connecting transit services Implement a marketing campaign to increase awareness and use
	Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	Variance of travel time	Reduce the mean clearance time per incident by 25 percent in 5 years.	Mean incident clearance time per incident	Responder training Quick clearance laws Towing agreements Traveler information to reduce delay during incidents
			Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.	Percentage of vehicles experiencing queuing in work zones Length of average and maximum queues in work zones Average duration in minutes of queue length greater than X miles	Shorten lane closure time (particularly during high-traffic hours) Provide travelers with advance notice and real-time information to avoid the work zone

The program description excerpts shown below were taken directly from the Delaware Valley Regional Planning Commission's Transportation Operations Master Plan (July 2009). Their Master Plan gives more detailed descriptions of the programs than an MTP covering multiple elements would entail. For the additional program details visit http://www.dvrpc.org/operations/Masterplan.htm.

Incident Management

Twenty-five percent of traffic congestion in large urban areas is because of traffic incidents ranging from flat tires to overturned tractor-trailers. These unforeseen events cause havoc, making commuters late, affecting truck deliveries, and ultimately making the region less competitive economically.

> Incident management is a multi-step process involving incident detection and verification, emergency responder response, management of on-site emergency personnel, traffic management, clearance of vehicles and debris, and recovery to normal traffic flow. It involves diverse technical skills and an assortment of different organizational entities. Incident management programs have to be sensitive to all phases of incident management and the institutional relationships, many of which are outside the purview of the traditional transportation planning and funding processes.[27]

Arterial Management

> In general, highways do not operate in isolation; they are usually part of larger travel corridors with parallel arterials, passenger rail lines, and bus routes. From a holistic perspective, the goal is to optimize travel in the whole corridor, not just expressways. Accomplishing this requires deploying ITS resources throughout the corridor and across modes. If traffic signals are optimized, parallel arterials can help relieve overcrowded expressways. Strategically located VMS at decision points can inform motorists of travel choices — what are the travel times via expressway versus arterials, or when is the next train arriving.[28]

Transit Management and Operations

Transit management programs include upgrading transit management centers and traveler information and fare collection systems, and implementing security technology. There is a broad range of ITS technology routinely incorporated into transit projects. New buses and rail vehicles, for example, typically come with diagnostic sensors and passenger information displays.

Work Zone Management

When a highway agency establishes a work zone,

> "…regardless of whether it is temporary maintenance activity or a long-term construction project, adequate precautions must be taken to warn motorists about changes in traffic patterns and potential bottlenecks. It is vital to minimize traffic delays and protect the safety of construction workers and motorists. Work zone plans and measures should be commensurate with the size and duration of the job and traffic volumes on the affected highway. Federal work zone regulations have enshrined these principals. Emerging technology is complementing these efforts, with portable devices to issue alerts and warnings to reckless drivers.
>
> Departments of transportation and other highway operators routinely develop maintenance traffic plans for construction projects and maintenance activities. Work zone traffic management elevates the level of planning and resources for projects that impact

[27] Delaware Valley Regional Planning Commission's *Transportation Operations Master Plan* (July 2009). Available at http://www.dvrpc.org/operations/Masterplan.htm

[28] Ibid.

expressways and high volume arterials. Depending upon the type of facility, duration of project, and impact on traffic, work zone initiatives may lead to formation of work zone management teams, pre-deployment of permanent or temporary CCTV cameras and speed detectors, and installation of warning devices and intrusion sensors."[29]

Programs	Responsible Partners
Incident Management	• County operators • Municipality operators • Emergency responders
Arterial Management	• State operators • County operators • Municipality operators • Transit operators
Work Zone Management	• County operators • State operators
Transit Management and Operations	• Transit operators • County operators • Municipality operators

[29] Delaware Valley Regional Planning Commission's *Transportation Operations Master Plan* (July 2009). Available at http://www.dvrpc.org/operations/Masterplan.htm

Goal	**Provide an Efficient, ReliableTransportation System**			
Outcome Objectives		Improve the average travel time during peak periods by 20 percent within 10 years and maintain at that level for the remaining 10 years.	Reduce the variability of travel time during peak periods by 15 percent within 10 years and 25 percent within 20 years.	
Activity Objectives	Evaluate and retime 95 percent of the traffic signals in the region (if needed) at least once every 3 years.	Implement a single region-wide automated fare collection system within 5 years that allows transit users to pay electronically for transit fare on all transit services with the same card.	Reduce the mean clearance time per incident by 25 percent in 5 years. (Clearance time defined as the time between awareness of an incident and restoration of lanes to full operational status.)	Reduce the average and maximum length of queues, when present, by 20 percent over 7 years.
Strategies	Implement program and finances for signal retiming every 3 years	Involve integrating the system across multiple modes or services Implement a consistent system with other connecting transit services Implement a marketing campaign to increase awareness and use.	Responder training Quick clearance laws Towing agreements Traveler information to reduce delays during incidents	Shorten lane closure time (particularly during high-traffic hours) Provide travelers with advance notice and real-time information to avoid the work zone
Programs	Arterial Management	Transit Management and Operations	Incident Management	Work Zone Management

In a complete MTP example, an objectives tree summary would be prepared for Goal 7 and Goal 8.

If this were a full MTP example, the following chapters would be incorporated into the plan per the Table of Contents. Not being operations related, the following chapters will not be shown as excerpts in this sample plan:

Chapter 6 — System Integration

Chapter 7 — System Expansion

Chapter 8 — Appendices

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