

# Statewide Opportunities for Linking Planning and Operations A Primer



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



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*A Primer*

# Statewide Opportunities For Linking Planning and Operations

*prepared for*

Federal Highway Administration

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*Flex your power!  
Be energy efficient!*

Dear Colleague:

The Federal Highway Administration's (FHWA) Office of Planning, Environment, and Realty, and Office of Operations, and the American Association of State Highway Officials (AASHTO) have developed this primer on Statewide Opportunities for Linking Planning and Operations. This primer is intended to raise the awareness of the benefits and opportunities for coordinating planning and operations activities within State Departments of Transportation (DOT). The intent of this document is to start the necessary conversations between DOT Planning and Operations staff, but also becomes a useful resource when searching for informative material on the subject. I think you will find the Quick Reference guide located in Section 1 to be especially useful. The Quick Reference details the current catalog of material on linking planning and operations. It is the intent of FHWA to keep this Quick Reference updated and accessible via the Internet through the Planning for Operations Website ([www.plan4operations.dot.gov](http://www.plan4operations.dot.gov)). There will be additional material on this subject provided on the website soon.

I am pleased to have chaired the AASHTO panel that advised the consultant team that developed the primer. I would like to thank the panel members for their time and input into the process. Our panel consisted of representatives from both the Subcommittee of System Operations and Management (SSOM) and the Standing Committee on Planning (SCOP), including:

*From SSOM:*

Larry Orcutt - Chair, Caltrans  
Richard Arnebeck, Minnesota DOT  
Michael Floberg, Kansas DOT  
R. Craig Reed, Pennsylvania DOT  
Connie Sorrell, Virginia DOT

*From SCOP:*

Scott Bennett, Arkansas DOT  
Dale Buskirk, Arizona DOT  
Gerald Ross, Georgia DOT  
Machelle Watkins, Missouri DOT

I have enjoyed working with this panel and the consulting team. I hope that you find this material useful in your daily work and that you will continue to work to link transportation operations and planning functions.

Sincerely,

*Lawrence H. Orcutt*

LAWRENCE H. ORCUTT  
Division Chief  
Division of Research and Innovation

Enclosure



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# Foreword

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# METRIC CONVERSION FACTORS (INTERNATIONAL SYSTEM OF UNITS)

<b>SI* (MODERN METRIC) CONVERSION FACTORS</b>				
<b>APPROXIMATE CONVERSIONS TO SI UNITS</b>				
<b>Symbol</b>	<b>When You Know</b>	<b>Multiply By</b>	<b>To Find</b>	<b>Symbol</b>
<b>LENGTH</b>				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
<b>AREA</b>				
in <sup>2</sup>	square inches	645.2	square millimeters	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.093	square meters	m <sup>2</sup>
yd <sup>2</sup>	square yard	0.836	square meters	m <sup>2</sup>
ac	acres	0.405	hectares	ha
mi <sup>2</sup>	square miles	2.59	square kilometers	km <sup>2</sup>
<b>VOLUME</b>				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft <sup>3</sup>	cubic feet	0.028	cubic meters	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.765	cubic meters	m <sup>3</sup>
NOTE: volumes greater than 1000 L shall be shown in m <sup>3</sup>				
<b>MASS</b>				
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")
<b>TEMPERATURE (exact degrees)</b>				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
<b>ILLUMINATION</b>				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m <sup>2</sup>	cd/m <sup>2</sup>
<b>FORCE and PRESSURE or STRESS</b>				
lbf	poundforce	4.45	newtons	N
lbf/in <sup>2</sup>	poundforce per square inch	6.89	kilopascals	kPa
<b>APPROXIMATE CONVERSIONS FROM SI UNITS</b>				
<b>Symbol</b>	<b>When You Know</b>	<b>Multiply By</b>	<b>To Find</b>	<b>Symbol</b>
<b>LENGTH</b>				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
<b>AREA</b>				
mm <sup>2</sup>	square millimeters	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	square meters	10.764	square feet	ft <sup>2</sup>
m <sup>2</sup>	square meters	1.195	square yards	yd <sup>2</sup>
ha	hectares	2.47	acres	ac
km <sup>2</sup>	square kilometers	0.386	square miles	mi <sup>2</sup>
<b>VOLUME</b>				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m <sup>3</sup>	cubic meters	35.314	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	cubic meters	1.307	cubic yards	yd <sup>3</sup>
<b>MASS</b>				
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
<b>TEMPERATURE (exact degrees)</b>				
°C	Celsius	1.8C+32	Fahrenheit	°F
<b>ILLUMINATION</b>				
lx	lux	0.0929	foot-candles	fc
cd/m <sup>2</sup>	candela/m <sup>2</sup>	0.2919	foot-Lamberts	fl
<b>FORCE and PRESSURE or STRESS</b>				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in <sup>2</sup>

\*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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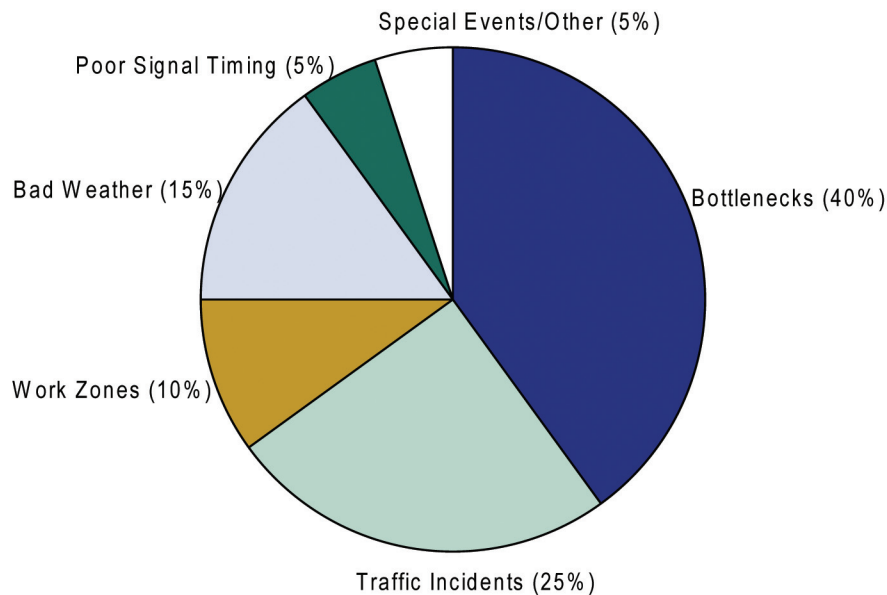


# 1.0 Background and Purpose

Former NJDOT Commissioner Frank J. Wilson once stated that “transportation defines a civilization; it gives value to time, quality to life and energy to the economy”. If true, a State’s ability to manage the condition, efficiency, and performance of its transportation system directly affects the overall well-being and economic viability of the State. State Departments of Transportation (DOTs) are the primary state agency responsible for planning and programming mobility needs, as well as constructing, managing, and operating the statewide transportation system. Historically, short term needs and maintenance of transportation facilities has been the responsibility of State DOT operations departments, while long-term planning and capital programming has been the responsibility of State DOT planning departments. And in many DOTs these two departments have operated independently of one another, with limited interaction or overlap.

Traditionally, State DOTs have concentrated on mitigating recurring congestion by removing bottlenecks and improving poor signal timing. Often viewed exclusively as a big city problem, congestion reduction was achieved by increasing system capacity to meet demand. Building new roadways or adding additional lane miles is an accepted practice; one that focuses on the long-range planning process and requires major financial investments. However, the source of congestion in the United States is increasingly related to non-recurring forms of congestion, such as traffic incidents, work zones, bad weather, and special events (Figure 1.1). Although non-recurring congestion is a regular phenomenon, it is often inefficient, impractical, or counterproductive to apply standard capacity additions to these types of problems. As a result, new approaches and relationships are necessary to effectively diminish congestion and enhance mobility.

**Figure 1.1 Sources of Congestion: National Summary<sup>1</sup>**



Responding to the challenges and impacts of non-recurring congestion requires cooperation among practitioners within different divisions of a state DOT and among Federal, State, regional, and local levels. Creating and sustaining linkages between planning and operations staff can help State DOTs to efficiently manage congestion. Resource limitations both in terms of funding and available land for new infrastructure investment, require that planning and operations staff focus on the efficient use of the transportation system.

State DOTs play a significant role in both planning and operating the transportation infrastructure, but most of the available reference materials that address linking planning and operations have been targeted towards the regional or metropolitan planning organization (MPO) level. To address this deficiency, the Federal Highway Administration (FHWA) has developed this primer for State DOT planning and operations staff to document the benefits of and the means to facilitate a cooperative relationship between State DOT planning and operations divisions.

## 1.1 WHAT IS THE PURPOSE OF THIS PRIMER?

This primer is designed to raise awareness of the benefits and opportunities for coordinating planning and operations activities within State DOTs, targeted at mid-level DOT planning and operations staff. To achieve this goal, the primer provides the following information:

<sup>1</sup> *Traffic Congestion and Reliability: Linking Solutions to Problems*, FHWA (July 2004).



- Descriptions of the relevance of planning to operations and operations to planning (Section 1.2);
- Organization of the current set of materials, projects, and documentation associated with the topic of linking planning and operations (Section 1.3);
- Identification of gaps and opportunities for linking planning and operations at state DOTs (Section 1.4);
- Description of steps that DOTs can take to better link planning and operations in several key areas, highlighted by case studies of State DOTs that have worked towards linking planning and operations (Section 2.0); and
- A self assessment questionnaire that State DOT planning and operational staff can use to help them understand how well they are linking planning and operations (Section 3.0).

## 1.2 WHY LINK PLANNING AND OPERATIONS AT STATE DOTs?

What value does linking planning and operations at State DOTs provide? This fundamental question must be answered before providing guidance on how to make those linkages. Linking planning and operations can improve transportation decision making and the effectiveness of transportation systems by helping planners and operators consider the full range of relevant strategies to address regional goals and objectives. For state DOTs, linking planning and operations within the agency can also benefit the DOT's relationship with regional and local partners and help DOTs better partner with those agencies to identify the appropriate solutions to specific transportation problems.

This section highlights the roles of planning and operations staff, the benefits of linking their functions for each, and the benefits for transportation system users.

### Role and Benefits for Planning within State DOTs

Planning at the statewide level involves setting goals and objectives for the agency; identifying multimodal needs and deficiencies in the transportation system; scoping projects or strategies to address the needs and deficiencies; evaluating projects or alternatives; estimating the costs for the projects and strategies; prioritizing the potential projects and strategies to best meet the State's needs over the short- and long-range; and in some cases congestion or performance monitoring. These are incorporated into several different planning efforts including statewide long-range transportation plans (LRTPs), Statewide Transportation Improvement Programs (STIPs), corridor or modal plans/studies (e.g., transit plans, corridor studies, ITS strategic plans, congestion management process (CMP), etc.), and congestion/performance monitoring.

- Statewide Long Range Transportation Plan. This plan is used by most States to identify the long range (20 to 30 year) goals, objectives, and priorities of the

agency and, in some cases, to identify funding levels for specific programs and projects. The State's long range transportation plan is one of the key opportunities for integration with operations, whether through identifying goals and objectives that address system management and operations, data sharing opportunities, identifying operational needs or strategies, identifying funding opportunities for ITS or operations, or other means.

- Statewide Transportation Improvement Program (STIP). A STIP is a financially constrained plan of scoped projects that are scheduled for implementation by a certain horizon year. 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, now requires that the STIP must be updated at least every four years.<sup>2</sup> STIPs vary from state to state in coverage, but typically they identify the level of investment in specific projects and programs. Some States have begun to more closely link their STIP to their long range plans. The STIP represents an area of potential linkage between planning and operations. A few States have identified specific ITS and operations projects, strategies, or programs within their STIP.
- Corridor/Regional/Modal Studies. Most State DOTs conduct studies oriented towards specific corridors, regions, or modes. Linking planning and operations in this context typically includes addressing operational and intelligent transportation systems (ITS) solutions for a corridor or mode through its own ITS strategic plans or system management plans. These studies are often conducted by regional or metropolitan planning organizations as well; though State DOTs tend to lead these studies for non-metro areas. These plans sometimes include an ITS or system management alternative, and

**Linking Planning and Operations - An Exercise**

Raising awareness of the benefits of linking planning and operations requires open communication and understanding between departmental divisions. To help build this understanding, State DOTs can encourage interaction between planning and operations divisions staff.

A simple mean to improve connections is to sponsor a get-together for personnel from the two divisions to help both managerial and line staff meet and understand what their colleagues do. At the meeting, staff from each division should participate in an exercise where they identify the roles and responsibilities of the members of the other division. Based on that, a discussion of how the two divisions help each other can be conducted, following the key linkage areas presented in this primer.

An exchange such as this offers both parties an opportunity to understand possible connections between departmental activities and most importantly to open a dialog that establishes a connection between planning and operations departments.

<sup>2</sup> The Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for Users (SAFETEA-LU), 23CFR450.216(a).

in some cases integrate ITS or operational strategies within other traditional improvements as part of an alternative.

- **Congestion/Performance Monitoring.** Some planning groups at State DOTs are responsible for monitoring the performance of the transportation system, at the system, project, and/or program level. The assessments are used to evaluate performance (e.g., congestion, safety, accessibility, etc.) and provide input to make policy, process, procedure, and program improvements. Much of this performance monitoring is dependent on or can benefit from data that are collected and maintained by the operations groups.

For planners, collaboration with operators can:

- Foster greater consideration of day-to-day transportation system operations in developing transportation goals, objectives, and priorities;
- Help planners better understand how operational strategies can meet regional transportation goals and objectives;
- Support more comprehensive analysis of issues such as reliability, security, and safety that are difficult to address solely with traditional infrastructure investments;
- Provide access to system-wide, 24-hour travel data that can help characterize system performance and travel conditions, identify critical transportation needs, and prioritize funding; and
- Provide operations data and expertise to improve forecasts of future conditions, broaden the understanding of existing conditions, and analyze the effectiveness of alternative investments.

## **Role and Benefits for Operations within State DOTs**

Operations is the active day-to-day management of the existing transportation system. It achieves its objectives through a customer focused approach that utilizes operations data collection, analytical tools, and performance measures to continuously monitor and optimize the operation and safety of the transportation system.

Operations activities are frequently grouped organizationally with maintenance activities. Maintenance activities typically include the daily upkeep and repair of the transportation assets, such as minor repairs to roads and bridges (crack sealing, pothole filling, etc.), responding to emergency repairs and incidents, snow and ice removal, and related concerns. Operational activities maintain the transportation system by managing the daily movement and flow of vehicles through the use of incident management systems, ITS technologies (such as ramp metering, signal timing optimization, message board and 511 crash/information notification systems), and related efforts.

Operations personnel have a solid foundation of data collection technologies and capabilities, as well as a working understanding of the day-to-day issues and condition of the transportation system.

For operators, collaboration and coordination with planners can:

- Provide increased opportunities and incentives for getting involved in the planning process, thereby helping to shape system goals and objectives;
- Clarify the role of operations in meeting the region's transportation vision and goals and direct attention to the value of M&O strategies;
- Help operators have a greater understanding of how the long-range planning process can support M&O activities and how M&O activities fit into the context of regional goals and objectives.
- Provide regional leadership and greater participation by stakeholders in regional M&O efforts;
- Increase resources assigned to operations projects and programs.

### **Benefits for System Users**

Ultimately, greater coordination and collaboration among planners and operators improves transportation decision making and benefits the traveling public, businesses, and communities.

For system users, collaboration and coordination of planners and operators will allow for:

- Improved ability to address short- and long-term needs—Improved traffic operations information and understanding can help planners better predict future conditions and system improvements. It can also bring attention to operational improvements that can be implemented in a shorter time frame than traditional infrastructure investments. This will lead to a more effective mix of operational, capital, safety, maintenance, and preservation investments.
- Improved reliability—Travelers and freight shippers are increasingly sensitive to unanticipated disruptions to tightly scheduled personal activities and manufacturing supply-chain processes. Yet trip times have become increasingly unpredictable due to the growth in non-recurring congestion—unexpected or unusual congestion caused by accidents, inclement weather, special events, or construction. Growth in overall traffic volumes often means that even small disruptions can have a significant ripple effect on transportation system performance over a broad geographic area. Today, non-recurring congestion accounts for about half of all travel delay. The planning process typically deals with ongoing or predictable congestion issues, and traditional infrastructure investments that do not address the disruptions that are the source of non-recurrent congestion. Stronger connections between planners and operators help planners consider programs and strategies to improve reliability, such as deployment technologies to rapidly detect incidents; variable message signs and other approaches for providing quick, reliable traffic information to the public and media outlets; and use of roving incident response teams to quickly clear accidents to open up a roadways for full operation.

- Improved emergency preparedness—Coordination between planning and operations reinforces efforts ensure emergency preparedness and transportation security. Regional operations planning and flexibility a critical element of a secure transportation system. States and regions that advance operational flexibility in their planning and investment prioritization are building their capacity to address the myriad of emergency and security situations that could arise. addition, sources of funding may be available specifically for activities that support transportation security and emergency preparedness, which can be used to support transportation M&O objectives.

### 1.3 QUICK REFERENCE/LINKING PLANNING AND OPERATIONS

Linking planning and operations functions at State DOTs can help optimize transportation system performance by making better use of data and analytical tools and improving the overall understanding of the role of operations activities relative to other congestion mitigation strategies. Coordination between State DOT planning and operations divisions provides a unique outlet to exchange information and ideas about the same system, but from differing perspectives. Working together helps both parties productively achieve organizational goals such as reducing congestion on the transportation system.

In recent years, the topic of linking planning and operations has received significant attention. The FHWA reference guide *Getting More by Working Together - Opportunities for Linking Planning and Operations* was developed to address these issues at the regional level. Although most of the relevant literature to date has focused on linkages at the regional or metropolitan planning organization level, some resources have relevance to both regional and statewide levels. This primer uses the following five linkage opportunity categories both to organize previous and ongoing efforts in the area of linking planning and operations and to describe best practices for linking planning and operations at State DOTs:

- Data, Analysis Tools, and Performance Measures;
- Operations in Transportation Plans and Corridor Studies;
- Institutional (Coordination, Partnerships, Training, Organization, and Education);
- Regional Considerations; and
- Regulation and Policy.

Developing strategies to link planning and operations within State DOTs requires a solid foundation and understanding of current practices and techniques utilized by planning and operations professionals. To facilitate this effort, a “quick reference” of recent and current research publications was developed (Figure 1.2) and cross referenced with the five linkage categories outlined above. The reference material is divided into “primary” resources, those resources directly targeted to

the category, and “secondary” resources, resources that are associated with the category. The graphic provides a high level summary of the substantial number of published and ongoing research efforts related to the topic of linking planning and operations.

The quick reference illustrates the association between primary and secondary documentation within each of the five linkage opportunities relevant to State DOTs. This reference also serves to guide users to documentation relevant to their needs. The reference section of this document (Section 4.0) provides a short narrative of each document in the quick reference along with a recent web-address (when available) for the document.

Figure 1.2 Quick Reference to Key Resources Within Linkage Opportunity Areas

Statewide Planning for Operations Reference Project Categories				
Performance Measures, Data, Analysis Tools	Operations in Transportation Plans/Corridor Studies	Institutional – Coordination, Partnerships, Training, Organization	Regional Considerations	Regulation and Policy
<p><b>PRIMARY</b></p> <p>Guidebook to Effective Freeway Performance Measurement, NCHRP 03-68, 2007</p> <p>Traffic Analysis Toolbox, FHWA, 2004</p> <p><i>Use of Existing Analysis Tools to Advance Operations in Planning, FHWA, ongoing</i></p> <p>Operations Data for Planning Applications: Identifying Needs, Opportunities, and Best Practices, TRB TRC E-C095, 2006</p> <p><b>SECONDARY</b></p> <p>Getting More by Working Together, FHWA, 2004</p> <p><i>ITE Traffic Engineer's Handbook Planning for Operations – Ch 6, FHWA, ongoing</i></p> <p><i>Integrated Corridor Management Initiative, FHWA, ongoing</i></p>	<p><b>PRIMARY</b></p> <p><i>ITE Traffic Engineer's Handbook Planning for Operations – Ch 6, FHWA, ongoing</i></p> <p><b>SECONDARY</b></p> <p>Management and Operations Guidebook, FHWA-HOP-08-007</p> <p>Getting More by Working Together, FHWA, 2004</p> <p>Operations Data for Planning Applications: Identifying Needs, Opportunities, and Best Practices, TRB TRC E-C095, 2006</p> <p>Peer-Exchange, June 2007 – for State DOTs, FHWA</p> <p><i>Integrated Corridor Management Initiative, FHWA, ongoing</i></p> <p><i>Use of Existing Analysis Tools to Advance Operations in Planning, FHWA, ongoing</i></p> <p><i>Multi-state Operations Guide, NCHRP 03-84, ongoing</i></p>	<p><b>PRIMARY</b></p> <p>Coordinating Planning and Operations Peer-exchange, June 2007 – for State DOTs, FHWA, ongoing</p> <p><i>Integrated Corridor Management Initiative, FHWA, ongoing</i></p> <p><i>Multi-state Operations Guide, NCHRP 03-84, ongoing</i></p> <p>Mainstreaming Management and Operations into Transportation Program Development, AASHTO-NCHRP 8-35/2</p> <p><i>Transportation Operations Training Framework (AASHTO) NCHRP 20-77, ongoing</i></p> <p><b>SECONDARY</b></p> <p>Getting More by Working Together, FHWA, 2004</p> <p><i>Use of Existing Analysis Tools to Advance Operations in Planning, FHWA, ongoing</i></p> <p><i>ITE Traffic Engineer's Handbook Planning for Operations – Ch 6, FHWA, ongoing</i></p> <p>Regional Concept for Transportation Operations, FHWA-HOP-07-122, June 2007</p>	<p><b>PRIMARY</b></p> <p>Getting More by Working Together, FHWA, 2004</p> <p>Regional Concept for Transportation Operations FHWA-HOP-07-122, June 2007</p> <p><b>SECONDARY</b></p> <p>Management and Operations Guidebook, FHWA-HOP-08-007</p> <p><i>ITE Traffic Engineer's Handbook Planning for Operations – Ch 6, FHWA, ongoing</i></p> <p><i>Integrated Corridor Management Initiative, FHWA, ongoing</i></p> <p><i>Multi-state Operations Guide, NCHRP 03-84, ongoing</i></p>	<p><b>PRIMARY</b></p> <p>Congestion Management Process Guidebook, FHWA-HOP-08-008</p> <p>Management and Operations Guidebook, FHWA-HOP-08-007</p> <p>Business Plan: Mainstreaming Systems Operations in State DOTs, NCHRP 20-7, 2005</p> <p>Developing and Implementing Transportation Management Plans for Work Zones, FHWA, 2005</p> <p><b>SECONDARY</b></p> <p>Mainstreaming Management and Operations into Transportation Program Development, AASHTO-NCHRP 8-35/2</p>

Key: Red Text: Document is currently not released and/or under development.

Black Text: Document is published and available, see weblink or publication number.

## 1.4 IDENTIFIED GAPS FOR STATE DOTs

This section identifies potential gaps in communication or intra-departmental coordination that may impede linking planning and operations. For each of the five linkage areas identified in the quick reference, potential information gaps or coordination opportunities are defined. Chapter 2 will investigate these gaps and identify resources to improve linkages between planning and operations. Case studies showcase specific lessons learned by DOTs attempting to address these gaps.

### **Data, Analysis Tools, and Performance Measures**

Performance measures are recognized as having increased importance by State DOTs. With increased availability of data to support measures, agencies can better assess and respond to customer needs. Operational staff can collect significant data that may benefit the agency as a whole, but the data collected by operations personnel are not typically used in the traditional planning process. The following questions may help State DOTs address gaps associated with performance measures, data, and analysis tools:

- How can DOT staff become better acquainted with operations data and its possible uses and limitations?
- How can DOTs work better both within the organization and with regional partners to archive, manage, and share data?
- What types of performance measures and analysis tools can be used to capture the effects of operational strategies not captured using traditional planning methods and tools (e.g., non-recurring delay and safety)?
- What planning analysis tools can benefit from operations data?

### **Operations in Transportation Plans and Corridor Studies**

Transportation plans, corridor studies, and similar planning efforts provide key resources to formally capture the link between planning and operations. These studies are the substance of planning activities and present opportunities to engage in the other linkage areas identified in this primer. Operations data tailored or readily adapted to meet the needs of planning studies may greatly assist in developing planning studies that account for improved operations strategies. The following questions may help State DOTs address gaps associated with the integration of operations in transportation plans and corridor studies:

- How can operations be integrated into long range transportation plans, regional plans, or corridor studies that serve as a blueprint for future State transportation investments?
- How do current federal requirements impact a planner's ability to utilize operations data in planning studies and are methods available to tailor or adapt the data to meet the needs of planning studies?



- How can staff from different parts of the transportation organization contribute and support the development of the long range plan, corridor studies and other planning studies at the DOT?

### **Institutional (Coordination, Partnerships, Training, Organization, and Education)**

The strength and potency of institutional structures are often an overlooked stumbling block that can make or break the ability to link planning and operations activities. The following questions may help State DOTs address gaps associated with institutional barriers expressed by State DOT officials:

- Who are the primary stakeholders within a given organization or for a particular project or program? How do stakeholders differ from decision makers?
- When are formal memoranda of understanding (MOU) needed?
- How often and in what form should communications occur between stakeholders within a region?
- Do opportunities exist to inform and educate decision makers and how do they occur?
- How can education and training improve an understanding of planning and operations activities and reduce barriers that hinder the exchange of ideas?
- Are there processes, arrangements, or established practices available to assist in developing partnerships to manage cross-jurisdictional projects?
- Are there any formal or informal forums or programs available within the organization that promote communication between departments?

### **Regional Considerations**

The transportation problems faced by State DOTs transcend physical and political boundaries that govern the management and operation of the transportation system. As a result, increasing coordination and cooperation with regional partners and neighboring States can help maximize performance and efficiency. The following questions may help State DOTs address gaps associated with regional considerations:

- How can State DOTs improve their understanding and management of transportation issues experienced in urban, rural, and transitional areas?
- What programs or organizations are available to help manage inter-state issues or projects?
- What benefits have been observed by bringing together the relevant parties to develop multi-state solutions?
- How can State DOTs look at statewide issues within a regional context and plan beyond one's jurisdictional boundaries?

## **Regulation and Policy**

Regulation and policy define State DOT areas of responsibility. Yet regulation and policy may limit an agency's ability to try new approaches or techniques, even when the result may be improved efficiency and performance. The following questions may help State DOTs address gaps associated with regulation and policy:

- How can operational activities, which are often fiscally constrained, be linked to other programming activities within State DOT transportation budgets?
- How can support from the top be developed within State DOTs both organizationally and fiscally?
- How can an agency alter its strategic direction to improve support of operations activities?
- How does committing additional staffing and funding resource to operations and management activities improve the performance of the transportation infrastructure and the statewide transportation system as a whole?

## 2.0 Opportunities for Linking Planning and Operations

The central purpose of this guidebook is to provide a primer to State DOT management and staff seeking to improve the linkages between their planning and operations functions. This chapter provides guidance on steps DOTs can take to create and improve these linkages as well as examples of DOTs and other transportation agencies that have successfully implemented some of the strategies outlined in this guidebook.

The guidance provided in this chapter is organized around the five linkage areas presented in Chapter 1:

- Data, Analysis Tools, and Performance Measures;
- Operations in Transportation Plans and Corridor Studies;
- Institutional (Coordination, Partnerships, Training, Organization, and Education);
- Regional Considerations; and
- Regulation and Policy.

Each section opens with a description of what it means to link planning and operations in that area. Then, guidance is provided to help DOTs begin the effort to link planning and operations; sustain that linkage through changes in staff, investment cycles, and others; and provide challenges and opportunities that DOTs face when attempting to link planning and operations. Each of the five sections of this chapter is organized around those three key themes – beginning linkages, sustaining linkages, challenges and opportunities.

The guidance provided in this chapter is intended to be valuable for any DOT attempting to link planning and operations. Many DOTs will have begun making linkages within some areas, but will find other linkage areas useful. DOTs that have begun making linkages across the board should find the information on sustaining linkages to be especially relevant.

### 2.1 DATA, ANALYSIS TOOLS, AND PERFORMANCE MEASURES

Data, analysis tools, and performance measures are three of the most significant areas for linking planning and operations, and are cited by DOTs as the most common issues and challenges for mainstreaming operations. Performance measures, data, and analysis tools are grouped together because they build upon one another to form a coherent whole. Data provides the backbone for improving link-

ages between planning and operations. Planners and operation personnel often use different data for related purposes (e.g., identifying what areas are congested). Operations staff typically are responsible for the short term or day-to-day functions – if there is an incident, what can we do to provide travelers information, divert traffic, or reduce response and clearance times. Planners are responsible for developing long term plans and programs to accommodate mobility needs within the community. Similar or the same data can support both purposes and an efficiently integrated data collection and management program can help ensure that everyone has access to the data that they need and in the form they need it.

Analysis tools are vital to develop objective assessments of transportation investments and performance. Analysis tools produce more realistic results when they are built on quality data and take into account the full range of potential strategies (capacity expansion, operations, transit, etc.). States can use analytic tools to conduct program-level tradeoffs (e.g., what happens if more money is spent on operations or on capacity expansion), or to analyze how integrating capacity expansion and operational improvements can improve system-wide performance.

Performance measures are a key mean for decision makers to understand the impacts of their decisions. High quality analysis tools and data are needed to develop meaningful performance measures. Performance measures help identify the benefits of applying different strategies to the transportation system. Once projects are built or deployed, performance measures can be used again to assess the effectiveness of the strategies.

## Data

### *Creating and Beginning Linkages*

A peer exchange held in May, 2005 on Operations Data for Planning Applications<sup>3</sup> identified the following steps for linking operations data and transportation planning:

- **Make a case for the benefits of using operations data for planning applications and performance measures.** Benefits include: optimization of operations and maintenance activities; travel and simulation model validation; managing congestion; emergency preparedness; air quality non-attainment; performance measurement; congestion relief; traveler information; data collection safety; and expanded understanding of traffic conditions (non-recurring congestion). Planning, performance measure, and other data needs should be compared to available operations data.
- **Bring all stakeholders in early in the process.**
- **Develop a relationship between operations staff and planning staff (and data and performance measures staff).** Create a task force, committee, or project team composed of operations staff, planners, and data experts; define agency-office roles and responsibilities; and identify the varying needs and similarities between operations and planning offices.
- **Develop a Data Plan. Document the collection of data elements, from planning and from operations, and opportunities to integrate the data.**
- **Identify where data will be stored, maintained, and distributed from.**
- **Address data issues.** Improve the quality, coverage, and compatibility of data collection efforts; explore data partnerships (e.g., local agencies, universities, research entities, private sector); evaluate new data sources; and develop software tools to address archiving, analysis, and data compatibility.

#### **Georgia DOT Data Sharing**

The Georgia DOT has a comprehensive approach to transportation data collection, management, and sharing.

On the operations side, Traffic Management Center staff recently developed a set of data validation checks and a quality assurance plan to smooth raw data gaps and increase the overall quality of data to levels satisfactory for other uses beyond operations, including planning. Planning staff now make use of these data in their studies.

Similarly, Operations staff has been using statewide ATR data maintained by the planning group to plan for hurricane evacuations, using real-time count data along identified hurricane routes.

<sup>3</sup> <http://onlinepubs.trb.org/onlinepubs/circulars/ec095.pdf>.

- **Recognize rural versus urban data considerations.** Data needs, availability, equipment and tools, stakeholders, sharing opportunities, etc. may vary for urban versus rural areas. These need to be recognized, identified, considered, and addressed.
- **Identify a champion within the agency or decision-making body.**
- **Develop training on the benefits, roles and responsibilities, data sources and issues.**
- **Start small.** Establishing an operations data program is a long-term process. DOTs may likely want to start with a common data item, such as traffic count and speed data, and expand to other areas as appropriate.

### *Sustaining Data Linkages*

Some considerations for sustaining operations data linkages with planning at the State level include:

- **Maintain the relationship between operations and planning staff (and data and performance measures staff).** Continue regular meetings of the task force, committee, or project team composed of operations staff, planners, and data experts; review and refine agency-office roles and responsibilities and needs; and reassess coordination and data sharing opportunities.
- **Maintain and update training.** Staff changes and new data collection and management technologies require ongoing training to ensure that DOT staff are aware of and able to use the best available data for their analysis.
- **Monitor and address data issues.** Regularly monitor and assess data quality, coverage, collection, sources, tools, and compatibility issues. Critical to this step is regular maintenance of data collection equipment.
- **Recognize data collection resource requirements.** There are on-going needs for resources to collect, maintain, and report on data. These needs include the funding necessary to support such efforts along with the staff and capabilities to maintain data collection and reporting programs.

#### **Caltrans Traffic Analysis Tools**

The California DOT (Caltrans) has long used and promoted traffic analysis tools, performance measures, and data for operations planning. Caltrans uses tools of several types (sketch-planning, travel demand modeling, HCM-based, signal optimization, and simulation). The range of tools used by Caltrans helps to ensure that the transportation solutions that Caltrans' selects have a sound objective basis.

Caltrans, working with the University of California at Berkeley and related institutions, has developed a real time performance measurement system (PeMS) for freeways. The system provides real time freeway performance information and can perform detailed quick response analysis on historical freeway performance, primarily through data obtained from detectors. This system is the foundation for development of Corridor System Management Plans. More information is available from <https://pems.eecs.berkeley.edu/>.

## Analysis Tools

### *Creating and Beginning Linkages*

A second key to linking planning and operations is through the development and use of traffic analysis tools that capture the benefits of different types of transportation strategies. Traffic analysis tools function better and produce more realistic results when they are built on quality data. In addition, analysis tools or methods that take into account the full range of potential strategies (capacity expansion, operations, transit, demand management, etc.) will help improve decision making and conducted program-level tradeoffs (i.e., what happens if more money is spent on operations or on capacity expansion). Unfortunately, most transportation analysis tools and methods are not typically sensitive to many of the benefits derived from operational improvements, particularly planning models. For instance, current planning practices do not typically recognize non-recurring delay or its causes (e.g., traffic incidents, workzones, bad weather, special events, etc.), which is estimated to represent approximately 50 to 60 percent of the total delay. FHWA's ITS Deployment Analysis System (IDAS) is one tool that does capture non-recurring delay and there are several efforts ongoing and planned to improve existing planning and operations analysis tools to address operational strategies and/or non-recurring congestion (e.g., Strategic Highway Research Program (SHRP 2)). Some transportation professionals are implementing innovative methods using existing tools to analyze operational strategies and/or estimate non-recurring delay.

#### **U.S. DOT ITS Cost / Benefit Databases**

The Intelligent Transportation Systems Joint Program Office (ITS JPO) of the U.S. Department of Transportation (U.S. DOT) has established several user-friendly databases that provide a national resource to support informed decision-making by transportation leaders. The databases include:

- The ITS Costs Database can be used to support project cost estimation during planning or preliminary design, and for policy studies and cost-benefit analysis. Both non-recurring (capital) and recurring (operating and maintenance) costs are provided where possible. [www.itscosts.its.dot.gov](http://www.itscosts.its.dot.gov);
- The ITS Benefits Database documents findings from ITS deployment evaluations on the effect of ITS on transportation systems performance and provides convenient access to typical benefits of ITS deployments. [www.itsbenefits.its.dot.gov](http://www.itsbenefits.its.dot.gov);
- The Deployment Statistics Database contains national survey data that tracks the level of deployment of ITS technology in metropolitan and rural areas. [www.itsdeployment.its.dot.gov](http://www.itsdeployment.its.dot.gov); and
- The Lessons Learned Database captures the experiences of stakeholders in their planning, deployment, operations, maintenance, and evaluation of ITS. [www.itslessons.its.dot.gov](http://www.itslessons.its.dot.gov).

One critical step in linking planning and operations is the selection of the appropriate traffic analysis tool(s), taking into account the analysis need (e.g., deficiency analysis, alternatives analysis, performance monitoring, etc.), characteristics (facilities, modes, strategies, traveler responses, performance measures), and resource requirements (cost, staffing, schedule, data needs, tool knowledge). Multiple tools may be needed for a particular effort. Operations and planning staff who may be involved with selecting or using analysis tools should work together to select the appropriate tool for the task at hand. This activity should involve planning staff educating operations staff on the methods and tools used for planning purposes, and operations staff educating planning staff on the methods and tools used for operations, as appropriate.

Table 2.1 identifies analysis tools and methods that may support operational analysis within typical transportation planning efforts. Detailed information on tool selection, a decision support methodology, and the use of various types of traffic analysis tools are provided in the FHWA's Traffic Analysis Toolbox.<sup>4</sup> For example, the tool box provides guidance on which categories of tools are most appropriate for analyzing operational strategies such as freeway management systems (e.g., ramp metering), arterial management systems, incident management, work zones, traveler information, etc. The categories of tools include:

- **Sketch-planning methodologies and tools** produce general order-of-magnitude estimates of travel demand and traffic operations in response to transportation improvements. Sketch-planning tools perform some or all of the functions of other analytical tools using simplified analytical techniques and highly aggregated data. Sketch-planning approaches are typically the simplest and least costly of the traffic analysis techniques, but are usually limited in scope, analytical robustness, and presentation capabilities.
- **Travel demand models** have specific analytical capabilities, such as the prediction of travel demand and the consideration of destination choice, mode choice, time-of-day travel choice, and route choice, and the representation of traffic flow in the highway network. These are mathematical models that forecast 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, but not to evaluate travel management strategies, such as intelligent transportation systems (ITS)/operational strategies. 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. These inadequacies generally occur because of the poor representation of the dynamic nature of traffic in travel demand models.

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<sup>4</sup> <http://www.ops.fhwa.dot.gov/trafficanalysistools/toolbox.htm>.



- Most **analytical/deterministic tools** implement the procedures of the Highway Capacity Manual (HCM). The HCM procedures are closed-form (a practitioner inputs data and parameters and, after a sequence of analytical steps, the HCM procedures produce a single answer), macroscopic (input and output deal with average performance during a 15-minute or a 1-hour analytical period), deterministic (any given set of inputs will always yield the same answer), and static (they predict average operating conditions over a fixed time period and do not deal with transitions in operations from one system state to another). These tools quickly predict capacity, density, speed, delay, and queuing on a variety of transportation facilities and are validated with field data, laboratory test beds, or small-scale experiments. Analytical/deterministic 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 optimization tool methodologies** are mostly based on the HCM procedures. However, traffic optimization tools are primarily designed to develop optimal signal phasings 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. Some optimization tools can also be used for optimizing ramp metering rates for freeway ramp control. More advanced traffic optimization tools are capable of modeling actuated and semi-actuated traffic signals, with or without signal coordination.
- **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. They consider platoons of vehicles and simulate traffic flow in brief time increments. Macroscopic simulation models operate on the basis of aggregate speed/volume and demand/capacity relationships. Macroscopic models have considerably fewer demanding computer requirements than microscopic models (discussed below). They cannot, however, analyze transportation improvements in as much detail as microscopic models, and do not consider trip generation, trip distribution, and mode choice in their evaluation of changes in transportation systems.
- **Mesoscopic models** combine the properties of both microscopic (discussed below) and macroscopic simulation models. As in microscopic models, the unit of traffic flow for mesoscopic models is the individual vehicle and it assigns vehicle types and driver behavior, as well as their relationships with roadway characteristics. Their movement, however, follows the approach of macroscopic models and is governed by the average speed on the travel link. Mesoscopic model travel prediction takes place on an aggregate level and does not consider dynamic speed/volume relationships. As such, mesoscopic models provide less fidelity than microsimulation tools, but are superior to typical planning analysis techniques.

- **Microscopic simulation models** simulate the movement of individual vehicles based on car-following and lane-changing theories. Typically, vehicles enter a transportation network using a statistical distribution of arrivals (a stochastic process) and are tracked through the network over brief time intervals (e.g., 1 second or a fraction of a second). Upon entry, each vehicle is assigned a destination, a vehicle type, and a driver type. In many microscopic simulation models, the traffic operational characteristics of each vehicle are influenced by vertical grade, horizontal curvature, and superelevation, based on relationships developed in prior research. Computer time and storage requirements for microscopic models are significant, usually limiting the network size and the number of simulation runs that can be completed.
- The most widely available and used form of **archived data** are from traffic surveillance equipment on freeways, typically volumes, speeds, and lane occupancies from point-based detectors, spaced anywhere from one-third to one mile. Use of additional forms of archived data such as travel times derived from probe vehicles, cell phone tracking, and toll tags or safety data is still in its infancy. Even in areas where freeway traffic surveillance data are available, many agencies do not take advantage of the data collected and stored by traffic management centers. Often the data are not formally managed in a data archive because the processing, analysis, resource, and training/education requirements are lacking. Archived data can be used for analysis tool inputs; calibrating/validating operations and planning analysis tools; reporting congestion performance trends; analyzing existing conditions; real-time traveler information; and strategy evaluation.
- Many of these tools can be used to develop performance measures for comparing and prioritizing investment strategies and communicating the benefits to decision-makers. Unfortunately, traditional planning methods are not typically sensitive to many of the benefits derived from operational improvements (e.g., reduction in non-recurring delay and crashes) and the use of **operations-oriented performance measures** is not widespread. With the exception of the sketch planning tools that were designed specifically to assess ITS and operational impacts (e.g., IDAS) and some simulation tools, existing models are limited to studying operational treatments that improve base capacity (e.g., ramp meters, signal timing). However, over time more agencies are recognizing the need to expand the performance measures used to evaluate transportation investments, and are incorporating more operations-oriented measures into their planning process.

**Table 2.1 Transportation Planning Needs and Operational Analysis Tools**

<b>Transportation Planning Needs</b>	<b>Operational Analysis Tools/Methods</b>
Needs assessments/deficiency analysis	<ul style="list-style-type: none"> <li>• Travel demand forecasting models</li> <li>• Deterministic models</li> <li>• Traffic signal optimization tools</li> <li>• Simulation</li> <li>• Archived operations data</li> <li>• Operations-oriented performance metrics</li> </ul>
Preliminary screening assessments	<ul style="list-style-type: none"> <li>• Sketch planning tools</li> </ul>
Alternatives analysis	<ul style="list-style-type: none"> <li>• Sketch planning tools</li> <li>• Travel demand forecasting models</li> <li>• Simulation</li> </ul>
Strategic ITS planning	<ul style="list-style-type: none"> <li>• Sketch planning tools</li> <li>• Travel demand forecasting models</li> </ul>
Project scoring/ranking/prioritizing	<ul style="list-style-type: none"> <li>• Travel demand forecasting models</li> <li>• Deterministic models</li> <li>• Operations-oriented performance metrics</li> </ul>
Corridor and environmental analysis	<ul style="list-style-type: none"> <li>• Deterministic models</li> <li>• Travel demand forecasting models</li> <li>• Traffic signal optimization tools</li> <li>• Simulation</li> </ul>
Planning for non-recurring congestion	<ul style="list-style-type: none"> <li>• Sketch planning tools</li> <li>• Travel demand forecasting models</li> <li>• Simulation</li> </ul>
Performance monitoring	<ul style="list-style-type: none"> <li>• Deterministic models</li> <li>• Traffic signal optimization tools</li> <li>• Archived operations data</li> <li>• Operations-oriented performance metrics</li> </ul>
Evaluations of deployed projects	<ul style="list-style-type: none"> <li>• Sketch planning tools</li> <li>• Travel demand forecasting models</li> <li>• Archived operations data</li> <li>• Operations-oriented performance metrics</li> </ul>

Source: *Improving the Application of Existing Methods to Advance Transportation Operations*, FHWA (estimated August 2008).

### *Sustaining Tool Linkages*

Sustaining the operations and planning link through analysis tools involves continuous assessment of the most appropriate traffic analysis tool(s) for each new effort at hand. Several steps can be taken to help sustain these linkages:

- Start small. Initial efforts to develop tools for planning analysis may want to focus on a particular corridor to highlight the usefulness of these tools or to test different approaches. As a DOT settles on an approach, the use of these tools can be expanded to other corridors or used broadly for all state analysis.
- Work to enhance existing tools. The tools and methods that DOTs are using to capture operational strategies will require regular enhancement as a DOTs understanding of the potential for operational strategies improves. Most traffic analysis tools are enhanced over time to provide additional capabilities based on user needs.
- Participate in research efforts. Research provides opportunities to improve the manner in which existing planning and operations analysis tools and methods are applied. Research efforts are conducted by USDOT; the Transportation Research Board through the SHRP, National Cooperative Highway Research Program (NCHRP), and other related programs; American Association of State Highway and Transportation Officials (AASHTO), and others.
- Conduct training exercises. Training on the use of the tools and methods is vital to ensure that staff understand their use and are able to produce valid results.

### **Performance Measures**

#### *Creating and Beginning Linkages*

Performance measures are another critical component for linking planning and operations. Performance measures can be used to help assess current and future conditions, compare potential transportation strategies, allocate resources, and monitor the effectiveness of transportation improvements. In addition, they are invaluable when presenting information to decision-makers and the public.

Developing, implementing, and evaluating performance measures involves many of the same considerations as operations data discussed previously. Performance measures need to effectively capture the impacts of operational or ITS strategies on system reliability and safety. State DOTs need to collaborate with all necessary stakeholders in developing performance measures or performance measures programs. Operations and planning staff often develop separate performance measurement programs with little or no coordination or consistency. The development of performance measures should include planning and operations staff, and policy-makers to ensure that capacity based analysis is supplemented with considerations of reliability and safety measures.

Several efforts have been performed or are currently underway containing information and recommendations on developing a performance measurement system. From those efforts, some of the key steps for developing performance measures that more effectively link planning and operations include:

- **Include operational considerations in vision, goals, and objectives.** If the State's vision, goals, and objectives include operational considerations (e.g., provide a safe and reliable transportation system), operations-oriented performance measures (e.g., crashes, travel time reliability or variability, etc.) will be needed to evaluate whether or not the goals and objectives are being achieved.
- **Create a committee that addresses performance measures.** The development and implementation of performance measurements requires a significant commitment of staff time and resources. This committee needs to include stakeholders from across the DOT, including both planning and operations. The committee should be created from the outset and be a sustained group of practitioners devoted to identifying the uses and audiences for the performance measures, selecting measures, identifying data sources and analysis tools/methods, and deciding the most appropriate frequency of analysis and distribution of performance findings.
- **Learn from other State's experiences.** Some States have fairly sophisticated performance measures programs; others have implemented performance measures to varying degrees. Where possible, obtain information on other State's experiences through existing studies, available documentation or websites, and/or phone or e-mail contacts. FHWA Office of Operations maintains a website dedicated to performance measures and contains the most current work in this area.<sup>5</sup>
- **Include operations-oriented performance measures.** Traditional Highway Capacity Manual (HCM)-based performance measures for mobility (V/C ratio and level of service) cannot effectively assess operational investments and their benefits to reliability and safety. HCM based measures need not be ignored,

#### Minnesota DOT

MnDOT has a long history of linking performance measures to decision making. MnDOT uses performance measures to explain and justify funding for specific programs, thus creating a formal relationship between investments and outcomes. For example, MnDOT estimates the impact of increasing the number of highway service patrol vehicles on average incident clearance time and, indirectly on overall traffic delay. This helps demonstrate how changes to the highway service patrol program impact mobility, one of the goals of the statewide plan.

[www.dot.state.mn.us/tmc/incmgmt.html](http://www.dot.state.mn.us/tmc/incmgmt.html)

<sup>5</sup> [http://ops.fhwa.dot.gov/perf\\_measurement/index.htm](http://ops.fhwa.dot.gov/perf_measurement/index.htm).

but should be supplemented with reliability and safety measures. NCHRP's Guide to Effective Freeway Performance Measurement: Final Report and Guidebook provides guidance on performance measures as part of the planning process, development of performance measures, data and data processing needs, using performance measures, and examples of applications.

- **Define and document roles and responsibilities.** It needs to be clear what the roles and responsibilities are for developing, implementing, evaluating, and publicizing the performance measures.

### *Sustaining Performance Measure Linkages*

In order to sustain the performance measures linkage, it is critical to recognize the performance measurement process is evolutionary. Performance measurement evolution provides feedback into the analysis process, and can result in improved data, data collection and estimation procedures, and analysis tools and methods for estimating performance. Although all of the steps identified under creating and beginning the linkages above need to be continuously monitored and refined, there are several key steps that will help sustain linkages between planning and operations including:

- **Use consistent performance measures across agency functions.** States should select, implement, and report performance measures consistently across all of the agency functions to the extent possible. Performance measure continuity should be maintained across time horizons; for trend monitoring project planning and design, forecasting, and evaluations.

- **Assess data and tool availability to analyze the performance measure.** The ability to generate operations-oriented performance measures is highly dependent upon data availability and the capabilities of the various analysis tools. In some cases, State's may need to consider developing their own tools or methods to analyze desired performance measures. For example, some performance measures could be built into existing equipment or archived data systems (i.e., locations and extents of bottlenecks measure could be built into an archived data system). Developing performance measures for decision makers can help highlight the need for data and tools to calculate those measures.

#### **WSDOT Gray Notebook**

Washington State DOT (WSDOT) began the publication of Measures, Markers and Mileposts, better known as the Gray Notebook, in 2001 to review the performance of both the transportation system and WSDOT as an agency. The Gray Notebook is a central place to identify WSDOT's top concerns. The Gray Notebook is organized by strategic objectives, one of which is to "Manage and operate state transportation facilities to improve the safety and reliability of state transportation systems..." Specific operational measures within this area include incident response time and travel time reliability.

[www.wsdot.wa.gov/accountability](http://www.wsdot.wa.gov/accountability)

- **Generate performance results regularly.** Operations is more of a day-to-day function than planning. If performance measures are generated on a regular

basis, adjustments to how the system is operating can be made based on more current information, the effectiveness of implementing various strategies can be estimated, and better investment decisions can be made. There should be a feedback loop where the goals and objectives are examined and checked against the effectiveness of the strategies.

- **Disseminate performance measures across the agency and to the public.** Outreach and communication of the performance measures is a vital step to ensure that they meaningfully impact decisions. After focusing on the development of measures, efforts must turn to the communication of these measures to the general public and stakeholders. Using graphics that resonate with a variety of technical and nontechnical audiences can help ensure that the appropriate messages are communicated.

## Challenges and Opportunities

State DOT planners and operations professionals need to coordinate and collaborate on how transportation planning and operations data, analysis tools and methods, and performance measures can best be used to analyze, evaluate, and report the benefits of investments in transportation operations, with the objective of making the transportation system work better.

There are several challenges and opportunities for States to develop, sustain, and improve linkages of planning and operations in the areas of data, analysis tools, and performance measures. Some of these include:

- **Traditional focus on Level of Service (LOS).** In most States, freeway performance is still largely based on LOS which does not capture the nature and extent of congestion, especially when interruption is due to non-recurring events such as traffic incidents, work zones, bad weather, and special events. In order to better link operations and planning, more detailed performance measures than LOS should be used, particularly those that consider non-recurring congestion and safety.
- **Analysis gap between operations and traditional investments.** Traditionally, ITS and operations projects are analyzed and deployed as individual projects,

### Caltrans - I-880 Corridor System Management Plan

Caltrans has launched an intensive demonstration project for system management and operations plan development on a highly congestion urban freeway corridor in the San Francisco Bay Area. The effort utilizes archived freeway performance data, analysis of the causes of congestion, identification on bottlenecks, and simulation tools to determine the best mix of projects, strategies, and actions to relieve congestion. A combination of system management and operational strategies are emphasized to reduce congestion. The project is coordinated with the San Francisco Bay Area Metropolitan Transportation Commission (MTC) and local partners. This demonstration will be used as a best practice for development of additional Corridor System Management Plans in California to link planning and operations and to emphasize the importance of operational improvements and strategies to relieve congestion, restore capacity, and manage the system for highest productivity.

<http://calccit.org/880-report.pdf>

separate from other types of investments. Both planners and engineers need to see the benefits of operations data and analyzing operations strategies within the planning process, moving away from deploying operations as individual projects or additions to capital investments; operational strategies need to be integrated and analyzed in combination with other types of investments based on improving system-wide transportation efficiency. In addition, many of the analysis tools do not support the analysis of operational strategies in a consistent manner as traditional investments. Planners and operations staff should work together to come up with the best strategy, or sets of strategies, that address a particular problem. They also need to work together to select and use the most appropriate analysis tools, data, and performance measures for the particular task at hand.

- **Data limitations.** Expanded use and refinement of data brings a variety of new issues including:
  - **Coverage and quality.** Budget and staff are needed to adequately and consistently deploy, operate, maintain, and support the equipment and data archiving system(s).
  - **Purpose.** Different stakeholders have different data needs.
  - **Usability.** Even in areas where data archiving systems exist, they tend to be early in the evolution with data only available in large text files or not easily accessible. Data needs and formats should be identified so archived data could be made more useful.
  - **Repurposing data.** Repurposing data between planning and operations is needed and States should consider data business plans and how to improve on the use and efficiency of data when funds are not available
- **Education, outreach, and training.** Many of the tools available for analyzing operational strategies may not be known or understood by planners or consistent with planning-type analysis tools. An education and outreach effort may be necessary to provide guidance on how analysis tools and methods can be used. The same applies to operations data and performance measures. Selected measures need to be understandable and communicated to both technical and lay audiences.



## 2.2 OPERATIONS IN TRANSPORTATION PLANS/CORRIDOR STUDIES

All State Departments of Transportation (DOTs) develop planning studies that are used to set strategic directions, describe transportation system conditions and needs, and identify future investments in transportation projects and programs. SAFETEA-LU language specifies the inclusion of management and operations strategies in statewide transportation plans.<sup>6</sup> For the purposes of this guidebook, the diversity of plans and studies conducted by State DOTs can be represented by three broad types:

1. Strategic planning documents such as strategic plans and business plans that set the direction for the organization through mission statements, goals, objectives, and strategies, or other similar concepts, and monitor progress towards those goals.
2. Statewide plans that identify current and future overall transportation system needs, often set policies for the transportation system, identify current and future expected levels of funding, and in some cases identify specific projects and programs or scenarios for future funding. These plans typically consider major investment categories, such as preservation of pavement and bridge assets and investments in major capacity, but do not always address day-to-day operational and system maintenance needs.
3. Corridor, regional, small area, and modal studies address a more specific piece of the transportation system and often provide a forum for detailed analysis of transportation system deficiencies and needs and potential new investments to help meet those needs. These studies address a wide range of potential activities, but frequently focus on major capacity needs. At many DOTs, day-to-day operations and maintenance considerations have not traditionally been included in these studies.

Although different DOTs use different methodologies and delivery mechanisms to achieve these purposes, most perform all of these functions. These plans and studies represent an opportunity to link planning and operations through both the development of specific analysis and recommendations as part of the planning process and the process of engaging with internal and external stakeholders. These studies provide an opportunity for planning and operations staff to interact and share data and experiences to plan for the future transportation system.

### Creating and Beginning Linkages

There are several steps that DOTs can take to create improved links between planning and operations through plans and studies. For beginning these linkages,

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<sup>6</sup> The Safe Accountable Flexible Efficient Transportation Equity Act – A Legacy for Users (SAFETEA-LU), 23CFR450.214(b).

three general topics have been identified – establishing technical advisory committees for transportation plans and studies; incorporating operational strategies into State, regional, and corridor studies; and developing stand alone needs assessments for operations.

### *Technical Advisory Committees*

One of the first steps to improve the linkage between planning and operations through transportation planning activities is to establish a technical advisory committee with a broad-based representation from within (and potentially outside) the DOT. Technical advisory committees present both formal and informal means to share information, ideas, and concerns among staff. Committees for specific studies provide an opportunity to engage staff at the appropriate level – likely senior program managers for strategic and statewide plans and field staff for corridor studies. Committees established for specific plans and studies can also grow into permanent committees, described further in the Institutional linkage area.

Quality planning studies are built on a foundation of rigorous technical analysis that provides information to help decision makers identify needs and prioritize solutions. The purpose of a technical advisory committee is to provide guidance on the methods, data, and tools that are used to conduct the technical analysis and to identify creative solutions for the particular problems identified within a study. By fully engaging with technical experts throughout the organization, DOT plans and studies can ensure that the needs considers and solutions recommended are broad based and reflect all of the activities in which the DOT engages.

#### **Oregon Transportation Plan**

The 2006 update to the Oregon Transportation Plan (OTP) represents one of the most thorough attempts to integrate operations into a long range transportation plan. The OTP directly includes both operational goals and projects. One of the seven goals of the OTP is titled Management of the System, with a focus on improving “the efficiency of the transportation system by optimizing the existing transportation infrastructure capacity with improved operations and management.” Operational themes are woven throughout the strategies and technical analysis that make up the plan. A ‘Maximum Operations’ scenario examined the impact of focusing future transportation investments on operations instead of capacity improvements.

[www.oregon.gov/ODOT/TD/TP/ortransplanupdate.shtml](http://www.oregon.gov/ODOT/TD/TP/ortransplanupdate.shtml)

### *Include Operational Strategies in State, Regional, and Corridor Plans*

A second key means to link planning and operations is to specifically include operations within the plan or study. State DOTs typically define goals around key concepts – such as mobility, safety, accessibility, environmental protection, and others – and then craft a definition and objectives for the goal that describes the intended outcome in more detail. At the strategic and state plan levels, DOTs there are multiple potential levels of integration. At the most basic level, a DOT may establish a goal specific to operations that defines what the agency would like to

achieve in this area, but keep that goal separate from other goals. A more advanced integration would include developing language for all agency goals that reflects operational considerations. For example, a safety or mobility goal might note operational strategies for the DOT to pursue in coordination with other strategies.

At the statewide planning level, operations should be included as a significant program category. Statewide plans often broadly describe needs on the transportation system across all modes and programs. Including operations as one of several programs competing for funding can help elevate operational considerations to the same level as major capacity improvements. DOTs may also want to build operational considerations into their analysis of other improvements, asking important questions like, 'What will it take to operate and maintain this capacity expansion once complete?'. More advanced integration of operational considerations may include identifying thresholds for considerations of operational and other strategies. For example, congestion management processes developed by many DOTs and MPOs create a toolbox of a variety of strategies to address congestion (including ITS deployments, new capacity, incident management, and others) and provide guidelines for the application of these strategies.

At the corridor and regional study level, more detailed needs for operations within specific pieces of the transportation system should be addressed. For these studies, operational needs can be defined both broadly (as a program) and as specific strategies within a corridor or region. For example, a corridor study might identify potential operational strategies that could support or supplant a capacity expansion strategy, such as ramp metering. For many corridors, stand alone operational strategies, such as roadway weather information systems and roadway service patrols may be relevant to addressing safety and other concerns. In addition, these studies should include strategies for on-going maintenance and system upgrades as these elements can require substantial funding. DOTs should pick the mix of strategies that best help them meet their goals in a cost effective manner.

**Minnesota DOT Highway Systems Operation Plan**

The MnDOT Highway Systems Operation Plan (HSOP) was developed in 2005 to help MnDOT understand the operations needs of the highway system. The HSOP identifies the relevant ways that MnDOT operational programs connect to the statewide plan policies. The HSOP uses performance measures to help capture how different levels of investment impact operations activities and overall system performance.

[www.oim.dot.state.mn.us/hsop.html](http://www.oim.dot.state.mn.us/hsop.html)

One of the ways that planning can contribute to the development of operational strategies is through the evaluation and promotion of travel demand management strategies. These strategies include parking, telecommuting/flextime, ride sharing, and similar efforts. These are means to help reduce overall traffic volumes on roadway systems during peak periods. State DOT planning personnel can play a role in helping to design these incentive programs in coordination with MPO staff and other regional and local partners. Key programs could include direct cash benefits for reducing the number of vehicles using a company lot, employer transit

subsidies, information to support ride sharing, financial support of vanpools, and other similar efforts.

Active traffic management represent a more intensive method to manage the flow of traffic on the transportation system. These methods include real-time, dynamic management of traffic through the use of managed lanes, shoulder use in peaks, dynamic signing and re-routing, and other similar strategies. A full integration of operations into transportation planning will include evaluation of these strategies along side more traditional capacity expansion projects.

### *Develop an Operational 'Modal' Plan*

In addition to including operational strategies in existing planning efforts, DOTs may want to pursue a study that addresses operational needs across the state. Although operations is not typically thought of as a mode, an operational plan can provide the value for operations that typical modal plans, such as highways, transit, bicycle/pedestrian, and aviation, provide to those modes. To improve understanding of operational needs, DOTs have started conducting System Operations plans or including operational elements as part of a highway modal plan. An operational modal plan can provide additional detail on system operational needs and benefits. It can provide a resource for information that can help level the playing field when investment decisions are made and can help identify how different types of operational strategies can best be put to effect to address specific needs or deficiencies.

#### **PennDOT Transportation Systems Operations Plan**

Pennsylvania DOT (PennDOT) Bureaus of Highway Safety and Traffic Engineering and the Center for Program Development and Management jointly developed a Transportation Systems Operations Plan (TSOP) that sets forth the statewide direction for projects in ITS and operations. TSOP provides a coordinated approach to operations under a statewide framework that defines project areas and sets up guidelines for inclusion of operations projects within PennDOT's capital program. Each region will develop a Regional Operations Plan (ROP) that is based on the TSOP.

[www.paits.org/tsop](http://www.paits.org/tsop)

### **Sustaining Linkages**

Sustaining linkages requires special effort in this area, because of the challenge of maintaining the continuity of the planning process through studies that have fixed start and end dates. Although most plans and studies are intended to provide ongoing inputs to the decision-making process, in practice it can be challenging to ensure that these connections are made.

Several potential methods exist to help sustain linkages between planning and operations through plans and studies, including:

- **Developing implementation committees that meet after the technical study is complete to review progress towards study goals.** These committees can meet on a regular basis (yearly, quarterly, or more frequently, depending on

the study) and can include members of the technical committee established for the project.

- **Conducting periodic study updates that provide a mean to keep the study up-to-date with changes in the transportation system.** This is a more formal means of tracking progress than an implementation committee, but the increased formality can help ensure that staff participate actively.
- **Develop analysis tools that provide input to the ongoing project development and programming processes at State DOTs.** Transportation plans and studies, with their long-range view of transportation issues are intended to provide the starting point for the programming process – in which DOTs make decisions about how to allocate funding to specific projects and programs. As part of plans and studies, DOTs can develop tools that allow them to conduct ongoing evaluations of the broad range of projects and programs they consider in the allocation of funds. If they are developed using the priorities and strategies identified in the plans and studies, these tools can help ensure that operational solutions – as well as capacity, preservation, maintenance, and other strategies – are well represented in the programming process.

#### **Maryland CHART Non-Constrained Deployment Plan**

The Maryland Coordinate Highways Action Response Team (CHART) Non-Constrained Deployment Plan (NCDP) is a long-term, unconstrained plan defining capital projects for management and operations of the existing roadway network. The NCDP lays out a plan for a system to manage and operate existing roads, without constraints on time, money, or other resources. The NCDP provides the Maryland State Highway Agency with a picture of a model CHART system without significant constraints and provides input into the more traditional, construction-oriented planning and budgeting processes.

[www.chart.state.md.us](http://www.chart.state.md.us)

These methods also have the benefit of ensuring continuity from one planning study to the next. As these methods, tools, and committees become part of the organizational culture of an agency, they help ensure that changes in staff and management do not require reinventing these practices each time a DOT produces a particular plan or study.

## **Challenges and Opportunities**

Although plans and studies present a significant opportunity to link planning and operations at State DOTs, there are clear obstacles to improving this linkage, including:

- **Time constraints.** Staff at DOTs being asked to participate on technical advisory committees have other, primary responsibilities. Though these staff may see the value of participating in plans and studies, it can be challenge for them to find the time to participate meaningfully. With many DOTs facing hiring freezes or limits and challenges attracting new staff, finding time for new responsibilities can be a major challenge.

- **Lack of data and tools.** Planning staff at some DOTs may perceive a lack of resources needed to analyze operational investments or conduct program trade-offs. Staff developing plans and studies for a DOT may have a difficult time explaining or justifying operation-oriented strategies without investments in tools and methods.
- **Established organizational culture.** Every DOT has a long history of operating in a particular manner. Staff are used to conducting a certain set of activities in a particular way and may be reluctant to make changes to their behaviors. These individuals often have deep experience with the transportation system and may be skeptical of the value of tools and methods that do not accurately capture their experience.
- **Study continuity.** As noted above, one of the biggest challenges facing linking planning and operations through plans and studies is the simple fact that these documents are completed over a fixed set of dates. Without active attempts to continue meetings of technical groups and monitor study progress, the foundations built through these studies may need to be recreated again and again.

Solutions to these challenges will not come easily. Establishing a strong link between planning and operations through plans and studies will require a concerted effort at multiple levels of the DOT, including:

- **Change management.** As DOTs face new challenges, such as a shift towards operations, the culture of the DOT will need to change along with it. DOT culture does not change overnight or by mandate, but requires an ongoing process to help shift the organization to a different way of thinking. This process needs to take place at all levels – from senior management down to staff levels and in all divisions and offices of an agency – and through an active attempt to generate ideas and solutions across staff offices and titles.
- **Development of analytic resources.** For operational strategies and improvements to be included successfully in plans and studies, DOTs will need to invest in the tools and data used to analyze them. This investment is a process, rather than a one-time effort. As the relevant tools are developed they can support both specific studies and plans, as well as the type of on-going analysis of strategies that is part of the programming process. The Data, Tools, and Performance Measures linkage area provides detailed information about these strategies.
- **Training.** Because planning and operations staff may be treading into new territory, training opportunities need to be provided. These opportunities could include both general information on linking planning and operations and the roles different DOT staff play in the organization, as well as specific training on analytic tools or methods to help evaluate operational programs and projects. The Institutional linkage area includes detailed information about improving linkages in these areas.

## 2.3 INSTITUTIONAL

Institutional arrangements refer to organizational structures, divisional responsibilities, coordination among agency divisions, and DOT interactions with other agencies and individuals. Institutional issues are important because of their impact on how agency goals are achieved, rather than how agency goals are set.

Though each State DOT has a unique institutional make up, there are several common dimensions along which they are organized. One key dimension is the level of centralization. In centralized DOTs, a majority of the direction provided by a headquarters location is supported by the district offices. In decentralized DOTs, the districts are responsible for development of budgets and programs. A second dimension is the authority of the chief executive. In some DOTs, the top representative is a Secretary of Transportation or “CEO” of the Transportation Department. In others, the Transportation Director reports to a Commission of six to eight representatives appointed by the governor. The makeup and structure of the DOT greatly impacts the institutional arrangement of planning and operations.

For the purposes of this primer, four institutional areas have been identified as relevant to improving linkages between planning and operations.

1. Coordination includes working with partners across divisional units, stakeholders, and other transportation agencies.
2. Education and Training are vital for ensuring that an agency’s workforce has the skills and knowledge to tackle current transportation challenges. Where agencies are centralized training and education comes from the headquarters of the agency, if an agency is decentralized each district must have an approach (and budget) for training and education. Opportunities for education and training in the areas of planning, ITS, and operations are many and varied. Education and training includes the process of raising awareness and learning new skills, tools, and methods.
3. Partnerships are paramount to the development of transportation solutions. Though State DOT planning and operations divisions lead individual projects and programs, partnering between the two divisions can focus the agency on improving the transportation efficiency, safety, and overall performance. For a decentralized agency the lead may come from district level staff rather than headquarter staff. From staffing to financial participation there are many models that showcase successful partnerships that

### **KansasDOT ITS Unit**

Kansas DOT is a centralized organization with six District Offices. Bureaus support statewide functions such as design and planning. In 1996 the ITS Unit was formed within the Bureau of Transportation Planning. This unique location for the ITS unit helped KDOT integrate ITS into the KDOT business process. Funding, contracting, planning, design, operations and maintenance of ITS has been a consideration for all KDOT Bureaus. Quarterly meetings of an ITS Steering Committee, with representatives from each bureau and nearly all districts, established communication across the agency.

[www.ksdot.org/burTransPlan/burovr/wwdo/itsu.asp](http://www.ksdot.org/burTransPlan/burovr/wwdo/itsu.asp)

provide mutual benefits. Partnering also includes external stakeholders, such as metropolitan planning organizations, tollway authorities, public works personnel, first responders, and other technology related stakeholders who have vital roles in the performance of the overall transportation system.

4. The institutional concept of organization refers to the specific roles and responsibilities that individuals, divisions, districts, and agencies have for planning or operating the transportation system. This includes the administrative structure of the transportation agency, the process used to develop programs and project and the key offices or divisions that play important roles in linking planning and operations.

## Creating and Beginning Linkages

There are several steps in the institutional area that DOTs can take to improve linkages between planning and operations. One of the most significant is to identify a change agent champion at the outset. This individual should be responsible for generating and maintaining links to planning and operations divisions. The champion defines key stakeholders to engage and determines the form and frequency of communication as well as the schedule for stakeholder involvement.

A second mean to begin linkages is to identify opportunities for interaction among internal and external stakeholders. Early coordination and involvement by key stakeholders in plans, studies, and other efforts will improve buy-in and understanding of programs throughout the agency. Ideally coordination predates the inception of a project or program and provides continuity across multiple projects.

Coordination across the agency can take several forms. One common form that has been used is to develop an ongoing operations committee. Many DOTs use such a committee to help identify ways in which the organization can better incorporate operational solutions. In addition to committees of managers, DOTs should develop formal and informal methods to increase interaction among staff. These interactions can be on steering committees for individual studies or through occasional informal gatherings, but regular interaction is an important step to encourage the sharing of ideas across divisions.

### University of Maryland Operations Academy

The University of Maryland (UMD) recently hosted the first operations academy (OA). The OA was conceived in response to difficulties for state DOT executives in finding qualified professionals to run their operations agencies. The OA is an immersion program that provides transportation agency staff with the skills they would need to become leaders in the field of transportation operations. The ideal student is an assistant state or district engineer who has significant responsibility for operations, but whose background is in engineering, maintenance, or similar fields. The key topics for the course include the relevance of operations, how operations are conducted, customer service, performance measures, communication, and management of personnel.

[www.operationsacademy.org](http://www.operationsacademy.org)



A third option for beginning linkages is to identify training opportunities for staff in planning and operations divisions. These opportunities can include national or regional conferences, training seminars or workshops on analysis tools, or in-depth training opportunities. In order for staff to improve linkages between planning and operations, they need to understand the value of each division and have a good command of the data and tools needed to do a rigorous analysis of a broad range of strategies.

A final mean to begin linkages is to develop a communication protocol for projects and programs. Creating linkages requires clear, frequent communication of agency and project specific information. This includes communication both internally (e.g., determining which groups need to receive notices about divisional or project decisions) and externally (e.g., presenting study results to external stakeholders and the general public).

## Sustaining Linkages

Addressing institutional linkages is key to all of the areas presented in this primer. Developing strong institutional linkages helps ensure that when key decisions are made, all appropriate parties are at the table and have a good understanding of all types of transportation investments. For example, when a DOT is conducting a transportation study, a DOT with strong institutional linkages will have well-trained staff who know how to analyze operational solutions, who communicate with other divisions in the organization to develop a broad-based understanding of the issues, and who have partnered with external stakeholders to develop the most cost-effective solutions.

Providing ongoing communication is another key area for sustaining linkages. Keeping stakeholders informed of project progress as well as engaged at key decision points is important for keeping a project moving forward. If stakeholders become disengaged from the process the usual result is delay in project until all stakeholders are up-to-speed. An appropriate level of communication is a key to sustaining linkages between planning and operations as well as other stakeholders.

Throughout the lifecycle of the project or program it is important to not lose sight of the big-picture. An agency's commitment to a project or program generally begins in the planning stages and is passed off to the operations group in deployment and implementation phases. The process of getting from planning to

### The Doug MacDonald Challenge

Former WSDOT Secretary Doug MacDonald created a challenge to identify a simple explanation to illustrate to the public why controlling the flow of vehicle onto a highway through tolls, ramp meters, and similar methods can speed traffic and ease congestion?

The winning solution by Paul Haase used funnels, rice and a stopwatch. The same quantity of rice was dumped all at once into one funnel and gradually poured into the other. Gradually pouring took 27 seconds, while dumping took 40 seconds (and produced several rice-sized traffic jams). This shows how slowly adding traffic to a highway facility can increase its useable capacity and provide benefits for all users.

[www.wsdot.wa.gov/Traffic/Congestion/Rice](http://www.wsdot.wa.gov/Traffic/Congestion/Rice)

deployment is often long and tedious and to sustain the linkage of the planning side of the agency with the operations side of the agency a step back is often required to remind all stakeholders of the bigger picture and end product of the work being done. For example, did the project meet the original intent of the purpose and need? Did the project do what it was supposed to do?

## Challenges and Opportunities

Within any given State DOT there are significant and daily opportunities to link planning and operations, but there are clear obstacles to improving this linkage, including:

- **External Stakeholders.** Sustaining linkages is particularly challenging when dealing with and “bringing along” many stakeholders from within and outside the agency. Continued support of the program from all stakeholders is necessary for overall project support and maintaining the linkage of planning and operations. Providing stakeholders with the necessary levels of education, awareness, and training is a key to overcoming this challenge. Opportunities in education and training should include both planning personnel and operations personnel.
- **Staff Changes.** Staff changes are inevitable in long-term programs where planning and operations are involved. Critical to addressing staff changes is in realizing the amount of education, awareness and consensus building has already occur on the project and bring the new staff up to speed in past decisions and direction of the project. A good step to assisting new staff in a project is the documentation of early decisions and directions. This documentation can help new staff arrivals understand earlier commitments of the project.

Opportunities to improve linkages and overcome these challenges include:

- Engaging decision makers early in the process, in both planning and operations, can greatly facilitate the speed at which decisions are made. When decision makers are faced with project decisions, the earlier the information was provided to them the better. A continued stream of the project information to decision makers keeps them engaged and support of the programs.
- Engaging appropriate stakeholders and getting them to the table, keeping them engaged throughout the process. Planners will work with certain stakeholders through the development and planning cycles of projects and often these stakeholders are different than those generally involved by the operations staff. Engaging the appropriate stakeholders, through communications material or education forums, throughout the program cycle is an important success factor in moving programs forward.

## 2.4 REGIONAL CONSIDERATIONS

Transportation system users expect seamless transitions between systems and jurisdictions. Congestion has no regard for lines on a map, often extending beyond municipal, state, and other jurisdictional borders. As a result, the planning and operation of state transportation systems increasingly require State DOTs to coordinate with other agencies such as MPOs, other regional agencies, local municipalities, and/or other State DOTs to address transportation needs and deficiencies with a common purpose and vision. Although guidance is available on linking planning and operations at the regional level, there is limited material addressing linkages between State and regional practitioners.

The first three linkage areas in this guidebook focus on practical things that can be done to link planning and operations functions within a State DOT. This section identifies the steps needed to improve coordination across DOTs and between DOTs and other transportation agencies.

### Creating and Beginning Linkages

Integrating regional considerations into State DOT planning and operations activities requires personnel to work with individuals from various backgrounds who maintain different responsibilities and objectives. Depending upon their location, State DOT personnel may interact with transportation professionals focused on urban issues, rural issues, or both. In some circumstances, some cases may require the consideration of issues effecting neighboring States. Regardless of the circumstances, State DOT personnel will face issues in at least the following two areas:

- Working cooperatively with MPOs and other regional and local agencies to plan for and integrate operational functions;
- Managing the hand-off between agencies in a region.

#### Kansas City Scout

Kansas City Scout (KC Scout) is a bi-state traffic management system used to manage traffic on more than 90 miles of freeways in the Kansas City metro area. KC Scout uses cameras and sensors to monitor highways and feeds information to electronic message boards and a Highway Advisory Radio system. Missouri and Kansas DOTs have worked together in planning and operating this vitally important transportation management tool first identified in the 1994 Kansas City Early Deployment Study.

[www.kcscout.net](http://www.kcscout.net)

#### 511.org

511 is a 24-hour, free phone and Web traveler information service for the San Francisco Bay Area. It provides real-time traveler information including: traffic conditions; incidents; driving times; public transit schedule, route and fare information; ridesharing; and bicycle information. 511 is managed by a partnership of public agencies led by the regional planning agency Metropolitan Transportation Commission (MTC), the California Highway Patrol (CHP), and the California Department of Transportation (Caltrans).

<http://511.org>

Beginning an initial dialog with regional stakeholders is an important first task to integrating regional considerations within State DOT planning and operations activities. State DOTs need to have a collaborative process in place with MPOs and other regional agencies in their state to ensure that the transportation investments meet the vision of the region.

An initial step for encouraging dialogue around linking planning and operations is to include regional and local planning and operations staff on technical advisory committees for State planning and deployment studies. These individuals can provide valuable insight into the planning process. Similarly, State DOT staff and managers should participate in advisory committees for regional efforts. In both cases, it will be important to understand the appropriate staff to participate in these studies. Although operations DOT staff may partici-

participate in regional operations efforts, it may be useful to include DOT planning staff. Similarly, regional operations staff may be valuable participants in State-led corridor or regional studies.

Another means to begin building relationships within a region includes participating in or sponsoring regional meetings, seminars, conferences, or other events that help build understanding and trust across different organizations. Within these forums State DOT planning and operations staff can both learn from and provide guidance to MPO and local agency staff on how to include operations within planning activities within their own organizations and within the region as a whole. Joint training exercises for MPO and State DOT staff can help ensure that staff at both agencies are interacting with one another to develop solutions to transportation issues within the region.

## Sustaining Linkages

Sustaining a collaborative relationship between State DOTs and regional planning and operations personnel requires a sustained and long-term commitment to improving regional transportation system performance. State DOT officials can promote collaborative planning and management of operations through several activities, including:

- **Developing joint planning studies for ITS and operational deployments.** Because State, regional, and local staff all have important roles to play in the transportation system, a joint plan that touches on the appropriate roles of each agency and provides a means to develop operational strategies that help to

### Hampton Roads ITS Strategic Plan

The regional ITS Strategic Plan developed for Hampton Roads, VA was a collaboration between the Virginia Department of Transportation and the Hampton Roads Planning District Commission (HRPDC). The 2004 effort is the third update to the plan, which provides a region-wide paradigm for ITS deployments and includes a range of cross-jurisdictional stakeholders in the planning process. The plan address project development and phasing, identifies quick-fix solutions to improve transportation mobility, and establishes benchmarks for measuring regional and project performance.

[www.hrpdc.org/TRANS/TRANS\\_ITS.asp](http://www.hrpdc.org/TRANS/TRANS_ITS.asp)

maximize the use of the overall transportation system, not just a single piece.

- **Providing explicit guidance to regional agencies.** Many smaller MPOs and local governments lack the resources of a large MPO or State DOT and may not be as aware of the opportunities that operations can provide. In many states, the DOT plays an important role in helping provide guidance to other transportation agencies that can help define the circumstances in which these agencies should consider operational investments and the types of investments that are appropriate.

- **Participate in multi-state partnerships, corridor coalitions, and similar activities.** These multi-state efforts present an opportunity to address transportation issues that cut across regional and state lines. The long distance nature of many freight movements, for example, means that weather, incidents, and investments in one state can significantly impact operations in another state. Working collaboratively on these issues can help improve the overall efficiency of the transportation system.

- **Develop a Shared Regional Vision.** Most transportation organizations develop a vision, goals, and objectives that drive the direction and resources used to maintain and operate the system. Though agencies often consider other goals when developing their individual agency vision, goals and objectives, State DOTs and MPOs may want to work closely together to define a single vision for a given region. Successfully planning, managing, and operating transportation infrastructure today requires shared vision by regional stakeholders and decision-makers. This vision can be developed through formal committees and task forces, and should be used to influence all decisions that are made within the region. The benefit of a shared vision that encompasses all pieces of the transportation system – state highways, arterials, transit systems, etc. – is that potential solutions will consider true system impacts from a user

#### Oregon Transportation System Plan Guidelines

Cities and counties in Oregon are required to conduct Transportation System Plans (TSPs) that identify the system of facilities that meet transportation needs in a community or county. ODOT is currently updating guidance for TSPs to include information about operational solutions applicable to the specific transportation issues faced by local agencies. When complete, the TSP guidelines will provide help to local agencies to identify locations where operational investments can address transportation issues and needs.

[www.oregon.gov/ODOT/TD/TP/TSP.shtml](http://www.oregon.gov/ODOT/TD/TP/TSP.shtml)

#### EZ-Pass Toll Collection

The Interagency Group (IAG), a consortium of agencies using E-Z Pass electronic toll collection, was founded in 1991 with 8 member agencies in New York, New Jersey, and Pennsylvania. Today, the system has 23 member agencies in 12 states, with 9 million customers served. Through the efforts of the IAG, the agencies have developed a system that provides participating customers with a seamless tolling experience and common operating policies and protocols.

[www.e-zpassiag.com](http://www.e-zpassiag.com)

perspective, rather than the addressing each piece of the system individually. Establishing the vision should include individuals with broad-based experience in both the regional agency and State DOT. Once established, it is important for planning and operations staff from all levels to support and carry the shared vision forward.

## Challenges and Opportunities

State DOT officials may encountered a variety of challenges when working with regional partners and neighboring State DOTs to achieve regional coordination. The following illustrates some of the more common challenges and provides insight to potential opportunities for overcoming them.

- **Rural versus urban considerations.** State DOTs need to be conscious of the area (urban or rural) in which they are coordinating activities. In urban areas, the State DOT typically owns and operates a significant piece of the overall state transportation system that handles both long distance through trips and daily commuting trips. In rural areas, the state highway may be the only facility that provides connections to other towns, and the continued operation of that facility through inclement weather, serious incidents, and other unexpected phenomenon is essential to the life of rural areas and small towns. For both cases, urban and rural, State DOTs need to work with regional agencies.

Within urban environments, State DOT officials will most likely work with an MPOs or other regional agencies when considering regional issues or activities. In rural areas, a regional agency may have limited staff and may be dependent on the State DOT for technical analysis. Building partnerships in these areas are vital to ensure trust. State DOTs resources and training should be used to work closely with the agencies so they have a full understanding of why different solutions are possible or recommended.

- **Standardization of approaches.** Beyond communication, the development of standardized regional approaches and methodologies can play a major role in furthering regional coordination. A common criticism often expressed by transportation personnel from all levels is an inability to utilize information and data from other agencies or departments. More times than not, this issue is attributed to data either being collected or stored in formats incompatible with one another. As a result, overlaps in data collection efforts, duplication of archived data, and expenses associated with converting data for use often occur.

Several opportunities exist for State DOTs to work with regional and local planners and operations personnel. For example, the development of a regional ITS architecture can help further the synchronization and implementation of both State and regional ITS projects. Additionally, State DOTs can also work with local or neighboring agencies to develop joint performance measures used by regional partners; which improves reporting accuracy and accessibility between agencies. Training activities offered by State DOT officials for regional planners and operations personnel provides an opportunity

to provide guidance, improve standardization, as well as meet regional or local colleagues face to face.

Besides working with regional and local agencies, the opportunities offered to regional and local agencies can also be extended education institutions and research organizations located within the region.

## 2.5 POLICY AND REGULATION

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.

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 Congestion Management Process (CMP) within the metropolitan planning process. 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).”

Although State DOTs are not required to implement the congestion management process, they should be active participants with the Metropolitan Planning Organizations (MPO) within the state. Generally, the State DOT coordinates with MPOs and SAFETEA-LU has strengthened this coordination by requiring MPOs in a TMA to include operations and management strategies in the Congestion Management Process, a mainstay for planning future improvements to the system. State DOT involvement provides one means to ensure consistency among regional agencies and the State DOT.

### **FHWA Workzone Policies**

The FHWA Work Zone website provides information and guidance to State DOTs pertaining to the Work Zone Safety and Mobility Rule published on September 9, 2004. The website presents examples of the rule implementation, provides a section on frequently asked questions, and provides guidance and presentations on the topic. State DOT Planning and Operations staff have benefited from early, targeted resource material being made available as the rule was finalized. This work zone website provides much of the necessary guidance material a State DOT would need to comply with the new work zone rules.

[www.ops.fhwa.dot.gov/wz/index.asp](http://www.ops.fhwa.dot.gov/wz/index.asp)

The planning regulations of SAFETEA-LU also indicate that the statewide planning process “shall (to the maximum extent practicable) be consistent with the development of applicable regional intelligent transportation systems (ITS) architectures. . . .” (23 CFR 450.208(f)) The Final Rule also encourages “consultation with, or joint efforts among, the State(s), MPO(s), and/or public transportation operators (23 CFR 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.

## Regional ITS Architecture

Statewide and Regional ITS Architectures 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 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 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.

## Creating and beginning linkages

There are several steps that DOTs can take to create improved links between planning and operations through regulation. It is clear in the language of SAFETEA-LU that cooperatively developed strategies are required thereby encouraging those linkages between planning and operations groups. One such beginning would be for State DOT planning groups and operations group to engage with MPOs as they develop their Congestion Management Process for their regions.

Developing an ITS Architecture is another good first step in creating linkages between planning and operations. 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 impor-

### **Caltrans Corridor Mobility Improvement Account**

In 2006, California passed a \$4.5-billion bond measure, a significant portion of which funded the Corridor Mobility Improvement Account (CMIA) Program. The CMIA Program focuses on managing and operating transportation systems and corridors for highest sustained productivity and reliability using performance measures. Projects funded by the CMIA program must include traffic system management elements such as detection, ramp metering and other operational improvements, in addition to new lanes or other traditional transportation improvements.

[www.catc.ca.gov/CMIA\\_Guidelines\\_Adopted.pdf](http://www.catc.ca.gov/CMIA_Guidelines_Adopted.pdf)



tant 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 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. To develop such an architecture required collaboration between those groups planning and operating future and existing systems.

In transportation planning, a regional ITS architecture has its greatest impact on institutional integration in that it is not developed in a vacuum, rather with many stakeholders together detailing the future systems. 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.

### **Sustaining linkages**

Sustaining linkages requires special effort in the area of regulations and policy, because of the potential links to satisfying requirements for funding in transportation programs. The 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. Through these periodic revisions linkages between the planning and operations areas of the State DOTs are sustained.

Regional and Statewide ITS Architectures are living documents where routine revisions must be made for the document to remain a viable resource to the agency. Policies may be established by the State DOT so that continual revision cycles are established for the ITS architecture document thereby linking planning and operations with working groups dealing with the revisions for the ITS architecture.

#### **Integrated Corridor Management**

The USDOT's five year integrated corridor management (ICM) Initiative is designed to promote innovation in the development of new approaches for efficiently managing existing assets within a corridor. Eight locations were selected as pioneer sites to test operational coordination of multiple transportation networks and the institutions responsible for corridor mobility. Through the ICM initiative, the USDOT will demonstrate how intelligent transportation systems (ITS) technologies can efficiently and proactively manage the movement of people and goods in major transportation corridors. The integrated approach helps decision-makers invest in the best combination of strategies to minimize congestion and improve safety within a corridor.

[www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)

## **Challenges and Opportunities**

Although the ITS Architecture and metropolitan planning activities such as the CMP present significant opportunities to link planning and operations at State DOTs, there are clear obstacles to improving this linkage. Often times organization cultures find it hard to shift to a new way of doing things. Clearly FHWA policy is moving towards finding, creating, and maintaining those linkages between planning activities and operations. Until the shift is fully accepted a continued emphasis on establishing the link should exist.

Often the value of operations are overlooked as ribbon cutting ceremonies are rarely held for operations improvements. The obstacle to overcome is in recognizing and reporting on advancements and benefits realized by linking planning and operations. Newsletters or articles documenting system-wide improvements are cost-effective ways to overcome this obstacle.

## **3.0 Self Assessment**

The following table is designed as a self-assessment tool to help State DOT planning and operations groups to consider their current level of coordination and identify areas where additional attention can be brought to the agency. Key findings from the guidebook presented above were used in preparing the following questions for State DOT to use in assessing their status in linking planning and operations. The indicators are generic and not exhaustive. As such, these questions should be regarded as only the starting point for subsequent discussion focused on the five project categories detailed in the Quick Reference and discussed at length in Chapter 2.

While answering these questions may illuminate issues and opportunities, perhaps the greatest value of this work is in the resulting discussion among State DOT planning staff and staff involved in operations activities. 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 linking planning and operations, and the more “Yes” responses the further the agency is in linking the important functions.

1	Linkage Opportunity: Performance Measures, Data, Analysis Tools	YES	NO
	Have the benefits of using and sharing operations data been communicated with potential partners and stakeholders?		
	Have data needs for planning, performance measures, and other purposes been identified and compared to available data for possible use?		
	Is there a task force, committee, or other team/group composed of both Operations and Planning staff who consider the use and issues with operations data?		
	Is there a task force, committee, or other team/group composed of both Operations and Planning staff who work together to develop and refine performance measures?		
	Is there training available for the use of operations data for planning applications?		
	Do the traffic analysis tools and methods used for planning applications consider operational strategies or projects?		
	Have Planning staff been educated on the capabilities and benefits of using traffic analysis tools, particularly those that can analyze operational strategies and/or produce more realistic results (e.g., optimization and simulation models)?		
	Are performance measures generated on a regular basis?		
	Are some of the State's performance measures operations-oriented (e.g., crashes, travel time reliability or variability)?		
	Were experiences and lessons learned from other States or agencies obtained and used for establishing performance measures?		
	Are roles and responsibilities for developing, implementing, evaluating, and publicizing performance measures documented and clear?		
2	Linkage Opportunity: Operations in Transportation Plans and Corridor Studies	YES	NO
	Do the State's plans and studies include a vision, goals, and/or objectives that reflect operational considerations (i.e., provide safe and reliable transportation system)?		
	Do technical advisory committees for statewide, corridor, and regional planning studies include operations staff?		
	Do statewide planning studies include consideration of operations investments as well as major capacity investments, access management, and other strategies?		
	Do planning staff have easy access to information about the long term needs for operating the state highway system?		
	Do planning staff conduct implementation activities as part of the long range planning process?		

	Do planning studies make use of rigorous analysis tools to evaluate transportation projects and investments?		
<b>3</b>	<b>Linkage Opportunity: Institutional (Coordination, Partnerships, Training, Organization, and Education)</b>	<b>YES</b>	<b>NO</b>
	Are project champions from the State DOT formally identified on projects or programs?		
	Are there regularly scheduled meetings or task force meetings for the Planning group and Operations group to discuss shared activities?		
	Does the Operations group issue a newsletter or have a website to share operations based activities and information?		
	Does the Planning group issue a newsletter or have a website to share planning activities and information?		
	Does the State DOT have formalized systems to catalog and maintain memorandum of understanding with project partners?		
	Are there regularly schedule learning or training session focused on operations in the State?		
	Are there regularly schedule learning or training sessions focused on planning activities in the state?		
	Are there internal periodic meetings, conferences, or events where planning staff and operations staff have the opportunity to share program successes throughout the State DOT?		
	Does DOT staff participate in external meetings, conferences, or events where planning and operations staff interact?		
<b>4</b>	<b>Linkage Opportunity: Regional Considerations</b>	<b>YES</b>	<b>NO</b>
	Does the State DOT consult with and provide awareness to MPOs, regional/local planning agencies, or neighboring State DOTs of planning or operational activities occurring within their jurisdiction?		
	Does the State DOT coordinate and/or collaborate directly with MPOs, regional/local planning agencies, or neighboring State DOTs on planning or operational activities?		
	Are there scheduled meetings, committees, or other activities designed to coordinate with regional/local planners and operations personnel?		
	Does the State DOT actively work with or provide guidance to MPOs and/or local planning agencies on how to include operations in planning?		
	Are any formal agreements between the State DOT and MPOs, regional/local planning agencies, or neighboring State DOTs regarding a shared vision or approach to operating and managing the transportation system in place?		

	Are any formal arrangements or agreements between the State DOT and MPOs, regional/local planning agencies, or neighboring State DOTs regarding standardizing data management, storage, or performance measures in place?		
<b>5</b>	<b>Linkage Opportunity: Regulation and Policy</b>	<b>YES</b>	<b>NO</b>
	Does your agency have a policy to work with MPOs on the Congestion Management Process (developed by MPO)?		
	Does your agency have a policy for revisions to the Statewide or Regional ITS Architecture?		

## 4.0 Resources

This primer is designed to raise awareness of the benefits and opportunities for coordinating planning and operations activities within State DOTs, and to be a reference for further resources available on this topic. To facilitate this effort a “quick reference” of recent and current research publications was developed (Figure 1.2) cross referencing available information to five linkage categories. Also case studies synopses are presented throughout the material. This section presents further resource material that the reader may pursue to learn more about linking planning and operations.

For the quick reference graphic presented as Figure 1.2 the reference material is divided into “primary” resources, those resources directly targeted to the category, and “secondary” resources, resources that are associated with the category. The below information steps through each linkage category and presents the status of the material along with a weblink of the full text, where available.

### Performance Measures, Data, Analysis Tools

#### *Primary*

- Guidebook to Effective Freeway Performance Measurements NCHRP 03-68, 2007. [http://gulliver.nationalacademies.org/news/blurb\\_detail.asp?ID=7477](http://gulliver.nationalacademies.org/news/blurb_detail.asp?ID=7477)
- Traffic Analysis Toolbox Volume II: Decision Support Methodology for Selecting Traffic Analysis Tools. [http://ops.fhwa.dot.gov/trafficanalysistools/tat\\_vol2/index.htm](http://ops.fhwa.dot.gov/trafficanalysistools/tat_vol2/index.htm)
- Use of existing Analysis tools to Advance Operations in Planning, ongoing
- Operations Data for Planning Applications: Identifying Needs, Opportunities, and Best Practices <http://onlinepubs.trb.org/onlinepubs/circulars/ec095.pdf>

#### *Secondary*

- Getting More by Working Together. [www.ops.fhwa.dot.gov/publications/lpo\\_ref\\_guide/index.htm](http://www.ops.fhwa.dot.gov/publications/lpo_ref_guide/index.htm)
- ITE Traffic Engineer’s handbook Planning for Operations – Ch. 6. <http://www.ite.org/bookstore/TEH/>
- Integrated Corridor Management Initiative. [www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)

### Operations in Transportation Plans/ Corridor Studies

#### *Primary*

- ITE Traffic Engineer’s handbook Planning for Operations – Ch. 6 [www.ite.org/bookstore/TEH/](http://www.ite.org/bookstore/TEH/)

### *Secondary*

- FHWA Management & Operations in the Metropolitan Transportation Plan: A Guidebook for Creating an Objectives-Driven, Performance-Based Approach, <http://www.ops.fhwa.dot.gov/publications/moguidebook/moguidebook.pdf>
- Getting More by Working Together  
[www.ops.fhwa.dot.gov/publications/lpo\\_ref\\_guide/index.htm](http://www.ops.fhwa.dot.gov/publications/lpo_ref_guide/index.htm)
- Operations Data for Planning Applications: Identifying Needs, Opportunities, and Best Practices, <http://onlinepubs.trb.org/onlinepubs/circulars/ec095.pdf>
- Peer Exchange, June 2007, Ongoing
- Integrated Corridor Management Initiative, [www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)
- Use of existing Analysis tools to Advance Operations in Planning, Ongoing
- Multi State Operations Guide, NCHRP 03-84, To be published soon

### **Institutional**

#### *Primary*

- Coordinating Planning and Operations Peer Exchange, Volpe, Ongoing
- Integrated Corridor Management Initiative, [www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)
- Multi State Operations Guide, NCHRP 03-84, To be published soon
- NCHRP 20-7 - Business Plan: Mainstreaming Systems Operations in State DOTs, [www.transportation.org/sites/ssom/docs/mainstreaming.pdf](http://www.transportation.org/sites/ssom/docs/mainstreaming.pdf)
- Transportation Operations Training Framework (AASHTO) NCHRP 20-77, Newly started

#### *Secondary*

- Getting More by Working Together,  
[www.ops.fhwa.dot.gov/publications/lpo\\_ref\\_guide/index.htm](http://www.ops.fhwa.dot.gov/publications/lpo_ref_guide/index.htm)
- Use of existing Analysis tools to Advance Operations in Planning, ongoing
- ITE Traffic Engineer's handbook Planning for Operations - Ch. 6,  
[www.ite.org/bookstore/TEH/](http://www.ite.org/bookstore/TEH/)
- FHWA Regional Concept for Transportation Operations: A Primer (RCTO),  
[www.ops.fhwa.dot.gov/publications/rctoprimer/rcto\\_primer.pdf](http://www.ops.fhwa.dot.gov/publications/rctoprimer/rcto_primer.pdf)

### **Regional Considerations**

#### *Primary*

- Getting More by Working Together,



[www.ops.fhwa.dot.gov/publications/lpo\\_ref\\_guide/index.htm](http://www.ops.fhwa.dot.gov/publications/lpo_ref_guide/index.htm)

- FHWA Regional Concept for Transportation Operations: A Primer (RCTO), [www.ops.fhwa.dot.gov/publications/rctoprimer/rcto\\_primer.pdf](http://www.ops.fhwa.dot.gov/publications/rctoprimer/rcto_primer.pdf)

### *Secondary*

- FHWA Management & Operations in the Metropolitan Transportation Plan: A Guidebook for Creating an Objectives-Driven, Performance-Based Approach, [www.ops.fhwa.dot.gov/publications/moguidebook/moguidebook.pdf](http://www.ops.fhwa.dot.gov/publications/moguidebook/moguidebook.pdf)
- ITE Traffic Engineer's handbook Planning for Operations - Ch. 6, [www.ite.org/bookstore/TEH/](http://www.ite.org/bookstore/TEH/)
- Integrated Corridor Management Initiative, [www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)
- Multi State Operations Guide, NCHRP 03-84, To be published soon

## **Regulation and Policy:**

### *Primary*

- An Interim Guidebook on the Congestion Management Process in Metropolitan Transportation Planning (FHWA-HOP-08-008), [www.ops.fhwa.dot.gov/publications/cmpguidebook/cmpguidebook.pdf](http://www.ops.fhwa.dot.gov/publications/cmpguidebook/cmpguidebook.pdf)
- FHWA Management & Operations in the Metropolitan Transportation Plan: A Guidebook for Creating an Objectives-Driven, Performance-Based Approach, [www.ops.fhwa.dot.gov/publications/moguidebook/moguidebook.pdf](http://www.ops.fhwa.dot.gov/publications/moguidebook/moguidebook.pdf)
- NCHRP 20-7 - Business Plan: Mainstreaming Systems Operations in State DOTs, [www.transportation.org/sites/ssom/docs/mainstreaming.pdf](http://www.transportation.org/sites/ssom/docs/mainstreaming.pdf)
- FHWA Developing and Implementing Transportation Management Plans for Work Zones, [www.ops.fhwa.dot.gov/wz/resources/publications/trans\\_mgmt\\_plans/index.htm](http://www.ops.fhwa.dot.gov/wz/resources/publications/trans_mgmt_plans/index.htm)

### *Secondary*

- Mainstreaming Management and Operations into Transportation Program Development: Guidance for Institutional Change, [www.transportation.org/sites/planning/docs/nchrp2.doc](http://www.transportation.org/sites/planning/docs/nchrp2.doc)

## **Case Studies**

Case study text boxes are located throughout this document to showcase specific examples of linking planning and operations. More detail with regard to each case study can be found at the weblink presented below.

Caltrans Traffic Analysis Tools:  
[pems.eecs.berkeley.edu](http://pems.eecs.berkeley.edu)

Cost/Benefit Databases:

[www.itscosts.its.dot.gov](http://www.itscosts.its.dot.gov)  
[www.itsbenefits.its.dot.gov](http://www.itsbenefits.its.dot.gov)  
[www.itsdeployment.its.dot.gov](http://www.itsdeployment.its.dot.gov)  
[www.itslessons.its.dot.gov](http://www.itslessons.its.dot.gov)

Minnesota DOT:

[www.dot.state.mn.us/tmc/incmgmt.html](http://www.dot.state.mn.us/tmc/incmgmt.html)

WSDOT Gray Notebook:

[www.wsdot.wa.gov/accountability/](http://www.wsdot.wa.gov/accountability/)

Caltrans I-880 Corridor System Management Plan:

[calccit.org/880-report.pdf](http://calccit.org/880-report.pdf)

Oregon Transportation Plan:

[www.oregon.gov/ODOT/TD/TP/ortransplanupdate.shtml](http://www.oregon.gov/ODOT/TD/TP/ortransplanupdate.shtml)

Minnesota DOT Highway Systems Operation Plan:

[www.oim.dot.state.mn.us/hsop.html](http://www.oim.dot.state.mn.us/hsop.html)

PennDOT Transportation Systems Operations Plan:

[www.paits.org/tsop](http://www.paits.org/tsop)

Maryland CHART Non-Constrained Deployment Plan:

[www.chart.state.md.us](http://www.chart.state.md.us)

Kansas DOT ITS Unit:

[www.ksdot.org/burTransPlan/burovr/wwdo/itsu.asp](http://www.ksdot.org/burTransPlan/burovr/wwdo/itsu.asp)

University of Maryland Operations Academy:

[www.operationsacademy.org/](http://www.operationsacademy.org/)

The Doug MacDonald Challenge:

[www.wsdot.wa.gov/Traffic/Congestion/Rice](http://www.wsdot.wa.gov/Traffic/Congestion/Rice)

Kansas City Scout:

[www.kcscout.net](http://www.kcscout.net)

511.org:

[511.org](http://511.org)

Hampton Roads ITS Strategic Plan:

[www.hrpdc.org/TRANS/TRANS\\_ITS.asp](http://www.hrpdc.org/TRANS/TRANS_ITS.asp)

Oregon Transportation System Plan Guidelines:

[www.oregon.gov/ODOT/TD/TP/TSP.shtml](http://www.oregon.gov/ODOT/TD/TP/TSP.shtml)

EZ-Pass Toll Collection:

[www.e-zpassiag.com](http://www.e-zpassiag.com)

FHWA Workzone Policies:

[www.ops.fhwa.dot.gov/wz/index.asp](http://www.ops.fhwa.dot.gov/wz/index.asp)

Caltrans Corridor Mobility Improvement Account:

[www.catc.ca.gov/CMIA\\_Guidelines\\_Adopted.pdf](http://www.catc.ca.gov/CMIA_Guidelines_Adopted.pdf)

Integrated Corridor Management:

[www.its.dot.gov/icms/index.htm](http://www.its.dot.gov/icms/index.htm)





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