An Interim Guidebook on the Congestion Management Process in Metropolitan Transportation Planning

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

Notice

Quality Assurance Statement

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

1200 New Jersey Avenue, SE
Washington, DC 20590

FEB 6 2008

Dear Colleague,

The Federal Highway Administration's (FHWA) Office of Planning, Environment, and Realty, and Office of Operations, and the Federal Transit Administration's (FTA) Office of Planning and Environment have developed two complementary documents: *An Interim Guidebook on the Congestion Management Process in Metropolitan Transportation Planning,* and *Management & Operations in the Metropolitan Transportation Plan: An Interim Guidebook for Creating an Objectives-Driven, Performance-Based Approach.* These two companion guidebooks reflect strong, continuing collaboration among FHWA, FTA, and professionals in the planning and operations communities nationwide.

These interim guidebooks are intended to be viewed as one integral package that promotes effective approaches to integrating management and operations strategies into metropolitan and statewide transportation planning processes, including the Congestion Management Process (CMP) requirement in larger metropolitan areas. They stand as products of our on-going effort to provide assistance in implementing key provisions of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). These documents present both a policy basis and the business case for stronger coordination and cooperation between planners and those managers of day-to-day transportation system operations on a multi-modal, area-wide basis. These documents do not create new requirements, but merely provide suggested approaches for addressing operations in the planning process.

We are designating these documents as "interim" at this time to enable the opportunity for a greater understanding of the approaches suggested. Based upon the input received from an extensive outreach and marketing effort, the documents will be revised and presented as final versions of the guidebook to be published at a later date. We look forward to receiving your feedback, reactions, and experiences in implementing these concepts. Please direct any comments, questions, and suggestions on these guidebooks to any of the following members of our staff:

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Sincerely,

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Enclosures

MOVING THE AMERICAN ECONOMY

Technical Report Documentation Page

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16. Abstract

The Congestion Management Process (CMP), which has evolved from what was previously known as the Congestion Management System (CMS), is a systematic approach, collaboratively developed and implemented throughout a metropolitan region, that provides for the safe and effective management and operation of new and existing transportation facilities through the use of demand reduction and operational management strategies. The CMP is required to be developed and implemented as an integral part of the metropolitan planning process in Transportation Management Areas (TMAs) – urbanized areas with a population over 200,000, or any area where designation as a TMA has been requested. Although the CMP is not required in non-TMAs, the CMP represents the state-of-the-practice in addressing congestion, and should be considered in metropolitan areas that are facing current and future congestion challenges.

This guidebook provides information on how to create an objectives-driven, performance-based congestion management process. While the focus of this guidebook is on the CMP, the principles of objectives-driven, performance-based planning can also be applied to other aspects of regional concern (safety, economic development, environment, etc.) in an MTP. The CMP represents the "state-of-the-practice" in responding to the growing challenge of congestion on urban transportation networks.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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1.0 PREFACE

The Congestion Management Process (CMP), which has evolved from what was previously known as the Congestion Management System (CMS), is a systematic approach, collaboratively developed and implemented throughout a metropolitan region, that provides for the safe and effective management and operation of new and existing transportation facilities through the use of demand reduction and operational management strategies. The CMP is required to be developed and implemented as an integral part of the metropolitan planning process in Transportation Management Areas (TMAs) – urbanized areas with a population over 200,000, or any area where designation as a TMA has been requested. Although the CMP is not required in non-TMAs, the CMP represents the state-of-the-practice in addressing congestion, and should be considered in metropolitan areas that are facing current and future congestion challenges.

The Congestion Management System has been described as a "7 Step" process; with the addition of a new "first step," the Congestion Management Process is an "8 Step" process, as follows:

1. Develop Congestion Management Objectives;
2. Identify Area of Application;
3. Define System or Network of Interest;
4. Develop Performance Measures;
5. Institute System Performance Monitoring Plan;
6. Identify and Evaluate Strategies;
7. Implement Selected Strategies and Manage Transportation System; and
8. Monitor Strategy Effectiveness.

This guidebook provides an overview of the Congestion Management Process. Together with a companion volume, *Management and Operations in the Metropolitan Transportation Plan*, the reader will find useful information about implementing an objectives-driven, performance-based approach to the metropolitan planning process. These guidebooks build upon over a decade of experience in effective congestion management, and emphasize a regional approach to transportation systems management and operations that has evolved in recent years. The output of several recent research efforts and workshops involving leaders in metropolitan planning, congestion management, and performance-based planning have informed this guidebook, and several additional, related projects are currently underway. We encourage readers to follow up on the links and references included in this document. This guidebook is intended as guidance only and does not create any new requirements. You may use an alternative approach if the approach satisfies the requirements of the applicable statutes and regulations.

(References to related guidance materials and useful web sites, as well as examples of good practices, are included throughout this guidebook and in Appendix D.)

2.0 INTRODUCTION

2.1 PURPOSE

The Safe Accountable Flexible Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU), the most recent reauthorization of the nation's surface transportation program, made several changes to metropolitan and statewide transportation planning provisions, ranging from an increase in the percentage of funding available for metropolitan planning, to modifications of the transportation planning factors to be considered in long-range planning. Among the most significant changes was the updated requirement for a "congestion management process" (CMP) in Transportation Management Areas (TMAs – urban areas over 200,000 in population), as opposed to "congestion management systems" (CMS). The change in name (and acronym) is intended to be a substantive change in perspective and practice, to address congestion management through a process that provides for effective management and operations, an enhanced linkage to the planning process, and to the environmental review process, based on cooperatively developed travel demand reduction and operational management strategies as well as capacity increases.

The Congestion Management Process is consistent with the increased emphasis on management and operations in SAFETEA-LU. Both are part of an emerging concept focused on regional objectives that drive performance-based planning for responding to congestion. This new focus retains the traditional role of the metropolitan planning organization (MPO) in long-range transportation planning, but empowers the MPO and its partners in planning for the ongoing operations and management of the transportation system. The CMP builds upon more than a decade of experience with planning for congestion management, including the Congestion Management Systems first introduced in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), as well as the accumulated knowledge of how greater availability of data, enhanced tools for data management and modeling, expanded use of intelligent transportation systems, and opportunities for regional cooperation and collaboration can improve the active management of the regional transportation system.

A well-designed CMP should help the MPO to:

- Identify congested locations;
- Determine the causes of congestion;
- Develop alternative strategies to mitigate congestion;
- Evaluate the potential of different strategies;
- Propose alternative strategies that best address the causes and impacts of congestion; and
- Track and evaluate the impact of previously implemented congestion management strategies.

Once congestion management strategies have been identified and selected as part of the Metropolitan Transportation Plan (MTP), the CMP can also be used to:

- Set priorities among projects for incorporation into the Transportation Improvement Program;
- Provide information for environmental analysis of proposed projects;
- Develop more detailed assessments of the potential for congestion, reduction at the corridor or activity-center level; and
- Assist in the ongoing monitoring and evaluation of projects and programs implemented throughout the region.

This guidebook provides information on how to create an objectives-driven, performance-based congestion management process. While the focus of this guidebook is on the CMP, the principles of objectives-driven, performance-based planning can also be applied to other aspects of regional concern (safety, economic development, environment, etc.) in an MTP. The CMP represents the "state-of-the-practice" in responding to the growing challenge of congestion on urban transportation networks.

This guidebook will enable the user to develop a congestion management process that will build upon the basic concepts of the CMS to develop a CMP that is:

- Objectives-driven; and
- Draws upon performance measures, operations data, and existing processes such as the regional Intelligent Transportation Systems (ITS) architecture.

2.2 CHANGES IN STATUTE AND PLANNING REGULATIONS

Titles III and VI of SAFETEA-LU, Sections 3005 and 6001, updated the requirement for addressing congestion in Transportation Management Areas (TMAs), mandating the incorporation of CMP within the metropolitan planning process. (See Appendix A for specific changes to the United States Code.)

In TMAs, SAFETEA-LU requires that the MPO "shall address congestion management through a process that provides for effective management and operation, based on a cooperatively developed and implemented metropolitan-wide strategy, of new and existing transportation facilities... through the use of travel demand reduction and operational management strategies." The Final Rule on Statewide and Metropolitan Transportation Planning, published on February 14, 2007, states that "The development of a congestion management process should result in multimodal system performance measures and strategies that can be reflected in the metropolitan transportation plan and the Transportation Improvement Program (TIP)."

> The Conference Report accompanying SAFETEA-LU provides some insight into the intent of Congress in requiring a CMP:
>
> "Subsection (i) involves transportation management areas, which are defined as urbanized areas with a population over 200,000. The transportation plans in these areas are based on a continuing and comprehensive planning process carried out by the MPO. Congestion management is achieved through the use of travel demand reduction and operational management strategies. Congestion relief activities under section 139 of title 23 are also to be used. The Secretary must certify that the planning process for each transportation management area is being carried out in accordance with Federal law no less often than every 4 years. This is a change from current law, which mandates certification every 3 years. The Secretary has the authority to withhold up to 20 percent of the funds attributable to the MPO if the metropolitan planning process of an MPO serving a transportation management area is not certified."
>
> "Subsection (k) is consistent with subsection 134(l) of current law and states that a metropolitan planning area classified as non-attainment for ozone and carbon monoxide under the Clean Air Act may not receive funds for any highway project that will result in a significant increase in single-occupant vehicles. The only exception would be if the project were addressed through a congestion management process."

TMAs are defined as metropolitan areas with a population greater than 200,000, but metropolitan areas can be designated TMAs at the request of the Governor and the MPO responsible for that region. TMAs account for 182 of the 385 MPOs nationwide; about 20 of these TMAs have populations under 200,000. Congestion represents a serious challenge for many MPOs, even those not designated as TMAs.

Congress also made specific reference to the treatment of state-mandated congestion management systems or programs. Such systems or programs were deemed to be consistent with the CMP, depending upon a finding by the Secretary of Transportation. In other words, the FHWA/FTA may determine that an existing congestion management system or program required under state law is, for all intents and purposes, a Congestion Management Process. This would depend on whether the existing process is consistent with the requirements set forth in the statute and in the Metropolitan Transportation Planning Final Rule.

> The CMP can potentially support three of the six areas of emphasis set forth in the **National Strategy to Reduce Congestion on America's Transportation Network**, released in May 2006. (CMP may also contribute to development of congestion-reduction projects in the "Corridors of the Future" program.)
>
> - Relieve urban congestion
> - Unleash private sector investment resources
> - Promote operational and technological improvements
> - Establish a "Corridors of the Future" competition
> - Target major freight bottlenecks and expand freight policy outreach
> - Accelerate major aviation capacity projects and provide a future funding framework

Congestion exacts a heavy price on all elements of society, from the economy to individual quality of life. Whether it takes the form of trucks stalled in traffic, cargo stuck at overwhelmed seaports, or airplanes circling over crowded airports, congestion costs America an estimated $200 billion a year. In 2003, Americans lost 3.7 billion hours and 2.3 billion gallons of fuel sitting in traffic jams.[1] Congestion also affects quality of life by trapping people in traffic, taking up time that could be spent with families and friends and in participation in civic activities. Congestion in all of its forms is the target of a major U.S. DOT initiative, the *National Strategy to Reduce Congestion on America's Transportation Network* (also known as the "Congestion Initiative").

The Congestion Management Process is intended to be an integral part of the metropolitan planning process, rather than a stand-alone program or system. The CMP also applies a new way of thinking about regional transportation systems management and operations (M&O). M&O is an integrated approach that seeks to optimize the performance of existing infrastructure through the implementation of multimodal, intermodal, and often cross-jurisdictional systems, services and projects. This includes regional operations collaboration and coordination activities between transportation and public safety agencies. M&O strategies aim at improving service efficiency, enhancing public safety and security, reducing traveler delays, and improving access to information for travelers. M&O strategies can include a broad range of activities, including

[1] http://www.fightgridlocknow.gov/.

incident management, travel demand management, freeway and arterial management, transit priority strategies, traveler information, and activities that support emergency preparedness and response. While M&O strategies can enable transportation operators to improve service without costly infrastructure projects, M&O is also built into many capital improvement programs to maintain efficient use of new capacity over the long-term.

Use of the CMP, while required for TMAs, represents *good practice* for planning in any urbanized area, particularly in fast-growing metropolitan areas and those with complex transportation networks. The CMP can be used to identify specific strategies that make the best use of new or existing transportation facilities, including but not limited to travel demand management, such as changes to land use, mode shifts, or changes to the time of day for travel; transportation systems management and operations, including approaches such as incident management through improved response to crashes, freeway management systems like ramp metering, improvements to arterial management such as traffic signal coordination, and improvements to transit operations; better travel information to help system users plan their trips in advance or respond to changing conditions; or capacity expansion through existing or new facilities as appropriate.

The new planning regulations relate the changes in law to current and evolving practice. The statute and regulations determine the scope of the CMP.

- The CMP is required in metropolitan areas with a population greater than 200,000 (TMAs), as well as in urbanized areas that have requested designation as a TMA.
- In TMAs in nonattainment of national ambient air quality standards for carbon monoxide or ozone, no Federal funds may be spent for capacity-expanding projects unless they come from a CMP.

Even if a metropolitan area is not a TMA or in nonattainment status, the CMP represents good practice in monitoring, assessing, and resolving congestion issues in any MPO. For a variety of reasons, the CMP offers a robust tool for identifying and evaluating transportation improvement strategies, including both operations and capital projects.

The Congestion Management Process is very closely aligned with the integration of transportation systems management and operations into the metropolitan planning process. Management and operations (M&O), which is discussed more extensively in a companion guidebook, has emerged as a vitally important approach to addressing both short-range and long-term transportation challenges.

2.3 RELATING CMP TO ELEMENTS OF THE METROPOLITAN TRANSPORTATION PLAN

"Management and Operations in the Metropolitan Transportation Plan: *A Guidebook for Creating an Objectives-Driven, Performance-Based Plan*," presents information about M&O that complements the material in this Guidebook on the Congestion Management Process in Metropolitan Transportation Planning. The M&O Guidebook provides an overall perspective on how management and operations can contribute to the development of the MTP. The M&O guidebook and the CMP guidebook were developed in tandem to ensure consistency of message and content.

SAFETEA-LU specifically requires consideration of M&O in the metropolitan transportation planning process; "Promote efficient system management and operation" is specifically identified as one of eight planning factors that must be taken into account in the development of the MTP (see Section 6001(h)). MPOs must also 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."

The intent of this document is to offer information on current best practice and emerging approaches in addressing congestion through a systematic, objectives-driven, performance-based process (as shown in Figure 1). The congestion management process, highlighted and represented in the shaded boxes of Figure 1, provides a useful tool for realizing plan objectives relating to congestion through system operations and management, travel demand strategies, and new capacity where appropriate. The suggested approach is consistent with the Final Rule on Statewide and Metropolitan Transportation Planning, published on February 14, 2007.

2.4 AN OBJECTIVES-DRIVEN, PERFORMANCE-BASED APPROACH TO ADDRESSING CONGESTION

Today the public expects and demands an effective transportation system that fosters mobility, safety, and security, while protecting environmental resources and enhancing economic development, community resources, and quality of life. Meeting this multitude of challenges requires a new way of thinking about how we plan for transportation in the nation's metropolitan regions. This new way of thinking embraces objectives-driven, performance-based planning and emphasizes management and operations as a new focus for metropolitan transportation planning.

Historically, MPOs have developed long-range plans with a 20 to 25 year horizon, focused on the capital investments (highways, transit, bicycle, and pedestrian facilities) needed to satisfy the anticipated demand. While these demands remain important and must be considered, the reality is that, in most metropolitan areas, this traditional approach is constrained by limited funding, environmental and quality of life considerations, and land use considerations. Additionally, given the long lead times for the capital investments to be constructed, the public remains frustrated by the lack of mobility improvements within a shorter timeframe. It is time for metropolitan transportation planning to provide a mix of long-term capital investment and both long-term and near-term operational enhancements to the regional transportation system.

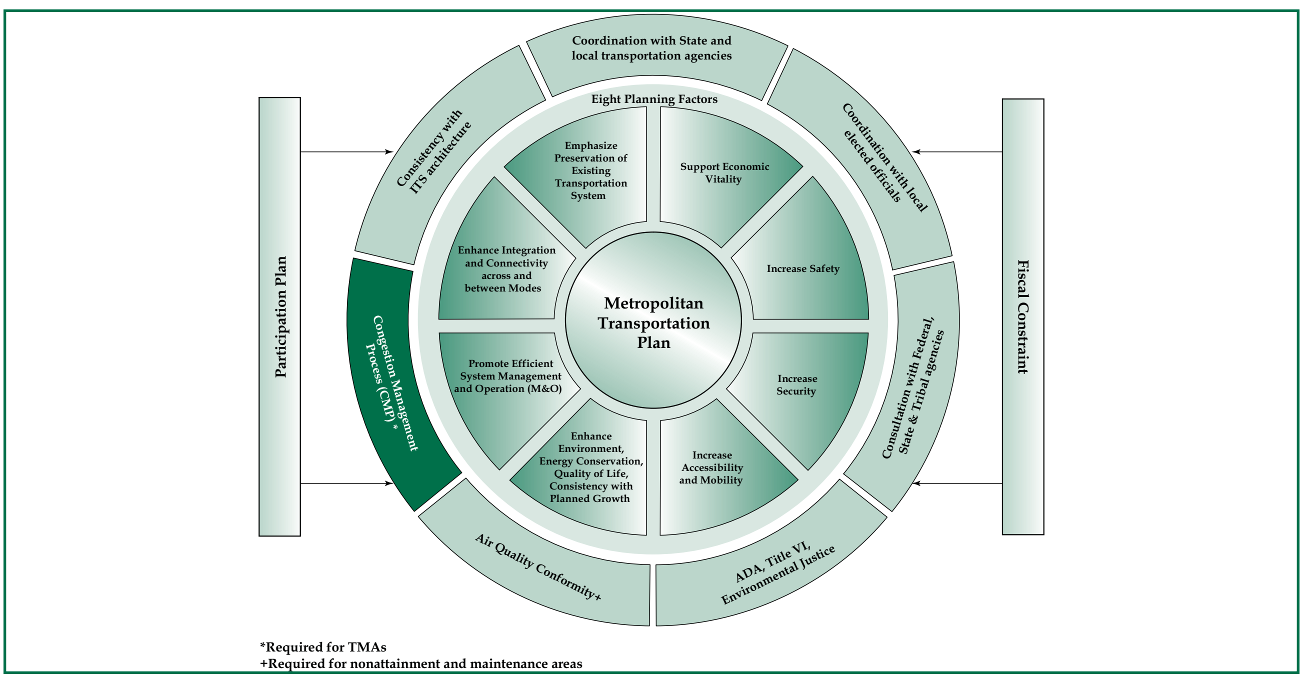
The objectives that particularly concern developers of the congestion management process derive from the vision and goals articulated in the metropolitan transportation plan. Participants in the planning process engage in the development of a long-range vision of the transportation system, presenting a shared view of how the region's highways, transit system, and other facilities contribute to achieving generally agreed-upon goals for mobility, access to jobs and other opportunities, economic development, environmental integrity, equity and environmental justice, and others. These goals are then used to derive regional objectives in each goal area. The objectives that will be most closely linked to the CMP address the management and operation of the region's transportation system as shown in Figure 2. These include objectives related to efficiency, reliability, and effective response to incidents. These regional operations objectives are specific and quantifiable, but are established at a regional scale as opposed to the corridor or facility level. (While objectives are set at the regional level, nothing precludes MPOs from establishing different performance targets for specific corridors or activity areas.) Figure 2 illustrates various statutory requirements and planning factors representing the metropolitan planning process, including the need for involvement of various participants in the process.

2.5 DEFINITION – WHAT IS A CMP?

The CMP is as much a way of thinking about congestion-related issues as it is a set of technical tools. To put it another way, the CMP uses a number of analytic tools to define and identify congestion within a region, corridor, activity center or project area, and to develop and select appropriate strategies to reduce congestion or mitigate the impacts of congestion. There are several common characteristics of "state-of-the-practice" congestion management processes, including:

- Links to operations objectives, driven by the goals expressed in the MTP;
- Defines systematic methods to monitor and evaluate system performance;
- Focuses comprehensively on management and operations, demand management, land use, and new capacity as ways to manage congestion;

Figure 2. Metropolitan Planning in Context



- Uses performance measures to identify, evaluate, and monitor congestion and congestion management strategies;
- Defines a program of data collection and management, preferably incorporating existing data sources (including archived ITS data if available), and coordinated with system operations managers throughout the metropolitan area;
- Details technical capabilities for evaluating the potential effectiveness of demand management and operational strategies;
- Defines implementation schedules or timetables for delivery of M&O strategies, including assignment of resources and responsibilities;
- Defines procedures for periodic review of the effectiveness of strategies selected for implementation, as well as assessments of the usefulness of performance measures and supporting data; and
- Considers congestion, its causes, and possible remedies in a holistic way, encompassing a broad range of multimodal transportation and nontransportation elements.

As noted above under section 1.2, the CMP can be linked to state requirements for congestion management systems and plans. This approach is intended not only to ensure continuity with congestion management approaches developed prior to SAFETEA-LU, but also to reinforce the CMP as an element of the overall planning process.

The CMP benefits greatly from a systematic approach to collecting and managing data for performance measurement. Such a "congestion management system" is necessary, but not sufficient for the purposes of the CMP. The Congestion Management Process also requires analysis and strategy development components.

- The CMP may yield reports on congested locations, congestion mitigation strategies, and system performance, but such stand-alone "congestion management plans" are not the focus of the Congestion Management Process. The CMP is intended to provide strategies for inclusion in the metropolitan long-range transportation plan, and may also be used for intermediate and short-term planning purposes.

2.6 BENEFITS OF THE CMP

The congestion management process contributes to achievement of regional congestion management objectives, and can deliver a number of collateral benefits as well. By addressing congestion through a comprehensive process, the CMP provides a framework for responding to congestion and other operational issues in a consistent, coordinated fashion. The CMP enables MPOs and their operating agency partners to measure performance, manage data, and analyze alternative strategies in a manner consistent with Federal requirements for environmental analyses under the National Environmental Policy Act of 1969 (NEPA) therefore, perhaps reducing redundant efforts. The CMP also enables MPOs to bring an objective basis to the process to pinpoint those congestion management strategies that will allow the region to target the most congested areas and achieve the greatest benefit by targeting the investment. As discussed below, Federal policy encourages integration of the metropolitan transportation planning process with NEPA, particularly with respect to the use of data and analysis of alternatives.

The CMP has the potential to help MPOs and the operating agencies involved in the process to create a credible, defensible planning process that yields effective congestion management projects. By providing continuity in the application of data and analysis techniques throughout the development and analysis of congestion management strategies, the CMP offers the opportunity for effectively integrating previously disparate, "stove-piped" elements into a coherent planning process.

Some congestion management strategies can have positive impacts on air quality in a number of ways. For example, by reducing delay and stop-and-go traffic, congestion management strategies that aim at smoothing traffic flow could save fuel that would otherwise be wasted in congested conditions. This not only saves travelers, transit operators, and freight carriers money, kit also reduces the amount of emissions produces form idling. Furthermore, application of some travel demand reduction and operational management strategies, coupled with transit service improvements, can either reduce or defer the need for adding new capacity in congested corridors, as well as facilitate the management of new capacity now and in the future.

2.7 MAKING THE LINK TO OPERATIONS OBJECTIVES IN THE MTP

As noted in the accompanying Guidebook, Management and Operations in the Metropolitan Transportation Plan, integrating M&O into the metropolitan transportation planning process has benefits for transportation planners and operators, and the traveling public. By working toward optimizing the transportation system with management and operations strategies, transportation planners are better able to demonstrate to the public and elected officials that progress is being made on reducing congestion in the short-term with lower cost techniques. Similarly, operators are able to make their limited staff time and other resources go farther by collaborating with planners and other operators to address operations from a regional perspective. Transportation operations improvements made in one jurisdiction are reinforced by coordinated improvements in neighboring areas enabling travelers to move seamlessly across the region without encountering inconsistent traveler information, toll collection technologies, or traffic signal timing.

Given that the fundamental purpose of management and operations improvements is to better serve the transportation system user through improved system performance, operations objectives are preferably described in terms of system performance outcomes as experienced by users. Objectives focused on outcomes to the user address issues such as travel times, travel time reliability, and access to traveler information.

If outcome-based objectives are not feasible due to factors such as lack of operations data or lack of consensus among decision makers around an appropriate system-level performance objective, the partners may develop operations objectives in terms of the performance of the system managers or operators. These objectives refer to indicators such as percentage of traffic signals retimed, number of variable message signs deployed, or incident response time. Although these objectives tend to focus on specific strategies or techniques and are not as ideal as outcome-based objectives for inclusion in the MTP, they may be the best interim objective until more outcome-based objectives can be developed. Operations objectives, and the performance measures derived from these objectives, are discussed in more detail below.

Moreover, the act of defining an M&O goal and regional operations objectives in the MTP will place increased attention on the operational performance of the transportation system. By including operations objectives that address system performance issues, such as recurring and nonrecurring congestion, emergency response times, connectivity among modes, and access to traveler information, the MTP will yield programs and strategies that more effectively address these concerns. Rather than focusing primarily on long-range system capacity needs, the MTP will encourage operations to play a more important role in transportation investment planning, and address both short- and long-range needs.

2.8 ROADMAP TO THE CMP GUIDEBOOK

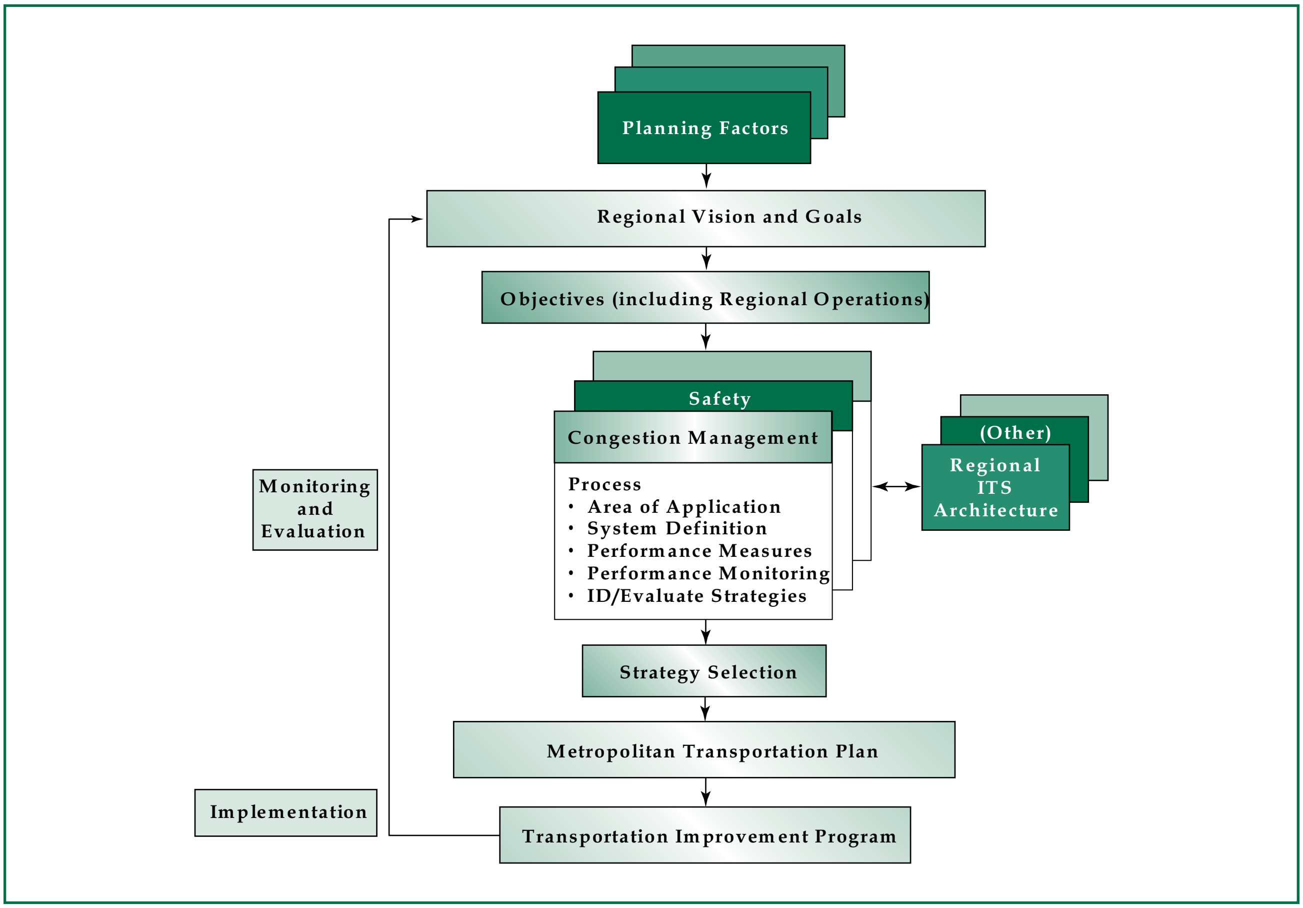
This guide is designed to help MPO to create an objectives-driven, performance-based congestion management process that meets SAFETEA-LU requirements for Transportation Management Areas.

The guidebook includes:

- A discussion of objectives-driven, performance-based planning and the characteristics of the CMP (Section 2);
- The Basics of CMP, including defining eight steps to developing a CMP (Section 3);
- "Development and Implementation of an Objectives-Driven CMP," which provides information about getting started in the development of the CMP, either building such a process from the ground up, or adapting existing systems and procedures (Section 4); and
- Information about how the CMP can provide a link to the environmental review process, as well as other potential applications of the CMP approach (Section 4).

Also included is a self-assessment tool that can provide a perspective on where an MPO stands in implementing the CMP (Section 6). Appendices provide a glossary of useful terms and references to other resources.

Figure 1. An Objectives-Driven CMP in the Planning Process

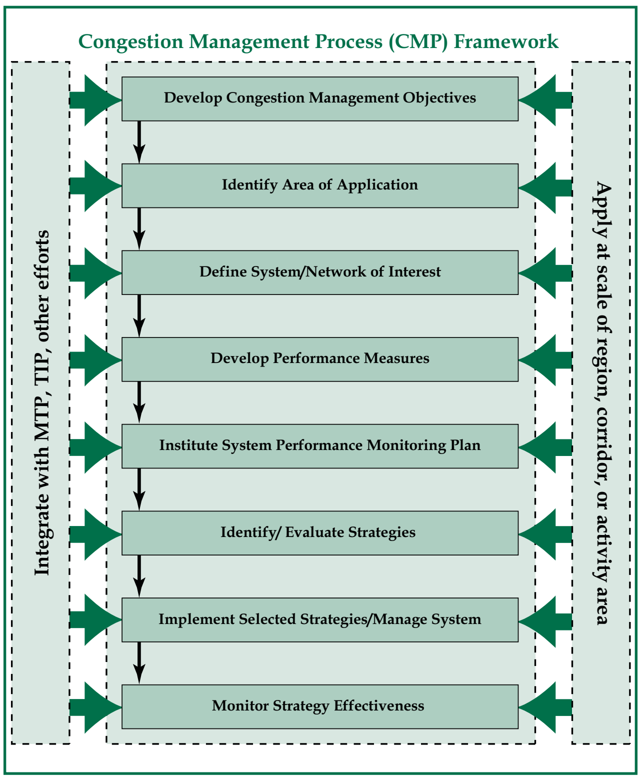


3.0 BASICS OF THE CMP

3.1 WHAT WE LEARNED FROM CMS

This section presents the foundation of the CMP based on over a decade of experience developing Congestion Management Systems (CMS). The CMP, while it builds upon previous practice and on the congestion management system first required under ISTEA, differs in significant ways from the CMS and from congestion management "plans." The CMP is intended to be an integral part of the planning process together with to the metropolitan transportation plan. The goals and objectives from the MTP feed directly into the beginning steps of the CMP. The CMP also has an increase emphasis on incorporating management and operations in the process. Figure 3 presents the framework on which the CMP is formed.

Figure 3. CMP Framework (the "8 Steps")



"Congestion Management objectives" relate specifically to the Congestion Management Process, but other objectives – focused on operations, land use, system preservation, and other regional priorities – can be derived from the vision and goals articulated in the metropolitan transportation plan. The essential elements of getting from Goals to Strategies are described below with illustrative examples specific to congestion management objectives.

Goals

Goals describe in broad terms what the region wants to accomplish, focused on *outcomes*.

Example: *Reduce congestion by improving transportation system reliability and reducing unexpected traveler delay*.

Congestion Management Objectives

Objectives are specific steps that help to accomplish the goal, and include *outcome- or output*-oriented measures. Objectives should be stated such in a way that performance measures (see below) can be derived from the objectives. Congestion management objectives may be related to other, operations-oriented objectives, such as making transit more attractive to commuters, or to objectives aligned with regional land use goals. Examples may include:

- Reduce incident-based delay (so that by 2010…);
- Reduce traveler delay associated with work zones, weather conditions, and special events (so that…);
- Improve access to travel information (so that…); and
- Improve transit system reliability (so that…)

Performance Measures

Performance measures provide metrics that can be used at a regional basis to track systemwide performance (used in developing a regional objective), or at a corridor, roadway, or intersection level to identify specific deficiencies within the system. Examples may include:

- Incident duration (mean minutes per incident);
- Vehicle hours of nonrecurring delay due to incidents;
- Total vehicle hours of nonrecurring delay;
- Buffer time (additional time to ensure travelers arrive at destination by intended time 95 percent of the time);
- Person throughput (number of persons traversing a corridor, summed across all travel modes, over a specified period of time);
- Public awareness of traveler information (through surveys);
- Public satisfaction with level of information available (through surveys);
- Public satisfaction with regional/corridor travel speeds and times (through surveys);

- Percentage of buses more than five minutes off schedule; and
- Number of rail system breakdowns/delays.

Strategies

Selected projects and programs are implemented in order to achieve objectives. These strategies may include capacity enhancement, safety projects, management and operations system preservation. Examples specific to the objective of improving system reliability and reducing traveler delay include:

- Roving incident response teams;
- Work zone information campaign;
- Variable message signs to alert about alternative routes;
- Traveler alert system;
- 511;
- Electronic real-time “next bus” information at bus stops;
- Increased rail inspections and maintenance;
- GPS systems to track transit buses; and
- Strategic combinations of any or all of the above.

3.2 CMP CONTENT

The CMP comprises a number of different elements that add up to a coherent, objectives-driven, performance-based approach to solving congestion problems. These components are described in the Final Rule on Statewide and Metropolitan Transportation Planning. The Rule states that the CMP shall include:

1. Methods to monitor and evaluate the performance of the multimodal transportation system, identify the causes of recurring and nonrecurring congestion, identify and evaluate alternative strategies, provide information supporting the implementation of actions, and evaluate the effectiveness of implemented actions;

2. Definition of congestion management objectives and appropriate performance measures to assess the extent of congestion and support the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies for the movement of people and goods. Since levels of acceptable system performance may vary among local communities, performance measures should be tailored to the specific needs of the area and established cooperatively by the state(s), affected MPO(s), and local officials in consultation with the operators of major modes of transportation in the coverage area;

3. Establishment of a coordinated program for data collection and system performance monitoring to define the extent and duration of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions. To the extent possible, this data collection program should be coordinated with existing data sources (including archived operational/ITS data) and coordinated with operations managers in the metropolitan area;

4. Identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies that will contribute to the more effective use and improved safety of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, are some examples of what should be appropriately considered for each area:

   a. Demand management measures, including growth management and congestion pricing;

   b. Traffic operational improvements;

   c. Public transportation improvements;

   d. ITS technologies as related to the regional ITS architecture; and

   e. Where necessary, additional system capacity.

5. Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy (or combination of strategies) proposed for implementation; and

6. Implementation of a process for periodic assessment of the effectiveness of implemented strategies, in terms of the area’s established performance measures. The results of this evaluation shall be provided to decision-makers and the public to provide guidance on selection of effective strategies for future implementation.[2]

[2] 23 CFR 450.320(c).

3.3 GETTING STARTED AND DEVELOPING THE CMP ("8 STEPS")

Step 1 – Develop Congestion Management Objectives

As noted in Section 3.1, congestion management objectives derive from the vision and goals articulated in the MTP. The vision and goals are likely to be developed early in the planning process, but the development of congestion management objectives may help to sharpen and focus the goals established in the MTP.

While the goals in the MTP may be couched in general terms, congestion management objectives should be defined in terms that enable participants in the process to focus on specific aspects of congestion, and to advance a timeframe within which the objectives would be attained. For example, congestion management objectives may be different for commute trips than for other travel purposes. Alternatively, objectives may be established for peak period travel as opposed to off-peak travel.

Specific congestion management objectives might also be developed for freight movement, and may be focused on activity areas or corridors where the movement of goods is particularly important, such as a port, terminal and warehousing district, or freight corridor. Such objectives could refer to achievement of the goals by a certain date, or in more general terms, such as "by the end of the decade."

Step 2 – Area of Application

A congestion management process should be applied to a specific geographic area and network of surface transportation facilities. Often an area of application may align with the same geographic area contained in the Regional ITS Architecture. This alignment would allow system inventories and network descriptions to directly link to the CMP to the Regional ITS Architecture. As previously noted, "acceptable" levels of system performance may vary by type of transportation facility, geographic location, and time, including time of day and weekday/weekend patterns.

In TMAs, the geographic limits of the CMP must encompass at least the TMA boundary. It would be advantageous to include the entire metropolitan area boundary, which is the TMA boundary plus the area that will become urbanized within twenty years, or some other rational criteria, such as the limits of an air-quality non-attainment area. In non-TMA MPOs, the preferential CMP boundary would most likely be the MPO planning area boundary. In areas where significant facilities or activity centers border the limits of a given metropolitan area, it may be appropriate to expand the CMP boundaries to include a broader analysis area.

Step 3 – System Definition

Whatever the geo-political boundaries of the CMP, the CMP network should identify the characteristics of the surface transportation network under consideration. The CMP should be multimodal, so the network should include both highway and transit facilities. Depending upon the nature of the region, and the congestion problems experienced by system operators, it may be appropriate to incorporate freight facilities such as marine or airport facilities, as well as rail transportation assets (commuter or intercity passenger as well as freight) that may be subject to congested conditions.

The CMP could consider particular corridors or activity centers, in addition to encompassing an entire metropolitan area. A CMP may also comprise a combination of regional, corridor, and activity area definitions, with each component serving different, specific purposes.

Step 4 – Developing and Using Performance Measures

The use of performance measures to assess the effectiveness and efficiency of the transportation network and of operations has greatly increased in recent years. Many of these measures are designed for more effective communication both with members of the public and with appointed and elected officials. Rather than using highly technical measures such as level of service, measures such as speed, travel time, and delay are employed to describe mobility and access at various levels, from the entire regional system to particular corridors, and even at the route or intersection

Characteristics of Good Performance Measures:

- Clarity and simplicity (e.g., simple to present and interpret, unambiguous, quantifiable units, professional credibility).
- Descriptive and predictive ability (e.g., describes existing conditions, can be used to identify problems and to predict changes).
- Analysis capability (e.g., can be calculated easily and with existing field data, techniques available for estimating the measure, achieves consistent results).
- Accuracy and precision (e.g., sensitive to significant changes in assumptions, precision is consistent with planning applications and with an operation analysis).
- Flexibility (e.g., applies to multiple modes, meaningful at varying scales and settings).

level. A number of recent reports provide useful information on performance measures, including the Final Report of the National Transportation Operations Coalition (NTOC) Performance Measurement Initiative (July 2005), which identified a handful of performance measures commonly accepted by Federal, state, and local transportation officials.

Table 1. Performance Measures from NTOC Performance Measures Initiative Final Report

Measure	Definition	Sample Units of Measurement
Customer Satisfaction	A qualitative measure of customers' opinions related to the roadway management and operations services provided in a specified region.	Very satisfied/Somewhat satisfied/Neutral/Somewhat dissatisfied/Very dissatisfied/Don't know/Not applicable.
Extent of Congestion – Spatial	Miles of roadway within a predefined area and time period for which average travel times are 30 percent longer than unconstrained travel times.	Lane miles of congested conditions or percent of congested roadways. Calculated as a ratio = 100 percent x (Congested Lane Miles)/(Total Lane Miles).
Extent of Congestion – Temporal	The time duration during which more than 20 percent of the roadway sections in a predefined area are congested as defined by the "Extent of Congestion – Spatial" performance measure.	Hours of congestion.
Incident Duration	The time elapsed from the notification of an incident until all evidence of the incident has been removed from the incident scene.	Median minutes per incident.
Non-Recurring Delay	Vehicle delays in excess of recurring delay for the current time-of-day, day-of-week, and day type.	Vehicle-hours.
Recurring Delay	Vehicle delays that are repeatable for the current time-of-day, day-of-week, and day type.	Vehicle-hours.
Speed	The average speed of vehicles measured in a single lane, for a single direction of flow, at a specific location on a roadway.	Miles per hour, feet per second, or kilometers per hour.
Throughput – Person	Number of persons including private vehicle occupants, transit riders, pedestrians, and bicyclists traversing a roadway section in one direction per unit time – by mode. May also be the number of persons traversing a screen line in one direction per unit time.	Persons per hour.
Throughput – Vehicle	Number of vehicles traversing a roadway section in one direction per unit time. May also be number of vehicles traversing a screen line per unit time.	Vehicles per hour.
Travel Time – Link	The average time required to traverse a section of roadway in a given direction.	Minutes per trip.
Travel Time – Reliability (Buffer Index)	The Buffer Time is the additional time that must be added to a trip (measured as defined by Travel Time – Trip) to ensure that travelers making the trip will arrive at their destination at, or before, the intended time 95 percent of the time.	Minutes. This measure may also be expressed as a percent of total trip time or as an index.
Travel Time – Trip	The average time required to travel from an origin to a destination on a trip that might include multiple modes of travel.	Minutes per trip.

- CMP performance measures should be derived from the vision, goals, and objectives established for the region during the metropolitan transportation planning process. The CMP itself is designed to put into action the vision and goals defined in the planning process by transforming goals into specific objectives, identifying where goals are not being achieved, and coming up with strategies that will help to achieve these goals. The CMP also provides ways to follow up and determine whether the strategies are contributing to success.

- Define for the region what congestion means, and what indicators best illustrate the impact of congestion on travelers and on economic activity. Recognize also that the best indicators or criteria may change over time.

- Review the most commonly used performance measures, and consider those that have been identified as the most useful. Appendix B lists a number of measures, including measures particularly suited to performance-based planning.

- Adopt key performance measures relevant to the operations objectives and to the congestion problems facing the region. Most regions use a variety of measures to identify congested locations and to track system performance over time.

- Include multimodal measures. For example, measures related to highway congestion should be accompanied by those related to transit, goods movement, and nonmotorized modes.

- Recognize that performance measures can be applied flexibly. Different levels of congestion, for instance, may be acceptable in different places and at different times.

Development of performance measures based on regional operations objectives is discussed in more detail in section 4.3 below, and in the accompanying Guidebook, **Management and Operations in the Metropolitan Transportation Plan**. Performance measures and analytical tools are also discussed in Appendix B of this document.

Step 5 – Developing a Performance Monitoring Plan

Historically, the availability of data has been one of the greatest challenges facing planners and system operators. With the advent of ITS technology for freeway and arterial management, detector data is increasingly available for major facilities in many metropolitan areas. Transit data is also increasingly available from advanced public transportation systems applications such as automatic vehicle location systems, which can provide information about schedule delay and on-time performance for transit.

Even greater quantities of information are likely to be available as next-generation systems utilizing Vehicle-Infrastructure Integration (VII) come on line over the next decade. Full deployment of VII depends upon a mutual decision of the public and private sectors, expected before 2010, but the deployment process will take some time to reach a critical mass. Nevertheless it is worthwhile to consider the potential impacts on transportation data availability of ubiquitous data collection from individual vehicles through a nationwide communications network. An unprecedented level of data on vehicle location and trajectories could be available in near-real time for both operational and planning purposes.

The Final Rule on Metropolitan Transportation Planning calls for "a coordinated program for data collection and system performance monitoring to assess the extent of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions." Data collection needs are based on the selected performance measures and appropriate analytical methods. The selected data elements should be relevant to the area, readily available, timely, reliable, consistent, and susceptible to forecasting. The Final Rule also directs that "To the extent possible, this data collection program should be coordinated with existing data sources (including archived operational/ITS data) and coordinated with operations managers in the metropolitan area." If data required to track system performance is unavailable, either on a regional or local level, the data collection and system monitoring program should indicate how data collection capabilities will be enhanced over time.

Common sources of data include traditional methods such as travel surveys and screenline counts; traffic counts, whether from temporary or permanent count stations for the Highway Performance Monitoring System; ITS traffic detection devices; aerial surveys; and speed studies. ITS components may collect useful data for operational purposes, so it would be advisable to make use of the ITS Regional Architecture to identify sources of such data. Since data may be made available from a number of different agencies in a given region, it is important to either establish common data formats or to establish a process for converting data from disparate sources into a single dataset for use in the CMP. This process may already be underway in regions where archived ITS data is in use for operational or planning purposes.

Step 6 – Identifying and Evaluating Strategies

Identifying Congested Locations

Selection of the appropriate performance measures, analytical tools, and available data enables the identification of congested locations. Congestion may be recurring or nonrecurring; the CMP should be capable of analyzing both types of congestion. Recurring congestion, which takes place at predictable intervals at particular locations, can generally be traced to a specific cause, such as a physical bottleneck or to conditions such as sun glare. Causes of nonrecurring congestion may be more difficult to isolate, and solutions may require non-traditional strategies.

In addressing recurring or nonrecurring congestion, the CMP might incorporate different levels of analysis, whether at the regional, corridor, or activity area scale. Ongoing data collection and monitoring is helpful in determining the effectiveness of strategies and the utility of the CMP itself. This issue will be visited again when we discuss the need for monitoring and evaluating the congestion management process.

Selecting Appropriate Analytical Tools

A variety of traffic analysis tools have been developed for different purposes. These tools are intended for application at different geographic scales, for different facility types, by travel mode, and according to the type of management strategy under consideration. Therefore, it is important to select analysis tools that are sensitive both to the congestion measures to be used and the types of congestion management strategies under consideration. The traffic analysis tools may also assess different traveler responses, according to different performance measures, and with different levels of resources required. The FHWA provides information about the characteristics of these tools and guidelines for selecting the appropriate tools on its Traffic Analysis Tools web site.[3] Traffic analysis tools can be grouped into the following categories:

- **Sketch-Planning Tools –** Sketch-planning methodologies and tools produce general order-of-magnitude estimates of travel demand and traffic operations in response to transportation improvements. They allow for the evaluation of specific projects or alternatives without conducting an in-depth engineering analysis. Therefore, sketch-planning approaches are typically the simplest and least costly of the traffic analysis techniques.

- **Travel Demand Models –** These are mathematical models that forecast long-term future travel demand based on current conditions and future projections of household and employment characteristics. Travel demand models were originally developed to determine the benefits and impact of major highway improvements in metropolitan areas. Travel demand models only have limited capabilities to accurately estimate changes in operational characteristics (such as speed, delay, and queuing) resulting from implementation of ITS/operational strategies.

- **Analytical/Deterministic Tools (HCM-Based) –** Most analytical/deterministic tools implement the procedures of the Highway Capacity Manual (HCM). As such, these tools quickly predict capacity, density, speed, delay, and queuing on a variety of transportation facilities. These tools are good for analyzing the performance of isolated or small-scale transportation facilities; however, they are limited in their ability to analyze network or system effects.

- **Traffic Signal Optimization Tools –** Similar to the analytical/deterministic tools, traffic optimization tool methodologies are mostly based on the HCM procedures. However, traffic optimization tools are primarily designed to develop optimal signal phasing and timing plans for isolated signal intersections, arterial streets, or signal networks. This may include capacity calculations; cycle length; splits optimization, including left turns; and coordination/offset plans.

- **Macroscopic Simulation Models –** Macroscopic simulation models are based on the deterministic relationships of the flow, speed, and density of the traffic stream. The simulation in a macroscopic model takes place on a section-by-section basis rather than by tracking individual vehicles. Macroscopic simulation models were originally developed to model traffic in distinct transportation subnetworks, such as freeways, corridors (including freeways and parallel arterials), surface-street grid networks, and rural highways.

- **Mesoscopic Simulation Models –** Mesoscopic models combine the properties of both microscopic (discussed below) and macroscopic simulation models. As such, mesoscopic models provide less fidelity than microsimulation tools, but are superior to the typical planning analysis techniques.

[3] http://ops.fhwa.dot.gov/trafficanalysistools/index.htm.

- **Microscopic Simulation Models –** Microscopic simulation models simulate the movement of individual vehicles based on car-following and lane-changing theories. These models are effective in evaluating heavily congested conditions, complex geometric configurations, and system-level impacts of proposed transportation improvements that are beyond the limitations of other tool types. However, these models are time consuming, costly, and can be difficult to calibrate.[4]

CMP Strategies

The managers of the congestion management process should consider the full range of potential strategies. Strategies can be grouped into the following broad categories:

1. **Adding More Base Capacity –** Increasing the number and size of highways and providing more transit and freight rail service. This can include expanding the base capacity (by adding additional lanes or building new highways) as well as redesigning specific bottlenecks such as interchanges and intersections to increase their capacity. This approach is not always possible due to constraints both physical and fiscal, but it remains an important approach to addressing congestion, alone and in combination with other strategies. It should also be noted that, in TMAs designated as nonattainment for ozone or carbon monoxide, expansion of facilities that would provide significant additional capacity for single occupancy vehicles (SOVs) cannot proceed using Federal funds unless "analysis demonstrates that travel demand reduction and operational management strategies cannot fully satisfy the need for additional capacity in the corridor and additional SOV capacity is warranted."[5] Given the expense and possible adverse environmental impacts of adding new SOV capacity, due consideration should be given to travel demand management and operational measures before electing to add capacity, rather than improving the utilization of existing capacity.

   – **Key Strategies:**

     » Adding travel lanes on major freeways and streets (including truck climbing lanes on grades);

     » Adding capacity to the transit system (buses, urban rail or commuter rail systems);

     » Closing gaps in the street network;

     » Removing bottlenecks;

     » Overpasses or underpasses at congested intersections;

     » High-occupancy vehicle (HOV) lanes; and

     » Increasing intercity freight rail capacity to reduce truck use of highways.

2. **Operating Existing Capacity More Efficiently –** Getting more out of what we have. Rather than building new infrastructure, many transportation agencies have embraced strategies that deal with the operation of the exiting network of highways transit systems, and freight services. Many of these operations-based strategies are enhanced by the use of enhanced technologies or ITS. (It should be noted that ITS projects must come from a regional ITS architecture. The relationship between the CMP and the regional ITS architecture is discussed in more detail in Section 4.4.)

   – **Key Strategies:**

     » Metering traffic onto freeways;

     » Optimizing the timing of traffic signals;

     » Faster and anticipatory responses to traffic incidents;

     » Reserved travel lanes or rights-of-way for transit operation;

     » Realigned transit service schedules and stop locations;

     » Providing travelers with information on travel conditions as well as alternative routes and modes;

     » Improved management of work zones;

     » Identifying weather and road surface problems and rapidly targeting responses;

     » Providing real-time information on transit schedules and arrivals;

     » Monitoring the security of transit patrons, stations, and vehicles;

[4] From FHWA Office of Operations web site, http://ops.fhwa.dot.gov/trafficanalysistools/type_tools.htm.

[5] 23 U.S.C. §450.320 (e).

- » Anticipating and addressing special events, including emergency evacuations, that cause surges in traffic;
- » Better freight management, especially reducing delays at border crossings;
- » Reversible commuter lanes;
- » Congestion pricing strategies, including high occupancy toll (HOT) lanes;
- » Movable median barriers to add capacity during peak periods;
- » Restricting turns at key intersections;
- » Geometric improvements to roads and intersections;
- » Converting streets to one-way operations; and
- » Access management.

3. **Encouraging Travel and Land Use Patterns that Use the System in Less Congestion Producing Ways –** Travel Demand Management (TDM), nonautomotive travel modes, and land use management. These strategies provide options that result in more people traveling in fewer vehicles, or trips made in less congested times. In some instance the goal is to substitute communications for travel, or to encourage regional cooperation to change development patterns and reduce sprawl.

   – **Key Strategies to Address Congestion:**

   - » Programs that encourage transit use and ridesharing;
   - » Curbside and parking management;
   - » Flexible work hours;
   - » Telecommuting programs;
   - » Bikeways and other strategies that promote nonmotorized travel;
   - » Pricing fees for the use of travel lanes by the number of persons in the vehicle and the time-of-day;
   - » Pricing fees for parking spaces by the number of persons in the vehicle, the time-of-day or location;
   - » Land use controls or zoning;
   - » Growth management restrictions such as urban growth boundaries;
   - » Development policies that support transit-oriented designs for corridors and communities involving homes, jobsites, and shops; and
   - » Incentives for high-density development, such as tax incentives.

Step 7 – Implementation and Management

This step involves the implementation and management of the defined strategies. Managers of the CMP should work closely with the operating agencies that have participated in the CMP process throughout the implementation of congestion management strategies and activities. At this step information developed through the CMP should be applied to establish priorities in the Transportation Improvement Program thereby facilitating the implementation of the congestion management process. This ensures a linkage between the CMP and funding decisions, either through a formal ranking and weighting of strategies and projects, or through other formal or informal approaches.

Step 8 – Monitoring Strategy Effectiveness

Managers of the CMP should periodically evaluate the effectiveness of strategies identified through the CMP. It is essential that the analysts utilize the performance measures developed through the CMP to determine the effectiveness of the selected strategies. In assessing the degree to which the CMP strategies addressed the problems of congestion, it is important to also assess the issue of how well, and to what extent the strategies were implemented, and to consider confounding factors that may have contributed to the success or failure of the selected projects or programs.

A decision to measure results requires a plan to collect pre-implementation data, as well as make preparations for an ongoing monitoring process, as discussed in Step 4 above. The ongoing monitoring process should be able to isolate those marginal changes in system performance that may be associated with the improvement.

Based on the feedback from the assessment process, the MPO should make appropriate adjustments to their effectiveness forecasting process and the CMP itself. These adjustments may be with respect to the strategies considered, or may reflect back to the performance measures used; the data collection and management component of the process; or the analytical methods and tools applied. The CMP should be subject not only to periodic review, but to a timetable for upgrading the tools and methods to keep pace with current practice.

3.4 LESSONS LEARNED FROM CURRENT PRACTICE

The FHWA and FTA continue to work with their partners in the metropolitan planning community to provide information and obtain feedback on the emerging planning practices. In preparation of publication of the Rule on Statewide Transportation Planning: Metropolitan Transportation Planning, FHWA had sponsored a series of workshops designed to inform stakeholders about emerging requirements and to gauge the reactions of practitioners to the new playing field.

In February 2006, FHWA sponsored a Peer Exchange workshop involving MPOs and state DOTs in a review of their experiences with congestion management systems and processes as currently configured. This workshop evolved into the "Congestion Management Processes Peer Exchange and Case Studies" project (July 2006). The workshop examined several key topics, including linkage of CMP with NEPA documentation, operations, and performance measures; coordination of the CMP with transit agencies; interagency coordination; and the use of CMP for setting priorities and evaluating project impacts.

The consensus of the planning practitioners involved in the Peer Exchange was that a transition from congestion management "systems" to a congestion management "process" makes sense – but none of the participants thought that the transition would be easy. Even in regions where congestion management has been an integral part of the process for years, there is still skepticism about what a CMS or CMP can contribute to solving a region's congestion problems.

Still other projects have focused on the challenges inherent in measuring, monitoring, and responding to congestion in metropolitan regions. One such study, "Traffic Congestion and Reliability – Trends and Advanced Strategies for Congestion Mitigation" (Cambridge Systematics, Inc. and Texas Transportation Institute, September 1, 2005) offered insight into how the causes, measurement, and monitoring of congestion vary in different settings, and focused on congestion trends and implications for the future. This report

Current Practice: Developed congestion management systems anticipate the evolution of the CMP, congestion management processes as part of the long-range metropolitan planning process.

The Atlanta Regional Commission (ARC) has established a CMP designed to manage congestion throughout the Atlanta, Georgia region and to maximize the safety and mobility of people and goods. The process involves four steps:

- Identification,
- Understanding and Priority,
- Implementation; and
- Data and Monitoring.

The ARC analysis framework uses a Congestion Management System Network that covers the 13-county Atlanta region, as well as major facilities in 5 adjacent counties, incorporating interstate highways, HOV facilities, major roadways and select minor roads. Congested locations are identified both through outputs of regional transportation models, using the Travel Time Index (TTI), and through field data collection in travel time studies.

Congested locations are identified according to TTI, where moderate congestion is indicated by TTI levels of 1.35 to 1.80, and severe congestion is indicated by a travel time index greater than 1.80. Once congested locations are identified, the CMP is used to help develop low-cost, high-impact solutions to congestion on the basis of regional priorities. Different locations can have different thresholds for "tolerable" levels of congestion, based on activity and travel patterns; priorities are also determined in the context of the intensity, extent, and duration of congestion. Analyses are undertaken in the form of corridor studies, focusing on the movement to and from activity centers from both facility and travelshed perspectives; and activity center analysis, which focuses on destination corridors and movement within activity centers.

Data is obtained from a variety of sources, including Advanced Traffic Management System (ATMS) data obtained from the regional Traffic Management Center; aerial photography data; and information from studies such as the Metro Atlanta Signal Timing Project, corridor studies, and information retained from the region's pre-existing congestion management system. The ARC is currently in the process of enhancing their analysis tools, including incorporating the impact of crashes and weather on non-recurring congestion. ARC planners are also establishing processes to track success through before and after studies where CMP mitigation strategies have been implemented. For further information on ARC's work please go to http://www.atlantaregional.com/cps/rde/xchg/arc/hs.xsl/605_ENU_HTML.htm.

emphasized the need for linking the planning process and the practice of transportation systems management and operations, and the need to make effective use of the data and analytical tools now available for assessing patterns of congestion.

In the wake of SAFETEA-LU and the new transportation planning requirements ushered in by that legislation, the FHWA sponsored workshops to review the new requirements and to focus on congestion management processes. The "SAFETEA-LU Planning Provisions Workshop" (prepared for FHWA and the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Planning by Cambridge Systematics, May, 2006) covered the spectrum of planning requirements at the statewide level and a number of requirements at the metropolitan level, emphasizing areas of continuity and topics where new thinking has emerged. The Congestion Management Process was among the areas that both draw upon existing practice, and seek new approaches and greater integration with the rest of the metropolitan transportation planning process.

Many of the findings of the studies referred to above have been incorporated into this guidebook. It is also important to recognize the connections between the development of this guidebook and other, concurrent efforts. FHWA/FTA is also currently undertaking the development of a guidebook for management and operations in the planning process; documenting and assessing various analysis tools with applications to transportation systems management and operations; and cataloguing resources available for statewide transportation planning.

Other MPOs have incorporated innovative elements into their congestion management processes. The **Delaware Valley Regional Planning Commission** (DVRPC), the MPO for the Philadelphia, PA region, has tightened the linkage between their CMP and their TIP by integrating their CMP database with the TIP database. DVRPC expects to make it easy for users of their web site "to easily switch between the TIP and CMP pages to enhance understanding and planning." CMP pages of the web site will incorporate clickable maps to allow users to access data, appropriate strategies, relevant adopted reports, and links to TIP projects for each congested subcorridor." CMP corridors have been used in the development of the current MTP for the region, and the MPO plans an update of the CMP "to provide [a] technical basis for the next Plan."[6]

[6] Neaderland, Zoe "System-Wide Analysis for Congestion Management: Lessons Learned from Preparing the Congestion Management Process for Delaware Valley Regional Planning Commission," TRB 2007 Annual Meeting CD-ROM, Transportation Research Board, The National Academies, Washington, D.C.

3.5 CHALLENGES AND OPPORTUNITIES

Ultimately, the CMP is intended to be a flexible approach to transportation problem solving that builds upon years of experience in congestion management. Congestion management systems were first advanced in ISTEA. Even the ISTEA requirements built upon earlier efforts to focus on congestion, including research projects and such practical products as the Institute for Transportation Engineers' (ITE) "A Toolbox for Alleviating Traffic Congestion." The intent of the move to a "congestion management process" is evolutionary: to incorporate congestion management into the planning process, while retaining the flexibility to apply the CMP approach at all levels of the project and program development and delivery process. The CMP should enable transportation planners and decision-makers to apply the most appropriate and effective tools and strategies to address congestion from the regional-level to location-specific improvement projects.

It is important to emphasize that the CMP is intended to support transportation decision making, as an integral part of the planning process. While the process may be supported by a program or system of data collection, monitoring, and analysis (a "congestion management system"), and may produce reports detailing alternative strategies and projects designed to address specific congestion problems (a "congestion management plan"), the CMP is a set of tools for identifying and addressing congestion throughout the long-range planning and project development cycle. MPOs that have long-standing congestion management programs or systems may be challenged in the transition to a fully integrated long-range transportation process that makes congestion management a "core" activity, as opposed to an isolated, stand-alone process. Even MPOs that have done an exemplary job of breaking down the "silos" that can separate elements of the planning process may face institutional barriers to fully integrating the CMP into the project development process, using CMP studies and products as part of the NEPA process. (This issue is discussed in more detail below.)

While there are many available technical methods that can assist in assessing the state of congestion in a given region, MPOs may be challenged in developing and maintaining these tools for their own regions. The ability to acquire and maintain the level of data collection and management is also a significant hurdle in many areas.

Different operating agencies may have quite different and distinct data collection and management systems. Even if data is collected into a regional data archive, many of these differences in how each agency collects, processes, and formats data may remain. MPOs may encounter significant barriers in consolidating information and reconciling these different data management practices.

The difficulties inherent in understanding and using data from multiple agencies underscores the need to involve the appropriate players from transportation system operating agencies, both at the policy and technical level. These challenges apply as well to attracting and retaining professional staff to manage the CMP. While obtaining the necessary level of commitment and continuity of involvement from agency staff is a formidable challenge, bringing together operations personnel and policy level representatives from multiple operating agencies can also offer tremendous opportunities for creating formal and informal networks and working relationships. Creating a CMP "team" can deliver real benefits by transforming "stakeholders" into partners in pursuing effective congestion management strategies.

Notwithstanding these challenges, the CMP offers an opportunity to institutionalize a new and strategic mindset toward transportation issues. The objectives-driven, performance-based approach to metropolitan transportation planning embodied in the CMP, and in the new emphasis on management and operations, can strengthen the planning process by directing attention to short- and medium-term measures to mitigate congestion, as well as to measures that will maintain the safety and efficiency of new and expanded transportation facilities into the future. The CMP approach can also be a template for approaching other regional objectives that are established through the planning and visioning process.

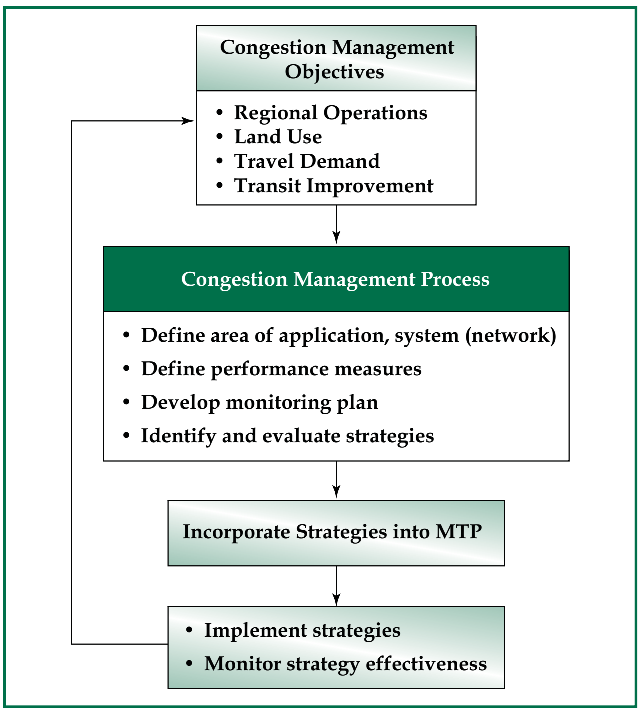
The challenges and opportunities outlined above may present themselves to an MPO and the other participants in the CMP at any stage in the development of the congestion management process. Whether adapting an existing system or starting from scratch, the architects of the CMP will be implementing a process that builds on past experiences while incorporating an objectives-driven, performance-based approach to addressing congestion.

4.0 DEVELOPMENT AND IMPLEMENTATION OF AN OBJECTIVES-DRIVEN CMP

4.1 DEVELOPING A CMP

Many MPOs already have existing systems or processes for congestion management, based on metropolitan planning rules and guidance developed under ISTEA and the Transportation Equity Act for the 21st Century (TEA 21), the successor authorization act for surface transportation. The statewide planning requirements spelled out in SAFETEA-LU also stipulate that "For purposes of this section... State laws, rules, or regulations pertaining to congestion management systems or programs may constitute the congestion management process under this section... if the Secretary finds that the State laws, rules, or regulations are consistent with, and fulfill the intent of, the purposes of this section..."

Figure 4. CMP – An Iterative Process



If no existing plan, program, system, or process can serve as the basis for the CMP, MPOs can look to several excellent models from across the country, and many resources from FHWA/FTA, the Association of Metropolitan Planning Organizations (AMPO), and other sources to help them get started.

As noted above, the CMP is based upon regional operations objectives articulated in the metropolitan transportation plan. The congestion management process incorporates specific, measurable, achievable, realistic, and time-bound ("SMART") objectives that reflect regional goals.

4.2 BEYOND THE "8 STEPS" – A SUSTAINABLE CMP

The CMP for any given region should be tailored to address the most critical needs of that region. The transportation planning process should already have provided input on the regional vision, goals, and objectives to which the CMP must respond. To gain an understanding of the needs of various stakeholders in the planning process with respect to congestion, it is important to reach out to operating agencies, advocacy groups, commercial interests, and members of the public.

- Decide on what you want to accomplish.

There should be general agreement on how the regional goals and objectives expressed in the MTP should be articulated in the context of the CMP. Different stakeholders will have different objectives, which must be accommodated in the overall process. An important place to begin this is through the public participation process of the MPO, where community visions are transformed into goals, objectives, and measurable performance indicators. And, the intent for the CMP to feed projects and strategies into the metropolitan transportation plan and TIP should be made clear.

- Develop a work team within the MPO and other necessary organizational arrangements such as a Steering Committee.

Existing organizational arrangements may be appropriate, or new committees can be formed. But, it is important for the groups to have broad membership of planning and operations staffs from the member organizations of the MPO – local jurisdictions, state DOTs, and public transportation operators.

- Prepare a timeline for developing the CMP.

While the application of the CMP to particular issues should be open-ended, there should be a strict timetable for developing the process. As with any plan strategy, it is good practice to have an implementation plan that includes specific tasks, schedules, levels of effort, and responsibilities for carrying out the CMP. Again, if the CMP is part of the MTP, CMP strategies can be treated just like the other implementation measures. But, whether or not the CMP is prepared as an element of the MTP, the timeline ought to allow time for the CMP to "feed" projects and strategies to the MTP development process. The timeline also should identify an update schedule, as well as data collection and analysis activities to support the periodic assessment of the effectiveness of implemented congestion management strategies.

- Conduct a CMP self assessment.

The purpose of the self-assessment is to determine where your MPO stands in adapting an existing congestion management system or plan into a CMP (that is, which elements of your CMP meet "best practice" levels), or what remains to be done in developing the CMP from square one. The self-assessment will require you to review and assess what you are doing now to address congestion, not only in terms of long-range planning, but the efforts of operating agencies to institute short-range programs to manage congestion.

In the course of the self-assessment, you will identify strengths and weaknesses of current efforts, in terms of establishing a collaborative, regional process; developing operations objectives; deriving appropriate measures of performance; instituting data collection and data management systems; identifying current congested locations and forecasting future congestion; and selecting and analyzing potential congestion management strategies. Ultimately, the self assessment process will help you to identify areas where you wish to make improvements improvement as you implement the CMP.

CMP Reflects Scenario Planning and Visioning Leading to MTP

By institutionalizing an objective-driven, performance-based planning process incorporating a range of stakeholders, the planning process will continue to evolve in response to the growing challenges of metropolitan transportation planning. The MTP that results from this process will clearly address management and operations of the transportation system. It should include:

- A vision, goals, and objectives that address management and operations;
- Measurable objectives that allow the region to track progress toward achieving its goals;
- Clear strategies for management and operations, backed by specific performance measures for evaluation; and
- A congestion management process that responds to regional priorities and to the interests and concerns of all of the region's stakeholders – including system operators.

Since the CMP is an integral part of the planning process, rather than a stand-alone effort, it incorporates the knowledge and understanding of all of the players who contribute to the development of the MTP. It also reflects the insight achieved through the process of establishing a regional vision and goals, and exercises such as scenario planning, which enable participants in the process to gain a richer understanding of possible futures and potential responses.

MPO/State Roles Should be Clearly Defined

While MPOs generally welcome, and benefit from the involvement of the state DOT in the metropolitan planning process, the active participation of the DOTs in the congestion management process is particularly important. Not only is the perspective of the DOT as an operator important in the sharing of data and developing congestion mitigation strategies, it is important that the state DOT appreciate the perspective and priorities of other participants in the congestion management process. "Acceptable" levels of congestion may differ according to transportation facility, geographic location (metropolitan area or subarea), and/or time-of-day. For instance, a higher level of congestion may be acceptable in a transit-oriented development (TOD) area, where planners hope to encourage the use of public transportation, while system operators may wish to maintain a higher level of service in areas poorly served by transit. In any case, the operators of facilities – including the state DOT – should be sensitive to the priorities of various stakeholders in the congestion management process. Participants in the CMP, including the MPO, state DOTs, transit operators, and other public or quasi-public operators should be flexible in selecting appropriate levels of service for critical components of the regional transportation network. "Performance measures," according to the Final Rule on metropolitan and statewide planning, "should be established cooperatively by the state(s), affected MPO(s), and local officials in consultation with the operators of major modes of transportation in the coverage area."[7]

Regional Collaboration and Cooperation

Collaboration on regional operations, including the development and implementation of the congestion management process, is essential. Collaboration enables regional, strategic development of projects and policies that have a regional effect on users, including activities such as incident management, advanced traveler information services, public safety and security, management of the impacts of special events, and implementation of electronic payment measures. A common thread in all of these activities is agreement upon

[7] **Statewide Transportation Planning; Metropolitan Transportation Planning; Final Rule**, Federal Register, Vol. 72, No. 30; February 14, 2007; Section 450.320 (pp. 7274 to 7275).

objectives and performance measures, so that projects can be evaluated on the same footing. Furthermore, collaboration among operators, service providers, and planners for all surface modes affecting, or affected by, congestion, helps to answer questions about the long-term operation, integration, and evolution of facilities and services.

Appropriate levels of collaboration and cooperation also help to identify the many stakeholders and interested parties who should be at the table sharing information and making operations decisions. This is also one of the objectives of the process that leads to the creation and ongoing maintenance of a Regional ITS Architecture, where the requirements of the various affected actors are accommodated through the development of a regional concept of operations. Finally, an understanding of how each participant perceives the individual agency's roles and responsibilities helps to improve accountability for improved system performance.

While a measure of collaboration and cooperation can be achieved through ad hoc or informal channels, an ongoing process that yields lasting value depends upon a consistent structure or framework for action, collaboratively developed and accepted policies, and resources for sustaining and implementing plans and programs. If no existing mechanisms, such as MPO committees that can assume responsibility for a collaborative CMP, are available, some forum for perpetuating the process should be established. Policy and technical committees can be used to get the word out to implementing agencies on the merits of the CMP measures. The local government representatives can make sure that strategies get reflected in their capital programs and operating budgets. Also, the state DOT is usually represented on these committees and their representatives can be asked to include the appropriate CMP measures in the state capital programs and operations budgets for the state system. Transit operator(s) represented on those committees can assist in proposing CMP measures and strategies, as well as include agreed upon strategies in their project and strategy submittals for inclusion in the plan and TIP.

- Identify and engage other key stakeholders.
  - Obvious stakeholders include system operators, commuter advocacy groups; reach out also to commercial vehicle operators, shippers, Chambers of Commerce, service industries.
- Describe the purpose and value in achieving collaboration.
  - Be prepared to answer question, "What's in it for me?" Use local data or national averages to calculate costs in fuel, productivity, air quality, etc.
- Get buy-in from decision-makers.
  - Make sure that CMP is aligned with goals and objectives of local elected and appointed officials.
- Commonly used methods of collaboration.
  - Engage interest groups by going to them, rather than inviting them to your turf; "surface the discontent"; make them vital elements in solution, rather than observers or passive beneficiaries.

4.3 DEVELOPING CONGESTION MANAGEMENT OBJECTIVES

Objectives are specific, measurable statements relating to the attainment of goals. In the MTP, congestion objectives should be regional or multi-jurisdictional in nature and cannot be achieved by a single entity or jurisdiction. In conjunction with selecting congestion objectives, performance measures are developed to assess whether or not the objective has been met.

In all cases, objectives should have "SMART" characteristics, as defined below:

- **Specific –** It provides sufficient specificity to guide formulation of viable approaches to achieving the objective without dictating the approach.
- **Measurable –** It includes quantitative measurements, saying how many or how much should be accomplished. Tracking progress against the objective enables an assessment of effectiveness of actions.
- **Achievable –** Objectives should be realistic and within the reach of the various participants in the CMP. Objectives should not represent a "wish list," but should take into consideration projections and trends used elsewhere in the metropolitan transportation planning process.
- **Realistic –** The objective can reasonably be accomplished within the limitations of resources and other demands. Still, the objective may be a "stretch" and require substantial coordination, collaboration, and investment to achieve. Since a judgment on how realistic the objective is cannot be fully evaluated until after strategies and approaches are defined, the objective may need to be adjusted iteratively.
- **Time-bound –** The objective identifies a timeframe within which it will be achieved (e.g., "by the year 2020").

By developing "SMART" objectives, system performance can be examined and monitored over time.

4.4 APPLYING THE CMP

As discussed before, the CMP is an integral element of the metropolitan transportation planning process. By applying the principles of objectives-based, performance-driven planning, the CMP actualizes the vision and goals defined for the region through the planning process.

Following the development of the Congestion Management Process, the MPO will want to focus on developing an implementation strategy. The MPO can implement the CMP in a number of different ways, or in a combination of different ways. Strategies, projects, or programs identified through the CMP can be realized:

- Directly, through the MTP and TIP;
- Indirectly, by working with the state DOT or local government members;
- By encouraging government agencies to include CMP activities in their operating budgets; and
- By encouraging that state or local agencies sponsoring congestion mitigation strategies incorporate CMP alternatives analyses during project development.

Applying the CMP in developing the MTP

The congestion management process provides a mechanism for identifying short-, medium-, and long-term strategies for addressing congestion on a systemwide, corridor-level, or site-specific basis. Once operations objectives relevant to the area in question have been established, the CMP draws upon appropriate performance measures to identify specific congestion problems. Data from the MPO's resources or from the appropriate operating agency is used to characterize the nature of the congestion problems, and technical tools are applied to help identify appropriate strategies.

The CMP uses a cooperative approach to involve both affected operators and the public in a consideration of strategies, both in terms of the effectiveness of proposed solutions and the acceptability to various stakeholders. Together, affected parties and system operators determine the availability of resources and the timing for implementation of proposed strategies. The actions identified through the CMP then become part of the alternatives analysis process, in which proposed solutions to the broad array of regional problems are considered in context. Actions offered through the CMP are then incorporated into the MTP, based on how they compete with projects and programs proposed by other interests during the planning process.

Identifying and selecting strategies through the CMP

The CMP may ultimately offer a single project or program to address congestion in a particular circumstance, but it is more likely that an array of alternatives will be put forward that can individually or collectively contribute to a reduction in congestion or a mitigation of the problems caused by congestion. The CMP continues to be relevant once these broad-brushed alternatives are laid out in the MTP. Products from the CMP will continue to be used in subsequent analyses, including the use of data and study results in the project development process.

The CMP might also be employed in selecting projects for incorporation in the TIP. Capital and non-capital projects from the MTP proposed to be funded under 23 U.S.C. and 49 U.S.C. Chapter 53, or requiring action from FHWA or FTA, are included in the TIP. The CMP offers a way to prioritize projects in the event that funds for implementation are limited, or to establish the "agreed to" list of projects to be included in the first year of the TIP.

Relationship of the CMP to the ITS Regional Architecture

The CMP and the Regional ITS Architecture are both technical tools that assist planners and system operators in developing and selecting strategies for improving the movement of people and goods in a region. The Regional ITS Architecture focuses on the application of information and communications technology to transportation problems in a technologically coordinated way. It is a common framework that guides practitioners in establishing communications (and, ideally, integration) across technology applications and helps them to choose the most appropriate strategies for processing transportation information. The Regional ITS Architecture defines the system components, key functions, organizations involved in developing an architecture, and the type of information to be shared between organizations and between parts of the system.

While the CMP is not focused on any particular set of strategies, an understanding of the Regional ITS Architecture is crucial in appreciating the existing and future interconnections, or even the simple ability to communicate, between agencies and systems. The ITS Architecture, which is by design a living document, to be updated on a periodic basis, provides an institutional framework as well as a vision of the interconnectedness among technologies, systems, and subsystems.

Applying the CMP in Nonattainment TMAs

SAFETEA-LU requires that "for transportation management areas classified as nonattainment for ozone or carbon monoxide pursuant to the Clean Air Act, Federal funds may not be advanced in such area for any highway project that will result in a significant increase in the carrying capacity for single-occupant vehicles unless the project is addressed through a congestion management process." While capacity-expanding projects are not prohibited, the CMP requirement means that the MPO must consider alternatives to capacity increases, and that measures would be incorporated into the project to make the most efficient use of the new capacity once it has been constructed. In all TMAs, attainment or non-attainment, the CMPs should identify strategies that complement proposed improvements. These may be measures such as ramp meters for new freeway lanes or access management on a parallel arterial. These complementary strategies extend the life of the SOV capacity in which we invest.

In ozone and CO non-attainment TMAs, MPOs must establish a congestion management process that gives priority to strategies that reduce congestion and improve the movement of people and goods without requiring the construction of new highway capacity. The decision process in dealing with this restriction on SOV capacity-expanding projects must be documented as part of the CMP in these areas.

Addressing Recurring and Nonrecurring Congestion

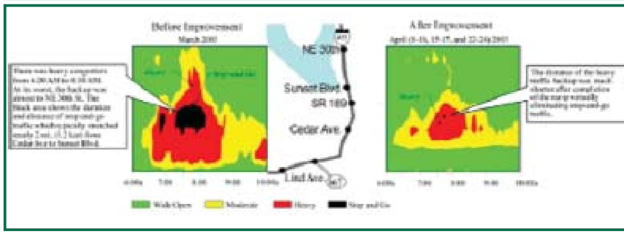
The CMP should enable the MPO to address both recurring congestion (usually caused by "bottlenecks" where capacity is constricted or where merging and weaving patterns cause conflicts) and non-recurring congestion (resulting from incidents, special events, or other phenomena like adverse weather). Either type of congestion may require analysis at the corridor or facility level in order to pinpoint problem locations or to identify and evaluate potential mitigation strategies.

The CMP should also be designed to enable assessment of activities that may not apply to a particular location, such as incident response strategies. Incident-related delay accounts for a large and growing proportion of travel delay, particularly in regions where travel demand is already stressing an over-burdened system.

The **Puget Sound Regional Council** (PSRC) has demonstrated that by providing better processes to understand the congestion data, a greater success has been realized in stakeholders' understanding of projects.

The PSRC has used innovative methods of presenting congestion data so that stakeholders better understand the region's transportation policy and planning related to CMP. This data has also proven very useful in educating stakeholders and helping stakeholders prioritize projects within a corridor given fiscal limitations and competing fiscal demands of multiple jurisdictions. The clear presentation of data helps them ensure that projects are selected that address the most severe congestion.

PSRC has partnered with WSDOT both to obtain and analyze data. The agency has developed innovative visuals to communicate the complexities of congestion. These include "brain scan" visual using colors to show the level of congestion based on lane occupancy throughout the 24-hour period along a corridor. Other visuals used are three-dimensional images that show the greatest level of delay as bars of varying heights on a regional map. These tools have been so successful that they are being shown widely throughout the region and helping to advance understanding of traffic congestion. These tools that have been used through the region on corridor studies will also be used in PSRC's stand-along CMP report, which is under development.



Linkages to the Statewide Planning Process and STIP

The Final Rule on Statewide and Metropolitan Transportation Planning makes it clear that coordination and consultation between the state Department of Transportation and the MPO is required; state DOTs are "encouraged to rely on information, studies, or analyses provided by the MPOs for portions of the transportation system located in metropolitan planning areas" (§450.208). Furthermore, the statewide planning process "shall (to the maximum extent practicable) be consistent with the development of applicable regional intelligent transportation systems (ITS) architectures..." The Final Rule also encourages "consultation with, or joint efforts among, the State(s), MPO(s), and/or public transportation operators (§450.212). The States should be partners in the development and application of the CMP, particularly for portions of the transportation network within the MPO that are operated by the state DOT. The development and content of the Statewide Transportation Improvement Program (STIP) can similarly be enabled through application of the CMP.

The **Southeast Michigan Council of Governments** (SEMCOG) shows the close integration of the CMP and the LRTP for ranking projects and realizing system improvements through clearly defined performance measures.

The SEMCOG developed a stand-alone CMP but knew that for any congestion mitigation strategies to be implemented, they needed to be part of the LRTP. During development of its 2030 LRTP, SEMCOG provided congestion analysis results and mitigation strategy recommendations developed in the CMP report to state and local agencies. This information, along with public input, was used by state and local road and transit agencies to propose projects for the LRTP.

In the LRTP, SEMCOG uses a weighting process to prioritize regional corridors and ensure that investment occurs in the areas with greatest need. One of the eleven performance measures used to weight corridors is congestion, and a number of other factors have congestion implications, such as improvements to corridors with high transit ridership and non-motorized transportation. Therefore, the corridor prioritization process is analytically driven and integrated with the CMP.

Tying funding to the CMP

Some CMP projects and strategies can be implemented by the MPO through inclusion in the TIP. It may be necessary to convince the TIP committee or decision making body on the merits of the CMP projects by ranking projects relative to their benefits. Other CMP projects/strategies may need to be included in state or local programs to accomplish implementation.

(Those projects that support the goals and objectives of the plan should be implemented; projects should be ranked according to how well they meet the goals and objectives of the plan.)

4.5 THE CMP AS A LINKAGE BETWEEN PLANNING AND NEPA

The Appendix to Part 450 referred to above points out the close links between the metropolitan transportation planning process as practiced by MPOs and the environmental analysis undertaken by project sponsors. Legal guidance previously distributed to planning agencies[8] notes that "much of the data and decision-making undertaken by state and local officials during the planning process carry forward into the project development activities that follow the TIP or STIP. This means that the planning process and the environmental assessment required during project development by NEPA (42 U.S.C. 4231 et seq.) should work in tandem, with the results of the transportation planning process feeding into the NEPA process."

The memorandum goes on to point out that this close linkage is not always observed in the course of project development. "In practice," note the authors of the memo, "the environmental analyses produced during the NEPA process are sometimes disconnected from the analyses used to prepare transportation plans, transportation improvement programs, and supporting corridor or subarea studies. Analyses and decisions occurring during transportation planning can be ignored or redone in the NEPA process, resulting in a duplication of work and delays in implementation of transportation projects. The sharp separation between the work done during the transportation planning process and the NEPA analysis and documentation process is not necessary." In other words, planning information can and should be incorporated into the environmental review process, rather than starting with a blank page for every project.

As further discussed in the memo, "NEPA and the government-wide regulations that carry out NEPA (40 C.F.R. Parts 1500 et seq.) clearly contemplate the integration of the NEPA process with planning processes...

- 40 C.F.R. 1501.2 requires that Federal agencies "integrate the NEPA process with *other planning at the earliest possible time* to ensure that planning and (agency) decisions reflect environmental values…"

Sections of the Final Rule referring to "Transportation planning studies and project development (§450.318, p. 7274) discuss the high standards that must be met for incorporation of planning studies into the NEPA process. The Rule notes that "Publicly available documents or other source material produced by, or in support of, the transportation planning process described in this subpart may be incorporated directly or by reference into subsequent NEPA documents, in accordance with 40 CFR 1502.21, if:

1. The NEPA lead agencies agree that such incorporation will aid in establishing or evaluating the purpose and need for the Federal action, reasonable alternatives, cumulative or other impacts on the human and natural environment, or mitigation of these impacts; and

[8] Memorandum: **Integration of Planning and NEPA Processes**, February 22, 2005; D.J. Gribbin, Chief Counsel, FHWA and Judith S. Kaleta, Acting Chief Counsel, FTA to Cindy Burbank, Associate Administrator, Office of Planning, Environment and Realty, FHWA and David A Vozzolo, Deputy Associate Administrator, Office of Planning and Environment, FTA.

2. The systems-level, corridor, or subarea planning study is conducted with:

   a. Involvement of interested state, local, tribal, and Federal agencies;

   b. Public review;

   c. Reasonable opportunity to comment during the metropolitan transportation planning process and development of the corridor or subarea planning study;

   d. Documentation of relevant decisions in a form that is identifiable and available for review during the NEPA scoping process and can be appended to or referenced in the NEPA document; and

   e. The review of the FHWA and the FTA, as appropriate.[9]

Appendix A to 23 CFR 450 (p. 7281), while addressing the level of detail appropriate for incorporation of planning analysis in project development studies, the Rule

Current Practice: Linking NEPA studies with the CMS Toolbox was a logical approach given that alternatives defined with congestion relief potential would be developed, screened, and evaluated for any NEPA study underway in the region.

The ***Mid-America Regional Council*** (MARC) serves eight counties and 116 cities in the greater Kansas City bi-state (Missouri and Kansas) region. In 2001, MARC developed an enhanced congestion management system (CMS) designed to integrate with the Regional Transportation Plan (RTP), Transportation Improvement Program (TIP), and corridor evaluations, including the Major Investment Study (MIS) planning processes. In developing its CMS, MARC identified a "CMS Toolbox" that incorporated a broad catalog of potential strategies under the following headings:

1. Highway projects;
2. Transit projects;
3. Bicycle and pedestrian projects;
4. Transportation Demand Management (TDM) strategies;
5. Intelligent Transportation Systems (ITS) and Transportation Systems Management (TSM) strategies;,
6. Access management strategies;
7. Land development strategies; and
8. Parking management strategies.

MARC adopted a policy that its CMS Toolbox of strategies would be considered when the purpose and need for an environmental study includes congestion management. The agency wanted to directly demonstrate how any suggested capacity improvements had been evaluated using the congestion management process.

At the time MARC was developing its CMS, the agency had established a network of facilities on which it collected data, including travel time studies and traffic counts, but was only using CMS methods to support the regional planning process by providing data to potential project sponsors for the RTP and TIP. Because the system is less congested than most other metropolitan regions of comparable size, the CMS has been less of a planning focus than in other locations.

MARC wanted to develop a transparent process to show how a capacity improvement had gone through the congestion management process. Linking NEPA studies with the CMS Toolbox was a logical approach given that alternatives defined with congestion relief potential would be developed, screened, and evaluated for any NEPA study underway in the region. The MARC CMS Policy adopted the following language on the integration of major investment studies to the metropolitan planning process:

The CMS Toolbox provides alternative congestion management strategies for consideration in MIS and Corridor Studies. When traffic congestion is referenced in the Purpose and Need Statement for an MIS, the MIS shall consider the congestion management strategies included in the MARC CMS Toolbox as a starting point for the development of alternative strategies. This does not preclude the MIS from considering other strategies that may not be in the CMS Toolbox, nor does it require that the MIS select a strategy from the CMS Toolbox be the preferred alternative, however, the MIS document must include a discussion of how the CMS Toolbox strategies were addressed.

Currently, there is no NEPA requirement that the CMS be incorporated into the NEPA process. Furthermore, MARC's policy that NEPA studies incorporate the CMS Toolbox is not codified in any agreements with implementing agencies, but instead is implemented on a voluntary and cooperative basis. However, MARC and the Missouri Department of Transportation (MoDOT) have worked closely in a number of instances to incorporate CMS Toolbox strategies into relevant projects.

A major benefit is that by coordinating planning and NEPA through the CMP, duplication or redoing the planning work in the NEPA process is avoided. This helps to "streamline" the NEPA process. Since adoption of the Policy, MARC has not been challenged about any projects in the TIP. MARC feels the region is accomplishing the goals that Congress had set for CMS when it was established, since transportation is being approached from a multimodal perspective. Overall, MARC feels that the partnerships among state, Federal, and regional government agencies are working well, with MARC staff continually involved in a significant number of projects. For more information on MARC's work go to:
http://www.marc.org/transportation/congestionmanagementsystem.htm.

[9] See 23 CFR 450.318 (b).

notes that "For purposes of transportation planning alone, a planning-level analysis does not need to rise to the level of detail required in the NEPA process. Rather, it needs to be accurate and up-to-date, and should adequately support recommended improvements in the statewide or metropolitan long-range transportation plan. The SAFETEA-LU requires transportation planning processes to focus on setting a context and following acceptable procedures. For example, the SAFETEA-LU requires a "discussion of the types of potential environmental mitigation activities" and potential areas for their implementation, rather than details on specific strategies. The SAFETEA-LU also emphasizes consultation with Federal, State, and Tribal land management, wildlife, and regulatory agencies.

However, the Environmental Assessment (EA) or Environmental Impact Statement (EIS) ultimately will be judged by the standards applicable under the NEPA regulations and guidance from the Council on Environmental Quality (CEQ). To the extent the information incorporated from the transportation planning process, standing alone, does not contain all of the information or analysis required by NEPA, then it will need to be supplemented by other information contained in the EIS or EA that would, in conjunction with the information from the plan, collectively meet the requirements of NEPA."

In this context, the CMP, if appropriately developed, can provide at a minimum a valuable starting point for the NEPA process, and ideally, could give the agency a "running start" on critical components of the NEPA process such as purpose and need, alternatives screening, among others (see section 5.2.3 for more information).

4.6 OTHER POTENTIAL APPLICATIONS OF CMP APPROACH

The Congestion Management Process is one of many elements feeding into the metropolitan transportation planning process. Along with requirements for coordination with state and local officials, consultation with Federal and tribal agencies, and consistency with the regional or statewide ITS Architecture, the CMP provides a mechanism for addressing regional, corridor-wide, and spot congestion issues in a comprehensive fashion. At the same time, the CMP works with the eight planning factors that should be considered in preparing long-range plans – and especially with promoting efficient and effective transportation system management and operations.

The CMP is not intended to replace any of the existing elements of the planning process, but instead to complement and efficiently organize existing methods and techniques, focusing on management and operations strategies as potential means for mitigating or offsetting existing and future congestion. By emphasizing system performance measures, and on the data needs derived from such measures, the CMP helps system planners to identify ways to maximize the use of existing capacity, and to extend the usefulness of proposed improvements by enhancing operational efficiency and effectiveness.

4.6.1 FREIGHT PLANNING

Most metropolitan areas face challenges in transportation planning for freight interests. Dramatically increasing freight flows in the metropolitan areas have contributed to increased congestion in the transportation system, imposing costs on shippers, consumers, and the environment. Using the congestion management process tools, processes, and data to support these tools and processes assist in addressing freight planning to address freight movement.

The United States Department of Transportation has developed a "Framework for a National Freight Policy".[10] This framework contains a vision of freight transportation systems that will ensure the efficient, reliable, safe and secure movement of goods and support the nation's economic growth while improving environmental quality. The "Framework" offers potential strategies that can be considered when assessing goods movement through the congestion management process.

The CMP can assist in addressing freight-specific congestion, and that congestion impacting freight movement, by incorporating specific freight-related strategies and by including freight in the development of an objectives-driven, performance based approach to resolving congestion issues. Freight-specific strategies might include truck-only lanes; infrastructure improvements to remove freight bottlenecks; and designated truck routes.

4.6.2 SAFETY PLANNING

Incorporating safety as a regional priority, and establishing specific safety-related performance objectives, is an important first step toward having safety considerations included in the metropolitan transportation planning process. When safety objectives are included in the MTP, this drives the development of safety-related performance measures in the CMP. An emphasis on safety becomes integral to the collection of crash and injury data, which further supports the analysis of safety during the planning process. As local jurisdictions develop and maintain crash information databases and conduct independent safety

[10] http://ostpxweb.dot.gov/freight_policy_framework.html (accessed 03/29/07).

analyses, such data can further support the identification of locations and types of safety improvements that are needed.

Involving local public safety officials as CMP stakeholders is key to identifying safety concerns and can provide useful input on key transportation safety issues. Planners can work with traffic, engineering, and public works staff to develop safety-related objectives in the CMP. These measures allow safety countermeasures to be incorporated into highway rehabilitation or improvement projects. Stand-alone projects to address critical safety issues also can be incorporated into the planning process.

4.6.3 LAND USE

The planning and management of urban land use greatly impacts transportation demand on the surface transportation system. Land use decisions are generally made at the local level, so considerations with respect to jurisdictional control should be kept in mind when advancing land use strategies. Including operational objectives dealing with land use in the metropolitan transportation plan highlights the importance of transportation investment for land development, regional demographic growth, and economic development. Land development strategies have been used in some areas to manage transportation demand on the system, and to help agencies meet air quality conformity standards. Such land use strategies can include limits on the amount and location of development until certain service standards are met, or policies that encourage development patterns better served by public transportation and nonmotorized modes. Examples of land use strategies include transit-oriented development, densification and infill strategies, and encouragement of mixed-use development.

4.6.4 NONMOTORIZED TRANSPORT (BICYCLE/PEDESTRIAN)

Incorporating nonmotorized transportation modes into the objectives of a regional transportation program adds an additional dimension in alleviating traffic congestion. nonmotorized modes of transportation, such as biking and walking, are sometimes overlooked by transportation professionals. Investments in these modes can increase safety and mobility in a cost-efficient manner, while providing a zero-emission alternative to motorized modes. Strategies focused on non-motorized modes can be implemented with relatively little cost, but tend to have local rather than systemwide impacts. The effectiveness of an investment in non-motorized travel depends heavily on coordination with local land use policies and connections with other modes, such as transit, for longer distance travel. Safety and aesthetics should also be emphasized in the design of bicycle and pedestrian facilities in order to increase their attractiveness. Representative strategies include sidewalks and bike lanes for local streets; improved bicycle facilities at transit stations and other destination locations; design guidelines for pedestrian-oriented development; improved safety and security for existing bicycle and pedestrian facilities; and exclusive non-motorized rights-of-way (i.e., rails-to-trails strategies).

4.6.5 PUBLIC TRANSPORTATION

Public transportation is an integral component of a region's transportation program, and transit operators join MPOs and state DOTs in making up the three the key planning and decision-making partners in metropolitan and statewide planning processes. Transit systems and services play important parts in measuring, responding, and managing both recurring and non-recurring congestion. However, because congestion typically is regarded only as "highway" congestion, the many roles and influential aspects of public transit are sometimes overlooked by transportation professionals in planning for congestion management.

Transit addresses congestion in a number of ways, over both the near- and longer-term timeframes. First, transit services, if time and cost competitive to driving, offer alternatives to single occupant vehicle usage. As such, transit can affects congestion as a vehicle-reduction strategy. But, transit operations themselves are vulnerable to congestion, with deteriorated travel times on buses limiting transit's ability to attract new riders. Over a longer-term, transit service, fixed route or guideway in particular, can be a catalyst for smart growth and transit-supportive land development/redevelopment. These development patterns, in turn, can provide a sustainable longer-term strategy for congestion management by strengthening the market for transit, as well as by shortening the lengths of trips that continue to be by auto.

Finally, transit operations may have significant impacts – positive and negative – on corridor congestion. Transit pullouts can significantly improve traffic flow by freeing capacity in curb lanes. Similarly, effective schedule adherence can ease rider connections and transfers, thereby improving transit system performance and attracting new riders.

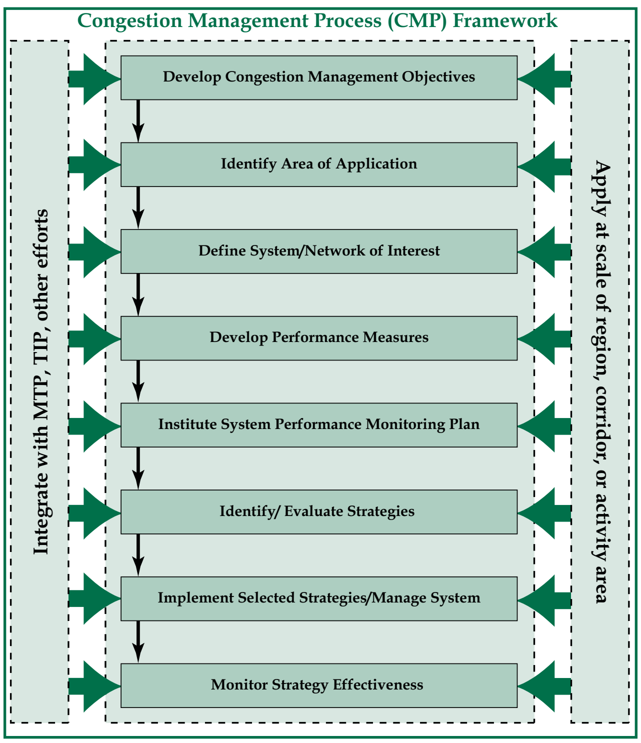
These considerations and many others illustrate the importance of involving transit operators in CMP development and implementation – as "customers" of congestion management, beneficiaries of improved system performance, and as an effective congestion management strategy group.

5.0 WHAT DOES AN OBJECTIVES-DRIVEN CMP LOOK LIKE?

5.1 CHARACTERISTICS OF THE CMP

The Congestion Management Process should be viewed, not as something separate from or outside of, the planning process, but as an integral part of the planning activity. Just as travel demand forecasting and modeling enable planners to estimate future needs and analyze the impact of alternative capital investments, the CMP assists in identifying system deficiencies, and in analyzing and selecting alternative strategies to address congestion for inclusion in the MTP. Figure 5 (below) details the framework for stepping through the CMP starting with the application of the goals and objectives from the MTP.

Figure 5. CMP Framework



5.2 DOCUMENTING THE CMP

Several different approaches are available for documenting the CMP process and its outputs. The MPO could develop a communications plan to inform and educate stakeholders on the purpose and content of the CMP. It is important to educate the stakeholders on the purpose for developing the CMP and the kinds of impacts the MPO is anticipating from implementation of the strategies. The communications should be in plain language. Simply informing stakeholders about the process is important, but not sufficient; ideally, the CMP should be incorporated into the region's plans for public participation and involvement in the transportation planning process.

The CMP, as part of the metropolitan planning process, should be incorporated in the final Metropolitan Transportation Plan, either through a discussion of the congestion management process and its elements or by reference. If the CMP is incorporated by reference, it is important that the CMP documentation be readily accessible to the community that the process itself is open to participation and review through the MPO's public participation plan. Strong linkages to the MTP, and opportunities for public participation in the process, are particularly important if CMP outputs are to be used during subsequent project development stages and documentation under NEPA.

Some MPOs will choose to issue a separate report or series of reports on the CMP. While the production of a "stand-alone" report can provide a means to focus on congestion challenges and proposed solutions, the document should be prepared in such a way that the CMP can be clearly understood to be an integral part of the planning process. The performance measures developed earlier in the congestion management process should be used to report on the success of implementing the CMP strategies.

5.2.1 STAND-ALONE CMP REPORT

To ensure that the CMP is accessible and well understood by stakeholders, the MPO might consider special reports or brochures advertising the process, including performance measures, strategies, and linkages to other aspects of the planning program. It is particularly important that decision-makers are aware of the CMP strategies and their potential benefits. Each of the governmental units, at the executive level and the business level, need to understand the importance of implementing CMP strategies.

If a stand alone CMP is done then the MPO should consider how to connect it to the MTP and TIP. Mention a number of MPOs have prioritization process to add projects that reward strategies that have been identified as congestion helpful.

5.2.2 CMP AS PART OF THE METROPOLITAN TRANSPORTATION PLAN

The CMP can be documented in the Metropolitan Transportation Plan through a discussion of the process and identification of strategies, projects, or programs that were generated through the congestion management process. The "8 Steps" of developing the CMP (described in Section 3.3 above) should be documented as part of the MTP, or incorporated by reference. Discussion of the CMP and its outputs can provide a bridge in the MTP between transportation challenges currently facing residents of the metropolitan area, and the proposals for projects that will be accomplished in the out years of the plan.

5.2.3 CMP AND NEPA DOCUMENTS

The Final Rule on Statewide and Metropolitan Planning issued in February, 2007[11] provides specific reference to the use of the CMP. The Rule notes that "...the results of analyses from management systems (e.g., congestion, pavement, bridge, and/or safety) may shape the purpose and need statement." (Appendix A, Part II Substantive Issues; Purpose and Need, 8.d.)

The Rule also notes that "MPO(s), state(s), or public transportation operator(s) may undertake a multimodal, systems-level corridor or subarea planning study as part of the metropolitan transportation planning process... The results or decisions of these transportation planning studies may be used as part of the overall project development process consistent with NEPA (42 U.S.C. 4321 *et seq.*) and associated implementing regulations (23 CFR part 771 and 40 CFR parts 1500-1508). Specifically, these corridor or subarea studies may result in producing any of the following for a proposed transportation project:

1. Purpose and need or goals and objective statement(s);
2. General travel corridor and/or general mode(s) definition (e.g., highway, transit, or a highway/transit combination);
3. Preliminary screening of alternatives and elimination of unreasonable alternatives;
4. Basic description of the environmental setting; and/or
5. Preliminary identification of environmental impacts and environmental mitigation."

These planning studies may be produced as part of the CMP and incorporated into the MTP. Both the findings and the supporting documentation can feed directly into the NEPA process.

To fully utilize the authority to link the transportation planning process with the NEPA process under 23 CFR 450, the planning studies and work (such as the CMP) must meet certain consultation, public involvement, and documentation requirements. See 23 CFR 450.318 (b) for more information. Any agency planning to use CMP results in NEPA should contact FHWA or FTA for assistance (see section 4.5 for more information).

5.2.4 "STATE OF THE SYSTEM" CMP REPORTING

MPOs typically have Annual Reports that report on plan successes and implementation. Some also issue quarterly reports or summary reports that focus on particular topics. These reports can serve as report cards and should be made available to appropriate decision-makers such as the local governmental agencies, state DOT's, the division offices of FHWA, and the Regional Office of FTA. The greater the extent to which CMP success stories can be shared with key stakeholders, the easier it will be to develop and implement strategies in the future.

If the MPO chooses to use the CMP outputs as part of a "state of the system" report, it is important to think about the format to be used and the appropriate level of detail. One should decide on the target audience and make sure the results are reported in a way that is understandable. Executives need to receive more general reports of success at the aggregate level while staff agencies should get the more detailed information. For instance, a report card or "dashboard"-style report aimed at elected officials can show how improvements such as ramp meters and message sign installations have spread out the traffic flow and prevented bottlenecks from occurring. This should help expand and continue funding for these kind of strategies.

5.3 USING CONGESTION OBJECTIVES AND PERFORMANCE MEASURES FOR THE CMP

Regional operations objectives derived from a regional vision and goals should drive the Congestion Management Process. The CMP will provide a framework for implementing operations objectives related to the effective and efficient management of the transportation system from the perspective of reducing or mitigating the impacts of congestion, whether such congestion affects the movement of people or goods. Through the CMP, transportation system operators and planners integrate the work of the CMP with M&O as part of the overall regional planning environment.

[11] 23 CFR 450.212, 450.318, and Appendix A to Part 450.

As noted previously, operations objectives derived from regional goals should be "SMART" – specific, measurable, achievable, realistic, and time-bound. SMART objectives lead to performance measures that can be tracked at different geographic scales (regional, corridor-level, site-specific), by mode or facility (passenger or freight, highway or transit, freeway or arterial), and over time (peak period, 24-hour, annual). While traditional transportation planning practice relied upon measures that relate to capital improvements, such as volume-to-capacity ratio and level of service, operations-oriented measures generally focus on the experience of system users. Such operations-oriented measures also address non-recurring, as well as recurring congestion. This shift in focus also implies a transition from facility-oriented point measures, such as flow or speed, to trip-related, customer-oriented measures such as reliability. System managers will strive to improve system performance with respect to:

Mobility

Mobility describes how well the system (usually defined at the corridor level) moves people and freight. Measures that can be derived from readily-available data, and can be modeled using currently-available tools, include:

- **Travel Time –** The average travel time for a corridor (or segment of a corridor) by facility type, by direction; and
- **Delay –** Total observed travel time less travel time under non-congested conditions (reported either as vehicle-hours or person-hours of delay).

Other measures of mobility include volume-based measures derived from distance and travel time include vehicle-miles traveled (VMT) and person-miles traveled (PMT); vehicle-hours traveled (VHT) and person-hours traveled (PHT); and derived measures such as person-hours of delay (PHD).

Reliability

Measures of reliability capture the relative predictability of travel times. Reliability measures focus, not on how many people are moving at what rate, but how much mobility varies from day to day. The "buffer index" is preferred, since it is more understandable and transparent than other measures, such as the standard deviation of travel time or percentile measures (e.g., the 85th percentile travel time). The buffer index is defined as the extra time (or time cushion) that travelers must add to their typical travel time when planning trips to ensure on-time arrival. Several analysis techniques can be applied to forecast travel time reliability, including microsimulation models and the ITS Deployment Analysis System (IDAS) methodology.

Productivity

Productivity, a measure of system efficiency, is generally defined as the ratio of output (or service) per unit of input. The input measures for transportation are based on capacity, including number of seats available for transit, or highway capacity (generally based on a typical capacity of 2000 vehicles per lane per hour). High levels of vehicle demand (volume), when combined with merging and weaving patterns, can result in significant reductions in capacity utilization. As traffic flows increase to the capacity limits of the roadway, speeds decline rapidly and throughput drops dramatically. One measure of this lost productivity (characterized as a percentage of threshold capacity) for a given facility or corridor is "equivalent lost lane-miles." Regardless of the measure used, however, productivity calculations require reliable automatic detection or significant field data collection (for volumes) at congested locations.

Safety

While safety performance can be considered as a separate area for analysis, the relationship of highway operational performance and safety (particularly in the context of incident-related delay) makes it appropriate to track certain safety measures in the service of operational objectives. In particular, the number and location of crashes, as well as the severity of crashes and time required to clear the incident, can contribute to an understanding of non-recurring delay.

5.4 APPLICATIONS OF ITS REGIONAL ARCHITECTURES

ITS strategies are likely to be a particularly significant component of CMP strategies in most TMAs. This implies that the CMP will have important links to documents and processes crucial to ITS implementation, including the ITS Regional Architecture.[12]

An architecture defines a framework within which a system can be built. It functionally defines what the pieces of the system are and the information that is exchanged between them. An architecture is important because it allows integration options to be considered prior to investment in the design and development of the pieces of the system. Intelligent Transportation Systems are interrelated systems that work together to deliver transportation services. Integration of these systems requires an architecture to

[12] The discussion that follows is derived from "Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region" (FHWA-OP-02-024), developed by the National ITS Architecture Team, as well as "FHWA's Final Rule and FTA's Policy for Applying the National ITS Architecture at the Regional Level" (FHWA-OP-01-029) (2001).

illustrate and gain consensus on the approach to be taken by a group of stakeholders regarding their particular systems. An ITS Architecture defines the systems and the interconnections and information exchanges between these systems.

A regional ITS architecture is a specific regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region. The purpose of developing a regional ITS architecture is to illustrate and document regional integration so that planning and deployment can take place in an organized and coordinated fashion. It is a common framework that guides practitioners in establishing ITS interoperability, and helps them choose the most appropriate strategies for processing transportation information. It defines the system components, key functions, organizations involved in developing an architecture, and the type of information to be shared between organizations and between parts of the system.

In transportation planning, a regional ITS architecture has its greatest impact on institutional integration. It provides a structure around which discussions can take place among regional stakeholders to gain consensus on the direction of ITS. It implies roles and responsibilities for each stakeholder involved to realize the benefits of ITS within the region.

One of the clearest differences between ITS and conventional transportation solutions is the level of interdependency that exists between projects and the degree to which information, facilities, and infrastructure can be shared with mutual benefit. A regional ITS architecture provides the framework for analyzing how ITS elements (e.g., management centers, roadside elements, vehicles, and travelers) are related and thereby, identify the areas for potential cooperation. Since opportunities for system integration and operational coordination extend beyond jurisdictional boundaries, development and ongoing maintenance of a regional ITS architecture can serve to promote both system and inter-jurisdictional integration.

5.5 USE OF ARCHIVED OPERATIONS DATA

A major benefit of the deployment of ITS is the availability of data collected for use in systems operations, but stored for use in other applications. ITS collect a vast amount of data for use in real-time control strategies such as incident management, traffic signal control, and traveler information services. These data can also be extremely valuable for many other purposes if they are saved and made accessible. For example, roadway surveillance data, such as traffic volumes and speeds measured at specific locations, have many potential applications in many fields of transportation. ITS data is available continuously, and depending upon the extent of the ITS system, available for facilities of particular interest for congestion management. Since data collection is automated, use of this data is often more cost-effective than traditional sources of planning data, which can be resource-intensive and infrequently collected. Data collected for traditional planning purposes is likely to be focused on a particular time period, and samples are collected either for project-specific purposes, or over broad geographic areas. ITS data covers specific facilities and locations across an extended period of time.

While data collected for a particular agency offers benefits for operations and planning for that entity, many planning organizations have implemented regional archives that consolidate available data from a number of cooperating agencies. Such regional archives provide information about multiple, often interrelated elements of the regional transportation network that can be applied to the region as a whole, or to particular corridors and activity areas. This data can contribute to an effective, inter-jurisdictional, interagency, and multimodal approach to congestion management.

Hampton Roads Planning District Commission (HRPDC) provides an excellent example of partnering to increase data collection and archiving capacity thereby increasing the value of the CMP.

HRPDC had an opportunity to enhance its CMP and operations planning via a partnership with the Virginia DOT's Smart Traffic Center (STC). The STC operations data is archived at the Smart Travel Lab at the University of Virginia. An Archived Data Management System (ADMS) was put in place in 2003 that is administered by the Smart Travel Lab. The system includes loop data from the Interstates that is available nearly in real time – it can be accessed the day after collection. Other archived data that can be accessed via the ADMS includes incident data, weather-related information, and signal system data from localities. Hampton Roads is working with localities, some of which have their own smart traffic centers, to coordinate data collection and archive it at the Smart Travel Lab.

HRPDC's primary measure of congestion is segment LOS based on travel volumes and Highway Capacity Manual methods. Additionally, HRPDC conducts travel time/speed runs every five years for the entire thoroughfare system for a.m. and p.m. peak periods. Using this data HRPDC staff are able to create 20 minute contour maps for select activity centers throughout the region. The agency has also been testing the use of cellular phone wireless data. In the future HRPDC would like to use data on delay and travel times and speeds, which would relate better to operations.

Some caveats are necessary with respect to archived ITS data, particularly with respect to the need for quality checking; data collected from traffic detectors and other ITS technology requires careful screening to identify data gaps or errors introduced through equipment failure or calibration issues. Data collection not only needs to be coordinated with operational data but also the real time system management information programs (required by Section 1201 of SAFETEA-LU) as they are developed. Even so, archived ITS data offers opportunities for in-depth analysis of particular locations that may be of interest in the CMP.

5.6 SCENARIOS (HYPOTHETICAL/TYPICAL)

In order to provide a perspective on the elements of a CMP, the following scenarios are offered. Each scenario presents the characteristics of a hypothetical metropolitan area, drawn from representative regions across the nation. The scenarios are intended to illustrate different aspects of the implementation process and uses of a congestion management process

Scenario A: The CMP in a Large Urbanized Area

MPO-A is a large and growing TMA with population over one million. The agency had developed a stand-alone congestion management system about six years ago. Currently the program has been revised into a CMP and is now a contributing element of, and updated on the same cycle as, the MTP and is consistent with MTP vision and goals. MPO-A is still working to better integrate their CMP with the long-range planning process. They have put in place a "CMP Committee" comprised of a range of stakeholders (including the state DOT, several municipalities, several counties, the transit agency, a bike/pedestrian representative, an environmentalist, a member of the trucking association, and a representative of the Chamber of Commerce) to facilitate regional coordination that guides updates and improvements to the CMP.

Initially, MPO-A collected data on corridor level travel times and average speeds, but found this to limit their ability to accurately measure the performance of the corridor. At the same time the Regional ITS Architecture was being developed for the area and "archive data" was identified as a key user service in the Regional ITS Architecture. Working together with the architecture group and data experts, a plan for collecting operations and planning data was defined.

Beginning about two years ago, the MPO began to collect segment specific data including LOS, percent under posted speed, travel time index, person throughput, and transit load factors. MPO-A based their new data collection approach on the multiple performance measures based on the regional operations objectives. The agency also used data generated by the travel demand model and archived operations data. As the Agency refined the use of the data being collected, they were able to begin analyzing the effects of nonrecurring congestion using interstate sensor data and freeway courtesy patrol data – this improvement to the CMP took place in more recent years of the program. This year the MPO-A began a successful program with collecting data annually from GPS units in vehicles at peak hours to determine travel times.

In order to align with the regional goal of reducing congestion on major corridors within the MPO boundaries, MPO-A identified eight "critical congested corridors" via a composite ranking using multiple performance measures identified above. This evaluation also identified possible causes of congestion, which assisted in identification of potential mitigation strategies.

During the past year the agency developed a "toolbox" of congestion management strategies in various categories, including operations, travel demand management (TDM), transit, nonmotorized transportation, land use, and capacity expansion. For each of the identified congested corridors, the most appropriate strategies were identified based on the characteristics of the corridor. Using the toolbox, a package of candidate alternatives was then defined to best meet the specific needs of each location. The agency has learned that in most cases, implementing strategies addressing more than one mode is most effective. MPO-A has now defined a program of fifteen projects that all tie back to the regional operations goal of reducing congestion.

From the inception of the CMP, MPO-A has monitored and evaluated the programmed improvements. MPO-A used the travel demand model, cost/benefit analysis, and microsimulation methods to evaluate the potential results of congestion mitigation strategies against performance measures. The strategies with the most beneficial expected results have been proposed for inclusion in the MTP and TIP.

MPO-A currently conducts evaluation of strategies on a case-by-case basis and tries to include evaluation costs as part of the overall project costs. The agency has found success in including evaluation costs in the project budget, and is using this technique as part of developing a more robust program of project evaluation.

Scenario A – Applying the Eight Steps

Drilling down on one specific objective for MPO-A and by using the eight steps detailed in Section 2.3 more information is applied to the process. Using the objective "reduce travel delay caused by incidents", the eight steps are applied as follows:

Step 1: Congestion Management Objectives

- MPO-A incorporates objectives derived from regional goals pertaining to managing or minimizing the impacts of congestion. In this case, the objective is to "reduce travel delay caused by incidents."

Step 2: Area of Application

- MPO-A aligns the area of application of this objective with the same regional boundaries defined in the Regional ITS Architecture and the MPO boundaries.

Step 3: System Definition

- MPO-A works with the regional operating and transit agencies to define the system specific to this objective. It is determined to apply this objective to the eight corridors identified in the congestion management process. The "reduce travel delay caused by incidents" objective will be applied to the eight critically congested corridors.

Step 4: Developing and Using Performance Measures

- Performance measures to assess the effectiveness and efficiency of the network specific to the defined objective include:
  - Incident Duration – the time elapsed from the notification of an incident until all evidence of the incident has been removed from the incident scene, possibly measured in median minutes per incident;
  - Speed – average travel speed; and
  - Safety – accident risk index.

Step 5: Develop a Performance Monitoring Plan

- To the extent possible, data will be collected on incidents to establish a baseline for current incident management performance. MPO-A will work with operating and transit agencies so that when incidents occur on any of the eight identified corridors, detailed and specific data is collected during the response. Using the area's traffic management system and transit data systems, real-time data will be collected. This data will comply with the collection schemes developed as part of the Regional ITS architecture, specific to the data archiving emphasis.

Step 6: Identifying and Evaluating Strategies

- The eight corridors are clearly identifiable and the analytical tools that have potential for use include real-time traffic signal optimization tools. From this key strategies are developed, such as deploying roving incident response teams and incorporating GPS systems to track transit buses. Key strategies include faster and anticipatory responses to traffic incidents, optimizing the timing of traffic signals, and monitoring real-time information on transit schedules and arrivals. MPO-A together with the regional operating and transit agencies have established evaluation strategies for improved operations to target "reduce travel delay caused by incidents."

Step 7: Implementation and Management

- MPO-A together with the operating and transit agencies work closely in implementing the strategies thereby addressing travel time delay due to incidents in the eight corridors.

Step 8: Monitoring Strategy Effectiveness

- Using the systems set up and detailed in the regional ITS architecture MPO-A periodically evaluate the effectiveness of the strategies by analyzing before and after data on travel times in the corridors as well as response times and durations of incidents. The transit agency also monitors the strategies to measure the effectiveness.

Scenario B: The CMP in a Growing Metropolitan Area

MPO-B has recently grown to a size where it is a transportation management area (TMA) that requires development of a CMP. Due to the timing in the development of this region's first CMP, the agency developed its CMP as a stand-alone study outside of the long-range plan. This initial CMP was linked to the MTP by reference only. As the process is implemented and the MTP is updated, MPO-B will fully integrate the CMP into the regional planning process and maintain the same update cycle as the rest of the regional planning activities.

The first step in the CMP was for MPO-B to develop a vision for how the region wanted to address congestion. This vision was linked back to the vision and goals developed for the existing metropolitan transportation plan. Information was solicited through the MPO's public participation process on priorities for both commuter and freight needs. The next step was to define five goals for its CMP. These goals included: reduce congestion, improve mobility, increase accessibility, promote travel options, and support economic growth. From these goals, regional operations objectives, focused on congestion, were developed.

To evaluate levels of congestion in the region, MPO-B initially chose a performance measure of LOS defined as volume-to-capacity ratio. However, at the outset of the process MPO-B had explicitly stated that it would seek to refine this definition and develop additional performance measures such as average speeds at peak and off-peak hours, VMT, transit load factors, and patterns of delay to identify recurring and nonrecurring congestion. As a smaller agency with limited technical capabilities, MPO-B largely depends on data collected by the state DOT. Because this data is not collected specifically for the MPO's needs, they found it to be difficult to get into a useful form for congestion analysis. Processing the data into a useful form ended up being one of the agency's primary challenges. As additional data collection means are identified, MPO-B will develop a data collection and analysis process to work with the other identified performance measures.

Following identification of congested areas, MPO-B identified potential mitigation strategies. A public input process was used to gauge levels of public and political support for the strategies, including transportation systems management (e.g., traffic signal coordination, freeway incident management systems), transportation demand management (e.g., alternate work hours, tolling), system expansion (e.g., transit and roadway capacity) and land use strategies (e.g., development of transit-oriented neighborhoods). A process was developed to analyze the alternatives and select the appropriate strategy for implementation. It was at this point in the process where information was fed back to the MTP and TIP for inclusion in the next revision cycles.

To implement the CMP, MPO-B relies on the CMP committee made up of key stakeholders. This committee fully developed the CMP and is charged with monitoring and evaluating the key CMP activities. Strategies will initially be evaluated using professional judgment based on how effective they will be at achieving outcomes including:

- Reduction in person trips during peak periods;
- Reduction in VMT during peak periods;
- Shift from SOV to other modes; and
- Desired capacity increases.

Quantitative methods for evaluating strategies will be developed once additional performance measures are finalized. Moving forward, MPO-B plans to use the CMP as a framework for establishing local and regional transportation policies and priorities that will feed into the metropolitan transportation plan. MPO-B will review the CMP to identify as priorities for funding those projects in the MTP that address the CMP goals. Projects selected for inclusion in the Transportation Improvement Program are consistent with both the region's MTP and the state's long-range, statewide, transportation plan.

Both of the scenarios of MPO-A and MPO-B show the important linkage of the regional vision and goals and how the two MPOs worked over given time periods to align the work and procedures of the CMP with the larger regional goals and objectives. Each MPO worked with regional agencies and incorporated operational objectives into the CMP. Also, each MPO developed performance measures based on work of the MTP. The scenarios also show how comprehensive evaluation programs that monitored and revised are important to allowing the CMP to remain integrated with other planning programs.

Scenario B – Applying the Eight Steps

Drilling down on one specific objective for MPO-B and by using the eight steps detailed in Section 3.3 more information is applied to the process. Using the objective "improve access to travel information," the eight steps are applied as follows:

Step 1: Congestion Management Objectives

- "Improve access to travel information" is identified as a key objective, based on regional congestion mitigation goals that call for encouraging travel behavior changes such as mode changes, travel time changes, or diversion from congested routes.

Step 2: Area of Application

- MPO-B aligns the area of application of this objective with the MPO boundary taking a regional approach to traveler information.

Step 3: System Definition

- MPO-B works with state DOT to define the freeway system as that area where increased travel information would benefit traveling public.

Step 4: Developing and Using Performance Measures

- Performance measures to assess the effectiveness and efficiency of providing improved access to travel information include:
  - Buffer times travelers generally apply to their trips and public awareness of traveler information programs.

Step 5: Develop a Performance Monitoring Plan

- MPO-B anticipates conducting a survey of travelers to gauge awareness and use of improved access to travel information.

Step 6: Identifying and Evaluating Strategies

- The MPO works with the state DOT to deploy variable message signs on the freeway system and a traveler alert system using e-mail messages.

Step 7: Implementation and Management

- MPO-B together with the state DOT work closely in implementing the strategies to increase the availability of travel information.

Step 8: Monitoring Strategy Effectiveness

- MPO-B conduct traveler surveys to determine public awareness of the increase travel information.

6.0 CMP CHECKLIST/SELF-ASSESSMENT

Key findings from the guidebook presented above were used in preparing the following questions for Metropolitan Planning Organizations to use in assessing their congestion management activities. The indicators are generic and not exhaustive. As such, these questions should be regarded as only the starting point for subsequent discussion focused on local issues.

While answering these questions may illuminate issues and opportunities, perhaps the greatest value of this work is in the resulting discussion among planning partners. The checklist may be applied effectively in facilitated group settings, as a useful catalyst to discussion, and with less attention to scores. "Yes" responses generally suggest progress toward implementation of a conforming Congestion Management Process.

1.	Getting Ready: Creating or Adapting a Congestion Management Process	YES	NO
	Do you have a plan for putting a new or revised CMP in place?		
	Is there an existing congestion management system or plan?		
	Have you identified the strengths and weaknesses of existing congestion management efforts?		
	Is there a schedule for implementation?		
	Are potential partners in congestion management activities involved in the process?		
	Have you identified agencies, system operators, and other stakeholders in the region who stand to gain from tackling congestion problems?		
	Have you identified compelling reasons for these potential partners and other stakeholders to get involved?		
	Have you considered the best institutional model for keeping partners at the table (MPO committee, task force, MOU, Blue Ribbon Panel)?		
	Are key decision-makers aware of the CMP and supportive of its role in plan and program development?		
	Have you identified a "champion" for congestion management efforts?		
	Are partners willing to commit time and resources to the effort?		

2.	Aligning the CMP with the Metropolitan long-range Transportation Plan	YES	NO
	Do the vision and goals articulated in the MTP support congestion management?		
	Are the vision and goals supported by relevant, measurable objectives?		
	Are transportation system management and operations strategies part of the region's long-range planning approach?		

3.	Developing Technical Capacity for Managing the CMP	YES	NO
	Have performance measures been identified to track progress toward achieving goals and objectives?		
	Is there a data collection program in place that enables performance tracking?		
	Is data collected to support performance measures?		
	Are the data collected relevant to the area, readily available, timely, reliable, consistent, and capable of being forecast or projected?		
	Are technical tools in place to identify congestion at various levels (regional, corridor, spot)?		
	Is the regional travel demand forecasting model capable of identifying locations subject to recurring congestion?		
	Are planning tools in place capable of assessing non-recurring congestion (e.g., microsimulation models, sketch planning tools, etc.)?		
	Have you identified potential congestion management strategies that could address regional, corridor-level, or spot congestion problems in your region?		
	Are strategies based not only on capital projects, but also transportation system management and operations measures?		
	Are all modes of transportation (single occupancy vehicle, shared ride, transit, intermodal connections, non-motorized means such as bicycling and walking) considered in developing appropriate congestion management strategies? Has the analysis of congestion included the movement of both people and goods?		
	Are appropriate analysis tools available to assess the potential of different strategies in addressing congestion?		

4.	Implementing the CMP	YES	NO
	Have CMP activities been incorporated into the MPO's public participation plan?		
	Are partner agencies and system operators of all modes directly involved in the development and analysis of potential congestion mitigation strategies?		
	Are CMP activities fully documented, either through direct incorporation into the MTP or by reference, as supporting documentation?		
	Are studies, analyses, and supporting documentation maintained for subsequent use in the project development process, if appropriate? Does the CMP address both recurring and non-recurring congestion?		
	Have ITS strategies proposed for congested locations been reviewed in the context of the Regional ITS Architecture?		
	For TMAs in nonattainment status for ozone or carbon monoxide: Does the CMP give priority to strategies that reduce congestion and improve the movement of people and goods without requiring the construction of new SOV capacity?		
	If new capacity is warranted, have management and operations measures been incorporated into the capacity-expanding projects that will manage the SOV facility safely and efficiently (or facilitate its management in the future)?		
	If other travel demand reduction and operational management strategies have been identified for the corridor in which new SOV capacity is proposed, but are not appropriate for the SOV facility itself, have these measures been incorporated into the proposed project, or committed to by the state or MPO for implementation?		

5.	Monitoring and Feedback	YES	NO
	Are systems in place for monitoring the effectiveness of congestion management strategies in your region?		
	Are the performance measures multimodal, thereby enabling tracking of both direct and indirect contributing factors and impacts?		
	Are performance measures used to track the effectiveness of strategies implemented to reduce congestion or mitigate impacts? Does the evaluation of strategies include possible unintended consequences or unanticipated costs?		
	Does the CMP incorporate procedures for periodic monitoring, evaluation, and enhancement of the congestion management process itself?		
	Are performance measures periodically reviewed for usefulness and applicability?		
	Are data collection and analysis procedures, and methods used to analyze and select potential strategies, routinely reviewed for possible improvements?		

6.	Certification Review	YES	NO
	Is the CMP documented so that consistency with CMP requirements (for TMAs and in nonattainment areas only) can be demonstrated?		

7.0 CONCLUSION

The Congestion Management Process provides a flexible, rational system for addressing congestion challenges across modal lines, and at different geographic scales and time spans. It shares with other transportation systems management and operations concepts an objectives-driven, performance-based approach to metropolitan transportation planning, and represents the leading edge of systems management practice for urban areas. While required only for Transportation Management Areas, the CMP offers a useful methodology for addressing transportation problems in growing metropolitan areas and those urban areas with complex transportation networks and multiple jurisdictions and operating agencies.

The CMP also incorporates mechanisms for ongoing monitoring and reporting on transportation system performance, and offers a framework for data collection and management that can support a variety of related project development activities. By using the CMP data and analysis throughout project development, planners and system managers can streamline the environmental review process. Integration of CMP analysis means that alternatives analysis does not have to start from square one, but instead can make use of information generated during the evaluation of system performance and the comparison of alternatives performed during development of the metropolitan transportation plan.

A. LEGISLATIVE LANGUAGE

SAFETEA-LU modified Title 23, Section 134 of the U.S. Code to include the following (corresponding changes were made to Title 49, the Public Transportation portion of the Code, under Section 5303):

''(k) TRANSPORTATION MANAGEMENT AREAS (TMA).

''(1) IDENTIFICATION AND DESIGNATION.

''(A) REQUIRED IDENTIFICATION. – The Secretary shall identify as a transportation management area each urbanized area (as defined by the Bureau of the Census) with a population of over 200,000 individuals.

''(B) DESIGNATIONS ON REQUEST. – The Secretary shall designate any additional area as a transportation management area on the request of the Governor and the metropolitan planning organization designated for the area.

''(2) TRANSPORTATION PLANS. – In a metropolitan planning area serving a transportation management area, transportation plans shall be based on a continuing and comprehensive transportation planning process carried out by the metropolitan planning organization in cooperation with the State and public transportation operators.

''(3) CONGESTION MANAGEMENT PROCESS. – Within a metropolitan planning area serving a transportation management area, the transportation planning process under this section shall address congestion management through a process that provides for effective management and operation, based on a cooperatively developed and implemented metropolitan-wide strategy, of new and existing transportation facilities eligible for funding under this chapter and chapter 53 of title 49 through the use of travel demand reduction and operational management strategies. The Secretary shall establish an appropriate phase-in schedule for compliance with the requirements of this section but no sooner than one year after the identification of a transportation management area....

''(m) ADDITIONAL REQUIREMENTS FOR CERTAIN NONATTAINMENT AREAS.

''(1) IN GENERAL. – Notwithstanding any other provisions of this chapter or Chapter 53 of Title 49, for transportation management areas classified as nonattainment for ozone or carbon monoxide pursuant to the Clean Air Act, Federal funds may not be advanced in such area for any highway project that will result in a significant increase in the carrying capacity for single-occupant vehicles unless the project is addressed through a congestion management process.

''(2) APPLICABILITY. – This subsection applies to a nonattainment area within the metropolitan planning area boundaries determined under subsection (e).

In addition, under the Statewide Planning Requirements, SAFETEA-LU added the following language to Title 23, Section 135 (and Title 49, Section 5304):

''(i) TREATMENT OF CERTAIN STATE LAWS AS CONGESTION MANAGEMENT PROCESSES. – For purposes of this section and Section 134, and Sections 5303 and 5304 of Title 49, State laws, rules, or regulations pertaining to congestion management systems or programs may constitute the congestion management process under this section and Section 134, and Sections 5303 and 5304 of Title 49, if the Secretary finds that the state laws, rules, or regulations are consistent with, and fulfill the intent of, the purposes of this section, Section 134, and Sections 5303 and 5304 of Title 49, as appropriate."

B. PERFORMANCE MEASURES AND ANALYSIS TOOLS

Measures for Performance-Based Planning

Accessibility

- Average travel time from origin to destination.
- Average trip length.
- Percentage of employment sites within x miles of major highway.
- Number of bridges with vertical clearance less than x feet.

Mobility

- Origin-destination travel times.
- Average speed or travel time.
- Vehicle miles traveled (VMT) by congestion level.
- Lost time or delay due to congestion.
- Level of service or volume-to-capacity ratios.
- Vehicle-hours traveled or VMT per capita.
- Person-miles traveled (PMT) per VMT.
- Customer perceptions on travel times.
- Delay per ton-mile.
- PMT per capita or worker.
- Person-hours traveled.
- Passenger trips per household.

Economic Development

- Economic cost of crashes.
- Economic cost of lost time.
- Percentage of wholesale, retail, and commercial centers served with unrestricted (vehicle) weight roads.

Quality of Life

- Lost time due to congestion.
- Accidents per VMT or PMT.
- Tons of pollution generated.
- Customer perception of safety and urban quality.
- Average number of hours spent traveling.
- Percentage of population exposed to noise above certain threshold.

Environmental and Resource Consumption

- Tons of pollution.
- Number of days in air quality noncompliance.
- Fuel consumption per VMT or PMT.
- Number of accidents involving hazardous waste.

Safety

- Number of accidents per VMT, year, trip, ton mile, and capita.
- Number of high accident locations.
- Response time to accidents.
- Accident risk index.
- Customer perception of safety.
- Percentage of roadway pavement rated good or better.
- Construction-related fatalities.

Operating Efficiency (System and Organizational)

- Cost for transportation system services.
- Cost-benefit measures.
- Average cost per lane-mile constructed.
- Origin-destination travel times.
- Average speed.
- Percentage of projects rated good to excellent.
- Volume-to-capacity ratios.
- Cost per ton-mile.
- Customer satisfaction.

System Preservation

- Percentage of VMT on roads with deficient ride quality.
- Percentage of roads and bridges below standard condition.
- Remaining service life.
- Maintenance costs.
- Roughness index for pavement.

Outcomes (Operational) Performance Measures

- Quantity of travel (users' perspectives).
  - Person-miles traveled.
  - Truck-miles traveled.
  - VMT.
  - Persons moved.
  - Trucks moved.
  - Vehicles moved.
- Quality of travel (users' perspectives).
  - Average speed weighted by person-miles traveled.
  - Average door-to-door travel time.
  - Travel time predictability.
  - Travel time reliability (percent of trips that arrive in acceptable time).
  - Average delay (total, recurring, and incident-based).
  - Level of Service (LOS).
- Utilization of the system (agency's perspective).
  - Percent of system heavily congested (LOS E or f).
  - Density (passenger cars per hour per lane).
  - Percentage of travel heavily congested.
  - V/C ratio.
  - Queuing (frequency and length).
  - Percent of miles operating in desired speed-range.
  - Vehicle occupancy (persons per vehicle).
  - Duration of congestion (lane-mile-hours at LOS E or f).
- Safety.
  - Incident rate by severity (e.g., fatal, injury) and type (e.g., crash, weather).
- Incidents.
  - Incident-induced delay.
  - Evacuation clearance time.

Outputs (agency performance)

- Incident response time by type of incident.
- Toll revenue.
- Bridge condition.
- Pavement condition.
- Percent of ITS equipment operational.

The Puget Sound Regional Council has produced a set of performance measures of particular interest because of its multimodal character. A summary of these measures is presented in the table below.

Analytical Methods

Current methods of data collection in widespread use which could support development of multimodal performance measures include:

- *Manual Traffic and Transit Surveillance*. On the highway side, this category includes traffic volume counts, spot speed observations, classification counts, aerial photography, videography, and license plate matching. For transit, this category includes boarding and alighting counts, peak load counts, and Section 15 reporting.
- *Manual Vehicle Surveillance*. This category includes floating car studies and the use of instrumented vehicles.
- *Manual Freight and Goods Movement Surveillance*. This category includes weight measurements, shipment records, average fuel consumption rate reports, travel logs, vehicle registration data and inspection records, Census of Transportation, Commodity Flow Survey, National Transportation Statistics Annual Report, Truck Inventory and Use Survey, and shipper logs.
- *User Surveys*. This category includes home travel surveys, roadside interviews and origin-destination surveys, onboard transit surveys, panel surveys, travel diaries, focus groups, and customer surveys.

The following data collection methods are emerging and will be increasingly available in the future:

- *Advanced Traffic Management Systems (ATMS)/Traffic Surveillance Technologies*. These ITS technologies collect information about the status of the traffic stream. Technologies in this category include loop detectors, infrared sensors, radar and microwave sensors, machine vision, aerial surveillance, closed circuit television, and acoustic, in-pavement magnetic, and vehicle probes.

[12] Buffer Index is a measure of system reliability related to the additional travel time (compared to the average) necessary to complete a trips based on the 95th percentile.

Measure	Highway	HOV	Transit
Travel Time and Delay	Point-to-Point Peak Travel Time Point-to-Point Peak Congestion Delay Congestion Duration	Point-to-Point Peak Travel Time Point-to-Point Peak Congestion Delay Congestion Duration	Point-to-Point Peak Travel Time Point-to-Point Peak Congestion Delay Congestion Duration
Travel Time Reliability	Standard Deviation of Peak Travel Time "Buffer Index"[12]	Standard Deviation of Peak Travel Time	On-time Performance
System Access	Not Applicable	Percent of Park and Ride Capacity Used	Percent of Park and Ride Capacity Used Percent of Population within x Distance of Transit Percent of Ridership with two or more Transfers
Throughput	Peak Hour Person Movement	Peak Hour Person Movement	Peak Hour Person Movement
Crowding	Lane Density or Occupancy	Lane Density or Occupancy	Peak Hour Load Factor Lane Density (HOV or Bus Lanes) Percent of Terminal Capacity Used
Safety	Accident Rate	Accident Rate	Transit Accidents and Crimes
Travel Time and Delay	Point-to-Point Peak Travel Time Point-to-Point Congestion Delay	Point-to-Point Midday (?) Travel Time Point-to-Point Congestion Delay	Not Applicable

Measure	Ferries	Freight	Nonmotorized
Travel Time Reliability	Schedule Reliability (Percent on-time Departures and Percent on-time Arrivals	Standard Deviation of peak Travel Time	Not Applicable
System Access	Percent of Park and Ride Capacity used Percent of Peak-Period Transit Access Capacity Used Percent of Trips Require a Ferry-to-Ferry Transfer	Not Applicable	Sidewalk Completeness Bicycle Route Completeness
Throughput	Peak Hour Person Movement	Not Applicable	Regional Trail Segments At or Over Capacity
Crowding	Boat Wait Time Percent of Terminal Capacity Used	Lane Occupancy or Occupancy Percent of Terminal Capacity Used	Not Applicable
Safety	Accident Rate	Accident Rate	Pedestrian or Bicycle Accidents or Crimes

Advanced Traveler Information Systems (ATIS)/Vehicle Navigation and Surveillance Technologies. These ITS technologies include vehicle navigation technologies, which determine the vehicle position in real time (GPS, LORAN, dead reckoning, localized beacons, map database matching and cellular triangulation); and vehicle surveillance technologies, which collect a variety of information about specified vehicles (weigh-in-motion devices, vehicle identification, vehicle classification, and vehicle location).

- *Payment Systems Technologies*. These ITS technologies not only allow electronic fund transfer between the traveler and the service provider, but also enable vehicle recognition. They include Automatic Vehicle Identification (AVI), smart cards, and electronic funds management systems.

Current data storage, manipulation, and dissemination methods include:

- *Highway Performance Monitoring System (HPMS) and Highway Economic Requirements System (HERS)*. These methods are statewide and urban area databases of a stratified sample of roadways. They are used to summarize highway conditions; select a set of needed improvements to highways based on minimum tolerable conditions specified by the program user (HPMS) or economic criteria based on benefit-cost analysis (HERS); and estimate the costs and consequences of these improvements.

- *Computerized Databases*. These databases could include information relative to highway, transit, freight, or other transportation system information. They are developed by Federal, state, and local agencies for the purpose of planning, budgeting, monitoring, and evaluating the transportation system.

- *Geographic Information Systems (GIS) and Computerized Mapping*. These methods are used to store, organize, display, and analyze geographically-referenced transportation-related data.

The following data storage and manipulation methods are emerging and will be increasingly available in the future:

- *Advanced Traveler Information Systems (ATIS)/Communications Technologies*. ITS communications technologies transmit and receive information from mobile and stationary sources (highway advisory radio, FM subcarrier, spread spectrum, microwave, infrared, commercial broadcasts, infrared or microwave beacons, cellular phones, two-way radio, and two-way satellites).

- *Interagency Coordination Technologies*. These ITS technologies connect traveler-related facilities to other agencies such as police, emergency service providers, weather forecasters and observers, traffic management centers (TMS), transit operators, etc.

- *Database Processing Technologies*. These ITS technologies manipulate, configure, or format transportation-related data for sharing among various platforms. General purpose database software is currently being adapted to transportation needs such as data fusion, maps, and travel services.

- *Work Scheduling, Reporting, and Inspection Technologies*. With these technologies, can combine the data collection and data storage processes into one. These technologies include palm-sized and notebook computers, hand-held portable data entry terminals, bar-code scanners, electronic clipboards, and voice recognition systems.

Current data analysis and forecasting methods include:

- *Sketch Planning Techniques*. These techniques include sketch planning demand models, systematic analysis and transfer of empirical data, quick-response travel estimation techniques, level of service (LOS), V/C ratio, and vehicle volume and speed estimation procedures. Some examples include the ITS Deployment Analysis System (IDAS) for determining the potential impacts of ITS applications, and EPA's COMMUTER Model, based on the FHWA TDM Evaluation Model, which can be used to estimate emission reduction potential for travel demand management strategies.

- *Macroscopic Simulation Models*. These traffic models are based on deterministic relationships developed through research on highway capacity and traffic flow. The simulation for a macroscopic model takes place on a highway section-by-section basis rather than on an individual vehicle basis. Typical software packages include TRANSYT.7F, CORFLO, and FREQ.

- *Mesoscopic Simulation Models*. Mesoscopic simulation models combine the properties of both microscopic (discussed below) and macroscopic simulation models. As in microscopic models, the mesoscopic models' unit of traffic flow is the individual vehicle. Their movement, however, follows the approach of the macroscopic models and is governed by the average speed on the travel link. Mesoscopic model travel simulation takes place on an aggregate level and does not consider dynamic speed/volume relationships. As such, mesoscopic models provide less fidelity than the microsimulation tools, but are superior to the typical planning analysis techniques. Examples of mesoscopic simulation models include CONTRAM, DynaMIT, and DYNASMART.

- *Microscopic Simulation Models*. These traffic models simulate the movement of individual vehicles, based on theories of car-following and lane-changing. Typically, the model simulates a statistical distribution of vehicles that enter the transportation network and then tracks them through the network on a second-by-second basis. Typical software packages include NETSIM, FRESIM, and INTEGRATION.

- *Land Use Allocation Models*. These models reflect the effects of the transportation system (i.e., effects on accessibility, economic development potential, etc.) on the type spatial distribution of future development.

- *Travel Demand Models*. Traditional travel demand models follow a four-step process, including trip generation, trip distribution, mode choice, trip assignment, and activity-based models. A number of software packages can be used to implement this process, including TRANPLAN, MINUTP, and EMME/2.

- *Freight and Goods Movement Models*. These methods include trend analysis, freight network models, and freight transportation demand models. Trend analysis uses historical growth rates for certain key markets, and projects these growth rates into the future, modified by correction factors reflecting competitive conditions, macroeconomic environments, and projections of technological efficiency improvements. Freight network models can handle a large number of freight modes, network links, and nodes, and can contain explicit mode choice algorithms-based on minimization of cost and time by mode and route. Freight transportation demand models are similar to network models, although they differ in that demand models explicitly estimate behavioral relationships such as mode and route choice.

- *Impact Models*. These models are used to estimate emissions, fuel consumption, and safety impacts of transportation improvements. Typical software packages include MOBILE and EMFAC.

Decision Support Methodology for Selecting Traffic Analysis Tools[13] presents step-by-step guidance for the tool selection process, along with a list of recommended readings. An automated tool that implements the guidance can be found at the FHWA Traffic Analysis Tools web site at: http://ops.fhwa.dot.gov/Travel/Traffic_Analysis_Tools/traffic_analysis_toolbox.htm.

The following data analysis and forecasting methods are emerging and will be increasingly available in the future:

- *Traffic Prediction Models*. These ITS technologies can be used to predict future traffic characteristics based on real-time information. Algorithms under development include real-time traffic prediction and traffic assignment.

- *Traffic Control Models*. These ITS-related models relate to the real-time control of traffic. Algorithms under development include optimal control and incident detection, and the mutual effects of these processes on one another.

- *Routing Models*. These ITS-related models relate to the routing of vehicles, including the generating of step-by-step driving instructions to a specified destination. Algorithms under development include the scheduling of drivers, vehicles, and cargo; route selection; commercial vehicle scheduling; and route guidance.[14]

[13] http://ops.fhwa.dot.gov/trafficanalysistools/tat_vol2/Vol2_Methodology.pdf.

[14] NCHRP Web Document 26: **Multimodal Transportation: Development of a Performance-Based Transportation Planning Process**; http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w26-a.pdf.

C. GLOSSARY

SELECTED GLOSSARY OF REGIONAL TRANSPORTATION PLANNING TERMS

Administrative modification. A minor revision to a long-range statewide or metropolitan transportation plan, transportation improvement program (TIP), or statewide transportation improvement program (STIP) that includes minor changes to project/project phase costs, minor changes to funding sources of previously-included projects, and minor changes to project/project phase initiation dates.

> An administrative modification is a revision that does not require public review and comment, re-demonstration of fiscal constraint, or a conformity determination (in nonattainment and maintenance areas). [23 CFR 450.104.]

Amendment [to plan or STIP/TIP]. A revision to a long-range statewide or metropolitan transportation plan, TIP, or STIP that involves a major change to a project included in a metropolitan transportation plan, TIP, or STIP, including the addition or deletion of a project or a major change in project cost, project/project phase initiation dates, or a major change in design concept or design scope (e.g., changing project termini or the number of through traffic lanes).

> Changes to projects that are included only for illustrative purposes do not require an amendment. An amendment is a revision that requires public review and comment, re-demonstration of fiscal constraint, or a conformity determination (for metropolitan transportation plans and TIPs involving ''non-exempt'' projects in nonattainment and maintenance areas). In the context of a long-range statewide transportation plan, an amendment is a revision approved by the state in accordance with its public involvement process. [23 CFR 450.104.]

Annual listing of obligated projects. A required listing of all projects and strategies listed in the transportation improvement program (TIP) for which Federal funds were obligated during the immediately preceding program year.

> The development of the annual listing "shall be a cooperative effort of the state, transit operator, and MPO." SAFETEA-LU gave special emphasis to listing two project types – investments in pedestrian walkways and bicycle transportation facilities, to ensure they are not overlooked. The listing shall be consistent with the funding categories identified in each metropolitan transportation improvement program (TIP). [SAFETEA-LU, 23 U.S.C. 134(j)(7)(B), 23 U.S.C. 135(g)(4)(B), 49 U.S.C. 5303(j)(7)(B), and 49 U.S.C. 5304(g)(4)(B) as described in FTA/FHWA Preliminary Guidance on Annual Listing of Obligated Projects, February 28, 2006, http://www.fhwa.dot.gov/HEP/annuallistatt.htm.]

Attainment area. Any geographic area in which levels of a given criteria air pollutant (e.g., ozone, carbon monoxide, PM10, PM2.5, and nitrogen dioxide) meet the health-based National Ambient Air Quality Standards (NAAQS) for that pollutant.

> An area may be an attainment area for one pollutant and a nonattainment area for others. A ''maintenance area'' (see definition below) is not considered an attainment area for transportation planning purposes. [23 CFR 450.104.]

Collaboration. Any cooperative effort between and among governmental entities (as well as with private partners) through which the partners work together to achieve common goals.

> Such collaboration can range from very informal, ad hoc activities to more planned, organized and formalized ways of working together. The collaborative parties work toward mutual advantage and common goals. They share a sense of public purpose, leverage resources to yield improved outcomes, and bridge traditional geographic, institutional, and functional boundaries. Collaboration leads to improved understanding of the ways various levels of government interact and carry out their roles and responsibilities. The resulting effect frequently streamlines operations and enhances quality of life for residents of the localities involved. [Public Technology, Inc., January 2003, Crossing Boundaries – On the Road to Public-Private Partnerships. Note: Inserted phrase "through which the partners work together to achieve common goals" for clarity.]

Conformity. A Clean Air Act (42 U.S.C. 7506(c)) requirement that ensures that Federal funding and approval are given to transportation plans, programs and projects that are consistent with the air quality goals established by a State Implementation Plan (SIP).

> Conformity, to the purpose of the SIP, means that transportation activities will not cause new air quality

violations, worsen existing violations, or delay timely attainment of the NAAQS. The transportation conformity rule (40 CFR part 93) sets forth policy, criteria, and procedures for demonstrating and assuring conformity of transportation activities. [23 CFR 450.104.]

Congestion management process (CMP). A systematic approach to addressing congestion through effective management and operation.

A systematic approach required in transportation management areas (TMAs) that provides for effective management and operation, based on a cooperatively developed and implemented metropolitan-wide strategy, of new and existing transportation facilities eligible for funding under title 23 U.S.C., and title 49 U.S.C., through the use of operational management strategies. [23 CFR 450.104.]

Congestion management system (CMS). A systematic and regionally accepted approach for managing congestion that provides accurate, up-to-date information on transportation system operations and performance and assesses alternative strategies for congestion management that meet state and local needs.

[23 CFR 500.109.]

Through SAFETEA-LU, the congestion management system has been replaced by the congestion management process. According to SAFETEA-LU, under certain conditions the congestion management system may constitute the congestion management process. [23 U.S.C. 135 (i).]

Consideration. One or more parties takes into account the opinions, action, and relevant information from other parties in making a decision or determining a course of action.

[23 CFR 450.104.]

Consultation. One or more parties confer with other identified parties in accordance with an established process and, prior to taking action(s), considers the views of the other parties and periodically informs them about action(s) taken.

This definition does not apply to the ''consultation'' performed by the States and the MPOs in comparing the long-range statewide transportation plan and the metropolitan transportation plan, respectively, to State and Tribal conservation plans or maps or inventories of natural or historic resources (see §450.214(i) and §450.322(g)(1) and (g)(2)). [23 CFR 450.104.]

Cooperation. The parties involved in carrying out the transportation planning and programming processes work together to achieve a common goal or objective.

[23 CFR 450.104.]

Coordinated public transit-human services transportation plan. Locally developed, coordinated transportation plan that identifies the transportation needs of individuals with disabilities, older adults, and people with low incomes, provides strategies for meeting those local needs, and prioritizes transportation services for funding and implementation.

[23 CFR 450.104.]

Proposed projects under three separate FTA formula funding programs (Special Needs of Elderly Individuals and Individuals with Disabilities, Job Access and Reverse Commute, and New Freedom) must be derived from a locally developed public transit-human services transportation plan. This plan must be developed through a process that includes representatives of public, private, and non-profit transportation and human services providers, as well as the public. An areawide solicitation for applications for grants under the latter two programs above shall be made in cooperation with the appropriate MPO. [SAFETEA-LU, Sections 3012, 3018, and 3019.]

Coordination. Cooperative development of plans, programs, and schedules among agencies and entities with legal standing and adjustment of such plans, programs, and schedules to achieve general consistency, as appropriate.

[23 CFR 450.104.]

Financially constrained or fiscal constraint. The metropolitan transportation plan, TIP, and STIP includes sufficient financial information for demonstrating that projects in the metropolitan transportation plan, TIP, and STIP can be implemented using committed, available, or reasonably available revenue sources, with reasonable assurance that the Federally supported transportation system is being adequately operated and maintained.

For the TIP and the STIP, financial constraint/fiscal constraint applies to each program year. Additionally, projects in air quality nonattainment and maintenance areas can be included in the first two years of the TIP and STIP only if funds are "available" or "committed." [23 CFR 450.104.]

Goals. Generalized statements that broadly relate the physical environment to values.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Intelligent transportation system (ITS). Electronics, communications, and information processing used singly or integrated to improve the efficiency or safety of surface transportation.

> [U.S. Department of Transportation, *Regional ITS Architecture Guidance – Developing, Using, and Maintaining an ITS Architecture for Your Region*, Version 2.0, July 6, 2006.]

Intermodal. The ability to connect, and the connections between, modes of transportation.

> [http://www.planning.dot.gov/glossary.asp.]

ITS architecture. Defines a framework within which interrelated systems can be built that work together to deliver transportation services.

> An ITS architecture defines a framework within which interrelated systems can be built that work together to deliver transportation services. It defines how systems functionally operate and the interconnection of information exchanges that must take place between these systems to accomplish transportation services. [U.S. Department of Transportation, *Regional ITS Architecture Guidance – Developing, Using, and Maintaining an ITS Architecture for Your Region*, Version 2.0, July 6, 2006. Combines definitions of "architecture" and "ITS architecture."]

Long-range transportation plan (LRTP).[15] A document resulting from regional or statewide collaboration and consensus on a region or state's transportation system, and serving as the defining vision for the region's or state's transportation systems and services.

> A document resulting from regional or statewide collaboration and consensus on a region or state's transportation system, and serving as the defining vision for the region's or state's transportation systems and services. In metropolitan areas, the plan indicates all of the transportation improvements scheduled for funding over the next 20 years. It is fiscally constrained, i.e., a given program or project can reasonably expect to receive funding within the time allotted for its implementation. [FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

[15] Sometimes referred to as Long-Range Plan (LRP), Constrained Long-Range Plan (CLRP), or Regional Transportation Plan. Historically, many MPOs and States have used the "long-range" terminology; however, the current regulation uses the term "metropolitan transportation planning" and "metropolitan transportation plans."

Maintenance. In general, the preservation (scheduled and corrective) of infrastructure.

> The preservation of the entire highway/transit line, including surface, shoulders, roadsides, structures, and such traffic-control devices as are necessary for safe and efficient utilization of the highway/transit line. [23 U.S.C. 101(a). Added transit line to the definition.]

Maintenance area. Any geographic region of the United States that the EPA previously designated as a nonattainment area for one or more pollutants pursuant to the Clean Air Act Amendments of 1990, and subsequently redesignated as an attainment area subject to the requirement to develop a maintenance plan under section 175A of the Clean Air Act, as amended.

> [23 CFR 450.104.]

Management and operations (M&O). See transportation systems management and operations.

Management system. A systematic process, designed to assist decision-makers in selecting cost effective strategies/actions to improve the efficiency or safety of, and protect the investment in the nation's infrastructure.

> A management system can include: Identification of performance measures; data collection and analysis; determination of needs; evaluation and selection of appropriate strategies/actions to address the needs; and evaluation of the effectiveness of the implemented strategies/actions. [23 CFR 450.104.]

Metropolitan planning area. The geographic area in which the metropolitan transportation planning process required by 23 U.S.C. 134 and Section 8 of the Federal Transit Act (49 U.S.C. app. 1607) must be carried out.

> [FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Metropolitan planning organization (MPO). The policy board of an organization created and designated to carry out the metropolitan transportation planning process.

> [23 CFR 450.104.]

> Regional planning body, required in urbanized areas with a population over 50,000, and designated by local officials and the governor of the state.

Responsible, in cooperation with the state and other transportation providers, for carrying out the metropolitan transportation planning requirements of Federal highway and transit legislation. Formed in cooperation with the state, develops transportation plans and programs for the metropolitan area. For each urbanized area, a Metropolitan Planning Organization (MPO) must be designated by agreement between the governor and local units of government representing 75% of the affected population (in the metropolitan area), including the central city or cities as defined by the Bureau of Census, or in accordance with procedures established by applicable state or local law. [23 U.S.C. 134(b)(1) and Federal Transit Act of 1991 Sec. 8(b)(1).]

Metropolitan transportation plan (MTP). The official multimodal transportation plan addressing no less than a 20-year planning horizon that is developed, adopted, and updated by the MPO through the metropolitan transportation planning process.

[23 CFR 450.104.]

Multimodal. The availability of transportation options using different modes within a system or corridor.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

National ITS Architecture (also "national architecture"). A common framework for ITS interoperability.

The term "national architecture" means the common framework for interoperability that defines – (a) the functions associated with intelligent transportation system user services; b) the physical entities or subsystems within which the functions reside; c) the data interfaces and information flows between physical subsystems; and d) the communications requirements associated with the information flows. [SAFETEA-LU Section 5310.] The National ITS Architecture is maintained by the United States Department of Transportation (DOT) and is available on the DOT web site at http://www.its.dot.gov.

Nonattainment area. Any geographic region of the United States that has been designated by the EPA as a nonattainment area under Section 107 of the Clean Air Act for any pollutants for which a National Ambient Air Quality Standard exists.

[23 CFR 450.104.]

Areas of the country where air pollution levels persistently exceed the National Ambient Air Quality Standards may be designated nonattainment. EPA uses six criteria pollutants [ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead] as indicators of air quality, and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS). [The Environmental Protection Agency, The Green Book, http://www.epa.gov/air/oaqps/greenbk/. March 15, 2006. Names of the pollutants added to definition.]

Objectives. Specific, measurable statements related to the attainment of goals.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Obligated projects. Strategies and projects funded under title 23 U.S.C. and title 49 U.S. C. Chapter 53 for which the supporting Federal funds were authorized and committed by the State or designated recipient in the preceding program year, and authorized by FHWA or awarded as a grant by the FTA.

[23 CFR 450.104.]

Operational and management strategies. Actions and strategies aimed at improving the performance of existing and planned transportation facilities to relieve congestion and maximizing the safety and mobility of people and goods.

[23 CFR 450.104.]

Operational concept [in ITS architecture]. An operational concept identifies the roles and responsibilities of participating agencies and stakeholders.

It defines the institutional and technical vision for the region and describes how the system will work at very high-level, frequently using operational scenarios as a basis. [U.S. Department of Transportation, *Regional ITS Architecture Guidance – Developing, Using, and Maintaining an ITS Architecture for Your Region*, Version 2.0, July 6, 2006.]

Operations. See Transportation Systems Management and Operations.

Operations and maintenance (O&M). The range of activities and services provided by a transportation agency and the upkeep and preservation of the existing system.

Specifically, operations includes the range of activities/services provided by transportation system agencies or operators (routine traffic and transit operations, response to incidents/accidents, special events management, work zone traffic management, etc; see "Operations"). Maintenance relates to the upkeep and preservation of the existing system (road, rail and signal repair, right-of-way upkeep, etc.; see "Maintenance").

Operations objective. The operations objective expresses the desired outcome that can be achieved by the partners through operations strategies.

> In the context of an RCTO, it is multi-jurisdictional in nature. It should be specific, measurable, achievable, realistic, and time-bound. [U.S. Department of Transportation, Regional Concept for Transportation Operations: A Management Tool for Effective Collaboration, Draft Version, January 5, 2007.]

Participation plan. MPOs must develop and utilize a "Participation Plan" that provides reasonable opportunities for interested parties to comment on the content of the metropolitan transportation plan and metropolitan TIP. This "Participation Plan" must be developed "in consultation with all interested parties."

> [23 U.S.C. 134(j)(5)(B) and 49 U.S.C. 5303(I)(5)(B).]

Performance measurement. A process of assessing progress toward achieving predetermined goals.

> Performance measurement is a process of assessing progress toward achieving predetermined goals, including information on the efficiency with which resources are transformed into goods and services, the quality of those outputs (how well they are delivered to clients and the extent to which clients are satisfied) and outcomes (the results of a program activity compared to its intended purpose), and the effectiveness of government operations in terms of their specific contribution to program objectives. [Transportation Research Board, *Performance Measures of Operational Effectiveness for Highway Segments and Systems – A Synthesis of Highway Practice*, NCHRP Synthesis 311; Washington, D.C.; 2003.]

Performance measures. Indicators of transportation system outcomes with regard to such things as average speed, reliability of travel, and accident rates.

> Used as feedback in the decision-making process. [FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp. Substituted the word "outcomes" for "performing."]

Planning factors. A set of broad objectives defined in Federal legislation to be considered in both the metropolitan and statewide planning process.

Both SAFETEA-LU and its predecessors, TEA 21 and ISTEA, identify specific factors that must be considered in the planning process. TEA 21 consolidated what were previously 16 metropolitan and 23 statewide planning "factors" into seven broad "areas" to be considered in the planning process, both at the metropolitan and statewide level. SAFETEA-LU increased the number of planning factors to eight by creating separate planning factors for safety and security. SAFETEA-LU added language to emphasize the correspondence between transportation improvements and economic development and growth plans.

Below are the planning factors for the metropolitan planning process. SAFETEA-LU specifies identical factors for the stateside planning process with the exception that the emphasis is on the state instead of the metropolitan area.

SAFETEA-LU states that in general the metropolitan planning process for a metropolitan planning area under this section shall provide for consideration of projects and strategies that will:

A. Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency;

B. Increase the safety of the transportation system for motorized and nonmotorized users;

C. Increase the security of the transportation system for motorized and nonmotorized users;

D. Increase the accessibility and mobility of people and for freight;

E. Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and State and local planned growth and economic development patterns;

F. Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight;

G. Promote efficient system management and operation; and

H. Emphasize the preservation of the existing transportation system.

[SAFETEA-LU Section 6001(a) and 23 U.S.C. 134 (h)(1) and 49 U.S.C. 5303(h)(1)(E).]

Planning for operations. Coordination of activities among transportation planners and managers with responsibility for day-to-day transportation operations.

These activities when conducted in harmony enhance the planning process and result in improved system performance – a more flexible, reliable, and efficient system – cheaper, faster, better. [FHWA/FTA, Planning for Operations Fact Sheet, January 2006.]

Programming. Prioritizing proposed projects and matching those projects with available funds to accomplish agreed upon, stated needs.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Project selection. The procedures followed by MPOs, states, and public transportation operators to advance projects from the first four years of an approved TIP and/or STIP to implementation, in accordance with agreed upon procedures.

[23 CFR 450.104.]

[1]**Region.** A metropolitan or other multi-jurisdictional area.

[2]**Region.** The geographical area that identifies the boundaries of the regional ITS architecture and is defined by and based on the needs of the participating agencies and other stakeholders.

In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area. [23 CFR Part 940.3.]

Regional concept for transportation operations. A management tool to assist in planning and implementing management and operations strategies in a collaborative and sustained manner.

[FHWA, *Draft Regional Concept for Transportation Operations Primer*, December 18, 2006.]

A Regional Concept for Transportation Operations (RCTO) serves as a guide for partners in thinking through what they want to achieve in the next 3-5 years and how they are going to get there. The primary components of an RCTO are a shared objective for transportation operations and a description of what is needed to achieve that objective.

[FHWA, *Fact Sheet: A Regional Concept for Transportation Operations – At a Glance*, August 2, 2006.]

Regional ITS architecture. A regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

[23 CFR 450.104, 23 CFR Part 940.3.]

The regional ITS architecture shall include, at a minimum, the following: 1) A description of the region; 2) Identification of participating agencies and other stakeholders; 3) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture; 4) Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture; 5) System functional requirements; 6) Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture); 7) Identification of ITS standards supporting regional and national interoperability; and 8) The sequence of projects required for implementation. [23 CFR 940.9.]

Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning. [23 CFP 940.5.]

Regional planning organization (RPO). An organization that performs planning for multi-jurisdictional areas. MPOs, regional councils, economic development associations, rural transportation associations are examples of RPOs.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Regional transportation operations collaboration and coordination. Working together in a sustained manner to address regional transportation operations.

Regional transportation operations collaboration and coordination is working together in a sustained manner to address regional transportation operations. Regional operations collaboration and coordination is a deliberate, continuous, and sustained activity that takes place when transportation agency managers and officials responsible for day-to-day operations work together at a regional level to solve operational problems, improve system performance, and communicate better with one another.

[FHWA, *Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security*, 2003.]

Regionally significant project. A transportation project that is on a facility which serves regional transportation needs and would normally be included in the modeling of the metropolitan area's transportation network.

A transportation project (other than projects that may be grouped in the TIP and/or STIP or exempt projects as defined in EPA's transportation conformity regulation (40 CFR part 93)) that is on a facility which serves regional transportation needs (such as access to and from the area outside the region; major activity centers in the region; major planned developments such as new retail malls, sports complexes, or employment centers; or transportation terminals) and would normally be included in the modeling of the metropolitan area's transportation network. At a minimum, this includes all principal arterial highways and all fixed guideway transit facilities that offer a significant alternative to regional highway travel. [23 CFR 450.104.]

Revision. A change to a long-range statewide or metropolitan transportation plan, TIP or STIP that occurs between scheduled periodic updates.

Note also: A major revision is an "amendment," while a minor revision is an "administrative modification." [23 CFR 450.104.]

Stakeholder. Person or group affected by a transportation plan, program or project. Person or group believing that they are affected by a transportation plan, program or project. Residents of affected geographical areas.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

State transportation improvement program (STIP). A statewide prioritized listing/program of transportation projects covering a period of four years.

Must be consistent with the long-range statewide transportation plan, MPO plans, and TIPs; required for projects to be eligible for funding under Title 23 U.S.C. and Title 49 U.S.C. Chapter 53. [23 CFR 450.104.]

Strategic highway safety plan (SHSP). A statewide-coordinated safety plan that provides a comprehensive framework, and specific goals and objectives, for reducing highway fatalities and serious injuries on all public roads. OR a plan developed by the State DOT in accordance with U.S.C. 148(a)(6).

[23 CFR 450.104.]

This statewide document, developed by the state DOT in a collaborative process, includes input from public and private safety stakeholders. The SHSP is a data-driven, four to five year comprehensive plan that integrates the 4Es: engineering, education, enforcement and emergency medical services (EMS). The SHSP strategically establishes statewide goals, objectives, and key emphasis areas developed in consultation with Federal, state, local, and private sector safety stakeholders. [FHWA, *Strategic Highway Safety Plans: A Champion's Guide To Saving Lives,* Guidance to Supplement SAFETEA-LU Requirements, April 5, 2006, http://safety.fhwa.dot.gov/safetealu/shspguidance.htm.]

Transportation demand management (TDM). Programs designed to reduce demand for transportation through various means, such as the use of transit and of alternative work hours.

[FHWA/FTA Transportation Planning Capacity Building Glossary. http://www.planning.dot.gov/glossary.asp.]

Transportation improvement program (TIP). A prioritized listing/program of transportation projects covering a period of four years that is developed and formally adopted by an MPO as part of the metropolitan transportation planning process.

Must be consistent with the metropolitan transportation plan; required for projects to be eligible for funding under Title 23 U.S.C.and Title 49 U.S.C. Chapter 53. [23 CFR 450.104.]

Transportation management area (TMA). An urbanized area with a population over 200,000, as defined by the Bureau of Census and designated by the Secretary of Transportation, or any additional area where TMA designation is requested by the Governor and the MPO and designated by the Secretary of Transportation.

[23 CFR 450.104.]

Transportation planning. A continuing, comprehensive, and cooperative process to encourage and promote the development of a multimodal transportation system to ensure safe and efficient movement of people and goods while balancing environmental and community needs.

Statewide and metropolitan transportation planning processes are governed by Federal law and applicable state and local laws. [Based on language found in 23 U.S.C. Sections 134 and 135.]

Transportation systems management and operations (TSM&O). An integrated program to optimize the performance of existing infrastructure through the implementation of systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.

> The term includes i) regional operations collaboration and coordination activities between transportation and public safety agencies; and ii) improvements to the transportation system such as traffic detection and surveillance, arterial management, freeway management, demand management, work zone management, emergency management, electronic toll collection, automated enforcement, traffic incident management, roadway weather management, traveler information services, commercial vehicle operations, traffic control, freight management, and coordination of highway, rail, transit, bicycle, and pedestrian operations. [H.R. 5689, proposed technical corrections to SAFETEA-LU.]

Unified planning work program (UPWP). A statement of work identifying the planning priorities and activities to be carried out within a metropolitan planning area.

> At a minimum, the UPWP includes a description of the planning work and resulting products, who will perform the work, timeframes for completing the work, the cost of the work, and the source(s) of funds. [23 CFR 450.104.]

Update. Making current a long-range statewide transportation plan, MPO, TIP, or STIP through a comprehensive review.

> Updates require public review and comment, a 20-year horizon year for the MTPs and long-range statewide transportation plans, a four-year program period for TIPs and STIPs, demonstration of fiscal constraint (except for long-range statewide transportation plans), and a conformity determination (for MTPs and TIPs in nonattainment and maintenance areas). [23 CFR 450.104.]

Vision. An agreed statement of the overall aims of a transportation plan.

> A vision is an agreed statement of the overall aims of a transportation plan. In the context of regional transportation, a vision is the regionally-agreed statement of the overall aims of the regional transportation plan; describes the target end-state. Typically, a regional transportation vision will drive its goals (policy statements – the ends toward which effort is directed), objectives (measurable results), and strategies (ways/means to achieve objectives). Note also that the definition of long-range Transportation Plan reflects that the LRTP serves "as the defining vision..." [While no specific FHWA/FTA source has been identified for this definition, it is useful to have a common understanding of the term "vision" such as offered here. For further perspective, below is a selected regional comment on vision.]

> "The vision statement reflects what the organization is striving for at the regional (external) and organizational (internal) levels. Everything we do at MPC should meet our vision for the future." [Metropolitan Planning Council [Chicago] Board of Governors 2005-2008 Strategic Plan – http://www.metroplanning.org/about/strategicplan.asp.]

Visualization techniques. Methods used to present information in a format that will promote the understanding of transportation plans and programs during the development process.

> Methods used by states and MPOs in the development of transportation plans and programs with the public, elected and appointed officials, and other stakeholders in a clear and easily accessible format such as maps, pictures, and/or displays, to promote improved understanding of existing or proposed transportation plans and programs. [23 CFR 450.104.]

D. REFERENCES

Publications

Getting More by Working Together: Opportunities for Linking Planning and Operations – A Reference Manual, Publication No.: FHWA-HOP-05-016, Electronic Document Library (EDL) No.: 14071, Federal Highway Administration, Washington, D.C., 2005.

Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security, Publication No. FHWA-OP-03-008, EDL No. 13686, Federal Highway Administration, Washington, D.C., 2003.

Congestion Management Process (CMP) Innovations: A Menu of Options, Prepared for: New York State Association of Metropolitan Transportation Organizations (NYSMPOs), February 24, 2006 URL: http://www.nysmpos.org/pdf/CMS_FINAL_REPORT.pdf.

ITS/Operations Resource Guide 2007, Publication No. FHWA-JPO-07-17, EDL No. 14353, Research and Innovation Technology Administration, Washington, D.C. An electronic version of this document is available at URL: http://www.resourceguide.its.dot.gov/.

Web Sites

FHWA: Systems Management and Operations Planner's Resource
www.plan4operations.dot.gov

FHWA: Regional Transportation Collaboration and Coordination
http://ops.fhwa.dot.gov/RegionalTransOpsCollaboration/note.htm

FHWA: Office of Operations
http://ops.fhwa.dot.gov/index.asp

FHWA: Office of Planning
http://www.fhwa.dot.gov/planning/index.htm

ITS Joint Planning Office Electronic Documents Library
http://www.its.dot.gov/itsweb/welcome.htm

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