

Final Report

NCHRP Project Number 20-07/345

**Program Planning and Development for
Transportation System Management and Operations (TSM&O)
in State Departments of Transportation**

Submitted by:

**Malcolm E. Baird, Ph.D., P.E. and
Pat Noyes, Pat Noyes & Associates**

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Program Planning and Development for Transportation System Management and Operations (TSM&O) in State Departments of Transportation

The research objectives of NCHRP 20-07/Task 345 were to “understand the state of the practice in transportation system operations program planning and to begin defining alternative approaches to develop and administer these multimodal plans for state, regional, and local networks.” Such program plans were believed to be “not consistently developed and variably comprehensive.”

The *Amplified Work Plan* was approved in mid-October of 2013, with a nine-month schedule for completion. To make the best possible use of resources and to ensure that Task 345 would complement other TSM&O initiatives by FHWA, AASHTO and others, the scope was more narrowly defined as follows:

Task 345 recommendations will focus on strategic, program-level planning for state DOTs and state leadership and support for TSM&O planning at all levels.

The project results are described on the following pages. The report is organized in six sections plus appendices.

- Literature Review
- State DOT Websites
- Interviews
- Beckman Center Workshop
- State of the Practice
- Recommendations
- Appendices (A-X)

Literature Review

The purpose of the literature review was to identify sources of material that might be useful in subsequent tasks and to help guide the selection of individuals to be interviewed and perhaps invited to the TSM&O Workshop.

The following sources of information were examined:

- *Planning for Operations* resources available from FHWA and the U.S. DOT
- Strategic Highway Research Program 2 (SHRP 2) products
- Additional Transportation Research Board (TRB) products

- Resources identified from keyword searches of the Web and the TRID database
- Direct contact with panel members and professional colleagues for leads on any unpublished or yet to be published materials
- Websites of professional, industry, and research organizations

Planning for Operations: USDOT and FHWA Websites

Multiple resources, including reports, guidelines, and case studies are available through several U.S. DOT websites. Two primary entry points are the homepage for the FHWA Office of Operations (with the theme “21st Century Operations with 21st Century Technology”) and the homepage for the U.S. Department of Transportation’s “Planning for Operations.” The URLs for those two sites are:

- 21st Century Operations with 21st Century Technology: <http://ops.fhwa.dot.gov/index.asp>
- Planning for Operations: <http://www.plan4operations.dot.gov/index.htm>

Both of these cross-linked sites provide access to valuable information about TSM&O.

One resource, entitled *Transportation Planning for Operations: Quick Guide to Practitioner Resources*, provides a listing and description of “knowledge resources to help provide answers to planners, operators, public safety professionals, and transportation decision makers” and includes “guidebooks, case studies, and workshops” relative to TSM&O. The information is contained in both an online tool and a downloadable brochure in PDF format:

HTML version: <http://www.ops.fhwa.dot.gov/publications/fhwahop13049/index.htm>

PDF: <http://www.ops.fhwa.dot.gov/publications/fhwahop13049/fhwahop13049.pdf>

Appendix A contains selected excerpts from the Web version of the brochure. Another, more extensive list of publications is available from the website, “21st Century Operations with 21st Century Technology” at: <http://ops.fhwa.dot.gov/travel/plan2op.htm> . Excerpts from that list are shown in Appendix B, including several of the same documents highlighted in Appendix A.

Of the FHWA resources reviewed, three documents seem most directly applicable to Task 345:

- *Statewide Opportunities for Linking Planning and Operations: A Primer*, May 2008
http://ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf
- *Statewide Opportunities for Linking Planning and Operations, Reference Manual*, May 2010
<http://www.fhwa.dot.gov/planning/processes/statewide/practices/manual/manual.pdf>
- *Creating an Effective Program to Advance Transportation System Management and Operations, Primer*, January 2012
<http://www.ops.fhwa.dot.gov/publications/fhwahop12003/fhwahop12003.pdf>

The second document (May 2010) builds on the first (May 2008). The third document introduces the “capability improvement” concept.

Strategic Highway Research Program 2 (SHRP 2)

SHRP 2, particularly the “Reliability” focus area, addressed a number of issues related to TSM&O. A few of the relevant projects are still underway, but nearly all have moved to the implementations stage. As a result, SHRP 2 information is now available from three sources—TRB, FHWA, and AASHTO.

The most complete information about the research projects and products is available from the SHRP 2 homepage: <http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx>. The most applicable SHRP 2 projects fall under a Reliability grouping referred to as “Organizing Transportation Agencies to Improve Reliability.” Excerpts are shown in Appendix C.

A report entitled *Business Case Primer, Communicating the Value of Transportation Systems Management and Operations* is available at:

http://www.tsmoinfo.org/pdf/SHRP_2_L17_Business_Case_Primer_Final.pdf.

Another SHRP 2 project, developed under the Renewal focus area, is also directly applicable to TSM&O. The project is entitled *Strategic Approaches at the Corridor and Network Level to Minimize Disruption from the Renewal Process*. A description is available at this address:

<http://www.trb.org/Main/Blurbs/168143.aspx>, and a PDF copy of the prepublication draft can be downloaded: <http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2prepubR11Report.pdf>.

As noted above, SHRP 2 is now moving to the implementation phase, and both FHWA and AASHTO have useful information about implementation projects and processes, at these addresses:

- AASHTO: <http://shrp2.transportation.org/Pages/default.aspx>
- FHWA: <http://www.fhwa.dot.gov/goshrp2/>

One of the FHWA implementation initiatives, “Organizing for Reliability,” will provide direct assistance to almost half of the state DOTs. More information about that effort is available at:

http://www.fhwa.dot.gov/goshrp2/Solutions/Reliability/L06_L01_L31_L34/Organizing_for_Reliability_Tools

Using SHRP 2 results, AASHTO has created a web-based publication, *Transportation Systems Management and Operations*, which includes a “One-Minute Evaluation” and other guidance built around the six “critical capability maturity dimensions that reflect agency ability to develop and maintain an effective TSM&O program.” <http://www.aashtotsmoguidance.org/>

Another implementation project, the web-based Knowledge Transfer System (KTS) (part of the SHRP 2 “L17” project) is under development and can be a valuable tool for dissemination of the Task 345 results. Further ahead, the joint effort by AASHTO, ITE, and ITS America to establish a National Operations Center of Excellence (COE) will support FHWA in implementation of L17. The KTS can be accessed at <http://www.tsmoinfo.org/>.

Additional Transportation Research Board (TRB) Publications

A number of other TRB resources related to TSM&O are shown in Appendix D. The descriptions include several projects accomplished through TRB but published by others.

Keyword Searches

Keyword searches of the TRID database and the Web identified a wide range of publications and other resources. Those that seem directly applicable to the objectives of Task 345 are shown in Appendix E, including documents, journal articles, and more than 30 PowerPoint presentations.

State and Regional Plans and Other Documents Related to TSM&O

The literature search identified more than 30 plans and other documents related to TSM&O or “operations” at the state or regional levels (plus one from NZ Transport). These documents are shown in Appendix F. The state-level plans are from just eight states: California, Florida, Maryland, Pennsylvania, Minnesota, Nevada, Virginia, and Wisconsin. Also included in Appendix F are strategic plans for traffic incident management (TIM) from four state DOTs (FL, KY, TN, WS). Information on a fifth TIM strategic plan, for Oregon, is contained in a PowerPoint presentation in Appendix D.

Unpublished Materials

Several unpublished documents were found during the literature search, but the most useful were provided by other professionals, including Steve Lockwood (PB Consult), Ryan Rice (CDOT), Brad Freeze (TDOT), Tony Kratofil (MDOT), and panel members Wayne Berman, Elizabeth Birriel, John Corbin, and Joan Sollenberger.

Several of those materials have since been published and are included in the appendices. Two still unpublished documents were used, with permission, in conjunction with the Workshop on TSM&O Program Planning and Development for State DOTs:

- *TSM&O State of the Practice* by Steve Lockwood
- *Transportation System Management & Operations Reorganization Report*, May 2013, Colorado Department of Transportation (*Strategic Plan* is pending.)

Organization Websites

Appendix G contains a list of professional, industry, and research organization web sites that were examined, with notes to highlight particular material or organizational focus applicable to Task 345. Regardless of the organization’s current attention to TSM&O, virtually all of these organizations have related interests and could be partners in advancing the results of Task 345.

State DOT Websites

The researchers visited the websites of a representative group of state DOTs to search for information directly related to TSM&O and to assess the extent to which TSM&O considerations are reflected in mission and vision statements, strategic plans and planning processes, performance measures, and organizational structures. The searches included a scan of each state's Strategic Highway Safety Plan as a possible model for TSM&O program development and to assess alignment between safety and TSM&O strategies (e.g., incident management, work zone management). The scans of these sites were conducted over a period of three months, beginning in November 2013.

A total of 30 websites were reviewed, for the DOTs that serve the following states:

- Arizona
- California
- Colorado
- Florida
- Georgia
- Idaho
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maryland
- Michigan
- Minnesota
- Missouri
- Nevada
- New Hampshire
- New Jersey
- North Carolina
- Ohio
- Oregon
- Pennsylvania
- Rhode Island
- South Dakota
- Tennessee
- Texas
- Utah
- Virginia
- Washington
- Wisconsin

The initial research plan was to examine the websites for 20-25 representative DOTs, but the number was expanded to ensure more complete geographic coverage and to include more of FHWA's "Organizing for Reliability-National Implementation Sites" (SHRP 2 implementation).

The findings from these website reviews are summarized as follows:

- None of the DOT mission/vision statements are inconsistent with the concepts of TSM&O, but few of the statements highlight system management or operations. Several statements include "operations" in phrases such as "plan, build, maintain, and operate." One statement moves "operations" to the front:

The mission of the Washington State Department of Transportation is to keep people and business moving by *operating* and improving the state's transportation systems vital to our taxpayers and communities [*emphasis added*].

Commonly cited goals are to improve safety, efficiency, mobility, economic growth, and quality of life and to preserve the environment. Several statements specify the movement of both people and goods.

The word "reliable" is included in the mission statements for at least five DOTs (Maryland, Minnesota, Missouri, New Hampshire, and Texas). One of the five Strategic Goals for Caltrans (adopted in 2007) is to "maximize transportation system performance and accessibility." One of the six goals for the Nevada DOT is to "efficiently operate the transportation system." The Rhode Island Department of Transportation's mission statement is the only one of the 30 that specifically references security: "to provide, maintain and *secure* an intermodal transportation

network [*emphasis added*] . . .“ Virtually no information was found in the Web searches emphasizing alignment of specific TSM&O goals and objectives with overall departmental goals and objectives.

- TSM&O considerations are not prominent in department-level strategic plans. Further, the Web searches found only a few direct links between departmental strategic planning processes and efforts to develop or improve TSM&O programs. The Colorado DOT FY 14-15 Performance Plan includes the following Strategic Policy Initiatives:
 - Safety
 - Infrastructure Condition
 - Congestion Reduction
 - System Reliability
 - Freight Movement & Economic Vitality
 - Environmental Stewardship
 - Reduced Delivery Delays

The Virginia DOT Business Plan for FY 14-15 includes several TSM&O-related objectives, including the following:

Objective 3.2: To implement a state-of-the-art traffic-management program that maximizes the use of existing infrastructure and reduces the footprint of future roadway improvements needed to address congestion

- The extent of information found on TSM&O-related performance measurement seems to depend, not surprisingly, on the respective DOT’s overall commitment to measuring and reporting performance. Some of the examined performance measurement systems are extensive and have been developed over long periods of time. Others are still in early stages of development. Nearly all have a few measures related directly or indirectly to TSM&O. Virtually all of the systems address safety (numbers and/or rates of fatal and injury crashes). Many address “mobility” and/or congestion (miles of travel, travel times, hours of delay, and/or estimated costs of congestion). Several include measures of incident response and/or incident clearance times. Some address roadway weather management (snow and ice removal/bare lane times). Some measure injuries and fatalities in work zones.

The search was not exhaustive, but a few unique measures were noted. North Carolina measures and reports on the reliability of ferry service as well as on-time arrival of passenger trains. MoDOT measures work zone impacts to the traveling public. Several DOTs report the number of oversize/overweight permits issued. TxDOT reports the percent of railroad crossings with signalization. The Maryland State Highway Administration measures annual user cost savings due to four separate activities: congestion management, incident management, implemented recurring congestion projects, and signal retiming.

- Department-level organization charts were found in varying levels of detail for most of the 30 DOTs. In most cases, it was relatively easy to identify the organizational unit or units that seem

to have primary responsibility for TSM&O and related activities. The organizational reporting level of those units varies. Many are closely linked with activities related to “maintenance,” and many are part of larger units broadly responsible for “operations.” The Colorado DOT has created a Transportation Systems Management & Operations unit reporting to the Executive Director.

- The search of Strategic Highway Safety Plans (SHSPs) found that most departments have closely followed the federal requirements, and the format and content is very similar in the vast majority of the published plans. One exception is Oregon’s *Transportation Safety Action Plan* (TSAP), described as “a uniquely Oregon document that . . . also serves as the State of Oregon’s *Strategic Highway Safety Plan* (SHSP), a document required by federal law.” The TSAP is also described as “the safety element for the *Oregon Transportation Plan (OTP)*.” The Minnesota SHSP cites several purposes, including:

Provide an overview and coordination with other safety plans and programs within the state – examples include the TZD program, Statewide Heavy Vehicle Safety Plan, Intelligent Transportation System Safety Plan, Central Safety Fund, and the Highway Safety Plan.

Virtually all of the state SHSPs address work zone safety. About two-thirds of the plans give at least some attention to incident management, secondary crashes, incident scene management or related topics. Only a few (i.e., Kentucky, Oregon, Wisconsin) recommend traffic incident management as an emphasis area. Perhaps the most useful comparison between the SHSPs and possible TSM&O program plans is that neither could succeed without an exceptional level of coordination, within the DOT and between the DOT and local and regional agencies and private sector organizations. In fact, the DOT must coordinate with many of the same agencies for the SHSP process as would be required for TSM&O program planning and development.

- Keyword searches for the acronym “TSM&O” produced matches in only a handful of DOTs, and most of those hits were incidental references to documents prepared by others. However, the Florida DOT uses TSM&O prominently at both the headquarters and district levels. Colorado DOT has created a “TSM&O unit.” The Tennessee DOT search revealed that \$2 million has been set aside for a “TSM&O Pilot” as one of six “2014 Strategic Air Quality Initiatives.”
- Searches for “operations,” “SOM,” and “system management” were more fruitful. However, the word “operations” is used in DOTs in many different contexts. A few examples: Planning, design, and **operation**; Maintenance **operations**; Transit **operations** and safety; Intersection **operations**; State Emergency **Operations** Center; asphalt paving **operations**; Concept of **Operations**; **Operation** Lifesaver; aircraft **operations**; Intelligent Transportation Systems (ITS) **operations**; Transportation **Operations** Center; days and hours of **operation**; toll **operations**; system management **operations**; and, in a small number of DOTs, Transportation Systems Management and **Operations**.

- Finally, the 30 home pages collectively highlight the many different stakeholders and competing priorities for state DOT attention and resources. Dozens of links are offered on every home page for information ranging from traveler information to highway and work zone safety to planning initiatives, public meetings, project schedules, grants, and “doing business.” Because of the time of year when the searches were conducted, many included winter driving information. Several included information about declining revenues and funding shortfalls. For instance, the MoDOT website features “Stark Reality of the Road Ahead.” Several of the home pages, including those for California, Florida, and Rhode Island, featured images of major highway investments. Several highlight their safety service patrols. VDOT had a three-minute video entitled “The Everyday Story of Operations.”

The Oregon DOT home page included this list of “Popular Topics”:

- Active Transportation Section
- Bike/Ped Plan
- Climate Change
- Columbia River Crossing (I-5 bridge replacement project analysis, permitting and review)
- ConnectOregon
- Least Cost Planning
- ODOT Properties for Sale
- Oregon Sustainable Transportation Initiative
- Passenger Rail
- Project Tracking Map
- Road Usage Charge Program
- Salem Railroad Baggage Depot
- Solar Highway
- Statewide Transportation Improvement Program (STIP)
- Sustainability Program
- Tolling and Pricing
- Winter driving tips
- Why drive with Ed?

These are illustrations of just some of the wide range of issues that compete with TSM&O for the available resources and the attention of policy makers.

Interviews

Interviews were conducted with a total of 19 individuals to learn more about TSM&O within their respective organizations. The interviewees included representatives of three regional planning agencies/MPOs, one regional planning and operating agency, one FHWA official, and fourteen DOT senior managers (current or former) serving the states of California, Colorado, Florida, Iowa, Kentucky, Michigan, Minnesota, Missouri, Nevada, North Carolina, South Dakota, Tennessee, Washington, and Wisconsin. Table 1 lists the individuals who were interviewed along with their agency affiliations. Although all of the project interviews were expected to be via telephone, the researchers were able to conduct face-to-face interviews with representatives of the Colorado and Tennessee DOTs. As noted below, the researchers also talked with a number of other knowledgeable professionals who provided helpful information, insight, and advice.

Each interview lasted approximately one hour. The two researchers conducted the first several interviews jointly to help ensure a consistent approach. A set of basic questions was used as a guide, but the interviews were relatively open-ended. The objective was to learn about the state-of-the-practice in the represented organization and to clarify or expand on information from the department's website. Questions addressed topics such as the roles of specific organizational units, status and significance of TSM&O program planning, links with organizational strategic planning, department-wide integration of TSM&O, collaboration with external partners, budgeting, and expectations for the future.

As noted during the scan of DOT websites, "TSM&O" is not widely used in state DOTs, but several interviewees reported increasing use within their department, often attributed to CMM workshops. All of the interviewees were at least familiar with and understood the concepts associated with "TSM&O." The researchers used "TSM&O" in asking questions.

The individuals interviewed were believed to be among the most knowledgeable about TSM&O in their respective organizations or, in a few cases, to have a unique perspective. Without exception the interviewees had first-hand knowledge and were willing to share their experiences and insights. They all seemed frank in describing shortcomings and obstacles, but they were also enthusiastic and optimistic about the role of TSM&O within their respective organizations.

Four of the agencies represented in the interviews are regional organizations created to address transportation and other community issues that exceed the jurisdictional boundaries of individual local governments. All of the four serve large metropolitan regions, including one region that includes parts of two states. The Los Angeles MTA has responsibilities for both transportation planning and operation of transportation services, particularly public transit. The other three regional agencies are also the designated Metropolitan Planning Organizations (MPOs) for their respective communities.

The MAP-21 definition of TSM&O seems directly applicable to regional planning and coordination, which are core responsibilities for the four regional agencies. All have developed TSM&O plans or incorporated TSM&O in their ongoing planning processes. All seem to be effective coordinators and facilitators for

**Table 1. Persons Interviewed for NCHRP 20-07/345
TSM&O Program Planning and Development for State DOTs**

Person/Title	Agency	Person/Title	Agency
Wayne Berman* Team Leader	Federal Highway Administration	Steve Lund State Maintenance Engineer	Minnesota DOT
Natalie Bettger* Senior Program Manager, Congestion Management and System Operations	North Central Texas Council of Governments	Laurie Matkowski* Manager, Office of Transportation Operations Management	Delaware Valley Regional Planning Commission
Elizabeth Birriel, P.E., CPM* ITS Program Manager	Florida DOT	Meredith McDiarmid, P.E.* Traffic Control Engineer	North Carolina DOT
John Corbin, P.E., PTOE* State Traffic Engineer	Wisconsin DOT	John Nisbet Director of Traffic Operations	Washington State DOT
Keith Damron, P.E.* Senior Transportation Project Manager, CDM Smith	formerly Director of Planning, Kentucky Transportation Cabinet	Deena Platman* Principal Transportation Planner	Portland Metro
Brad Freeze Director Traffic Operations Division	Tennessee DOT	Frank Quon* Executive Officer - Highway Program	Los Angeles Metro Transportation Authority
David Huft Research Program Manager and ITS Coordinator	South Dakota DOT	Ryan Rice Director Transportation Systems Management & Operations	Colorado DOT
Denise Marie Inda, P.E., PTOE* Assistant Chief Operations Engineer	Nevada DOT	Joan Sollenberger* Chief Office of Strategic Development	California DOT
Tony Kratofil Region Engineer Metro Region	Michigan DOT	Julie Stotlemeyer Traffic Liaison Engineer	Missouri DOT
Sandra Larson Director Systems Operations Bureau	Iowa DOT		

*Panel member for NCHRP20-07/345

TSM&O implementation. All seem very familiar with their respective state DOT(s) and have managed their regional TSM&O programs to accommodate and to leverage support from their DOTs.

State DOTs are all similar in many respects, but some of the differences among DOTs are especially important relative to TSM&O. The 14 DOTs listed in Table 1 reflect some of those important differences relative to whether the state includes one or more large metropolitan areas; levels of traffic congestion and unreliable travel times; availability of public transit and other alternative travel modes; significance of roadway weather management during winter months; exposure to other extreme weather events or other natural disasters; experience with ITS and related services and activities; experience with managed lanes and other innovation approaches; centralized vs. decentralized organizational structures; and experience in coordinating with other state, local and regional agencies. More extensive interviews with a large number of DOTs would have been desirable, but differences in the characteristics cited above can be found among the represented DOTs.

The 14 DOTs listed in Table 1 clearly are *not* representative of all the state DOTs in one important way—the vast majority of the 12 can be categorized as innovators or early adopters relative to TSM&O. The results should be interpreted accordingly. If the results of the Task 345 project are to be meaningful for all of the state DOTs, attention should be given to fundamentals for all DOTs as well as to refinement and fine-tuning of already advanced programs.

In addition to the interviews described above, aspects of the project were discussed with a number of other knowledgeable professionals, including Steve Lockwood (PB Consult), Gummada Murthy (AASHTO), Steven Gayle (RSG, formerly Binghamton Metropolitan Transportation Study), Eileen Singleton (Baltimore Metropolitan Council), Melanie Crotty (Metropolitan Transportation Commission (CA)), Tom Jacobs (University of Maryland), Subrat Mahapatra (Maryland SHA), and two senior officials with the Tennessee DOT, Paul Degges (Chief Engineer) and Toks Omishakin (Chief of Environment and Planning). All of these experienced professionals provided helpful information, insight, and advice. The researchers also used opportunities to discuss TSM&O program planning with other professionals through participation in the Tennessee Operations and Safety Conference in November 2013, and the 2014 TRB Annual Meeting.

The interviews and discussions with other professionals helped clarify information from the literature search and the exploration of DOT websites, and were instrumental in developing the workshop agenda. A number of common themes and issues emerged during the series of interviews, and those themes and issues are reflected in the following observations on the state of the practice in state DOTs. Many of the interviewees offered insights and suggestions that influenced both the structure of subsequent tasks and the project recommendations.

Workshop on TSM&O Program Planning and Development for State DOTs

The invitation-only workshop was held on April 2nd and 3rd, 2014, at the Arnold and Mable Beckman Center of the National Academies of Sciences and Engineering on the campus of the University of California-Irvine. A total of 27 individuals participated in the workshop, including representatives of 14 state DOTs, 6 regional agencies (5 of which are MPOs), five other professionals, and the 2 researchers/facilitators. Table 2 shows the workshop participants by name, title, and organizational affiliation.

Advance Materials

Participants were asked to review a package of “Advance Materials” prior to the workshop. The list of those materials is shown as Figure 1. Several of the documents provided in this package were revised as a result of the workshop, and the revised versions are described later in this report. The following advance material documents were not revised following the workshop and are shown in their original form in Appendix H:

- Definitions
- State DOT Program for TSM&O: Organizational Features and Critical Interfaces
- Excerpt from AASHTO One-Minute Guidance
- *TSM&O State of the Practice* by Steve Lockwood

Pre-Workshop Survey

Participants were also asked to respond to an online survey approximately two weeks prior to the workshop. The survey was designed for multiple purposes:

- Determine areas of agreement, divergence, and uncertainty among the participants
- Refine the content and time allotments for the workshop sessions
- Validate (or refute) preliminary research findings
- Jumpstart the workshop with information about the participant’s background and expertise, and identify perspectives that were *not* directly represented
- Stimulate thinking about workshop topics

The survey asked fourteen questions in four sections: (1) Background, (2) Status of TSM&O, (3) TSM&O Planning and Development, and (4) Moving Forward. Most questions had multiple parts, and respondents were asked to choose from a range of possible responses. Only the final question, with four parts, was open-ended. Representatives of state DOTs and regional agencies were asked to respond to all of the questions. Other participants (e.g., FHWA, private sector) responded to only the first nine questions which asked about the participant's background and expertise. The survey results are shown in Appendix I.

Table 2. Workshop Participants
NCHRP 20-07/345, TSM&O Program Planning and Development for State DOTs
Beckman Center, Irvine, CA, April 2-3, 2014

Name/Title	Organization
Natalie Bettger,* Senior Program Manager-Congestion Management and System Operations	North Central Texas Council of Governments
Elizabeth Birriel,* ITS Program Manager	Florida DOT
Brent Cain, Deputy State Engineer	Arizona DOT
John Corbin,* State Traffic Engineer	Wisconsin DOT
Melanie Crotty, Director of Operations	Metropolitan Transportation Commission
Keith Damron,* Senior Transportation Project Manager	CDM Smith
Brad Freeze, Director, Traffic Operations Division	Tennessee DOT
Dean Gustafson, State Operations Engineer	Virginia DOT
David Huft, Research Program Manager & ITS Coordinator	South Dakota DOT
Denise Marie Inda,* Chief Traffic Operations Engineer	Nevada DOT
Tom Jacobs, Director, Center for Advanced Traffic Technology	University of Maryland
Tony Kratofil, Region Engineer, Metro Region	Michigan DOT
Sandra Larson, Director, Systems Operations Bureau	Iowa DOT
Steve Lockwood, Senior Vice President	PB Consult
Steve Lund, State Maintenance Engineer	Minnesota DOT
Laurie Matkowski,* Manager, Office of Transportation Operations Management	Delaware Valley Regional Planning Commission
Charles Meyer, Safety and Traffic Engineering Branch Manager	Colorado DOT
Gummada Murthy, Associate Program Director, Operations	AASHTO
John Nisbet, Director of Traffic Operations	Washington State DOT
Richard Perrin, Executive Director	Genesee Transportation Council

Name/Title	Organization
Deena Platman,* Principal Transportation Planner	Portland Metro
Frank Quon,* Executive Officer - Highway Program Authority	Los Angeles Metro Transportation
Tracy Scriba, SHRP2 Reliability Coordinator	FHWA Office of Operations
Joan Sollenberger,* Chief, Office of Strategic Development	California DOT
Ralph Volpe, Freight Technology/Operations Specialist	FHWA
Malcolm Baird, Principal Investigator	Consultant
Pat Noyes, Principal	Pat Noyes & Associates

* NCHRP 20-07/345 Panel Member

**List of Advance Materials
for
Workshop on TSM&O Program Planning and Development for State DOTs**

Documents Provided (Please Review)

1. Definitions
2. Purposes for TSM&O Program Planning and Development
3. State DOT Program for TSM&O: Organizational Features and Critical Interfaces
4. TSM&O Program Components for State DOTs
5. Comparison of Long Range Transportation Planning and TSM&O Planning for Services, Projects, and Activities
6. Excerpt from AASHTO One-Minute Guidance
7. Steve Lockwood, *TSM&O State of the Practice*

Documents to Scan

1. Colorado DOT, *Transportation System Management & Operations Reorganization Report*, May 2013 [Link](#)
2. Florida DOT, *Florida Transportation Systems Management and Operations, Strategic Plan, Final: Version 2*, December 13, 2013 [Link](#)
3. NZ Transport Agency, *State Highway Asset Management Plan, 2012-2015* [Link](#) and [SHAMP Flyer](#)
4. FHWA (Especially Item c.)
 - a. *Statewide Opportunities for Linking Planning and Operations: A Primer*, May 2008, http://ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf
 - b. *Statewide Opportunities for Linking Planning and Operations, Reference Manual*, May 2010 <http://www.fhwa.dot.gov/planning/processes/statewide/practices/manual/manual.pdf>
 - c. *Creating an Effective Program to Advance Transportation System Management and Operations, Primer*, January 2012 <http://www.ops.fhwa.dot.gov/publications/fhwahop12003/fhwahop12003.pdf>

Figure 1. List of Advance Materials

Workshop Results

The agenda for the Workshop is shown on the next page as Figure 2. A combination of plenary and breakout sessions was used along with a group exercise and material to review overnight. The participants were divided into four groups, each with balanced representation of agency types and state demographics. The four groups were combined in different ways in the breakout sessions to encourage effective interaction among all of the participants over the course of the workshop. The groups worked separately on the visioning exercise described below.

Four workshop objectives were identified in the introductory session, in the form of questions to be addressed over the day-and-a-half period:

- What constitutes a State DOT TSM&O Program?
- What are the key components for an effective TSM&O Program Plan?
- What is our vision for state TSM&O Programs in 2020?
- What is the national path forward to facilitate effective TSM&O program planning for state DOTs?

All of the participants were actively and constructively engaged throughout the workshop, and each of the four questions were answered, some with more detail and clarity than was expected given the relatively limited time.

The questions about the components of a “TSM&O Program” and the components of a “TSM&O Program Plan” led to the idea of a “Framework for TSM&O Program Planning and Development,” including five components and a set of questions that DOTs should ask themselves in the early stages of TSM&O Program Planning and Development. The Framework is discussed in more detail in the “Recommendations” section of this report

The 2020 Vision for State TSM&O Programs was addressed through a group exercise that began during the lunch break on the first day. Prior to lunch, each of the four pre-designated groups was given the instructions shown in Figure 3. Each group was allowed to pick from among the four scenarios. One group selected Scenario #2, one group selected Scenario #3, and two groups selected Scenario #4.

Four very creative and enthusiastic presentations were made at the plenary session following lunch, followed by discussion among all participants. Based on the four presentations, the researchers prepared the following summary of the collective 2020 Vision, which was made possible, or at least facilitated, by TSM&O Program Plans prepared in 2014. The following features were reflected in varying degrees in all or most of the presentations, imagined to be in 2020:

- The state’s transportation system is safer, more efficient, and more reliable as a result of targeted TSM&O investments.
- The state DOT is a leader, actively engaged with local and regional agencies to advance TSM&O throughout the state.

Workshop Agenda

TSM&O Program Planning and Development for State DOTs NCHRP 20-07/Task 345

The Beckman Center
Irvine, CA
April 2-3, 2014

April 2nd (Day One)

- 7:00 a.m. Registration and Breakfast Buffet
- 8:00 a.m. Welcome and Discussion of Workshop Objectives
- 8:15 a.m. Self Introductions
- 8:30 a.m. Plenary Session:
 - a. Group Credentials and Perspectives
 - b. Definitions
 - c. TSM&O State-of-the-Practice in State DOTs
- 9:45 a.m. Break
- 10:15 a.m. Breakout Sessions: TSM&O Program Components
- 11:30 a.m. Lunch (and Inspiration)
- 12:45 p.m. Plenary Session: TSM&O Vision 2020
- 2:15 p.m. Break
- 2:45 p.m. Breakout Sessions : TSM&O Program Planning and Development
- 4:00 p.m. Break
- 4:15 p.m. Wrap Up
- 5:00 p.m. Reception

April 3rd (Day Two)

- 7:00 a.m. Breakfast Buffet
- 7:45 a.m. Plenary Session
 - a. Review of Previous Day and Survey Results
 - b. TSM&O Program Planning, Development, and Implementation
 - c. Final Assessment
- 10:15 a.m. Break
- 10:30 a.m. Plenary Session—Path Forward
- 11:45 a.m. Adjourn

Figure 2. Workshop Agenda

Exercise

A Vision for State DOT TSM&O Programs

Imagine it is the year 2020. In late 2014, your DOT prepared a TSM&O Program Plan. Over the lunch break, work in your assigned group to develop an outline for one of the following, and explain how the TSM&O Program Plan supported TSM&O accomplishments in your DOT. Each group will have 5-6 minutes during the next session, starting at 12:45, to present your product and explain how the Program Plan made a difference.

- 1) A script for a Webinar focused on how your TSM&O program has improved safety and reliability for transportation users since 2014.
- 2) A promotional piece on what your state DOT's TSM&O program has accomplished since 2014. This will be used to encourage public support and state and federal funding.
- 3) An article for TR News describing how TSM&O has been strategically integrated throughout your department.
- 4) A brief TSM&O presentation to a corporate team looking at your state as a possible site for a Super Hub with more than 12,000 employees and 24/7 operations using highway, rail, and air cargo.

Be creative!!!

Figure 3. Instructions for 2020 Vision Exercise

- The DOT is a more effective, efficient, and agile organization, with TSM&O concepts integrated throughout the department.
- The DOT's TSM&O program is proactive, aggressive, and effective.
- The state has made significant changes in priorities to advance TSM&O and, in at least one imaginary state, has made dramatic organizational changes.
- The DOT is more effective as a multi-modal and intermodal partner, working with public transit, rail, and other modes for passenger and freight transport.
- The department has effective processes to gather, analyze, disseminate, and share data with multiple partners, public and private, to improve the movement of people and goods.

- The DOT provides an array of TSM&O services targeted to meet specific needs and can effectively create packages of service and projects to recruit industry, improve quality of life, and accomplish other state goals as they arise.
- The TSM&O message is compelling and meaningful for multiple audiences, including elected officials and the freight and business communities.
- The state DOT is a leader among all public agencies in responsiveness, adaptability, resourcefulness, and efficient use of resources.

The fourth question to define a successful workshop was “What is the national path forward to facilitate effective TSM&O program planning for state DOTs?” That question was the subject of the final session of the workshop, and the responses are also presented in the “Recommendations” section.

State of the Practice

The researchers' assessment of the state of the practice is summarized below, beginning with some overall observations and followed by more detailed, categorical observations. This assessment is based on the literature review, the scan of DOT websites, the interviews and conversations described above, and the results of the Beckman Center Workshop.

The existing TSM&O programs in state DOTs seem to have evolved through a series of initiatives (e.g., ITS, traveler information, traffic incident management) that have been judged successful by their respective departments, partner agencies, and/or customers. Each success has led to consolidation of efforts and resources, expansion to other areas within the state, and additional, complementary initiatives. Project planning has certainly guided many of the DOTs, especially those with a longer history and a more extensive array of operational investments, but that planning has focused on immediate issues and short-term implementation. Much of the growth of even the more mature programs seems evolutionary, based on pragmatic response to problems, expansion from one community or area of the state to another, and application of new or improved technologies. A more formal, structured approach to “program planning” is just beginning to take form in a handful of states.

Only a few DOTs have developed “program plans” of any type, and the plans that have been developed are first or second generation. The developed plans are different in scope and format, and this research did not identify any single TSM&O “program plan” to recommend as the model for all state DOTs.

TSM&O is just beginning to be institutionalized, even in DOTs that are recognized as leaders in system management and operations. Progress still depends largely on champions. Project-based business processes are jerry rigged for TSM&O purposes, not always successfully. “Messages” to justify resource allocations are not well honed and are sometimes ineffective. Some policy makers and top managers are still skeptical. A number of DOTs have implemented TSM&O-related organizational changes in recent years, several in recent months (e.g., Colorado, Iowa, and Tennessee). These changes almost certainly reflect increased levels of commitment to TSM&O. However, some of the changes also can be attributed to concern for basic organizational efficiency and effectiveness, rearranging resources and responsibilities for similar functions (e.g., consolidating resources and responsibilities for ITS, traffic incident management, and related functions). Several of the interviewees described a need for program planning to set direction after the organizational objectives of efficiency, effectiveness, and statewide consistency have been achieved.

State DOTs seem to be approaching TSM&O on one of two paths or, more commonly, on both paths in parallel. One path is to view TSM&O as a concept or an overarching strategy that needs to be integrated throughout the department. With that approach, every departmental function and organizational unit should contribute to optimizing transportation system performance, to “preserve capacity and improve security, safety, and reliability.” (In practice “security” does not seem to have the same importance as the other goals.)

The second, often parallel, path is working toward an identifiable “program” with certain TSM&O responsibilities assigned to a specific organizational unit. Functions typically assigned to the separate unit include most aspects of ITS, traffic operations, traffic incident management, and some aspects of traveler information. That organizational unit is also expected to serve as an advocate and coordinator for TSM&O, internally and externally.

None of the interviewed DOTs described their approaches in exactly this way, but most seem to be pursuing some combination of approaches concurrently. For discussion, Figure 4 illustrates that combined approach and the associated organizational features and critical interfaces.

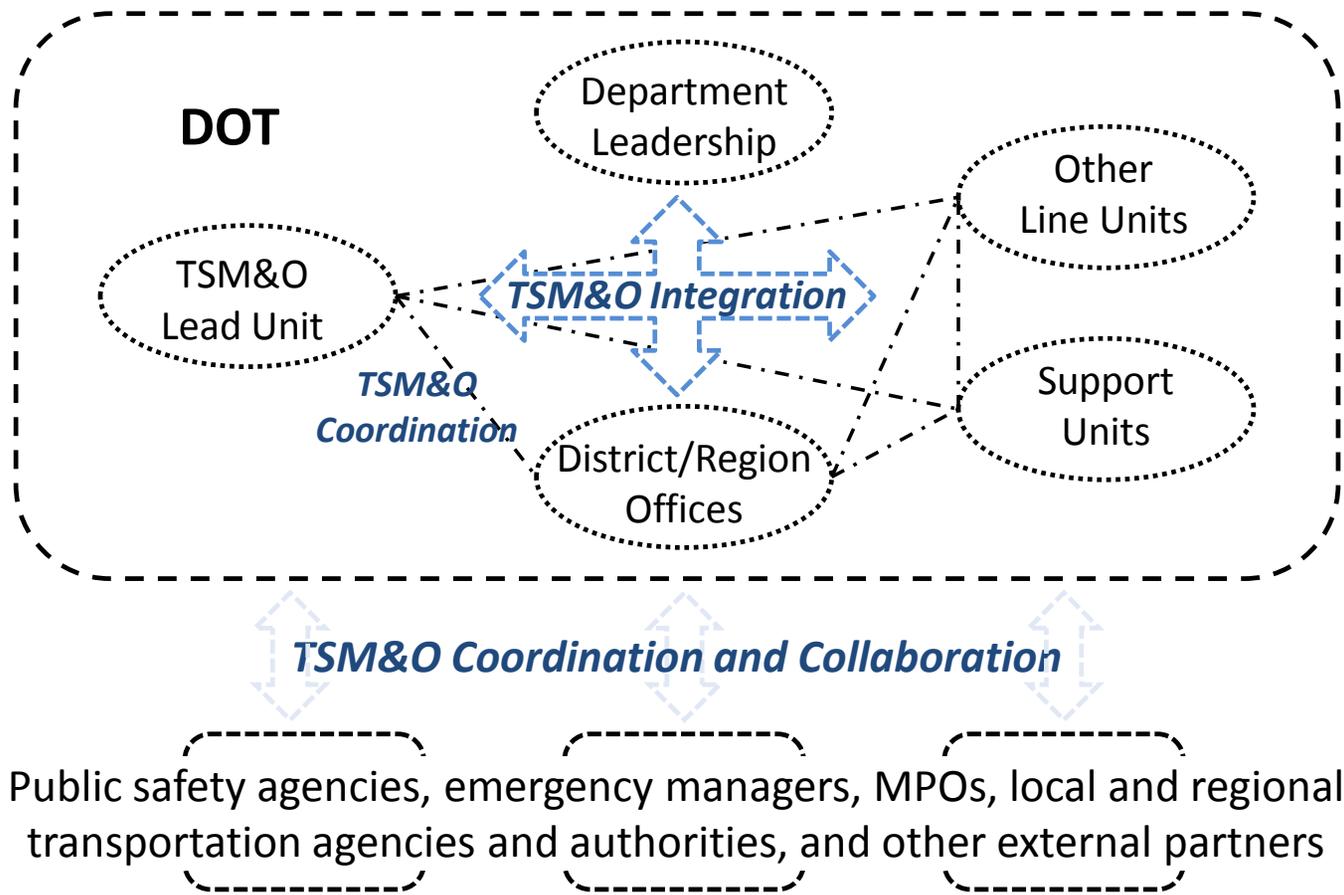
Additional State-of-Practice Observations

More detailed observations on the state of the practice are offered below, under five categorical headings that are used later in this report to help define the framework for TSM&O program planning and development:

- Mission, Vision, Goals, Objectives, and Performance Measures
- Leadership and Organization (including Integration, Coordination, and Collaboration)
- Resources (Financial, Human, Infrastructure, Technology)
- Business Processes
- Services, Projects, and Activities

Mission, Vision, Goals, Objectives, and Performance Measures

- As noted previously, the reviewed departmental mission/vision statements do not reflect significant shifts toward system management and operations. However, some DOTs have adopted at least a few goals and objectives that focus on system management and operations, and most of those same DOTs have adopted TSM&O-related performance measures. Only a few TSM&O programs within DOTs have separate, formal mission/vision statements, goals, or objectives, or performance measures beyond those used at the department level.
- The links between department-level strategic planning and TSM&O program planning and development seem weak or unclear. Several of the interviewees intend to become more involved in departmental strategic planning, but most TSM&O managers seem to feel that other internal coordination issues are more immediate.
- The limited success among state DOTs in articulating a TSM&O vision has focused internally, on a DOT *organizational* vision, without proposing a statewide vision that would be equally meaningful for all TSM&O stakeholders.



**Figure 4. State DOT Program for TSM&O:
Organizational Features and Critical Interfaces**

Leadership & Organization

- Much of the success of TSM&O to date is attributed to individual champions and sponsors. Attempts to institutionalize the shift toward TSM&O are increasing and some progress is being made, but many successes are credited to a particular Secretary/Director/Commissioner, Chief Engineer, other senior manager, or to dedicated and persuasive mid-level managers. For instance, the literature review identified some forward-thinking TSM&O related documents that now seem to be less influential within the respective departments than when prepared under previous administrations. Several instances were cited where a sponsor was able to overcome difficult resistance to change, as well as other situations where the absence of a sponsor or champion made implementation more difficult. Looking forward, most TSM&O managers believe that future success will continue to depend heavily on champions and sponsors.
- Policy makers are generally supportive of TSM&O and recognize the importance of operational improvements. Most seem to agree that the direct and indirect costs of capital intensive solutions are increasingly prohibitive, and significant revenue increases are seen as unlikely at least for the near term. However, some board members, elected officials, and other policy makers, even some senior executives, seem more *resigned* to the circumstances than *enthusiastic* about TSM&O. It appears that advocates need to offer more compelling justifications for operations improvements; be more positive than “it’s all we can afford;” and describe TSM&O initiatives in ways that capture the benefits—as investments with immediate, significant returns on investment.
- Virtually all of the contacted DOTs are working to clarify the relative responsibilities of “headquarters” and “regions/districts” for TSM&O and, concurrently, to improve the effectiveness of processes that require *shared* responsibilities between units in the two parts of the organization. Of course, similar statements regarding headquarters and field office relationships could be made relative to many topics in addition to TSM&O, but the issues seem especially important for TSM&O.

Very little information is available about this relationship in the literature, DOT websites are headquarters centric, and all but one of the DOT interviews conducted as part of this research were with headquarters personnel. Only one workshop participant was from a region office.

Many DOT representatives stressed the critical role of their regions/districts in the success of TSM&O, but most departments seem to rely almost exclusively on “good working relationships” built around personal contacts and informal coordination to ensure effective interaction between headquarters and field units. A few DOTs have created or plan to create formal TSM&O coordinating committees including region/district representatives. Florida DOT has conducted a series of structured TSM&O workshops to improve communication and shared understanding between headquarters and field offices, in some cases including local and regional agencies in the workshops.

- Integration, coordination, and collaboration are cited as critical for the success of TSM&O, but examples of success are limited. The idea of integration within the DOT seems to have almost universal support, but few specific measures were found to achieve integration. A noted exception was that Caltrans has a Director's Policy under consideration to make TSM&O considerations part of the job description for key positions throughout the department.
- DOTs seem to have solid working relationships with some of the important external partners for TSM&O, but DOTs do not seem to be making any special efforts to enhance those relationships or to build new partnerships. Most of the efforts to improve working relationships seem to be focused internally. In some cases, internal coordination was described as more challenging than coordination with external partners.

Many DOTs have effective working relationships with law enforcement and other public safety agencies, attributed largely to the experiences with traffic incident management. Those relationships are especially strong where the DOT and public safety agencies are collocated in joint operations centers. Many DOTs also have good working relationships with their state emergency management agency. DOT representatives are designated participants in the activities of MPOs, and DOT staff serve in numerous advisory roles, formal and informal, for local governments and regional organizations. However, it does not seem that DOTs are building on or expanding those existing relationships to advance TSM&O in a structured or deliberate way. Most of the interviewees agreed that the DOT should provide statewide leadership and support for TSM&O, but many questioned whether their department had adequate resources or standing for such efforts.

Resources (Financial, Human, Infrastructure, and Technology)

- The strain on DOT budgets is not just reducing the numbers and size of major capital improvement projects. TSM&O program development and TSM&O services, projects, and activities are also impacted. TSM&O must compete with other programs and priorities, and in some cases "cuts" are applied "across-the-board." Important human resource issues include recruiting, training, and retaining employees with skills needed for TSM&O positions, and the limited career paths available. Many DOTs are under pressure to reduce the size of their work force and/or to consider more outsourcing. Some rebalancing has been necessary between TSM&O-related positions filled by state employees and those filled through contracts. Concerns about technology and infrastructure resources revolve around needed replacements and upgrades for ITS devices and communication systems, establishing statewide standards and guidelines, consistency in the application of standards, and difficulties in making decisions when technology is changing so rapidly but decision-making processes are increasingly cumbersome.
- The costs of TSM&O proposals are sometimes questioned by policy-level officials as excessive, even though such projects are usually a fraction of typical capital costs and have higher benefit-cost ratios. Possible reasons, in addition to skepticism about the benefits, include: (1) highway operating and maintenance costs are not routinely considered as part of policy decisions about

capital funding, and are, therefore, not well understood; (2) capital projects often require a relatively small non-federal “match” (i.e., costs are viewed from a local/state perspective); (3) it may be easier for decision makers to relate personally to millions than to billions; and (4) operating funds are seen as “quickly spent” whereas capital funds are seen as “investments” with continuing value. Regardless of the reasons, it seems that more effort is needed to change such paradigms, to develop new tools for economic evaluation of alternatives, and to gain a higher level of confidence among policy makers.

Business Processes

- Of all the business processes important to TSM&O, “planning” has received the most attention in the literature and was frequently mentioned in the interviews. “Programming” was often included in the discussion as an extension of planning.

Many DOTs are working toward more effective integration of TSM&O into the ongoing long-range transportation planning processes, i.e., the type of planning that is carried out in the “planning division.” Many interviewees described efforts to establish closer working relationships between “operations” and the planning division. At least two DOTs (Washington State and Wisconsin) seem to have integrated TSM&O considerations into their long-range transportation plans. However, the extent to which those integrated plans have influenced budgets, allocation of other resources, and day-to-decision-making is unclear.

Some DOTs are also developing unique, separate processes for TSM&O planning, i.e. planning specifically for TSM&O services, projects, and activities, sometimes referred to as “Deployment Planning.” Numerous plans have been prepared for specific services, projects, and activities covered under the TSM&O umbrella—ITS Plans, Traffic Incident Management Plans, Traffic Operations Plans, Emergency Evacuation Plans, Special Events Plans. All states are required to have a Strategic Highway Safety Plan (SHSP) and other safety plans to qualify for federal funding. At least eight states have prepared plans that encompass multiple aspects of TSM&O. Some DOTs (including MnDOT and NZ Transport) have developed “operations” plans that address maintenance and TSM&O as a package.

Several planning issues seem to be intertwined. To what extent should TSM&O be integrated and/or coordinated with long-range transportation planning (LRTP)? Are separate TSM&O plans needed in addition, or instead? Who should lead TSM&O-specific planning, “operators” or “planners”? How can LRTP be effectively coordinated with TSM&O planning? What about planning for all aspects of “operations,” including maintenance? To facilitate discussion, Table 3 compares conventional long-range transportation planning and TSM&O “deployment planning” relative to scope, purposes, concepts, practices, stakeholders, and end products.

Table 3.-Comparison of Long Range Transportation Planning and TSM&O Planning

Long-Range Transportation Planning	Planning for TSM&O Services, Projects, and Activities (Deployment Planning)
Twenty year horizon	Three-ten year horizon
Capital improvements	Operating improvements
Infrastructure and related services	Services and related infrastructure
Multiple long-term goals and objectives	Focused goals and objectives that can be monitored in short term
Many stakeholders with direct and indirect interests	Most stakeholders are system users and service providers
Well established, broad-based networks for communication and coordination	New networks being created
Well organized interest groups	Unstructured interest groups
Future capacity required to meet future travel demand	Operating strategies to address current traffic delays, reliability, safety, and security
Predict future travel demands	Respond to (and attempt to modify) existing travel demands
Data needed from a few agencies, for selected dates, using averages	Data needed from multiple sources, continuously, using many statistical measures
A few critical, one-time decisions related to location, capacity, and design	Multiple, ongoing decisions, each involving multiple variables and interactions
Once built, cannot be moved	Continuously adaptable
Route/segment/project specific	Geographic area or system-wide
Capital programs	Operating budgets and staffing
Billions	Millions
Federal funds (and some state/local)	State and local funds (and some federal)
Comprehensive federal regulations, mandates, and prerequisites	No significant federal requirements; limited FHWA and SHRP 2 guidance
Decades of practice in all 50 states and most of the 340+ MPOs	A few years of practice in a few states and MPOs
Travel demand models	Traffic simulation models
Land use and socioeconomic factors	Traffic and safety performance measures
Cooperation and Coordination	Coordination and Collaboration
Planners and civil engineers	Managers, operators, and systems engineers

Formal education, training, certification, and career paths	On the job training
Popular view: New facilities are needed to deal with congestion	Popular view: What is TSM&O?
Decades of experience (the way we've always done it)	Limited experience (we've never done it)
Long-range consequences	Immediate consequences
Well-defined responsibilities and authority within agency span of control	Overlapping responsibilities and authority with significant external dependencies
Product (the plan) is separated from implementation by many years and many interim steps	Product (the plan) is used for immediate decision making and commitment of resources
AASHTO Standing Committee on Planning	AASHTO Subcommittee on Systems Operations and Management

- Another key business process for TSM&O is “Budgeting and Accounting.” Few DOT budgets include a TSM&O line item or identifiable category. TSM&O usually relies on informal arrangements for support from multiple line items rather than a specific, predictable line item. DOT budget processes tend to emphasize capital improvements. Accordingly, TSM&O managers have developed skills in packaging operational investment into “projects” to compete for funding as part of the project-focused budgeting processes. Likewise, TSM&O managers have learned to extract budget and accounting information from processes designed for project-based budgeting and accounting systems. These expedient solutions are not conducive to effective decision making or to effective financial planning. It appears that new or adapted processes are needed for budgeting and accounting for TSM&O purposes, but managers do not have the time and/or authority to pursue such changes.
- Some interviewees recognize the need for another business process that might be called “Communication, Marketing, and Outreach,” but little progress has been made in meeting that need. During interviews and conversations, numerous references were made to the need to better inform or educate key stakeholders and the public, or the need to “sell” TSM&O. The vast majority of those with direct responsibility for TSM&O agreed that advocacy is an important part of their responsibilities. However, no specific plans were found to develop business processes for communication or marketing or any other means of informing, educating, or selling, either internally or externally. More positively, targeted efforts such as FDOT’s series of district-level workshops could provide a foundation for on-going business processes for communication and marketing.

Services, Projects, and Activities

- Virtually every DOT provides at least a few TSM&O services (e.g., traveler information), has implemented at least a few TSM&O projects (e.g., deployment of ITS technologies), and carries

out a few TSM&O activities (e.g., maintenance of TSM&O infrastructure and technology). As described previously, these services, projects, and activities have evolved without structured program planning, and examples of TSM&O integration, coordination, and collaboration are limited. This is not to discount the significant accomplishments by the state DOTs in improving transportation system management and operations, but to suggest that these components of a structured TSM&O program can be even more successful if the services, projects, and activities are in alignment with mission, vision, goals, and objectives, contribute to measured performance, and are supported by effective leadership and organizational structures, effective business processes, and adequate resources.

Project Recommendations

Based on the literature review, review of state DOT websites, document scans, interviews and discussions with other professionals, the Beckman Center Workshop, and the assessment of the state of the practice, recommendations are offered below relative to each of the following:

- Articulated Needs for TSM&O Program Planning and Development
- Framework for TSM&O Program Planning and Development
- Potential Research Topics
- Path Forward

Articulated Needs for TSM&O Program Planning and Development

In much of the research for this project it seemed that the needs for TSM&O program planning and development were not apparent to all stakeholders or perhaps had not been clearly articulated. Therefore, Table 4 is recommended to describe those important needs in a concise format. These are the potential benefits of a TSM&O Program Plan. These are the purposes for which a DOT should invest in TSM&O program planning and development.

These needs are interrelated but each is important enough to warrant separate identification. Some of the listed needs may be more important than others depending on circumstances, and DOTs may wish to rewrite or reorder this list to reflect their own circumstances.

**Table 4. Needs for
TSM&O Program Planning for State DOTs**

1. Define (or clarify) program mission, vision, goals, objectives, and performance measures
2. Describe, contextualize, and interconnect program components and subcomponents
3. Establish (or clarify) organizational roles, responsibilities, and strategic relationships (internal and external)
4. Recommend and prioritize actions to improve program components and commit resources
5. Inform and influence internal stakeholders, TSM&O partners, policy makers, and customers
6. Increase responsiveness to changes that may redefine the DOT's roles and responsibilities

Framework for TSM&O Program Planning and Development

Table 5 illustrates the recommended “Framework for TSM&O Program Planning and Development” which includes five interrelated components:

- Mission, Vision, Goals, Objectives and Performance Measures
- Leadership and Organization
- Business Processes
- Resources (Financial, Human, Technology, & Infrastructure)
- Packages of Services, Projects, and Activities, with Related Policies and Guidelines

As indicated in Table 5, these components should be addressed as part of an ongoing, iterative process that is mutually supportive with other departmental plans and initiatives, builds on established relationships with other TSM&O stakeholders, and is adapted to the unique characteristics and circumstances of each DOT.

In a particular DOT, some of the framework components may already have been addressed, in whole or in part, by departmental strategic planning or other management initiatives. Likewise, TSM&O program planning may be able to provide needed input for other departmental plans or initiatives. The TSM&O Program Plan should also build on previous TSM&O-related plans (e.g., ITS Plan, TIM Plan) and should help implement recommendations from such plans as well as recommendations from CMM workshops, self-assessments, and recommendations from other organizations that share TSM&O responsibilities.

The program plan should address issues and provide guidance at the department level as well as for key units within the department. As noted previously, many DOTs are attempting to integrate TSM&O department-wide and, in parallel, to create distinct units with direct responsibilities for TSM&O services, projects, and activities and perhaps for TSM&O coordination among units. This means that each of the five framework components must address both department and unit-specific issues.

The TSM&O program planning process should take into account all of the department’s strengths, weaknesses, opportunities, and threats relative to TSM&O. Further, the commitment to program planning and subsequent implementation should be clearly established. To help ensure the development of a meaningful TSM&O Program Plan, Table 6 suggests a set of questions that a DOT should ask itself early in the planning process. The answers to these overarching questions will also help define a more detailed scope for the five components listed in Table 5 and discussed below.

Mission, Vision, Goals, Objectives and Performance Measures

Stated simply, all stakeholders need a clear understanding of what the department is trying to accomplish. Program planning should establish (or clarify) departmental mission, vision, goals, objectives, and performance measures relative to TSM&O and show how TSM&O considerations are in alignment with broader departmental considerations.

Table 5. Framework for TSM&O Program Planning and Development for State DOTs

Component	Description
	<p>TSM&O Program Planning should be an ongoing, iterative process within the context of other departmental plans and initiatives, relationships with TSM&O stakeholders, and other strengths, weaknesses, opportunities, and threats. In most DOTs, a primary goal will be to integrate TSM&O throughout the department. In parallel, distinct organizational units may have responsibility for specific TSM&O services, projects, and activities and for TSM&O coordination among other units. Program planning should also address external coordination and collaboration. State DOTs should address these and other overarching issues and questions (see Table 6) before attempting a TSM&O Program Plan.</p>
<p>1. Mission, Vision, Goals, Objectives, and Performance Measures</p>	<p>The Program Plan should be based on a clear understanding of what the department is trying to accomplish. TSM&O goals and objectives and performance measures should be visibly aligned with the department’s mission and vision. The lead TSM&O unit should have clear mission, vision, etc. The DOT should promote a shared, statewide vision among all TSM&O stakeholders.</p>
<p>2. Leadership and Organization</p>	<p>Leadership and organizational responsibilities and corresponding authority should be well defined, and the Program Plan should address topics such as department-wide integration of TSM&O, responsibilities of key organizational units, interaction with external stakeholders, and mechanisms for setting priorities and making other leadership decisions.</p>
<p>3. Business Processes</p>	<p>The Program Plan should identify the most important business processes for TSM&O success, evaluate each of those processes, and propose improvements to help ensure TSM&O success. Some of the processes will be departmental and will need to be adapted or have new variations added. In addition some entirely new processes may be needed to support TSM&O.</p>
<p>4. Resources (Financial, Human, Infrastructure, and Technology)</p>	<p>The available and needed resources should be systematically evaluated for all aspects of the TSM&O program. Constraints on those resources and the implications for the TSM&O program should be examined, and the Program Plan should include strategies to improve both the availability and effective use of key resources.</p>
<p>5. Packages of Services, Projects, and Activities with Related Policies and Guidelines</p>	<p>The Program Plan should broadly identify the packages of TSM&O services, projects and activities that would be most effective in accomplishing the DOT’s mission, vision, goals, and objectives. The Program Plan should also innumerate policies and decision-making guidelines for implementation of services, projects, and activities (e.g., warrants, priorities, service levels).</p>

Table 6. Overarching Questions for State DOTs Considering TSM&O Program Planning and Development

The recommended Framework for TSM&O Program Planning and Development provides a consistent, comprehensive approach for all states, but the context will be different for each DOT. Accordingly, DOTs should address the following questions early in the planning process:

- Are we committed to support TSM&O and to make changes recommended by a TSM&O Program Plan?
- Why is a TSM&O Program Plan important? What will it get us? What are we trying to accomplish? How will we explain the purpose to other stakeholders?
- What will be included in the TSM&O Program Plan? What will the Table of Contents look like? Will it include all of the components of the recommended “Framework for TSM&O Program Planning and Development for State DOTs”? Which of the components will be most important for our department?
- Who will lead the process? Who will be consulted? How will decisions be made? What role will the MPOs have? What role will FHWA have?
- How will we involve all of the key units in the department (e.g., planning, maintenance, construction, regions)? How will we ensure that each unit feels “ownership” when it is time for implementation?
- Do we need to make special provisions to involve the region/district offices? Will the TSM&O Program Plan provide the same level of guidance and direction to the region/district offices as to headquarters?
- What parts of the TSM&O Program Plan do we have already? What is our “point of departure”?
- Will this duplicate existing plans? How will this plan be linked and coordinated with existing plans (e.g., SHSP, LRTP, ITS, TIM)?
- What existing planning and decision-making processes need to be considered, incorporated, or accommodated (e.g., departmental strategic planning, STIP, TIP, Congestion Management Processes, legislative or regulatory initiatives)?
- How will we coordinate TSM&O Program Planning and Development with other initiatives (e.g., Asset Management, Performance Measurement, and Sustainability)?
- What have we learned from CMM Workshops and other self-assessments that should guide or be further addressed in the TSM&O Program Plan?
- How much will this cost and how long will it take?
- What are the risks of undertaking this effort? What happens if we don’t do this?
- Do we have the expertise needed to develop a TSM&O Program Plan? How do we assess our capabilities?

- What is the intended “status” when the TSM&O Program Plan is complete? “Accepted”? “Adopted”? “Endorsed”? By which organizations?
- What is the planning horizon? Should different components have different horizons? How often should the TSM&O Program Plan be updated?
- What are the constraints, givens, boundaries, sacred cows?
- Who are the audiences for the plan? Which are most important? Which have conflicting priorities? How can we manage expectations among stakeholders?
- How can we ensure that the TSM&O Program Plan (and the planning process) will help inform and influence the most important stakeholders? Who are the most important stakeholders? What about the Governor’s Office and the Legislature?
- What other DOTs have done this? What were their experiences and results?
- Who will execute the TSM&O Program Plan? What are the necessary steps or prerequisites for successful implementation? Will we have opportunities to “pilot” aspects of the program?
- How will we measure success? What will an A+ result look like?

Concurrently, program planning should establish (or clarify) the mission vision, goals, objectives and performance measures for the lead TSM&O unit and any other units with distinct TSM&O responsibilities. Program planning should ensure departmental and unit level alignment. All of these expressions of intent and the associated performance measures should be clear, officially adopted or endorsed, and widely distributed.

In addition to establishing an *organizational* vision for TSM&O, the department may want to lead the development of a comprehensive statewide TSM&O vision that is shared among *all* stakeholders at the state, regional, and local levels. Each stakeholder, including the DOT, should gain a better understanding of the roles of each of the other participants, the mutual dependencies, and the importance of cooperation, coordination, and collaboration.

Leadership and Organization

The Program Plan should ensure that leadership and organizational responsibilities (and the corresponding authority) are well defined. The planning process should candidly address organizational and decision-making issues and ensure that stakeholders have an opportunity to be heard and to influence the outcome. Such issues may include:

- Department-wide integration of TSM&O concepts and principles
- Development of an organizational unit(s) with lead responsibility for TSM&O
- Relative responsibilities of headquarters and region/district offices
- Responsibilities for TSM&O deployment planning

- Interaction with external stakeholders, expanding coordination and collaboration to enhance existing relationships and building new partnerships, and authority to speak for the department
- Reducing organizational dependence on champions and sponsors
- Mechanisms for setting priorities, resolving disagreements, and making other leadership and management decisions

The state of the practice review noted another important issue that might be addressed under the “Leadership and Organization” component—the less than enthusiastic support for TSM&O among some policy makers and organizational leaders. The symptoms were described in different ways—as skepticism about projected benefits, disproportionate scrutiny of costs, indifference, and a general sense that some leaders are resigned to TSM&O as a second-best approach because funding is so limited.

Some possible explanations and remedies are addressed in earlier sections of this report, and a new or revised business process for “Communication, Marketing, and Outreach” is suggested below. DOTs at different stages of organizational transition to TSM&O need different approaches to build leadership support. Regardless, the Program Plan offers an opportunity for proactive steps to improve the TSM&O “message” as well as the receptiveness of key decision makers, to purposefully change the paradigms and generate more enthusiasm and excitement for TSM&O as a way of doing business.

Business Processes

The Program Plan should identify the most important business processes for TSM&O success, evaluate each of the existing processes, and propose improvements or new processes to help ensure TSM&O success. The most important processes (existing or needed) will probably include all of the following:

- Planning for TSM&O Services, Projects, and Activities (i.e., Deployment Planning)
- Project Programming
- Budgeting and Accounting
- Procurement
- Systems Engineering
- Communication, Marketing, and Outreach
- Data Management
- Collaborating with External Partners
- Adapting to Rapid Changes in Vehicle Technology, Traveler Information, and System Operations

Many of these processes are departmental and are used by many organizational units (e.g., Budgeting and Accounting, Procurement). These will need to be adapted or have new variations to effectively support TSM&O. Other new or drastically modified processes will be needed (e.g., Adapting to Rapid Changes in Vehicle Technology, Traveler Information, and System Operations).

Some policy decisions will be required, and many of the process questions will lead to organizational questions. Who will “own” the process? Part of the question is whether “TSM&O Deployment Planning” will be carried out in the planning division or in an operations unit, but the department should also deal with the planning process and the differences between traditional long-range transportation planning and TSM&O Deployment Planning as summarized in Table 3.

As another example, the DOT almost certainly has a public information office, and “Communication, Marketing, and Outreach” sounds like a process that should or could be managed in the public information office. First, however, the department needs to clarify the purposes and expectations, and the process should be designed to best accomplish TSM&O goals and objectives. Questions about who owns the process should be secondary.

Resources (Financial, Human, Technology, & Infrastructure)

The program planning process should systematically evaluate the needed and available resources to support all aspects of the TSM&O program. Constraints on those resources, and the associated constraints on the program, should also be evaluated and described in the TSM&O Program Plan. The plan should include strategies to improve both the availability and effective use of all resources. In most cases, a staged, multi-year projection should be developed showing planned steps to improve resource availability and effective use.

Some of the “Resource” issues are likely to overlap with “Business Process” issues and will require intra-departmental coordination, especially with regard to Human Resources. Recruiting, training, developing, and retaining qualified TSM&O personnel will almost certainly be a human resource issue and will require interaction with DOT and state government human resource offices. To the extent that the DOT relies on outsourcing for human resources, procurement policies and procedures will be critical, requiring interaction with DOT and state procurement officers.

Packages of Services, Projects, and Activities with Related Policies and Guidelines

This component of the Program Plan should broadly identify the packages of TSM&O services, projects and activities that would be most effective in accomplishing the DOT’s adopted mission, vision, goals, and objectives. The plan should also describe policies and decision-making guidelines that will direct more detailed Deployment Planning for services, projects, and activities (e.g., warrants, priorities, service levels). In effect, this component should define the envelope and establish the foundation for subsequent TSM&O Deployment Planning.

As with other components, iteration will be important. Clear organizational responsibilities should be established for each set or package of services, projects, or activities. Several organizational units may need to share responsibilities for a particular service, project or activity, and collaboration with specific external partners may be critical to success. The associated demands on all categories of resources should be considered. Any unique requirements for business processes should be identified and addressed. No service, project and activity should be a candidate for subsequent deployment planning without systematic screening through the TSM&O Program Plan.

Potential Research Topics

Potential research topics related to TSM&O program planning and development are listed in Table 7. Several groupings of projects are shown (e.g., Businesses Processes, TSM&O Communication, Coordination and Collaboration) with the idea that a series of narrowly focused research projects might be more effective than a single, all encompassing project. Workshop participants were especially interested in ways to share “successful” or “best” practices, focusing on just a few topics per year.

Table 7 is not an exhaustive list of needed TSM&O research or even a priority list for such research. These topics reflect ideas and suggestions extracted from interview and workshop notes and from discussions about next steps to take advantage of opportunities and resolve problems. The intent is to provide examples and generate discussion as part of a more complete, systematic assessment of TSM&O research needs.

Table 7. Potential TSM&O Research Topics

Comprehensive

1. Guidance for TSM&O Program Planning for State DOTs
2. Pilot Development of TSM&O Program Plans
3. Guidance for Departmental Integration of TSM&O in Parallel with Development of Distinct TSM&O Organizational Units
4. TSM&O Program Planning in Coordination with Other DOT Initiatives and Mandates
5. TSM&O Deployment Planning: New Processes and Integration with Other DOT and Local Planning Efforts
6. Improving the Availability and Effectiveness of State Funding for TSM&O
7. Changing Roles of State DOTs: Benchmarking Other Industries and Organizations
8. Improving the Adaptability of State DOTs for Rapid Changes in Vehicle Technology, Traveler Information, and System Operations
9. Overcoming Cultural Challenges in the Transition to TSM&O-Oriented DOTs

Business Processes

10. Enhancement of State DOT Business Processes to Support TSM&O
11. Series on Enhancement of State DOT Business Processes to Support TSM&O
 - a. Effective Planning for TSM&O Services, Projects, and Activities (i.e., Deployment Planning)
 - b. Budgeting and Accounting

- c. Procurement
- d. Systems Engineering
- e. Communication and Marketing
- f. Data Management
- g. Collaboration with External Partners
- h. Adapting to Rapid Changes in Vehicle Technology, Traveler Information, and System Operations

TSM&O Communication

- 12. Business Case for TSM&O Program Planning in State DOTs
- 13. Justifying State DOT Investments in TSM&O
- 14. Framing TSM&O Benefit/Cost Analysis in Effective Language

Coordination and Collaboration

- 15. TSM&O Coordination and Collaboration between State DOTs and Other Agencies
- 16. Series on TSM&O Coordination and Collaboration between State DOTs and Other Agencies
 - a. State DOTs and MPOs
 - b. State DOTs and Other Local and Regional Agencies
 - c. State DOTs and the Freight Industry
 - d. State DOTs and the Emergency Management Community
 - e. State DOTs and the Digital Information Community

Successful Practices

- 17. TSM&O Successful Practices: Intra-Departmental Integration and Coordination of TSM&O
- 18. TSM&O Successful Practices: Coordination between Headquarters and Region Offices
- 19. TSM&O Successful Practices: Advancing TSM&O Through Departmental Strategic Planning
- 20. TSM&O Successful Practices: DOT Coordination and Collaboration with Other Agencies
- 21. TSM&O Successful Practices: State DOT's, Traffic Control Systems, and Vehicle Technologies
- 22. TSM&O Successful Practices: Data and Information Management

Path Forward

The final session of the Beckman Center Workshop focused on national steps to advance TSM&O Program Planning and Development for state DOTs. That theme was discussed further at the meeting of the NCHRP 20-07/345 Panel immediately following adjournment of the workshop.

The sense of both groups seemed to be that the need for TSM&O program planning has been confirmed, stakeholders are enthusiastic and prepared to support national efforts, and Task 345 has provided some additional foundational tools to complement the work of FHWA, AASHTO, and others. Much of the discussion revolved around the opportunities created by this convergence of recognized needs, the enthusiastic support, and basic tools that seem ready for further development and testing.

Ideas to move forward were consolidated under these seven broad headings:

1. National recognition and encouragement for TSM&O Program Planning
2. Guidance for TSM&O Program Planning
3. Pilot development of TSM&O Program Planning
4. Integration with CMM Workshops, Regional Operations Forums, FHWA TSM&O Planning Initiatives, NOCoE
5. Coordination among AASHTO, AMPO, NARC, and others
6. Priority TSM&O research
7. National community of practice for TSM&O (planning)

Table 8 on the following page is a suggested template for discussion of opportunities, roles, and responsibilities to turn these ideas into specific next steps. Many organizations, including individual state DOTs, can contribute, but progress at the national level will require leadership from key organizations, including the following:

- AASHTO Subcommittee on Transportation System Management and Operations (STSMO), formerly the Subcommittee on Systems Operations and Management (SSOM)
- Other AASHTO standing committees and subcommittees
- Federal Highway Administration (FHWA)
- National Operations Center of Excellence (NOCoE), the Institute of Transportation Engineers (ITE), ITS America, and the Transportation Research Board

Table 8. Advancing TSM&O Program Planning and Development: Roles of Key Organizations

	STSOM	Other AASHTO	FHWA	NOCoE & Other
1. National recognition and encouragement				
2. National guidance for TSM&O Program Planning (Framework+)				
3. Pilot development of TSM&O Program Plans (Framework+)				
4. Integration with CMM, ROFs, and other FHWA and NOCoE initiatives				
5. Coordination among AASHTO, AMPO, NARC, and others				
6. TSM&O research				
7. National community of practice for TSM&O Planning & Development				

Appendices

Appendix A

Excerpts from FHWA's *Transportation Planning for Operations*



Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach – A Guidebook

Presents an objectives-driven, performance-based approach for integrating M&O strategies into the metropolitan transportation plan (MTP) to maximize performance, fulfill Federal planning requirements, and meet customer needs.

<http://www.ops.fhwa.dot.gov/publications/fhwahop10026/index.htm>

"What is the FHWA-recommended approach for incorporating M&O into the metropolitan transportation planning process?"



Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference

Offers MPOs and their State and local partners a menu of options for incorporating operations into their plans. Provides an organized collection of sample operations objectives, performance measures, and excerpts of a metropolitan transportation plan incorporating operations.

<http://www.ops.fhwa.dot.gov/publications/fhwahop10027/index.htm>

"Where can I find sample objectives, performance measures, and a model plan for integrating operations into a transportation plan?"



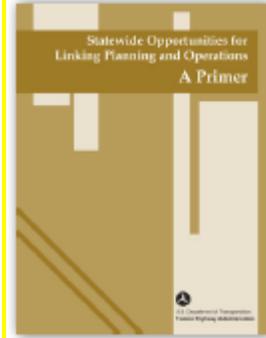
Statewide Opportunities for Integrating Operations, Safety, and Multimodal Planning: A Reference Manual

Provides "how-to" information to assist State DOTs in integrating these functional areas to produce better investment decisions. Identifies and describes opportunities at various levels of decision making – statewide, regional, corridor, and project – and the benefits of these approaches. Describes the benefits, challenges, stakeholders, and implementation actions for each opportunity. Also includes toolkits, case study examples, and self-assessment checklists at each level of decision making.

<http://www.fhwa.dot.gov/planning/statewide/manual/index.cfm>

"How can State DOTs integrate operations, safety, and planning?"

Statewide Opportunities for Linking Planning and Operations: A Primer



Highlights the benefits of linking planning for operations at the state level. Identifies and describes five major types of opportunities and provides case studies of successful practices. Also includes a self-assessment questionnaire to help State DOT planning and operational staff understand how well they are currently linking planning and operations.

"What are the best practices for integrating operations into planning at the state level?"

<http://ops.fhwa.dot.gov/publications/fhwahop08028/index.htm>

Regional Concept for Transportation Operations: The Blueprint for Action – A Primer

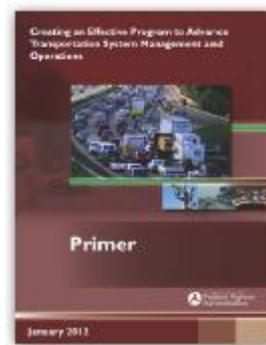


Introduces the Regional Concept for Transportation Operations, a management tool to help agencies think through, plan, and implement management and operations (M&O) strategies in a collaborative and sustained manner.

"How do we build a strategic plan to guide collaborative transportation efforts?"

<http://www.ops.fhwa.dot.gov/publications/rctoprimer/index.htm>

Creating an Effective Program to Advance Transportation System Management and Operations Primer



Offers high-level guidance on key program, process, and organizational capabilities that are essential to effective transportation system management and operations within agencies. It is aimed at program and activity-level managers responsible for M&O related activities in State, regional, and local transportation agencies. The "capability maturity" approach presented here identifies the key areas that impact program effectiveness: business processes, systems and technology, performance measurement, culture, organization and workforce, and collaboration.

"What capabilities does my agency need for a strong management and operations program?"

<http://www.ops.fhwa.dot.gov/publications/fhwahop12003/index.htm>

Appendix B

Excerpts from FHWA *Planning for Operations* Website

<http://ops.fhwa.dot.gov/travel/plan2op.htm>

Title and Description
A Primer - Statewide Opportunities For Linking Planning and Operations (HTML PDF 6.4MB) - 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. (Publication Number: FHWA-HOP-08-028)
Advancing Metropolitan Planning for Operations: An Objectives-Driven Performance-Based Approach – A Guidebook (HTML PDF 977KB) - This guidebook presents an approach for integrating management and operations (M&O) strategies into the metropolitan transportation planning process that is designed to maximize the performance of the existing and planned transportation system. (Publication Number: FHWA-HOP-10-026 February 2010)
Advancing Metropolitan Planning For Operations: Set Objectives Measure Progress See Results (HTML PDF 2MB) (Publication Number: FHWA-HOP-10-060)
Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations - A Desk Reference (HTML PDF 2.1MB) - This publication is a resource designed to enable transportation planners and their planning partners to build a transportation plan that includes operations objectives performance measures and strategies that are relevant to their region that reflect the community's values and constraints and that move the region in a direction of improved mobility and safety. (Publication Number: FHWA-HOP-10-027 April 2010)
Programming for Operations: MPO Examples of Prioritizing and Funding Transportation Systems Management & Operations Strategies (HTML , PDF 1.4MB) - This document discusses how metropolitan planning organizations have incorporated transportation systems management and operations projects into the programming phase of transportation investment decisionmaking in metropolitan areas.
Regional Concept for Transportation Operations: The Blueprint for Action - A Primer (HTML PDF 5MB) - A Regional Concept for Transportation Operations (RCTO) is a management tool to assist in planning and implementing management and operations strategies in a collaborative and sustained manner. Developing an RCTO helps partnering agencies think through and reach consensus on what they want to achieve in the next 3 to 5 years and how they are going to get there. The purpose of this document is to explain what an RCTO is the development of its elements and its applicability.
Statewide Opportunities for Integrating Operations Safety and Multimodal Planning: A Reference Manual (HTML PDF 1.8MB) - This publication is a reference manual designed to provide "how to" information to assist transportation professionals in taking actions to integrate these activities. It identifies and describes opportunities at various levels of decision making – statewide regional corridor and project - and the benefits of these approaches. It also highlights overarching themes such as the important role of multidisciplinary teams; data collection sharing and analysis; and broad use of performance measures within each of these levels. (Publication Number: FHWA-HOP-10-028 May 2010)

<p>Creating an Effective Program to Advance Transportation System Management and Operations: Primer (HTML PDF 2.9MB) (Publication Number: FHWA-HOP-12-003)</p>
<p>Capital District Transportation Committee Albany New York Case Study (HTML PDF 323KB) (Publication Number: FHWA-HOP-09-043)</p>
<p>Delaware Valley Regional Planning Commission Philadelphia Metropolitan Region Case Study (HTML PDF 306KB) (Publication Number: FHWA-HOP-09-044)</p>
<p>Wilmington Area Planning Council New Castle County Delaware and Cecil County Maryland Case Study (HTML PDF 340KB) (Publication Number: FHWA-HOP-09-045)</p>
<p>Metropolitan Transportation Commission San Francisco Bay Area Case Study (HTML PDF 455KB) (Publication Number: FHWA-HOP-09-047)</p>
<p>Regional Concept for Transportation Operations Fosters Planning For Operations in the Tucson Metropolitan Area Case Study (HTML PDF 403KB) (Publication Number: FHWA-HOP-09-048)</p>
<p>The Denver Region Traffic Signal System Improvement Program Case Study (HTML PDF 324KB) (Publication Number: FHWA-HOP-09-046)</p>
<p>Applying Analysis Tools in Planning for Operations (HTML PDF 1.6MB) (Publication Number: FHWA-HOP-10-001)</p>
<p>Developing Decisionmaker Support for Management and Operations at MetroPlan Orlando (HTML PDF 1.6MB) (Publication Number: FHWA-HOP-10-056)</p>
<p>Outcomes-Based Performance-Driven Planning at Metro Portland (HTML PDF 2.5MB) (Publication Number: FHWA-HOP-10-055)</p>
<p>Designing for Transportation Management and Operations: A Primer (HTML PDF 2.9MB) - This primer is focused on the collaborative and systematic consideration of management and operations during transportation project design and development. This is termed "designing for operations." Effectively designing for operations involves the development and application of design policies procedures and strategies that support transportation management and operations. The consideration of operations needs during the design process requires transportation design professionals to work closely with those with expertise in transportation operations intelligent transportation and transportation technology staff planning transit freight traffic incident management and other practitioners from multiple agencies to fully identify prioritize and incorporate operations needs into the infrastructure design. This primer introduces the concept for designing for operations and describes tools or institutional approaches to assist transportation agencies in considering operations in their design procedures as well as pointing out some specific design considerations for various operations strategies. (Publication Number: FHWA-HOP-13-013)</p>

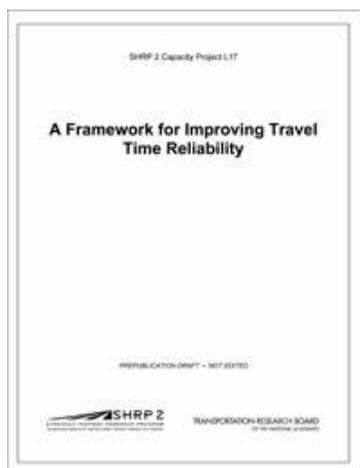
<p>An Interim Guidebook on the Congestion Management Process in Metropolitan Transportation Planning (HTML PDF 853KB) - This Interim Guidebook provides information on how to create an objectives-driven performance-based congestion management process. While the focus of this interim guidebook is on the congestion management process (CMP) the principles of objectives-driven performance-based planning can also be applied to other aspects of regional concern (safety economic development environment etc.) in an MTP. The CMP represents the "state-of-the-practice" in responding to the growing challenge of congestion on urban transportation networks. (Publication Number: FHWA-HOP-08-008)</p>
<p>Applying a Regional ITS Architecture to Support Planning for Operations: A Primer (HTML PDF MB) (Publication Number: FHWA-HOP-12-001)</p>
<p>Getting More by Working Together - Opportunities for Linking Planning and Operations: A Reference Manual (HTML PDF 5MB) - This resource guide is designed to help planning and operations managers understand the value of working together and realize the benefits of pursuing management and operations strategies at the regional scale. (Publication Number: FHWA-HOP-05-016)</p>
<p>Getting the Most from Your Transportation System Investments: Operating for Peak Performance (HTML PDF 1.1MB) (Publication Number: FHWA-HOP-10-030)</p>
<p>Integrating Demand Management into the Transportation Planning Process: A Desk Reference (HTML PDF 22MB) - The document has been developed to serve as a desk reference on integrating demand management into the transportation planning process. (Publication Number: FHWA-HOP-12-035)</p>
<p>Making the Connection: Advancing Traffic Incident Management in Transportation Planning (HTML PDF 2MB) The intent of this primer is to inform and guide traffic incident management (TIM) professionals and transportation planners to initiate and develop collaborative relationships and advance TIM programs through the metropolitan planning process. (Publication Number: FHWA-HOP-13-044)</p>
<p>Management & Operations in the Metropolitan Transportation Plan: A Guidebook for Creating an Objectives-Driven Performance-Based Approach (HTML PDF 1.79MB) - This Interim Guidebook is designed to provide a basis on which to integrate transportation system management and operations (M&O) into the metropolitan transportation planning process and to assist MPOs in meeting Federal requirements under SAFETEA-LU calling for M&O strategies to be incorporated into the metropolitan transportation plan (MTP). It highlights effective practices that result in an MTP with a more optimal mix of infrastructure and operational strategies founded on the inclusion of measurable performance-based regional operations objectives. (Publication Number: FHWA-HOP-08-007)</p>
<p>Operations Benefit/Cost Analysis Desk Reference (HTML PDF MB) (Publication Number: FHWA-HOP-12-028)</p>
<p>FHWA Operations Benefit/Cost Analysis Desk Reference: Real-World Examples of Application of the Guidance (HTML PDF 610KB) (Publication Number: FHWA-HOP-13-006)</p>
<p>FHWA Operations Benefit/Cost Analysis Desk Reference: Conducting Benefit/Cost Analysis of Strategies Impacting Non-Typical Traffic Conditions (HTML PDF 244KB) (Publication Number: FHWA-HOP-13-005)</p>
<p>FHWA Operations Benefit/Cost Analysis Desk Reference: Providing Guidance to Practitioners in the Analysis of Benefits and Costs of Management and Operations Projects (HTML PDF 1.1MB) (Publication Number: FHWA-HOP-13-004)</p>

<p>Operations Benefit/Cost Analysis TOPS-BC User's Manual – Providing Guidance to Practitioners in the Analysis of Benefits and Costs of Management and Operations Projects (HTML PDF 4.8MB) (Publication Number: FHWA-HOP-13-041)</p>
<p>Regional Concept for Transportation Operations: A Tool for Strengthening and Guiding Regional Transportation Operations Collaboration and Coordination (HTML DOC - 205KB) - This white paper is the first step in introducing and framing the idea of a Regional Concept for Transportation Operations. Subsequent work is planned involving many stakeholders and interest groups to explore its implications and more fully develop its scope in various settings. The result will be more detailed guidance for developing and using a Regional Concept for Transportation Operations.</p>
<p>Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety Reliability and Security (HTML PDF 4.98MB) - This primer was written for transportation professionals and public safety officials from cities counties and States who are responsible for day-to-day management and operations within a metropolitan region. It is intended to help agencies and organizations and the operations people within them understand the importance of regional collaboration and coordination how it happens and how to get started. (Publication Number: FHWA-OP-03-008)</p>
<p>The Collaborative Advantage: Realizing the Tangible Benefits of Regional Transportation Operations Collaboration (HTML PDF 3MB) - This manual uses nine collaborative efforts across the U.S. to illustrate the tangible benefits gained through key strategies such as sharing resources and expertise performing joint operations using common operations procedures and exchanging real-time information. The manual includes a six-step process to allow agencies to estimate their benefits of collaboration. (Publication Number: FHWA-HOP-08-001)</p>
<p>The Regional Concept for Transportation Operations: A Practitioner's Guide (HTML PDF 2MB) (Publication Number: FHWA-HOP-11-032)</p>
<p>The Role of Transportation Systems Management & Operations in Supporting Livability and Sustainability: A Primer (HTML PDF 5.7MB) - This primer describes the role of transportation systems management and operations (M&O) in advancing livability and sustainability. The document highlights the connections between M&O and livability and sustainability objectives and the importance of a balanced comprehensive approach to M&O in order to support those objectives. (Publication Number: FHWA-HOP-12-004 January 2012)</p>
<p>The Use of Operations Objectives and Performance Measures in Private and Public Organizations (HTML PDF 82KB) - This paper examines lessons and insights from private companies and public organizations that may apply to agencies in the United States working to advance transportation planning for operations using a strategic approach. (Publication Number: FHWA-HOP-10-029 February 2010)</p>

Appendix C

Selected SHRP 2 Reports Related to Organizing Transportation Agencies to Improve Reliability

Excerpts from: <http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/OrganizingTransportationAgencies.aspx>

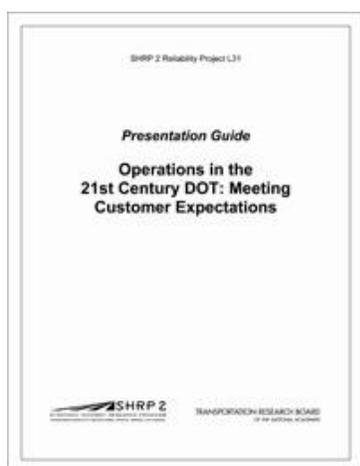


A Framework for Improving Travel Time Reliability (*SHRP 2 Project L17) Posted July 17, 2013

Transportation systems management and operations (TSM&O) strategies can improve travel time reliability, which yields both safety and economic benefits and improves road-user experience. To date, only a few transportation agencies have TSM&O programs to address travel time reliability, but a common understanding of the causes of unreliable travel times and the actions that can improve reliability have the potential to make TSM&O programs more widespread. To help move TSM&O into mainstream agency practice, A Framework for Improving Travel Time Reliability (SHRP 2 Project L17) created the L17 Knowledge Transfer System, a web-based tool designed to provide convenient one-stop access to the complete range of existing and new

TSM&O information. The KTS tool will be available for public use in a few months. This tool integrates products from SHRP 2 Reliability research projects and other sources of TSM&O information, and it provides an umbrella structure for incorporating the many individual elements of TSM&O. The [final report](#) describes the creation of the L17 Knowledge Transfer System, research about TSM&O, and branding and communication strategies for the web tool.

* To make research available as early as possible, SHRP 2 is temporarily posting final reports that have been submitted by the research team . . . These prepublication drafts, which have not been edited or formatted for publication, will be replaced by the final versions as they complete the editorial process.

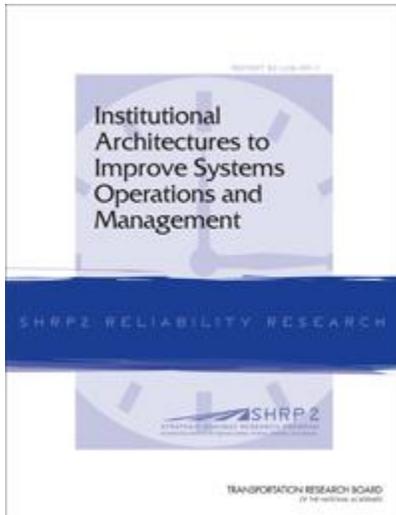


SHRP 2 Presentation and Guide: Operations in the 21st Century DOT: Meeting Customer Expectations (SHRP 2 Project L31)

Posted July 2, 2013

Operations strategies that improve how efficiently people and goods move throughout transportation systems can often be implemented relatively quickly and economically, especially when compared with new construction, as a strategy to reduce congestion. The presentation [Operations in the 21st Century DOT: Meeting Customer Expectations](#) and the accompanying [Presentation Guide](#) were created in SHRP 2 Project L31, Reliability Workshops for State and Public Sector Managers. These materials were created for presentations to the chief executive officers and senior managers of state departments of

transportation about the value of mainstreaming operations as a core mission and business practice in their agencies. The presentation is designed to be delivered within a 30-minute period and highlight not just the importance of transportation system operations but also tools that are now available through SHRP 2, the Federal Highway Administration (FHWA), and the American Association of State Highway and Transportation Officials (AASHTO) to assist states in advancing their state of practice in operations.

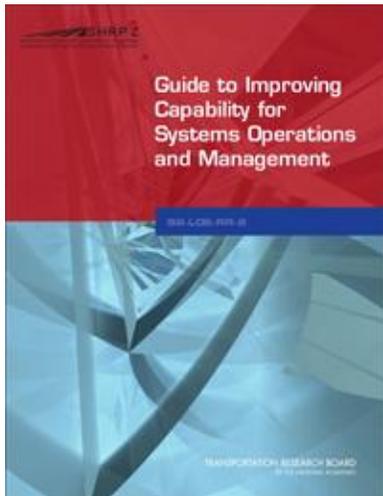


Institutional Architectures to Improve Systems Operations and Management (SHRP 2 Report S2-L06-RR-1)

Posted February 9, 2012

Strategies to improve travel time reliability often focus on highway operations. To be successful, operational strategies may require a collaborative and coordinated effort among many transportation organizations and within their key units. The purpose of SHRP 2 project L06: Institutional Architectures to Advance Operational Strategies, was to identify strategies by which transportation agencies can adjust their institutional architecture—including culture, organization and staffing, resource allocation, and partnerships—to support more effective systems operations and management (SO&M). SHRP 2 [Report S2-L06-RR-1](#): Institutional Architectures to Improve Systems Operations and Management,

identifies new organizational models. This report provides the basis for SHRP 2 Report S2-L06-RR-2: Guide to Improving Capability for Systems Operations and Management, including an examination of current state DOT practice and insights from other sectors with strong operational orientations. It establishes a systematic guidance framework based on the traceable relationships between the technical and business process features most supportive of effective SO&M and the institutional architecture that supports such processes.

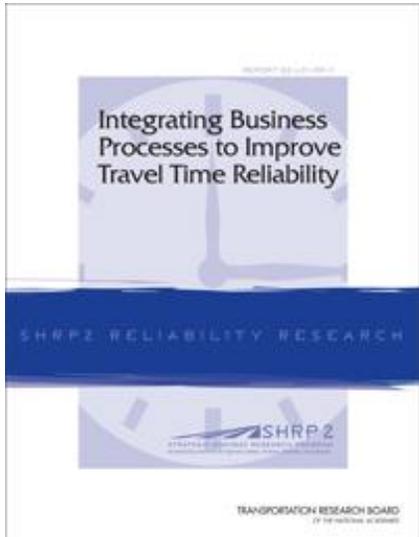


Guide to Improving Capability for Systems Operations and Management (SHRP 2 Report S2-L06-RR-2)

Posted November 17, 2011

The purpose of SHRP 2 [Report S2-L06-RR-2: Guide to Improving Capability for Systems Operations and Management](#) is to support transportation agencies in developing institutional arrangements to meet the special demands of congestion management, now emerging as a new transportation agency priority. In particular, the strategies appropriate to effective management of nonrecurring congestion present new challenges for agency policy, organization and staffing, resources, and partnerships, as well as for culture and leadership. This guide focuses on these special institutional challenges with a change management tool called the Institutional Capability Maturity

Model. The model starts with agency self-evaluation to determine the current circumstances and provides incremental strategies for evolving toward institutional arrangements most supportive of congestion management.

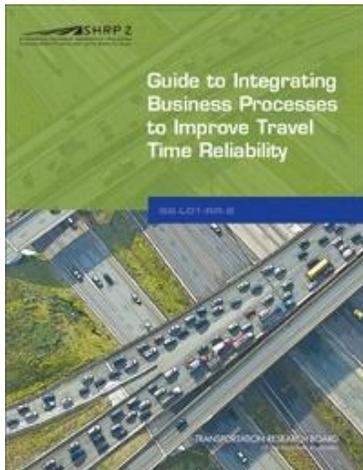


Integrating Business Processes to Improve Travel Time Reliability (SHRP 2 Report S2-L01-RR-1)

Posted October 3, 2011

Improving travel time reliability is an emerging business activity for transportation agencies in the United States. To improve the reliability of travel times on their roadway networks, transportation agencies must advance on a number of fronts. These include collecting and analyzing data; integrating travel time reliability considerations into planning, programming, and project delivery; adopting innovative operational strategies and technologies; and modifying their institutional structures and business practices surrounding traffic operations. SHRP 2 [Report S2-L01-RR-1: Integrating Business Processes to Improve Travel Time Reliability](#) addresses various ways that transportation agencies can reengineer their day-to-day business practices to

improve traffic operations, address nonrecurring traffic congestion, and improve the reliability of travel times delivered to roadway system users. This report, along with the accompanying guide (Report S2-L01-RR-2: [Guide to Integrating Business Processes to Improve Travel Time Reliability](#)) and other SHRP 2 Reliability products related to institutional structures and business process reengineering, is intended to help transportation agencies move forward in addressing nonrecurring traffic congestion and delivering more reliable travel times on their highway networks.



Guide to Integrating Business Processes to Improve Travel Time Reliability (SHRP 2 Report S2-L01-RR-2)

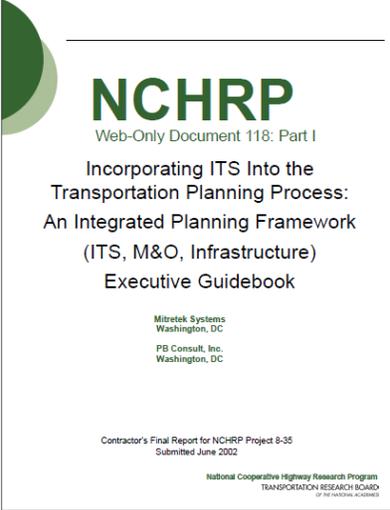
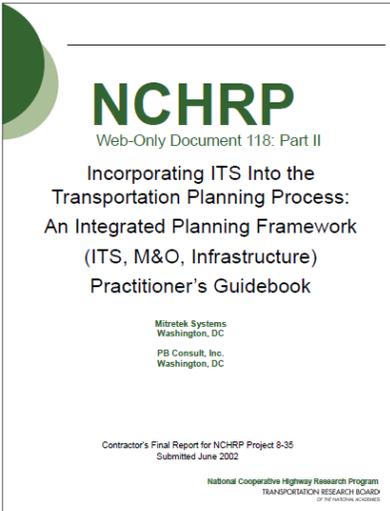
Posted September 6, 2011

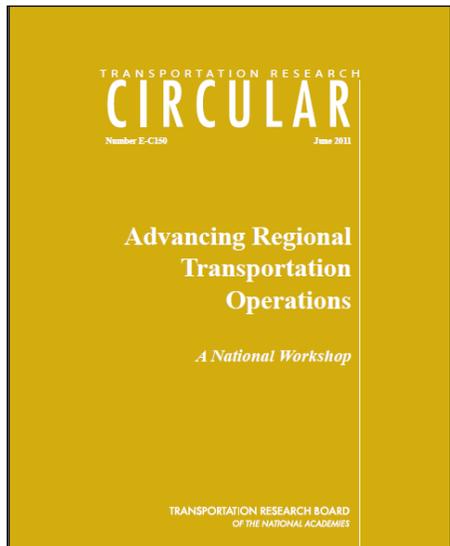
SHRP 2 Research [Report S2-L01-RR-2: Guide to Integrating Business Processes to Improve Travel Time Reliability](#) identifies influences that lead to process integration, common obstacles faced when implementing process integration, and an outline of the steps that can be referenced to implement and institutionalize processes. The steps reflect the need to define specific reliability goals, document current business processes and recommended changes, implement a process, measure outcomes against reliability goals, and institutionalize the process. The guide is not specific to any one process. Its purpose is to assist any agency that is seeking to improve travel time reliability

through improved coordination and integration of multiple processes and agencies.

Appendix D

Additional Transportation Research Board (TRB) Publications

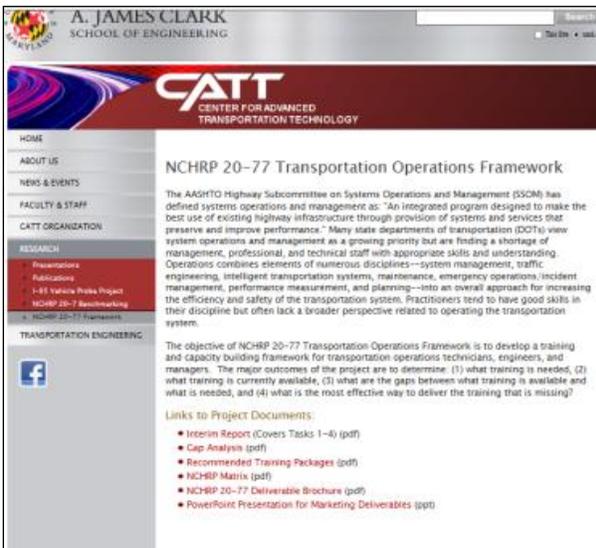
 <p>NCHRP Web-Only Document 118: Part I Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook</p> <p>Mitretek Systems Washington, DC PB Consult, Inc. Washington, DC</p> <p>Contractor's Final Report for NCHRP Project 8-35 Submitted June 2002</p> <p><small>National Cooperative Highway Research Program TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES</small></p>	<p>NCHRP Web-Only Document 118: Part I Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook</p> <p>Contractor's Final Report for NCHRP Project 8-35</p> <p>Submitted June 2002</p> <p>http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w118part1.pdf</p>
 <p>NCHRP Web-Only Document 118: Part II Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Practitioner's Guidebook</p> <p>Mitretek Systems Washington, DC PB Consult, Inc. Washington, DC</p> <p>Contractor's Final Report for NCHRP Project 8-35 Submitted June 2002</p> <p><small>National Cooperative Highway Research Program TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES</small></p>	<p>NCHRP Web-Only Document 118: Part II Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook</p> <p>Contractor's Final Report for NCHRP Project 8-35</p> <p>Submitted June 2002</p> <p>http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w118part2.pdf</p>



Advancing Regional Transportation Operations, A National Workshop
Transportation Research Circular
Number E-C150

June 2011

<http://onlinepubs.trb.org/onlinepubs/circulars/ec150.pdf>



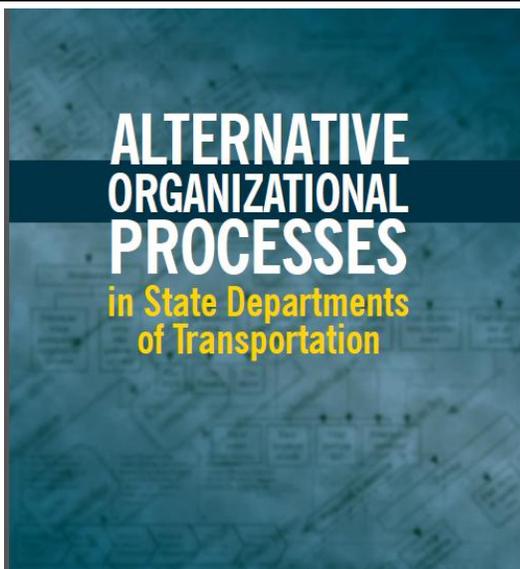
NCHRP 20-77 Transportation Operations Training Framework

Website (As of 1/27/2014)

<http://www.catt.umd.edu/research/transportation-operations-framework> (visited 11/4/13)

Links to Project Documents:

- Interim Report (Covers Tasks 1-4) (pdf)
- Gap Analysis (pdf)
- Recommended Training Packages (pdf)
- NCHRP Matrix (pdf)
- NCHRP 20-77 Deliverable Brochure (pdf)
- PowerPoint Presentation for Marketing Deliverables (ppt)



Alternative Organizational Processes for State Departments of Transportation

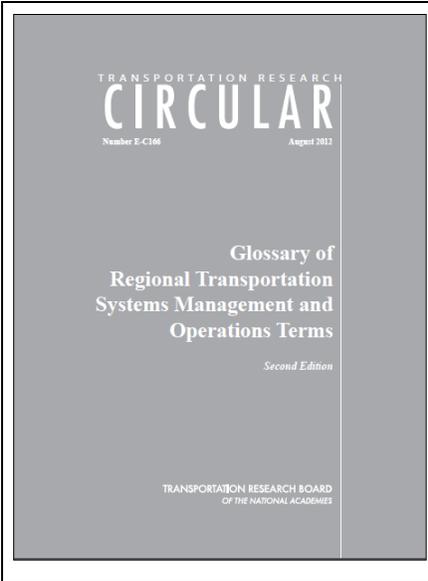
2009

The reported research was performed under NCHRP Project 20-24 (39)

(download from AASHTO)

https://bookstore.transportation.org/free_publications.aspx?ItemID=1409

<p>NCHRP Web Document 39 (Project SP20-24(14)): Contractor's Final Report</p> <p style="text-align: center;">Managing Change in State Departments of Transportation</p> <p style="text-align: center;">Scan 3 of 8: Innovations in Institutionalization of Operations</p> <p style="text-align: center;">Prepared for: National Cooperative Highway Research Program Transportation Research Board National Research Council</p> <p style="text-align: center;">Submitted by: Philip J. Tarnoff</p> <p style="text-align: right;">May 2001</p>	<p>Managing Change in State Departments of Transportation, Scan 3 of 8: Innovations in Institutionalization of Operations</p> <p>May 2001</p> <p>Managing Change in State Departments of Transportation NCHRP 20-24(14)</p> <p>http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-3.pdf</p>
<p>Project No. 20-24(20) COPY NO. XXX</p> <p style="text-align: center;">STRATEGIC PERFORMANCE MEASURES FOR STATE DEPARTMENTS OF TRANSPORTATION A HANDBOOK FOR CEOs AND EXECUTIVES FINAL REPORT</p> <p style="text-align: center;">Prepared for National Cooperative Highway Research Program Transportation Research Board National Research Council TransTech Management, Inc. 300 0nd St NE, Ste 220 Washington DC 20002 June 2003</p>	<p>Strategic Performance Measures for State Departments of Transportation: A Handbook For CEOs and Executives</p> <p>NCHRP 20-24(20)</p> <p>June 2003</p> <p>http://downloads.transportation.org/Quality-CEOHandbook.pdf</p>
<p style="text-align: center;">NCHRP PROJECT 20-24 (83): ALTERNATIVE DOT ORGANIZATIONAL MODELS FOR DELIVERING SERVICE</p> <p style="text-align: center;"><i>Prepared for:</i> American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Organizational Management (SOOM)</p> <p style="text-align: center;"><i>Prepared by:</i> Craig Secret and Joe Crosssett High Street Consulting Group, LLC Chevy Chase, MD Jessie Huang ICF International Fairfax, VA August 2012</p> <p style="text-align: center;"><small>The information contained in this report was prepared as part of NCHRP Project 20-24, Task 83, National Cooperative Highway Research Program.</small></p> <p style="text-align: center;"><small>SPECIAL NOTE: This report is NOT an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.</small></p>	<p>NCHRP Project 20-24 (83): Alternative DOT Organizational Models for Delivering Service</p> <p>August 2012</p> <p>http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-24(83)_FR.pdf</p>



**Glossary of Regional Transportation Systems
Management and Operations Terms,
Second Edition
Transportation Research Circular Number E-C166**

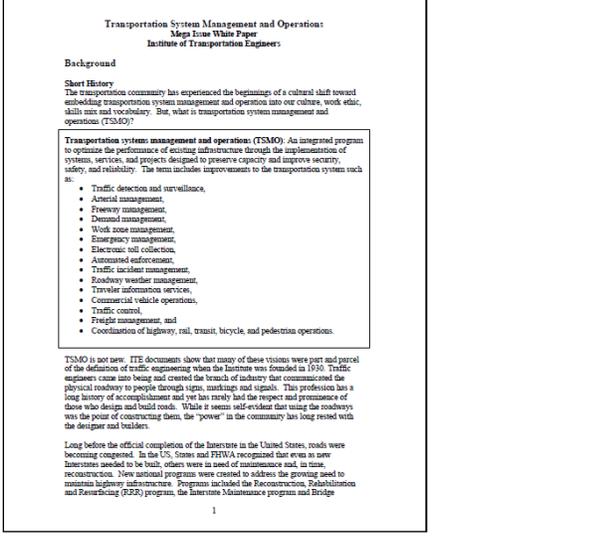
August 2012

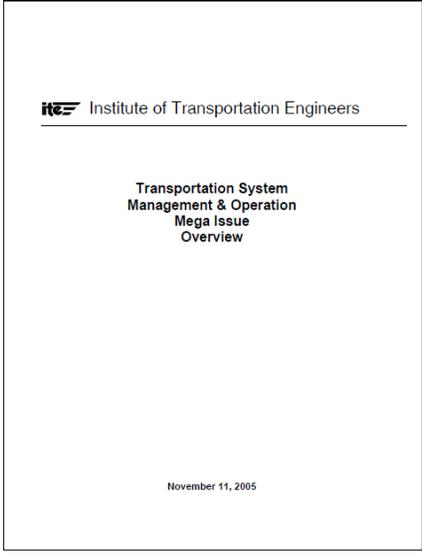
<http://onlinepubs.trb.org/onlinepubs/circulars/ec166.pdf>

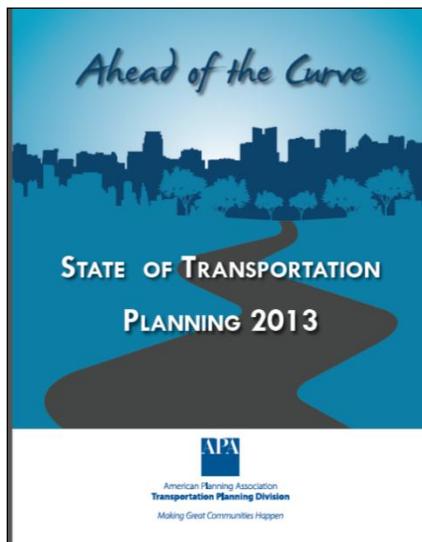
Appendix E

Miscellaneous Documents, Journal Articles, and PowerPoint Presentations

Miscellaneous Documents

 <p>The screenshot shows the website for the Road Network Operations Handbook. At the top, it says "Technical Committee on Network Operations" and "Introduction to road network operations and its component activities". Below this is a search bar and a "MAIN MENU" with options like "Network Operations", "1 Scope", "2 Delivery", "3 Role of ITS", "4 Handbooks", "ITS Handbook", "Network Operations", "Document Store", "Terminology", and "Acknowledgements". A "TOOLS" section includes "Contact Us", "Links", and "Search". The main content area is titled "Road Network Operations - Index" and "Table of Contents - Road Network Operations Handbook". It lists 16 numbered sections, including "1. Overview of Road Network Operations", "2. Road Network Operations", "3. Road Network Operation Tasks and Measures", and "4. ITS (Intelligent Transport Systems) in Road Network". On the right, there is a book cover for "MANUEL D'EXPLOITATION DES RESEAUX ROUTIERS" and "ROAD NETWORK OPERATIONS HANDBOOK".</p>	<h3>Road Network Operations Handbook</h3> <p>Website (As of 1/27/2014)</p> <p>Technical Committee on Network Operations, World Road Association/PIARC</p>
 <p>The screenshot shows the first page of the "Transportation System Management and Operations Mega Issue White Paper" by the Institute of Transportation Engineers. It includes a "Background" section, a "Short History" section, and a list of transportation systems management and operation (TSMO) activities. The TSMO activities listed are: Traffic detection and surveillance, Arterial management, Freeway management, Demand management, Work zone management, Emergency management, Electronic toll collection, Automated enforcement, Traffic incident management, Roadway weather management, Travel information services, Commercial vehicle operations, Traffic control, Freight management, and Coordination of highway, rail, transit, bicycle, and pedestrian operations. The document also contains a paragraph about the history of TSMO and the role of the Institute of Transportation Engineers.</p>	<h3>Transportation System Management and Operations, Mega Issue White Paper</h3> <p>2005</p> <p>Institute of Transportation Engineers</p> <p>http://www.ite.org/mega/M&Ofinal.pdf</p>

	<p>Transportation System Management and Operations, Mega Issue Overview</p> <p>November 11, 2005</p> <p>Institute of Transportation Engineers</p> <p>http://www.ite.org/mega/M&Osummary.pdf</p>
<p>Improving Transportation Systems Management & Operations: A Capability Improvement Workshop</p> <p>This memo provides a summary of the day-and-a-half Transportation Systems Management and Operations (TSM&O) Capability Improvement Workshop conducted on February 7–8, 2012 at the Broward County MPO. Attendees of the Workshop are listed at the end of this memo in Attachment 3.</p> <p>The purpose of the Workshop is to provide a consensus evaluation of the state of play and promising next steps in advancing the effectiveness of the region's TSM&O efforts. The Workshop identified the current levels of capability regarding key processes, organization, staff and collaboration issues that may assist the region in defining the priorities among an array of possible actions to improve regional TSM&O efforts.</p> <p>The tables that follow provide a summary of the consensus issues and views of the participants regarding current level of maturity and key improvement actions to get to the next level. The articulation of these views and comments are documented as brief bulleted points in order to minimize interpretation by the facilitation team.</p> <p>Note that the summary tables presented herein offer the region an opportunity to identify participants and leads for each potential action plan initiative.</p> <p>The memo that follows the summary tables was provided as background for the workshop attendees, describing the concept, intent and structure of the Workshop.</p> <p>The workshop was facilitated by Steve Lockwood of Parsons Brinckerhoff and Phil Tarnoff, a private consultant, with assistance from Reno Giordano of Parsons Brinckerhoff and Erin Flanagan of Cambridge Systematics. It is part of a series of workshops sponsored by FHWA. Further information on the concepts and guidance used in the workshop is available at ashito.com/guidance.org.</p>	<p>Improving Transportation Systems Management & Operations: A Capability Improvement Workshop (Broward County)</p> <p>Date of Workshop: February 7–8, 2012</p> <p>http://www.dot.state.fl.us/trafficoperations/TSMO/documents/District_4/SFL%20TSM&O%20Capability%20Improvement%20Workshop%20Memo%20FINAL_F2.pdf</p>
<p>Improving Transportation Systems Management & Operations: A Capability Improvement Workshop</p> <p>This memo provides a summary of the day-long Transportation Systems Management and Operations (TSM&O) Capability Improvement Workshop conducted on September 20, 2012 at the Portland Metro Regional Center.</p> <p>The purpose of the Workshop was to develop a consensus evaluation of the state of play and promising next steps in advancing the effectiveness of the region's TSM&O efforts. The Workshop participants identified the current levels of capability regarding key processes, organization, staff and collaboration issues that may assist the region in defining the priorities among an array of possible actions to improve regional TSM&O efforts.</p> <p>A special Overview Session entitled "Street Smart Communities: Managing Great Places to Live, Work and Travel" was held prior to the workshop, providing background on TSM&O and its potential benefits to improving the environment and facilitating livability and sustainability.</p> <p>The tables below provide a summary of the consensus issues and views of the participants in the Workshop regarding current level of capability and key improvement actions to get to the next level. The articulation of these views and comments are documented as brief bulleted points as they were made by participants, without interpretation by the facilitation team.</p> <p>These summary tables identify the key actions needed to improve TSM&O in the Portland region. It can be used as the basis for a regional action plan and identification of key leads for each action.</p> <p>In addition to the summary tables, several related items are attached:</p> <ul style="list-style-type: none"> • The pre-workshop background memo provided for the workshop attendees, describing the concept, intent and structure of the Workshop (Attachment 2) • Attendees of the Workshop (Attachment 3) • A partial list of attendees at the Overview Session (Attachment 4) <p>The workshop was facilitated by Steve Lockwood and Gary Euler of Parsons Brinckerhoff, with assistance from Reno Giordano of Parsons Brinckerhoff and Erin Flanagan of Cambridge Systematics. It is part of a series of workshops sponsored by FHWA. Further information on the concepts and guidance used in the workshop is available at ashito.com/guidance.org.</p>	<p>Improving Transportation Systems Management & Operations: A Capability Improvement Workshop (Portland)</p> <p>Date of Workshop: September 20, 2012</p> <p>http://library.oregonmetro.gov/files//portland_ts mo_capability_improvement_workshop_summary_final.pdf</p>

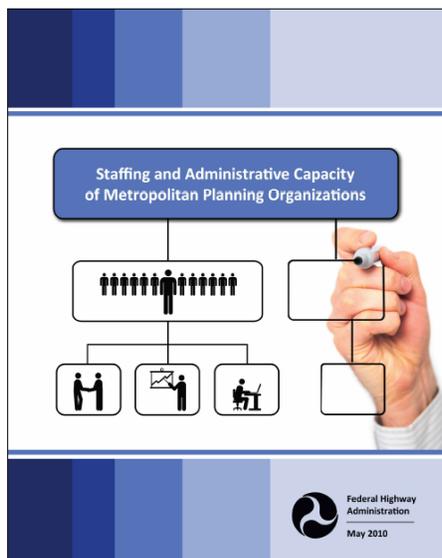


Ahead of the Curve: State of Transportation Planning 2013

American Planning Association, Transportation Planning Division, April 2013

April 2013

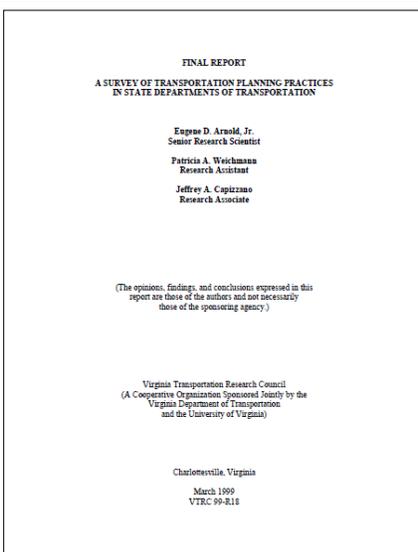
<http://www.mpoac.org/documents/aheadofthecurve.pdf>



Staffing and Administrative Capacity of Metropolitan Planning Organizations

May 2010

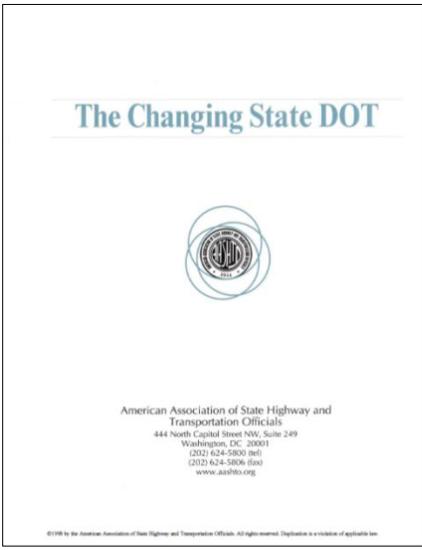
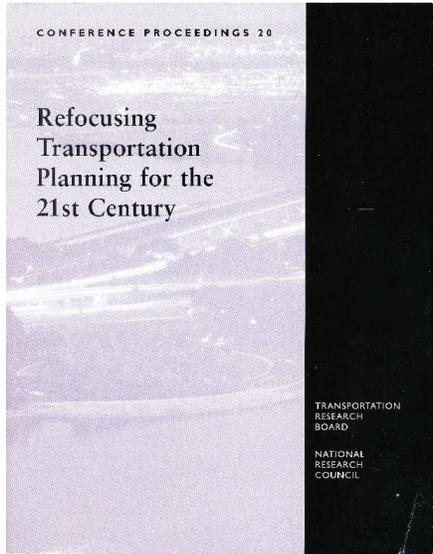
[http://www.cutr.usf.edu/programs/pcm/files/2010-05-Staffing and Administrative Capacity of MPOs.pdf](http://www.cutr.usf.edu/programs/pcm/files/2010-05-Staffing%20and%20Administrative%20Capacity%20of%20MPOs.pdf)



Final Report, A Survey of Transportation Planning Practices in State Departments of Transportation VTRC 99-R18

March 1999

http://www.virginiadot.org/vtrc/main/online_reports/pdf/99-r18.pdf

 <p>The Changing State DOT</p> <p>American Association of State Highway and Transportation Officials 444 North Capitol Street NW, Suite 249 Washington, DC 20001 (202) 624-5900 (tel) (202) 624-5806 (fax) www.aashto.org</p> <p><small>©1998 by the American Association of State Highway and Transportation Officials. All rights reserved. Duplication is a violation of applicable law.</small></p>	<p>The Changing State DOT</p> <p>1998</p> <p>AASHTO</p> <p>Order: https://bookstore.transportation.org/item_details.aspx?ID=1035</p>
 <p>CONFERENCE PROCEEDINGS 20</p> <p>Refocusing Transportation Planning for the 21st Century</p> <p>TRANSPORTATION RESEARCH BOARD NATIONAL RESEARCH COUNCIL</p>	<p>Refocusing Transportation Planning for the 21st Century. Proceedings of Two Conferences: Washington, D.C., February 7-10, 1999 and Irvine, California, April 25-28, 1999</p> <p>(not available electronically)</p>

Journal Articles

Ankner , William D., "Commentary: Revisiting Transportation Planning," Public Works Management & Policy, Vol. 9 No. 4, April 2005, 270-277

Charles, Phil, Luis Ferreira, and Ronald John Galiza, "Improving Traffic Systems Strategy and Operations Using a Capability Maturity Approach," Australian Transport Research Forum 2011 Proceedings, 28 - 30 September 2011, Adelaide, Australia.
http://www.atrf11.unisa.edu.au/Assets/Papers/ATRF11_0128_final.pdf (As of 2/17/2014)

Denney, Richard W. and Paul R. Olson, "Traffic Signal Operations Reviews: Common Threads." IMSA Journal, Mar.-Apr. 2013, pp. 26-32

Heanue, Kevin E. and Edward Weiner, "Metropolitan Transportation Planning: An Abbreviated History of the First 50 Years," TR NEWS 283, November-December 2012, pp. 28-36.

Lockwood, Stephen, "Institutional Architectures to Improve Transportation Systems Management and Operations: Guidance for State Departments of Transportation," TR News 284, January-February 2013, pp. 14-22.

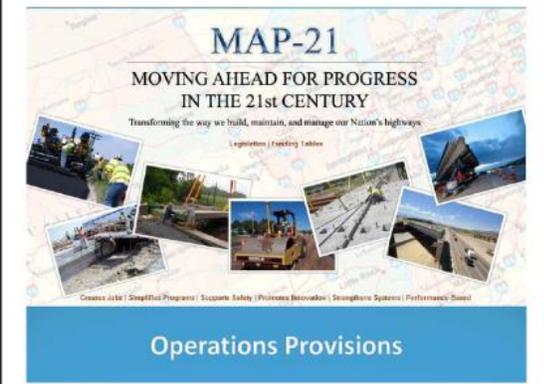
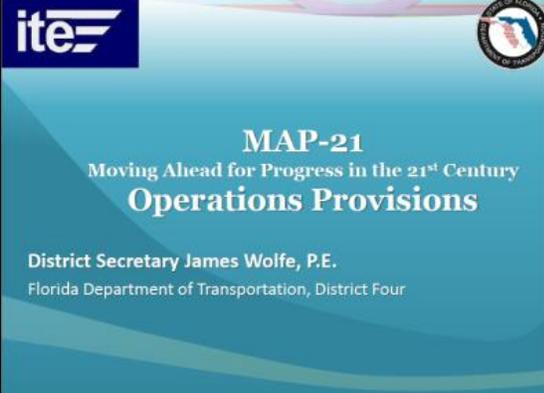
Morris, Michael H., "How to Take Adoption of Transportation Systems Management and Operations to the Next Level," ITE Journal, September 2008, pp. 18-22.

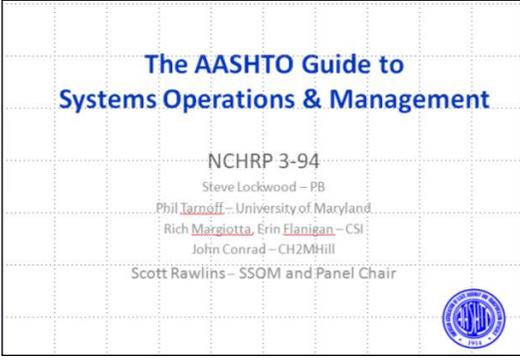
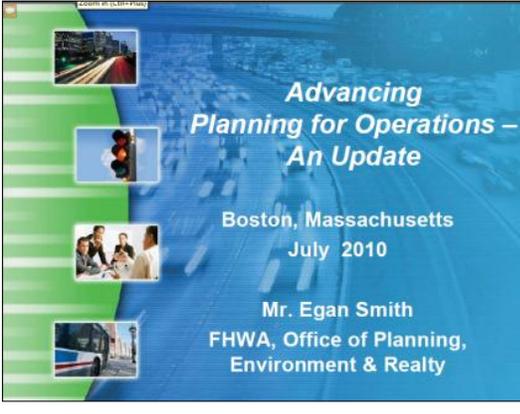
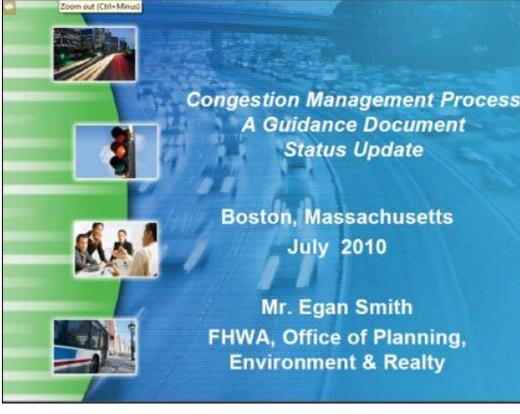
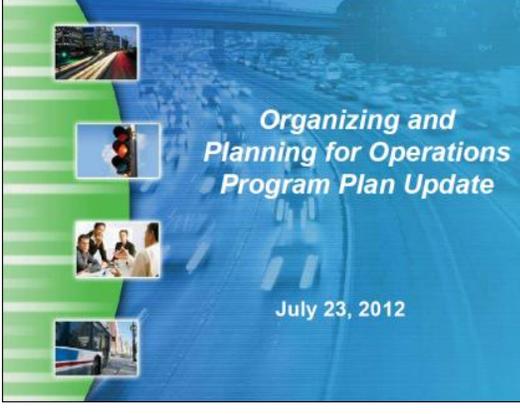
Pisarski, Alan E., "Working Through the Evolving Legacy of Metropolitan Transportation Planning," TR NEWS 283, November-December 2012, p. 27.

Poorman, John P. "A Holistic Transportation Planning Framework for Management and Operations," ITE Journal, May 2005, pp. 28-32.

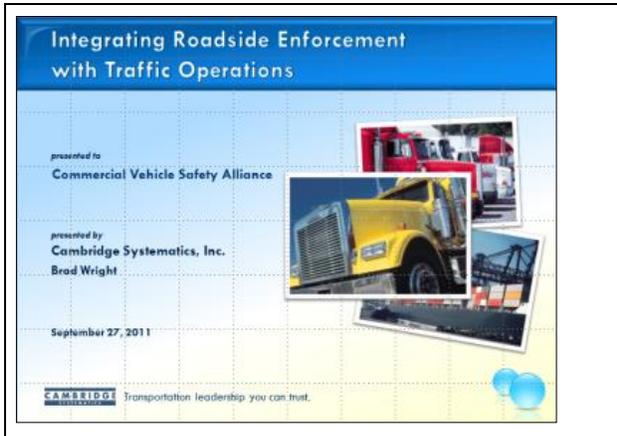
Tebow, Lonnie, "Pointing in the Right Direction-Traffic Signal Operations Reviews," IMSA Journal, Mar.-April. 2013 pp. 10-11.

PowerPoint Presentations

 <p>The slide features a map of the United States in the background. At the top, it reads "MAP-21 MOVING AHEAD FOR PROGRESS IN THE 21st CENTURY" with the subtitle "Transforming the way we build, maintain, and manage our Nation's highways". Below this, there are several small images showing highway construction and maintenance. At the bottom, a blue banner contains the text "Operations Provisions".</p>	<p>MAP-21: Operations Provisions</p> <p>http://www.fhwa.dot.gov/map21/docs/30aug_ops_tsm.pdf</p>
 <p>The slide has a blue gradient background. On the left is the ITE logo. On the right is the Florida Department of Transportation logo. The main text reads "MAP-21 Moving Ahead for Progress in the 21st Century Operations Provisions". Below that, it says "District Secretary James Wolfe, P.E. Florida Department of Transportation, District Four".</p>	<p>MAP-21 Moving Ahead for Progress in the 21st Century Operations Provisions</p> <p>District Secretary James Wolfe, P.E. Florida Department of Transportation, District Four (ITE)</p> <p>http://www.floridasectionite.org/Archives/Summer2013/ITE6-13Wolfe.pdf</p>
 <p>The slide has a dark blue background with a light blue wave at the top. It features the U.S. Department of Transportation logo and text: "U.S. Department of Transportation Federal Highway Administration Federal Transit Administration". The main title is "Moving Ahead for Progress in the 21st Century Act (MAP-21) – Statewide and Metropolitan Planning" in green. At the bottom right, it says "September 7, 2012".</p>	<p>Moving Ahead for Progress in the 21st Century Act (MAP-21)—Statewide and Metropolitan Planning</p> <p>September 7, 2012</p> <p>http://www.fhwa.dot.gov/map21/docs/07sep_planning.pdf</p>

 <p>The AASHTO Guide to Systems Operations & Management</p> <p>NCHRP 3-94 Steve Lockwood – PB Phil Tarnoff – University of Maryland Rich Margiotta, Erin Flanigan – CSI John Conrad – CH2MHill Scott Rawlins – SSOM and Panel Chair</p> 	<p>The AASHTO Guide to Systems Operations & Management, NCHRP 3-94</p> <p>April 2005</p> <p>Steve Lockwood – PB Phil Tarnoff – University of Maryland Rich Margiotta, Erin Flanigan – CSI John Conrad – CH2MHill Scott Rawlins – SSOM and Panel Chair</p>
 <p>Advancing Planning for Operations – An Update</p> <p>Boston, Massachusetts July 2010</p> <p>Mr. Egan Smith FHWA, Office of Planning, Environment & Realty</p>	<p>Advancing Planning for Operations—An Update</p> <p>Egan Smith, FHWA</p> <p>July 2010</p> <p>http://www.ampo.org/assets/1004_eganampo.pdf</p>
 <p>Congestion Management Process A Guidance Document Status Update</p> <p>Boston, Massachusetts July 2010</p> <p>Mr. Egan Smith FHWA, Office of Planning, Environment & Realty</p>	<p>Congestion Management Process: A Guidance Document, Status Update</p> <p>Egan Smith, FHWA</p> <p>July 2010</p> <p>http://www.ampo.org/assets/1003_fhwacmpguidebookstatusupd.pdf</p>
 <p>Organizing and Planning for Operations Program Plan Update</p> <p>July 23, 2012</p>	<p>Organizing and Planning for Operations, Program Plan Update</p> <p>July 23, 2012</p> <p>Organizing and Planning for Operations – FHWA Program Update</p>

 <p>AASHTO SSOM Webinar September 16, 2011</p>	<p>AASHTO SSOM Webinar</p> <p>September 16, 2011</p> <p>http://ssom.transportation.org/Documents/Master%20Presentation,%20SSOM%20webinar.pdf</p>
<p>SCOH “Operations” Breakfast Meeting 2013 AASHTO Annual Meeting</p> <p>Room: Governors Square 16 Sheraton Hotel Denver, Colorado 7:30 AM – 9:00 AM Saturday October 19, 2013</p> 	<p>AASHTO SCOH “Operations” Breakfast Meeting 2013 AASHTO Annual Meeting</p> <p>October 19, 2013</p> <p>http://maintenance.transportation.org/Documents/2013_AASHTO%20AM_SCOH%20Ops%20Breakfast%20Meeting_Final%20Draft-mv1_jh.pdf</p>
 <p>TSM&O Programs What is TSM&O and How is It Being Applied?</p> <p>presented to Southern District ITE</p> <p>presented by Kenny Voorhies Cambridge Systematics</p> <p>April 15, 2012</p> <p>Transportation leadership you can trust.</p> 	<p>TSM&O Programs: What is TSM&O and How is It Being Applied?</p> <p>April 15, 2012</p> <p>presented to Southern District ITE; presented by Kenny Voorhies, Cambridge Systematics</p> <p>http://sdite.org/presentations2012/1B-VOORHIES--Transportation_Systems_Management_and_Operations.pdf</p>
<p>AASHTO Special Committee on Transportation Security & Emergency Management</p> <p>Summary of 2010 State DOT Security/Emergency Management Survey Results</p> <p>Final Contractor’s Report May 2011</p>	<p>Summary of 2010 State DOT Security/ Emergency Management Survey Results</p> <p>May 2011</p> <p>Final Contractor’s Report</p> <p>AASHTO Special Committee on Transportation Security & Emergency Management</p> <p>http://scotsem.transportation.org/Pages/StateDOTSUrveyResults.aspx</p>

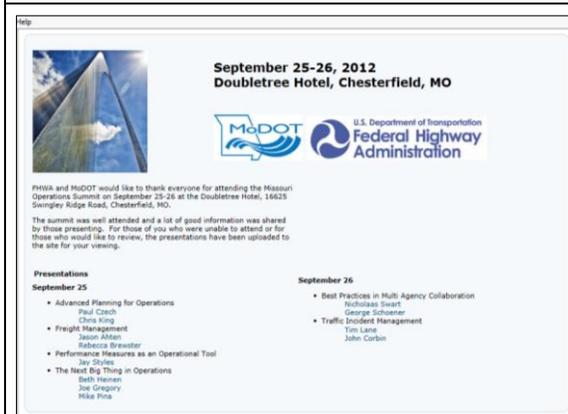
	<p>Integrating Roadside Enforcement with Traffic Operations</p> <p>Presented to Commercial Vehicle Safety Alliance Presented by Cambridge Systematics Inc, Brad Wright</p> <p>September 27, 2011</p> <p>www.cvsa.org/annual/docs/2011/08 CVSA%20Presentation_Wright.pptx</p>
	<p>Transportation Systems Management and Operations: TSM&O, National Overview</p> <p>Florida DOT</p> <p>http://www.dot.state.fl.us/trafficoperations/TSMO/documents-workshop/National%20TSMO%20Workshop%20Presentation.pdf</p>
	<p>Transportation Systems Management and Operations (TSM&O)</p> <p>August 2, 2011</p> <p>Elizabeth Birriel, P.E. Florida Department of Transportation</p> <p>http://www.ntoctralks.com/file_cabinet/download/0x000096450?1370629016</p>
	<p>Transportation Systems Management and Operations, TSM&O</p> <p>Elizabeth Birriel, P.E. Florida Department of Transportation</p> <p>http://www.dot.state.fl.us/trafficoperations/TSMO/documents-workshop/TSMO_%20Workshop-Executive_Presentation.pdf</p>



MN/DOT Highway Systems Operations Plan Update

Sue Lodahl, Mn/DOT
Andrew Mielke, SRF Consulting Group

<http://www.cts.umn.edu/events/conference/2011/documents/presentations/15-lodahl.pdf>



Missouri Operations Summit, MoDOT and FHWA, September 25, 2012

Advanced Planning for Operations

[Paul Czech](#)

[Chris King](#)

Freight Management

[Jason Ahten](#)

[Rebecca Brewster](#)

Performance Measures as an Operational Tool

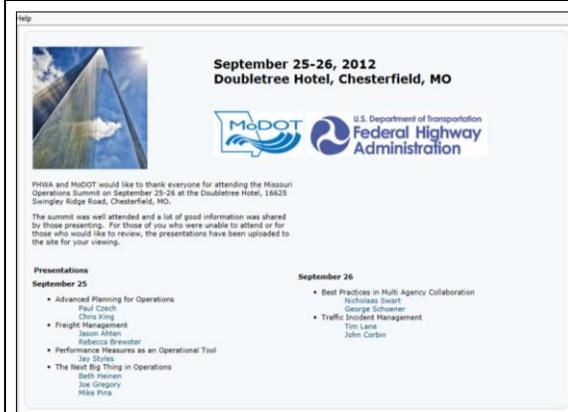
[Jay Styles](#)

The Next Big Thing in Operations

[Beth Heinen](#)

[Joe Gregory](#)

[Mike Pina](#)



Missouri Operations Summit, MoDOT and FHWA, September 26, 2012

Best Practices in Multi Agency Collaboration

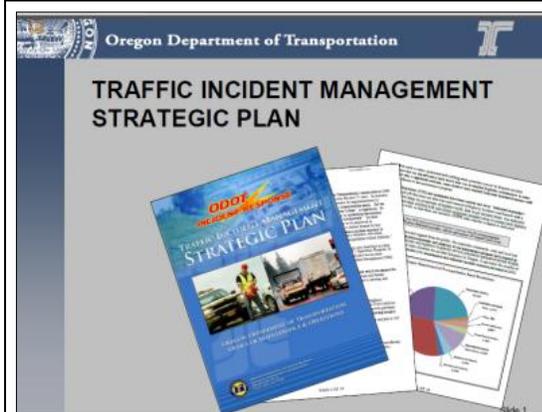
[Nicholaas Swart](#)

[George Schoener](#)

Traffic Incident Management

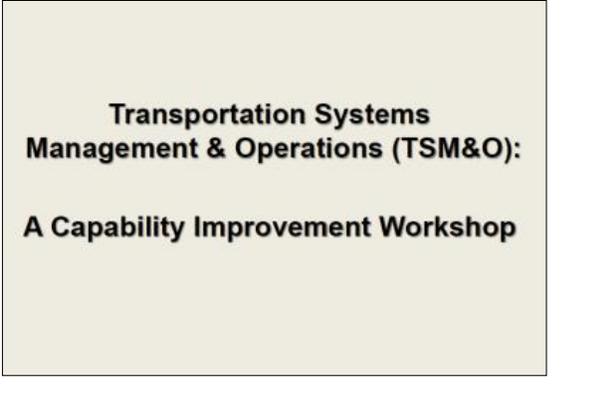
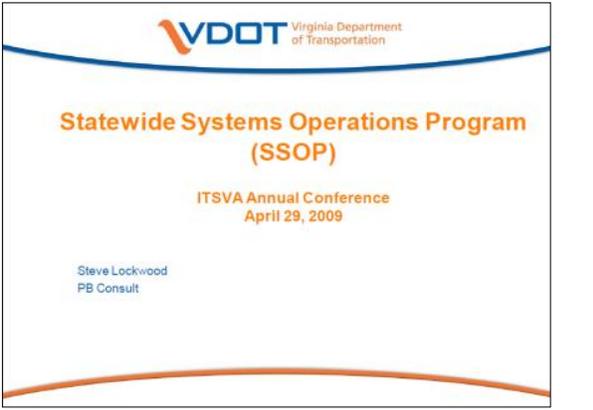
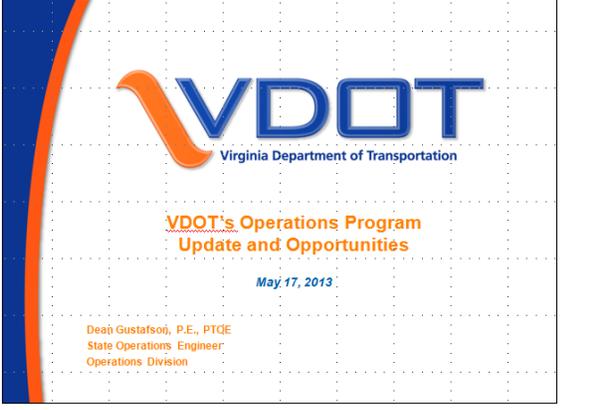
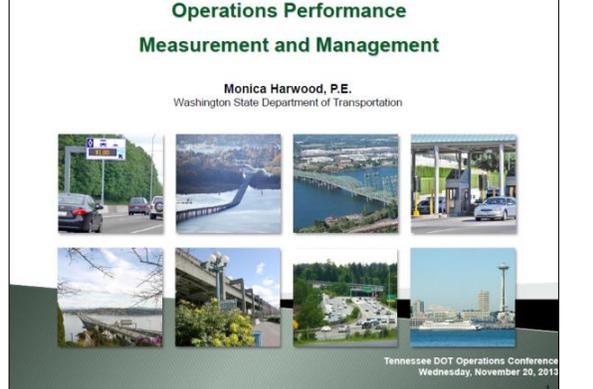
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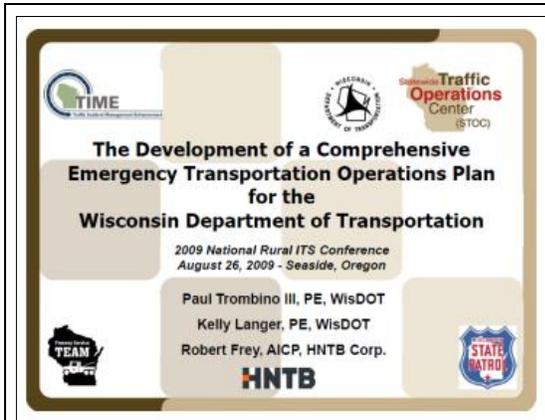
[John Corbin](#)



Oregon DOT Traffic Incident Management Strategic Plan

http://www.oregon.gov/ODOT/TD/TP_RES/docs/2012NWTC/2012NWTC_Presentations/22_TrafficIncidentPlan.pdf

 <p>Transportation Systems Management & Operations (TSM&O): A Capability Improvement Workshop</p>	<p>Transportation Systems Management & Operations (TSM&O): A Capability Improvement Workshop (Portland)</p> <p>http://library.oregonmetro.gov/files//portlandworkshoppresentfinal.pdf</p>
 <p>VDOT Virginia Department of Transportation</p> <p>Statewide Systems Operations Program (SSOP)</p> <p>ITSVA Annual Conference April 29, 2009</p> <p>Steve Lockwood PB Consult</p>	<p>Statewide Systems Operations Program (SSOP) ITSVA Annual Conference</p> <p>April 29, 2009</p> <p>Steve Lockwood, PB Consult</p> <p>http://www.itsva.org/resources/files/2009_Presentations/15_Lockwood.pdf</p>
 <p>VDOT Virginia Department of Transportation</p> <p>VDOT's Operations Program Update and Opportunities</p> <p>May 17, 2013</p> <p>Dean Gustafson, P.E., PTOE State Operations Engineer Operations Division</p>	<p>VDOT's Operations Program, Update and Opportunities</p> <p>May 17, 2013</p> <p>Dean Gustafson, P.E., PTOE State Operations Engineer</p> <p>www.itsva.org/meetings/2013/presentations/Gustafson.pptx</p>
 <p>Operations Performance Measurement and Management</p> <p>Monica Harwood, P.E. Washington State Department of Transportation</p>  <p>Tennessee DOT Operations Conference Wednesday, November 20, 2013</p>	<p>Operations Performance Measurement and Management</p> <p>Monica Harwood, P.E. Washington State Department of Transportation</p> <p>Wednesday, November 20, 2013</p> <p>http://www.tdot.state.tn.us/incident/conference2013/Strategies%20for%20Completing%20Performances%20in%20Mobility%20Management.pdf</p>

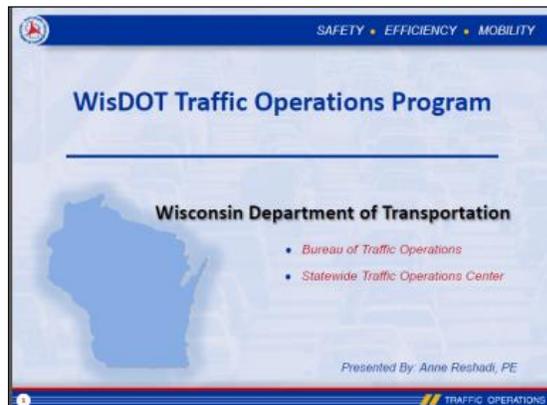


The Development of a Comprehensive Emergency Transportation Operations Plan for the Wisconsin Department of Transportation

2009 National Rural ITS Conference
August 26, 2009 - Seaside, Oregon

Paul Trombino III, PE, WisDOT
Kelly Langer, PE, WisDOT
Robert Frey, AICP, HNTB Corp.

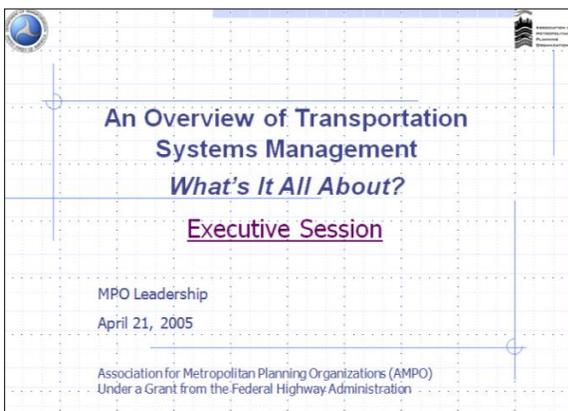
http://www.nritsconference.org/downloads/Presentations09/E2_Frey.pdf



WisDOT Traffic Operations Program

Presented by Anne Reshadi, P.E.

<http://tdawisconsin.org/data/publications/wisdot.ppt>

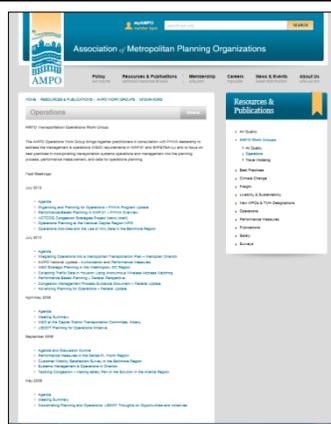


An Overview of Transportation Systems Management *What's It All About?*

Executive Session, MPO Leadership

April 21, 2005

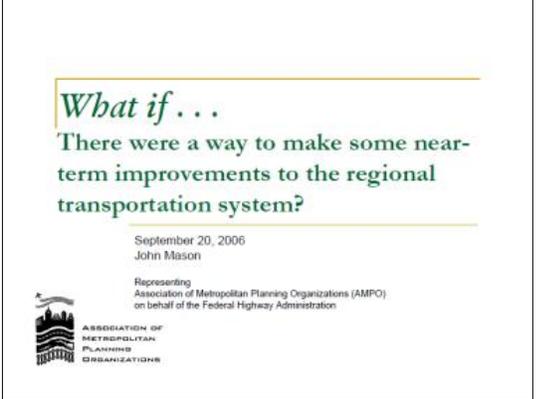
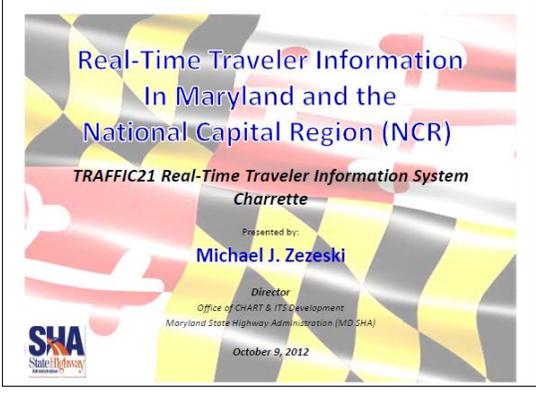
www.ampo.org/assets/38_executivesessionampoapr18.ppt



AMPO Transportation Operations Work Group

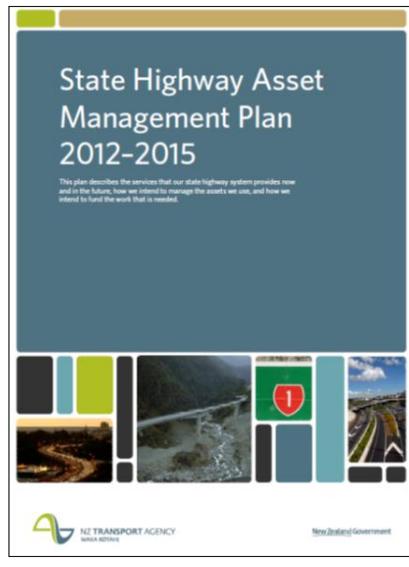
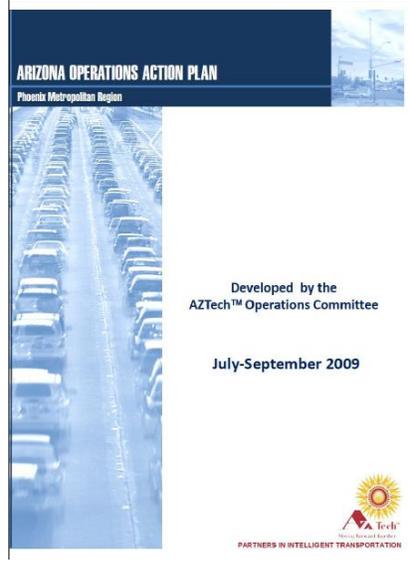
Links to Presentations

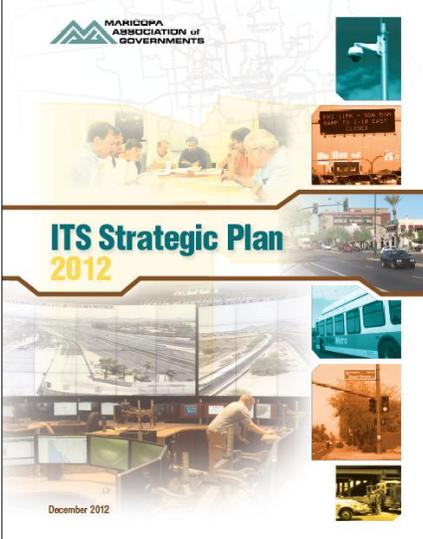
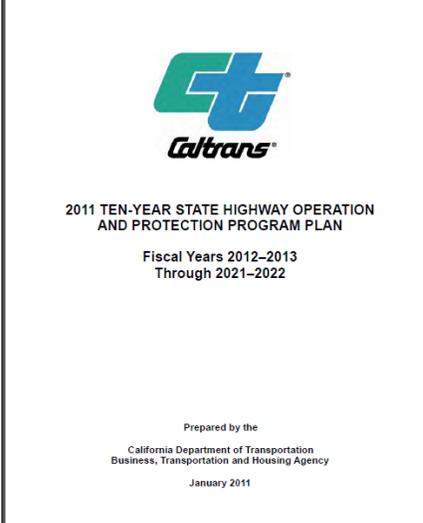
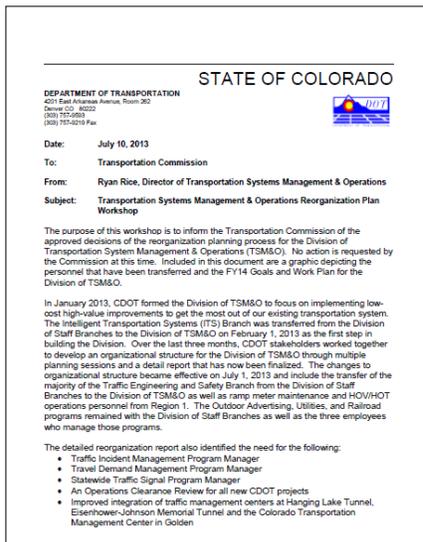
<http://www.ampo.org/resources-publications/ampo-work-groups/operations/> (As of 1/27/14)

<p>Update on Operations Planning at the National Capital Region Transportation Planning Board</p> <p>Andrew J. Meese, AICP Systems Management Planning Director Metropolitan Washington Council of Governments National Capital Region Transportation Planning Board</p> <p>Presentation to the AMPO Operations Work Group July 24, 2012</p>	<p>Update on Operations Planning at the National Capital Region Transportation Planning Board</p> <p>Andrew J. Meese, AICP</p> <p>Presentation to the AMPO Operations Work Group July 24, 2012</p> <p>http://www.ampo.org/assets/1747_meeseintegratingoperation.pdf</p>
 <p><i>What if . . .</i> There were a way to make some near-term improvements to the regional transportation system?</p> <p>September 20, 2006 John Mason</p> <p>Representing Association of Metropolitan Planning Organizations (AMPO) on behalf of the Federal Highway Administration</p> <p>ASSOCIATION OF METROPOLITAN PLANNING ORGANIZATIONS</p>	<p>Presentation to the National Capital Region Transportation Planning Board (TPB)</p> <p><i>What if . . .</i></p> <p>September 20, 2006</p> <p>John Mason, Representing Association of Metropolitan Planning Organizations (AMPO) on behalf of FHWA</p> <p>http://www.mwcog.org/uploads/committee-documents/jllWVIY20060914152931.pdf</p>
 <p>Real-Time Traveler Information In Maryland and the National Capital Region (NCR)</p> <p>TRAFFIC21 Real-Time Traveler Information System Charrette</p> <p>Presented by: Michael J. Zezeski Director Office of CHART & ITS Development Maryland State Highway Administration (MD SHA)</p> <p>October 9, 2012</p> <p>SHA State Highway Administration</p>	<p>Real-Time Traveler Information in Maryland and the National Capital Region (NCR)</p> <p>October 9, 2012</p> <p>http://connectedvehicle.itsa.wikispaces.net/file/view/Zezeski Real-Time+Traveler+Information+in+MD+10-03-12.pdf</p>
 <p>The Future of TMC Operations</p> <p>Steve Kuciemba Parsons Brinckerhoff October 24, 2011</p> <p>Managing the Big Picture</p> <p>PARSONS BRINCKERHOFF</p>	<p>The Future of TMC Operations</p> <p>October 24, 2011</p> <p>Steve Kuciemba, Parsons Brinckerhoff</p> <p>http://www.ibtta.org/files/PDFs/Kuciemba_Steve.pdf</p>

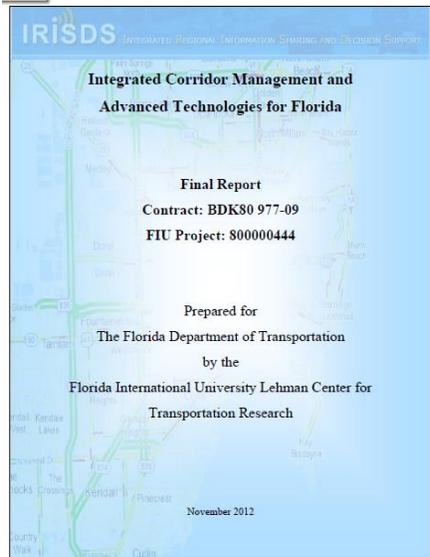
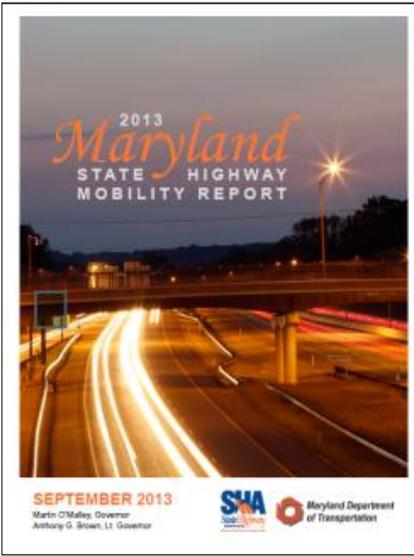
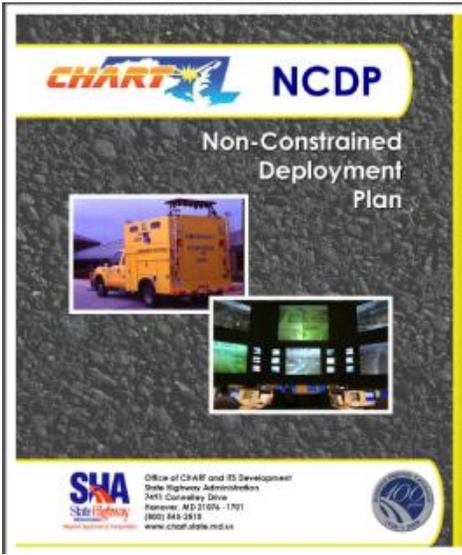
Appendix F

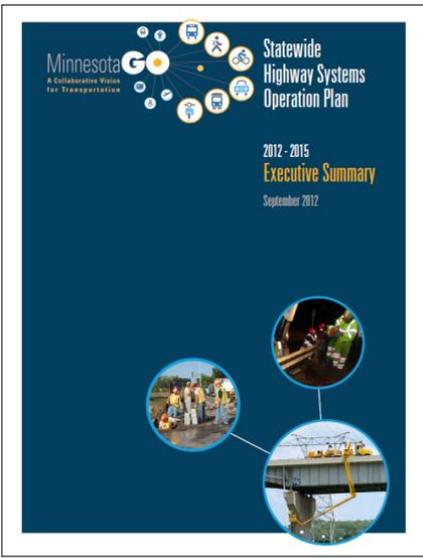
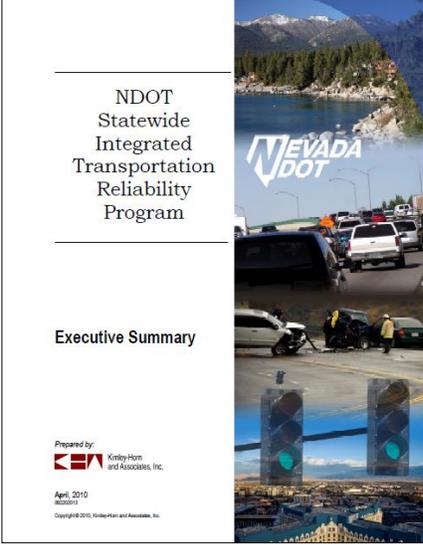
State and Regional Plans and Documents Related to TSM&O

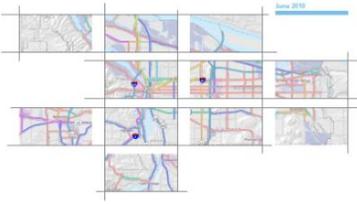
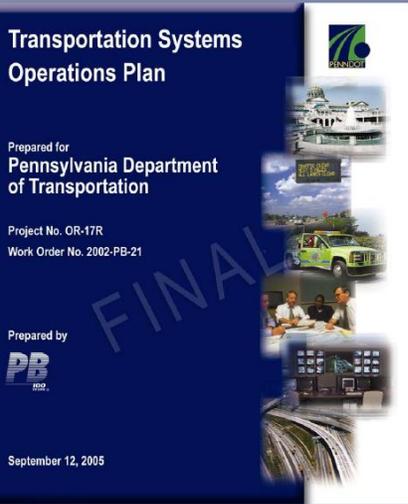
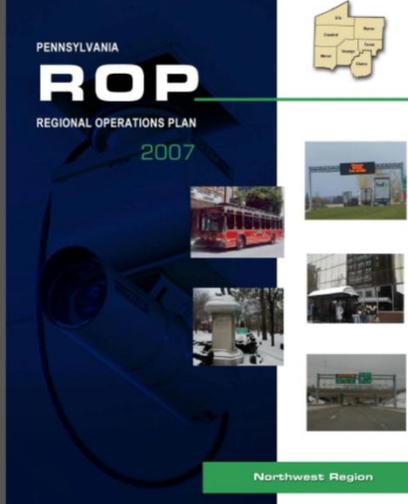
	<p>State Highway Asset Management Plan, 2012–15</p> <p>© NZ Transport Agency</p> <p>www.nzta.govt.nz</p> <p>October 2011</p> <p>http://www.nzta.govt.nz/resources/state-highway-asset-management-plan/</p> <p>Complete report: http://www.nzta.govt.nz/resources/state-highway-asset-management-plan/docs/state-highway-asset-mgmt-plan-2012-2015.pdf</p>
	<p>Arizona Operations Action Plan: Phoenix Metropolitan Region</p> <p>July-September 2009</p> <p>Developed by the AZTech Operations Committee</p> <p>http://www.aztech.org/docs/Arizona%20Operations%20Action%20Plan/AZ-Ops-Act-Plan.pdf</p>

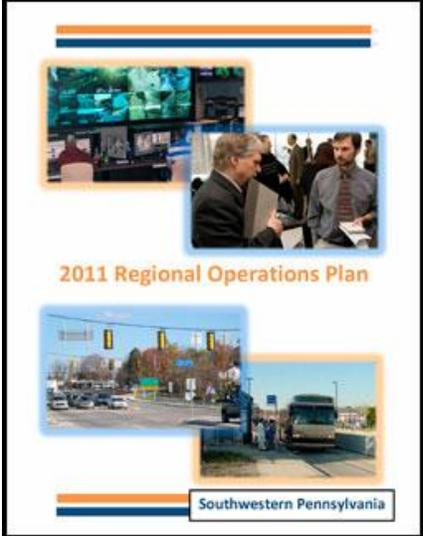
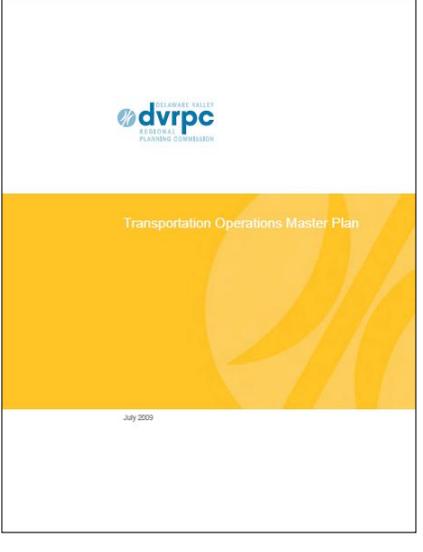
 <p>ITS Strategic Plan 2012</p> <p>December 2012</p>	<p>ITS Strategic Plan 2012</p> <p>December 2012</p> <p>Maricopa Association of Governments</p> <p>http://www.azmag.gov/Documents/ITS_2013-01-10_2012-ITS-Strategic-Plan.pdf</p>
 <p>Caltrans</p> <p>2011 TEN-YEAR STATE HIGHWAY OPERATION AND PROTECTION PROGRAM PLAN</p> <p>Fiscal Years 2012–2013 Through 2021–2022</p> <p>January 2011</p> <p>Prepared by the California Department of Transportation Business, Transportation and Housing Agency January 2011</p>	<p>Caltrans, 2011 Ten-Year State Highway Operation and Protection Program Plan</p> <p>Fiscal Years 2012–2013 Through 2021–2022</p> <p>January 2011</p> <p>http://www.dot.ca.gov/docs/reports/2011_Ten_%20Year_Shopp_Plan.pdf</p>
 <p>STATE OF COLORADO</p> <p>DEPARTMENT OF TRANSPORTATION 401 East Arkansas Avenue, Room 260 Denver, CO 80202 (303) 737-6633 (303) 737-6219 Fax</p> <p>Date: July 10, 2013</p> <p>To: Transportation Commission</p> <p>From: Ryan Rice, Director of Transportation Systems Management & Operations</p> <p>Subject: Transportation Systems Management & Operations Reorganization Plan Workshop</p> <p>The purpose of this workshop is to inform the Transportation Commission of the approved decisions of the reorganization planning process for the Division of Transportation Systems Management & Operations (TSM&O). No action is requested by the Commission at this time. Included in this document are a graphic depicting the personnel that have been transferred and the FY14 Goals and Work Plan for the Division of TSM&O.</p> <p>In January 2013, CDOT formed the Division of TSM&O to focus on implementing low-cost high-value improvements to get the most out of our existing transportation system. The Intelligent Transportation Systems (ITS) Branch was transferred from the Division of Staff Branches to the Division of TSM&O on February 1, 2013 as the first step in building the Division. Over the last three months, CDOT stakeholders worked together to develop an organizational structure for the Division of TSM&O through multiple planning sessions and a detail report that has now been finalized. The changes to organizational structure became effective on July 1, 2013 and include the transfer of the majority of the Traffic Engineering and Safety Branch from the Division of Staff Branches to the Division of TSM&O as well as ramp meter maintenance and HOV/HOT operations personnel from Region 1. The Outdoor Advertising, Utilities, and Railroad programs remained with the Division of Staff Branches as well as the three employees who manage those programs.</p> <p>The detailed reorganization report also identified the need for the following:</p> <ul style="list-style-type: none"> • Traffic Incident Management Program Manager • Travel Demand Management Program Manager • Statewide Traffic Signal Program Manager • An Operations Clearance Review for all new CDOT projects • Improved integration of traffic management centers at Hanging Lake Tunnel, Eisenhower-Johnson Memorial Tunnel and the Colorado Transportation Management Center in Golden 	<p>Transportation Systems Management & Operations Reorganization Plan Workshop</p> <p>July 10, 2013</p> <p>http://www.coloradodot.info/about/transportation-commission/documents/2013-archive-of-agendas-and-supporting-documents/july-2013/operations-workshop-memo-july.pdf/at_download/file</p>

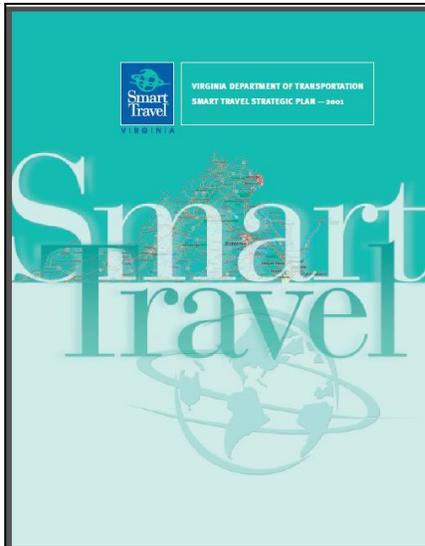
<p style="text-align: center;">CDOT's Transportation System Management & Operations Plan (Pending)</p>	<p style="text-align: center;">http://coloradotransportationmatters.com/other-cdot-plans/operations/</p> <p style="text-align: center;">Transportation System Management & Operations Reorganization Report , May 2013</p> <p style="text-align: center;">ftp://rrcs-67-52-234-195.west.biz.rr.com/Various%20FHWA%20documentation/CDOT%20Division%20of%20TSM&O%20Reorganization%20Final%20Report.pdf</p>
 <p style="text-align: center;">Florida Transportation Systems Management and Operations</p> <p style="text-align: center;">Strategic Plan</p> <p style="text-align: center;">Final: Version 2 December 13, 2013</p> <p>Prepared for: Florida Department of Transportation Intelligent Transportation Systems Program 605 Suwannee Street, M.S. 90 Tallahassee, Florida 32399-0450 (850) 416-5600</p>	<p style="text-align: center;">Florida Transportation System Management and Operations Strategic Plan</p> <p style="text-align: center;">Final Version 2</p> <p style="text-align: center;">December 13, 2013</p> <p style="text-align: center;">http://floridaitis.com/01ITSGC/doc-TSMO/TSMO-Strategic-Plan-2013-v2.pdf</p>
	<p style="text-align: center;">FDOT's ITS Program General Consultant, Transportation Systems Management & Operations</p> <p style="text-align: center;">Website (As of 1/27/2014)</p> <p style="text-align: center;">http://floridaitis.com/TSMO.html</p>

 <p>IRISDS Integrated Regional Information Systems and Decision Support Integrated Corridor Management and Advanced Technologies for Florida Final Report Contract: BDK80 977-09 FIU Project: 80000444 Prepared for The Florida Department of Transportation by the Florida International University Lehman Center for Transportation Research November 2012</p>	<p>Integrated Corridor Management and Advanced Technologies for Florida</p> <p>November 2012</p> <p>http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_TE/FDOT-BDK80-977-09-rpt.pdf</p>
 <p>2013 Maryland STATE HIGHWAY MOBILITY REPORT SEPTEMBER 2013 Martin O'Malley, Governor Anthony G. Brown, Lt. Governor SHA State Highway Administration Maryland Department of Transportation</p>	<p>2013 Maryland State Mobility Report</p> <p>Maryland State Highway Administration</p> <p>September 2013</p> <p>http://www.roads.maryland.gov/OPPEN/2013_Maryland_Mobility.pdf</p>
 <p>CHART NCDP Non-Constrained Deployment Plan Office of CHART and ITS Development State Highway Administration 7411 Convalley Drive Baltimore, MD 21076-1701 (800) 643-2818 www.chart.state.md.us</p>	<p>CHART Non-Constrained Deployment Plan</p> <p>2008</p> <p>http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf</p>

	<p>Maryland Transportation Operations Summit</p> <p>2008</p> <p>http://www.chart.state.md.us/downloads/readingroom/MarylandOperationsSummit/MTOS_White_Paper_Full_Version_08.pdf</p> <p>http://chart.maryland.gov/readingroom/marylandoperationssummit.asp</p>
	<p>Minnesota Statewide Highway Systems Operation Plan, 2012 - 2015</p> <p>September 2012</p> <p>http://www.dot.state.mn.us/maintenance/hsop/</p> <p>Executive Summary: http://www.dot.state.mn.us/maintenance/hsop/Executive-Summary-2012.pdf</p> <p>Full Report: http://www.dot.state.mn.us/maintenance/hsop/report.pdf</p>
	<p>NDOT Statewide Integrated Transportation Reliability Program, Executive Summary</p> <p>Nevada DOT © Kimley-Horn and Associates</p> <p>April 2010</p> <p>http://www.kimley-horn.com/projects/NevadaITRP/images/pdfs/Executive%20Summary%20-%202004-10.pdf</p>

 <p>REGIONAL TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS 2010 – 2020 June 2010</p> <p>Metro Joint Policy Advisory Committee on Transportation</p>	<p>Regional Transportation System Management and Operations, 2010 – 2020</p> <p>June 2010</p> <p>Metro, Joint Policy Advisory Committee on Transportation (JPACT)</p> <p>Executive Summary: http://library.oregonmetro.gov/files//executive_summary_june2010_final.pdf</p> <p>Full report: http://library.oregonmetro.gov/files//regional_tsmo_refinement_plan_june2010_final.pdf</p>
 <p>Transportation Systems Operations Plan</p> <p>Prepared for Pennsylvania Department of Transportation</p> <p>Project No. OR-17R Work Order No. 2002-PB-21</p> <p>Prepared by PB INC.</p> <p>September 12, 2005</p>	<p>Transportation Systems Operations Plan</p> <p>prepared for the Pennsylvania Department of Transportation by PB</p> <p>September 12, 2005</p> <p>http://www.dot.state.pa.us/Internet/Bureaus/PennDOTROP.nsf/defaultTSOP?OpenPage</p> <p>ftp://ftp.dot.state.pa.us/public/Bureaus/Cpdm/Final%20TSOP%20Report%2009-26-05.pdf</p>
 <p>PENNSYLVANIA ROP REGIONAL OPERATIONS PLAN 2007</p> <p>Northwest Region</p>	<p>Pennsylvania Regional Operations Plan (ROP)</p> <p>2007</p> <p>Northwest Region: http://northwestpa.org/wp-content/uploads/2013/03/NW-PA-FINAL-ROP.pdf</p> <p>Southwest Region: http://www.spcregion.org/pdf/ROP.pdf</p> <p>Region 5: http://www.co.berks.pa.us/Dept/Planning/Pages/RegionalOperationsPlan.aspx</p> <p>DVRPC Region District 6: http://www.dvrpc.org/operations/pdf/PennDOT%20District%2006-0%20Regional%20Operations%20Plan.pdf</p>

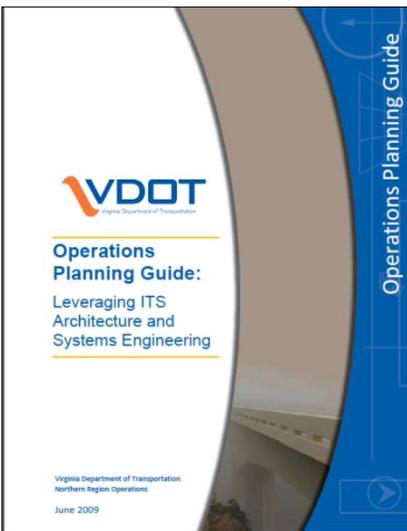
	<p>2011 Regional Operations Plan</p> <p>(Update by Southwestern Pennsylvania Commission)</p> <p>http://www.spcregion.org/trans_ops_rop.shtml</p> <p>http://www.spcregion.org/pdf/rop11/2011_ROP_FINAL_070611.pdf</p>
	<p>DVRPC Transportation Operations Master Plan</p> <p>July 2009</p> <p>Delaware Valley Regional Planning Commission</p> <p>http://www.dvrpc.org/reports/09049.pdf</p>
<p>Mobility 2035 – 2013 Update: Foreword</p> <p>A New Way of Planning</p> <p>For the past 20 years or so, transportation funding has increased fairly steadily. Beginning with the Intermodal Surface Transportation Efficiency Act of 1991, Congress began to systematically spend down the balance in the Highway Trust Fund. The trend continued with spending outpacing gas tax revenue and related fees. In 2008, the Trust Fund balance neared zero and Congress was forced to infuse the account with general revenue just to keep up with already approved funding commitments across the country. Since then, more than \$40 billion in general revenue has been added to keep the account solvent. In addition, federal and state laws were passed that provided transportation professionals with several innovative financial tools, such as additional bonding capabilities and more flexible public-private partnership arrangements that further increased the availability of near-term funding opportunities.</p> <p>The Dallas-Fort Worth Metropolitan Area was the recipient of its share of this additional revenue and was able to use it to implement critical roadway and transit projects and programs. However, the rate at which we were able to add capacity to our transportation system was exceeded by the continued unprecedented growth in people and businesses wanting to call Dallas-Fort Worth home. Between now and 2035, it is anticipated that the region's population will increase by 45 percent and employment will increase by 44 percent; however, new roadway capacity is expected to increase by only 14 percent while the rail network is expected to nearly triple.</p> <p>Despite the economic downturn that began in 2008, the state of Texas and the Dallas-Fort Worth region continue to sustain strong growth thanks to its diversified economy and favorable business climate. In fact, the 2010 US Census showed that municipalities and counties in North Central Texas are still experiencing considerable growth, resulting in the 12-county transportation planning area growing from 5.1</p>	<p>Mobility 2035: The Metropolitan Transportation Plan</p> <p>North Central Texas Council of Governments</p> <p>http://www.nctcog.org/trans/mtp/2035/index.asp</p>



Smart Travel Strategic Plan — 2001

Virginia Department of Transportation

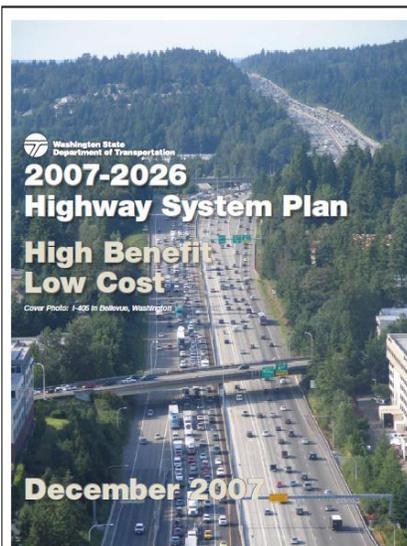
<http://www.virginia.gov/travel/resources/prog-smarttravel-strat-plan-01.pdf>



VDOT, Operations Planning Guide, Leveraging ITS Architecture and Systems Engineering

June 2009

[http://www.vdot-itsarch.com/docs/PlanningandProgramDeliveryGuideV1\(2009-11-17\).pdf](http://www.vdot-itsarch.com/docs/PlanningandProgramDeliveryGuideV1(2009-11-17).pdf)



2007-2026 Highway System Plan High Benefit, Low Cost

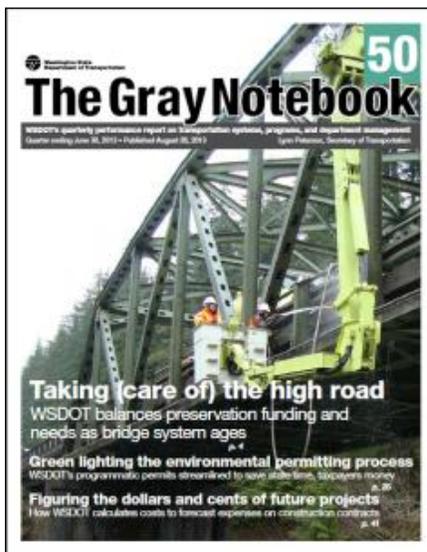
December 2007

Washington State Department of Transportation

<http://www.wsdot.wa.gov/NR/rdonlyres/B24AC1DA-8B9A-4719-B344-B083BB3F10FB/0/HSPweb.pdf>

Technical Update (2008)

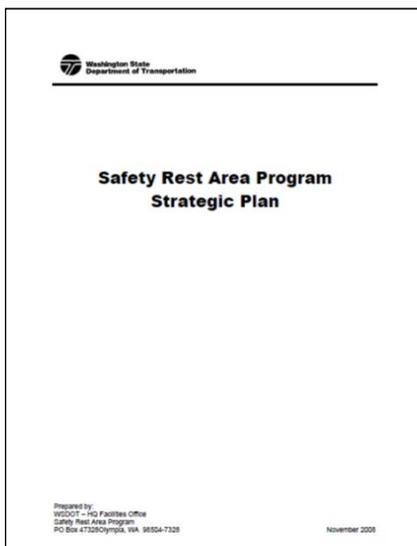
<http://www.wsdot.wa.gov/NR/rdonlyres/186864FF-64E9-4266-9311-797E38D003A9/0/20072026HSPTechnicalUpdate.pdf>



The Gray Notebook, WSDOT's Quarterly Performance Report on Transportation Systems, Programs, and Department Management

Quarter ending June 30, 2013, Published August 26, 2013

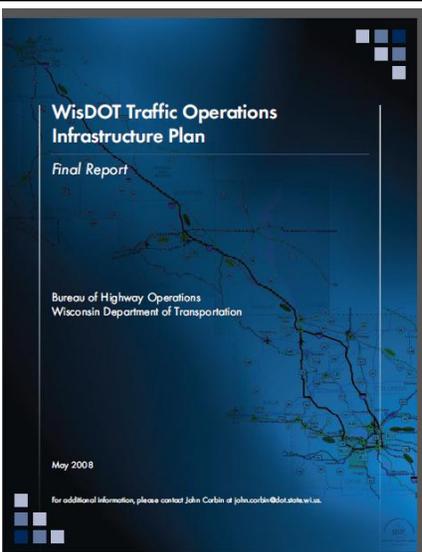
<http://wsdot.wa.gov/publications/fulltext/graynotebook/Jun13.pdf>



Safety Rest Area Program Strategic Plan

November 2008

<http://www.wsdot.wa.gov/NR/rdonlyres/6CEBB99E-B6AE-48A6-AF31-86382985044B/0/SRAstrategicPlan.pdf>



WisDOT Traffic Operations Infrastructure Plan, Final Report

May 2008

http://www.topslab.wisc.edu/its/toip/Final%20Reports/WisDOT_Traffic_Operations_Infrastructure%20Plan.pdf

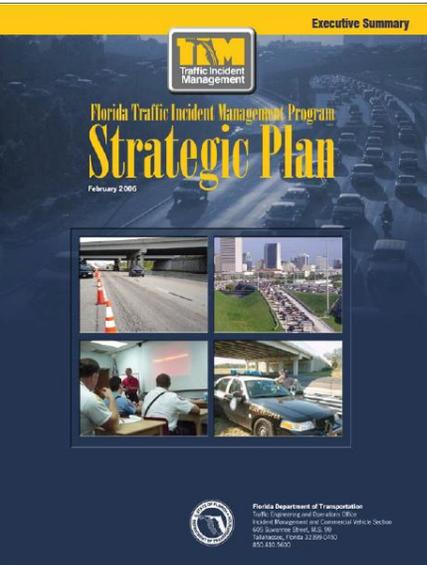
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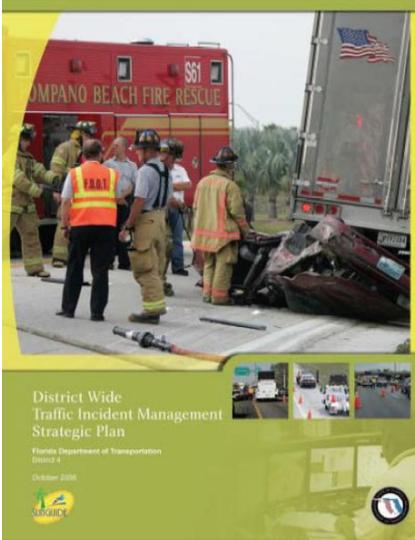
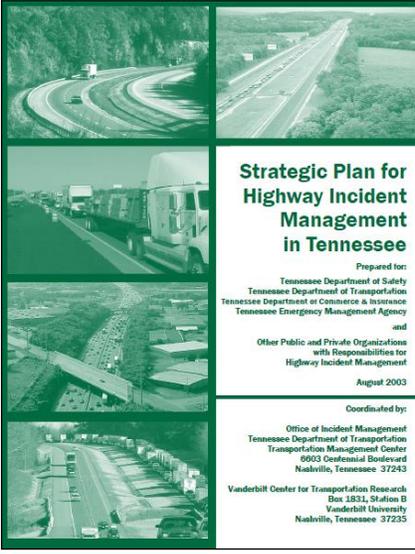
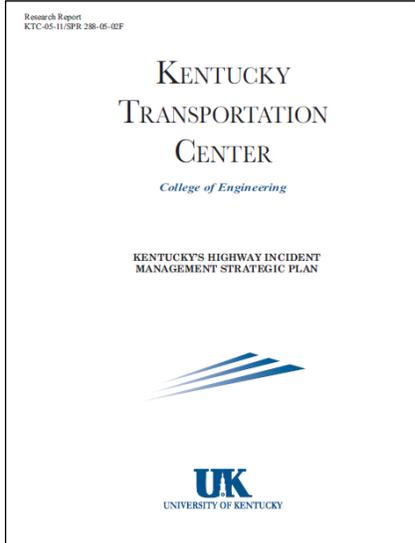
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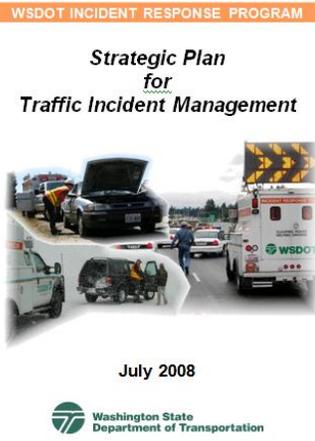
WisDOT Traffic Operations Infrastructure Plan, Priority and Emerging Priority Corridor Summaries and Statewide Layered Cost Estimates (April 2008)

http://www.topslab.wisc.edu/its/toip/Final%20Reports/WisDOT_TOIP_ExecutiveSummary.pdf

<p style="text-align: center;">TOIP IMPLEMENTATION PLAN AN ADDENDUM TO THE WISDOT TRAFFIC OPERATIONS INFRASTRUCTURE PLAN October 2009</p> <p>Introduction and Purpose</p> <p>In May 2008, the final report of the WisDOT Traffic Operations Infrastructure Plan (TOIP) was published. The TOIP defines methodologies and plans developed to assess the operational needs along Wisconsin's 17 strategic corridors and determine appropriate improvements (ITIs) to mitigate these needs. Furthermore, these needs were developed in a quantitative manner for alignment with traditional highway improvements, enhancing and extending the assessment of infrastructure on Wisconsin's roadways. Recently, the TOIP has been approved by WisDOT for implementation with recommendations from the TOIP integrated into Chapter 13 of WisDOT's Governor's State plan. This integration allows traffic operational devices to be deployed with infrastructure improvements per the recommendations set forth by the TOIP.</p> <p>A major component in developing the TOIP was assessing ITS technology deployment needs on the 17 corridors. These technologies focused on implementing ramp control and surveillance, corridor warning and information systems, and traffic signal systems to corridors that exhibited existing or future operational needs. Locations of individual corridors were recommended based on the TOIP location of Deployment Density. The TOIP specifies a planning-level approach for the deployment of ITS elements. The TOIP however, neither includes all ITS elements considered in this analysis nor does the TOIP go as far as to propose exact ITS element locations. Therefore, to provide both WisDOT Central Office and Regional staff more precise locations to install ITS technologies used in the TOIP, an implementation plan was created as an addendum to the TOIP. This implementation plan will focus on ITS element deployment primarily on the sixteen corridors that exhibited the most significant operational needs, as determined from the TOIP via "priority" corridors and seven "emerging priority" corridors. These corridors are listed below:</p> <ul style="list-style-type: none"> • Badger State Corridor (San Chasol/Sapporo Falls to Madison) • Capital Corridor (Milwaukee to Madison) • Fox Valley Corridor (Milwaukee to Green Bay) • South Central Corridor (Madison to Chicago via Janesville/Belleville) • Milwaukee Corridor (Milwaukee to Chicago) • Chippewa Valley Corridor (Minneapolis / Saint Paul to Eau Claire) • Wisconsin River Corridor (Madison to Harley/Roseau) • West Coast Corridor (Madison to Fire River's valley) • Peace Northwest Corridor (San Chasol/Sapporo Falls to Duluth/Superior) • Cornish Heritage Corridor (Dubuque to Madison) 	<p>TOIP Implementation Plan An Addendum to the WisDOT Traffic Operations Infrastructure Plan</p> <p>October 2009</p> <p>http://www.topslab.wisc.edu/its/toip/TOIP%20IMPLEMENTATION%20PLAN%202009_Oct%202011.pdf</p>																				
 <p>State Traffic Operations Program Policy Issue Paper</p> <p>Description of Policy Issue</p> <p>The Wisconsin Department of Transportation's (WisDOT's) Traffic Operations program uses traffic control strategies, devices and Intelligent Transportation Systems (ITS) to improve the performance of Wisconsin's highway network, and that of the Great Lakes regional highway network. The program focuses on two main areas:</p> <ul style="list-style-type: none"> • Traffic engineering and management services for highway improvement program delivery, and • Transportation operations, public safety, and emergency preparedness and response on the existing highway system. <p>Program activities specifically include:</p> <table border="0"> <tr> <td>• Statewide Traffic Operations Center (STOC)</td> <td>• Freight Operations</td> </tr> <tr> <td>• Freeway Service Teams (FST)</td> <td>• Work Zone Management</td> </tr> <tr> <td>• Freeway Traffic Management</td> <td>• Signing</td> </tr> <tr> <td>• Traffic Incident Management Enhancement (TIME)</td> <td>• Pavement Marking</td> </tr> <tr> <td>• Regional Incident Management Coordinators (RIMC)</td> <td>• Traffic Signal Systems</td> </tr> <tr> <td>• Emergency Transportation Operations (ETO)</td> <td>• Highway Lighting</td> </tr> <tr> <td>• Intelligent Transportation Systems (ITS)</td> <td>• Multi-state Partnerships</td> </tr> <tr> <td>• Traveler Information and 511 System</td> <td>• Traffic Operations Infrastructure Plan (TOIP)</td> </tr> <tr> <td>• ITSNet Communications Network</td> <td>• Transportation Research and Development</td> </tr> <tr> <td></td> <td>• Systems Interoperability and Data Management</td> </tr> </table> <p>The Traffic Operations program is not an alternative to highway construction, but the two programs work in concert. While a reliable transportation network is a benefit, traffic operations systems and services provide value to travelers and the economy that highway rehabilitation and capacity expansion cannot. Traffic operations systems and services mitigate the impacts of highway rehabilitation and construction activities (work zones) on communities and travelers.</p> <p>Unlike other state highway program components, the activities performed under the Traffic Operations program generally do not require extensive advanced planning and design. However, certain capital improvements are included in the program to enhance safety, manage congestion, support travel</p> <p style="font-size: small;">State Traffic Operations Program 1 July 12, 2012</p>	• Statewide Traffic Operations Center (STOC)	• Freight Operations	• Freeway Service Teams (FST)	• Work Zone Management	• Freeway Traffic Management	• Signing	• Traffic Incident Management Enhancement (TIME)	• Pavement Marking	• Regional Incident Management Coordinators (RIMC)	• Traffic Signal Systems	• Emergency Transportation Operations (ETO)	• Highway Lighting	• Intelligent Transportation Systems (ITS)	• Multi-state Partnerships	• Traveler Information and 511 System	• Traffic Operations Infrastructure Plan (TOIP)	• ITSNet Communications Network	• Transportation Research and Development		• Systems Interoperability and Data Management	<p>State Traffic Operations Program Policy Issue Paper</p> <p>Transportation Finance and Policy Commission Wisconsin Department of Transportation</p> <p>July 12, 2012</p> <p>http://www.dot.wisconsin.gov/about/tfp/docs/mtg8-issue-traf.pdf</p>
• Statewide Traffic Operations Center (STOC)	• Freight Operations																				
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	• Systems Interoperability and Data Management																				
 <p style="text-align: center;">Statewide Long-Range Transportation Plan</p>  <p style="text-align: center;">Wisconsin Department of Transportation</p>	<p>Connections 2030, Statewide Long Range Transportation Plan</p> <p>October 2009</p> <p>Wisconsin Department of Transportation</p> <p>http://www.dot.wi.gov/projects/state/2030-background.htm</p>																				

	<p>Memorandum Report Number 202 Regional Transportation Operations Plan for Southeastern Wisconsin: 2012-2016</p> <p>May 2012</p> <p>Southeastern Wisconsin Regional Planning Commission www.sewrpc.org</p> <p>http://www.sewrpc.org/SEWRPCFiles/Publications/mr/mr-202-reg-transportation-operations-plan-for-se-wisc.pdf</p>
	<p>Florida Traffic Incident Management Program, Strategic Plan,</p> <p>February 2006 Executive Summary http://www.dot.state.fl.us/trafficoperations/traf_incident/pdf/Executive%20Summary%20Final.pdf</p> <p>Full Report February 2006 http://www.dot.state.fl.us/trafficoperations/Traf_Incident/pdf/TIM%20Strategic%20Plan%20Final.pdf</p>
<p>Florida Traffic Incident Management Program Reference Document</p> <p>February 2006</p>  <p>Prepared for: Florida Department of Transportation Traffic Engineering and Operations Office Incident Management and Commercial Vehicle Section 505 Suwannee Street, M.S. 90 Tallahassee, Florida 32399-0450 (850) 415-5600</p>	<p>Florida Traffic Incident Management Program Reference Document</p> <p>February 2006</p> <p>http://www.i95coalition.org/i95/Portals/0/Public_Files/uploaded/Incident-toolkit/documents/Plan/Plan_TIM_FL_RD.pdf</p>

 <p>District Wide Traffic Incident Management Strategic Plan Florida Department of Transportation District 4 October 2006</p>	<p>District Wide Traffic Incident Management Strategic Plan, Florida Department of Transportation, District Four</p> <p>October 2006</p> <p>http://www.smartsunguide.com/pdf/fdot_4_tim_strategic_plan_10_31_06.pdf</p>
 <p>Strategic Plan for Highway Incident Management in Tennessee</p> <p>Prepared for: Tennessee Department of Safety Tennessee Department of Transportation Tennessee Department of Commerce & Insurance Tennessee Emergency Management Agency and Other Public and Private Organizations with Responsibilities for Highway Incident Management</p> <p>August 2003</p> <p>Coordinated by: Office of Incident Management Tennessee Department of Transportation Transportation Management Center 6903 Decennial Boulevard Nashville, Tennessee 37243 Vanderbilt Center for Transportation Research Box 1831, Station B Vanderbilt University Nashville, Tennessee 37235</p>	<p>Strategic Plan for Highway Incident Management in Tennessee</p> <p>August 2003</p> <p>http://www.tdot.state.tn.us/incident/CompleteIMPlan.pdf</p>
 <p>Research Report KTC-05-11/SPR 288-05-02F</p> <p>KENTUCKY TRANSPORTATION CENTER <i>College of Engineering</i></p> <p>KENTUCKY'S HIGHWAY INCIDENT MANAGEMENT STRATEGIC PLAN</p> <p>UK UNIVERSITY OF KENTUCKY</p>	<p>Kentucky's Highway Incident Management Strategic Plan</p> <p>June 2005</p> <p>http://www.ktc.uky.edu/files/2012/06/KTC_05_11_SPR288_05_02F.pdf</p>

 <p>WSDOT INCIDENT RESPONSE PROGRAM</p> <p><i>Strategic Plan for Traffic Incident Management</i></p> <p>July 2008</p> <p>Washington State Department of Transportation</p>	<p>WSDOT Incident Response Program, Strategic Plan for Traffic Incident Management</p> <p>July 2008</p> <p>http://www.wsdot.wa.gov/NR/rdonlyres/B79A29B1-2F56-43CA-BBC0-AFB25FACE209/0/IRStrategicPlan.pdf</p>
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Appendix G

Professional, Industry, and Research Organization Web Sites Examined

Organization/Program	URL	Notes
American Association of Port Authorities (AAPA)	http://www.aapa-ports.org/	Example of online operations oriented training: http://aapa.files.cms-plus.com/SeminarPresentations/07_OPsAFIT_Stone_Marshall.pdf
American Association of State Highway and Transportation Officials	http://www.transportation.org/Pages/default.aspx	SHRP 2: http://shrp2.transportation.org/Pages/default.aspx TSM&O Web-based guidance: http://www.aashtotsmoguidance.org/
American Planning Association (APA)	https://www.planning.org/	Opportunities: https://www.planning.org/education/training/ Publications include Performance Measurement in Transportation Planning, case studies in demand management, and advanced transportation planning
American Public Transit Association (APTA)	http://www.apta.com/Pages/default.aspx	
American Public Works Association (APWA)	http://www.apwa.net/	http://www.apwa.net/topics/transportation
ASCE, Transportation and Development Institute	http://www.asce.org/t di/	Policy Statement 495 - Operations and Management of Transportation Systems http://www.asce.org/Public-Policies-and-Priorities/Public-Policy-Statements/Policy-Statement-495---Operations-and-Management-of-Transportation-Systems/
Association of Metropolitan Planning Organizations (AMPO)	http://www.ampo.org/	Note "poll" on home page http://www.ampo.org/about-us/statewide-mpo-associations/ http://www.planning.dot.gov/Peer/Arkansas/arkansas.asp
Commercial Vehicle Safety Alliance (CVSA)	http://www.cvsa.org/home.php	
Consortium for ITS Training and Education (CITE)	http://www.citeconsortium.org/purpose.html	Training Courses: http://www.citeconsortium.org/curriculum.html
Eno Center for Transportation	https://www.enotrans.org/	

Forum of European National Highway Research Laboratories (FEHRL)	http://www.fehrl.org/?m=1	
Governors Highway Safety Association (GHSA)	http://www.ghsa.org/	State DOT Safety Offices: http://www.ghsa.org/html/links/shsos.html State Highway Safety Plan tools and resources: http://www.ghsa.org/html/resources/planning/index.html
I-95 Corridor Coalition	http://i95coalition.org/i95/Default.aspx	Operations Academy: http://i95coalition.org/i95/Training/OperationsAcademy/tabid/90/Default.aspx x Freight Academy: http://i95coalition.org/i95/Training/FreightAcademy/tabid/186/Default.aspx
Institute of Transportation Engineers	http://www.ite.org/	Multiple hits on “TSM&O” (a few for Traffic Signal Management and Operations)
ITE, Transportation Safety, State Programs and Initiatives	http://www.ite.org/safety/state.asp	Links to each state’s Strategic Highway Safety Plan
International Bridge, Tunnel and Turnpike Association (IBTTA)	http://www.ibtta.org/index.cfm	Future of TMC Operations: http://ibtta.files.cms-plus.com/PDFs/Kuciemba_Steve.pdf
International Municipal Signal Association (IMSA)	http://www.imsasafety.org/	
ITS America	http://www.itsa.org/	Focus on industry news
National Association of Development Organizations (NADO)	http://www.nado.org/	
National Association of Regional Councils (NARC)	http://narc.org/	Highway planning and funding: http://narc.org/issueareas/transportation/areas-of-interest/highway/
National Conference of State Legislators (NCSL)	http://www.ncsl.org/	Transportation Operations, Management and ITS Legislation Database: http://www.ncsl.org/research/transportation/transportation-operations-mgmt-its-db-overview.aspx
National Transportation Operations Coalition (NTOC)—AASHTO	http://www.ntoctralks.com/main/summary	Mainly a forum with resource links to primary sources

Operations Academy™	http://www.operationsacademy.org/	Training opportunities
Organisation for Economic Co-operation and Development (OECD)	http://www.oecd.org/	
Victoria Transport Policy Institute	http://www.vtpi.org/	TDM focused
World Road Association-PIARC	http://www.piarc.org/en/	Strategies for Road Networks Operation: http://www.piarc.org/en/order-library/18046-en-Strategies%20for%20road%20networks%20operation.htm Handbook on Sustainable Traffic Management: http://road-network-operations.piarc.org/index.php?option=com_docman&task=doc_download&id=15&lang=en

Federal Highway Administration (FHWA) and Federal Transportation Administration (FTA)	http://www.fhwa.dot.gov/ http://www.fta.dot.gov/	Notes
Planning for Operations	http://www.plan4operations.dot.gov/	Several publications applicable for this project, focused on operations planning process
FHWA, Office of Operations	http://ops.fhwa.dot.gov/	Current news and recent publication releases related to FHWA activities in operations
FHWA, INVEST 1.0	https://www.sustainablehighways.org/764/132/transportation-systems-management-and-operations.html	Home: https://www.sustainablehighways.org/1/home.html SP-14 Transportation Systems Management and Operations: https://www.sustainablehighways.org/764/132/transportation-systems-management-and-operations.html
FHWA, Operations Performance Measurement	http://ops.fhwa.dot.gov/perf_measurement/index.htm	Provides information and resources to assist in implementing operations performance measurement
FHWA, Emergency Transportation Operations	http://ops.fhwa.dot.gov/eto_tim_pse/index.htm	Provides tools, guidance, capacity building and good practices to aid DOTs and their partners in their efforts to improve transportation network efficiency and public/responder safety when a <i>non-recurring</i> event either interrupts or

		overwhelms transportation operations.
FHWA, Resource Center Operations Team	http://www.fhwa.dot.gov/resourcecenter/teams/operations/index.cfm	Provides the latest in Operations and ITS information and technology
FHWA, National Highway Institute	http://www.nhi.fhwa.dot.gov/default.aspx	Training opportunities
FHWA, Office of International Programs	http://international.fhwa.dot.gov/links/pubs.cfm?link_ID=4	Provides an electronic library of international reports and studies.
Transportation Planning Capacity Building (TPCB) Program	http://www.planning.dot.gov/about.asp	Jointly administered by FHWA and FTA, TPCB products and services provide information, training, and technical assistance to the transportation professionals responsible for planning for the capital, operating, and maintenance needs of our nation's surface transportation system.
Transportation Planning Excellence Awards Program	http://www.fhwa.dot.gov/planning/tpea/	Examples of good practices in various transportation planning applications
Information RE: MAP 21	http://www.fhwa.dot.gov/map21/	http://www.fhwa.dot.gov/map21/factsheets.cfm http://www.fhwa.dot.gov/map21/presentations.cfm http://www.fhwa.dot.gov/map21/crossref.cfm
FHWA, Transportation Asset Management	https://www.fhwa.dot.gov/asset/	
FHWA, Active Transportation and Demand Management (ATDM)	http://ops.fhwa.dot.gov/atdm/index.htm	RITA Program Brief: http://ops.fhwa.dot.gov/publications/fhwahop12032/

Research and Innovative Technology Administration (RITA)	http://www.rita.dot.gov/	Notes
ITS Joint Program Office	http://www.its.dot.gov/its_jpo.htm	Focuses on intelligent vehicles, intelligent infrastructure and the creation of an intelligent transportation system through integration with and between these two components

John A. Volpe National Transportation Systems Center	http://www.volpe.dot.gov/	The National Transportation Systems Center whose mission is to improve transportation by anticipating and addressing emerging issues and advancing technical, operational, and institutional innovations across all modes
National Transportation Library	http://ntl.bts.gov/	Repository of U.S. DOT transportation information and serves as a portal to transportation data
University Transportation Centers	http://www.rita.dot.gov/utc/	Education focused
Transportation Safety Institute	http://www.tsi.dot.gov/about.aspx	Training focus

American Association of State Highway and Transportation Officials (AASHTO)	http://www.transportation.org	Notes
Subcommittee on Systems Operations and Management (SSOM)	http://ssom.transportation.org/	Reports and links on optimizing the system through operations
Standing Committee on Planning (SCOP)	http://planning.transportation.org	Research reports: http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=909 AASHTO Transportation Asset Management Guide
Subcommittee on Maintenance (SCOM)	http://maintenance.transportation.org	Maintenance publications: http://maintenance.transportation.org/Pages/References.aspx
Subcommittee on Asset Management	http://tam.transportation.org	Resources: http://tam.transportation.org/Pages/ManagementSystems.aspx
Special Committee on Transportation Security and Emergency Management (SCOTSEM)	http://scotsem.transportation.org	Reports: http://scotsem.transportation.org/Pages/Reports.aspx
Committee on Performance Management (SCOPM)	http://scopm.transportation.org	Presentations and publications: http://scopm.transportation.org/Pages/presentationsandpublications.aspx
Subcommittee on Traffic Engineering	http://scote.transportation.org	Projects and publications: http://www.trb.org/nchrp/pages/719.aspx

Subcommittee on Highway Transport (SCOHT)	http://highwaytransport.transportation.org/Pages/default.aspx	Freight Corridors: http://highwaytransport.transportation.org/Pages/highway_corridors.aspx
Freight Transportation Network	http://freight.transportation.org	Links to subcommittees by mode
Strategic Highway Safety Plan	http://safety.transportation.org/	Includes links to NCHRP Report 501 Integrated Safety Management Process, Strategic Highway Safety Plan, and NCHRP Report 500 Implementation Guides

Transportation Research Board (TRB)		Notes
Operations and Traffic Management Research	http://www.trb.org/OperationsTrafficManagement/OperationsandTrafficManagement1.aspx	Links to current publications, programs and activities related to operations and traffic management research
Security and Emergencies Research	http://www.trb.org/SecurityEmergencies/SecurityandEmergencies1.aspx	Links to current publications, programs and activities related to security and emergency research
Strategic Highway Research Program—SHRP 2	http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Blank2.aspx	Provides links to webinars, videos, research reports, project briefs, letter reports, implementation reports, fact sheets, overview material and other resources
SHRP2, Reliability	http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/Reliability_159.aspx	Reliability research in SHRP 2 focuses on reducing congestion through incident reduction, management, response, and mitigation. Projects that comprise the SHRP 2 Reliability Research Plan are shown in the Projects database
SHRP2, Reliability Products	http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/SHRP2system.aspx	Links to Reliability research products
SHRP2, Knowledge Transfer System, Transportation Systems Management and Operations	http://demo5.pbid.com/about_this_site/	New and expanding portal for knowledge resources and links that are designed to provide access to key reliability-related research and other key information sources

TRB Committees		
Regional Transportation Systems Management and Operations (RTSMO) and Subcommittees	https://sites.google.com/site/trbrtsmocommittee/	Considers TSM&O in a regional context and shares regional approaches to transportation problems by identifying research opportunities, creating knowledge, and disseminating information. The site provides links to the RTSMO subcommittees and their products.
Statewide Multimodal Planning	https://sites.google.com/site/statewideplanning/	Provides links to various peer exchange reports: https://sites.google.com/site/statewideplanning/activities
Metropolitan Policy, Planning, and Processes	http://www.gtcmppo.org/TRBADA20_3/	Supports MPO role of managing the implementation of long-range transportation plans, providing an objective, collaborative forum to explore all facets of plan development and implementation . . . Links to resources.
Transportation Programming and Investment Decision-Making	http://www.trb-programming.org/	Focuses on transportation programming at the local, metropolitan, and statewide levels. Programming identifies and prioritizes transportation investments in the near-term, matching projects with available funding
Public Transportation Planning and Development	http://www4.uwm.edu/cuts/trb/index.html	To examine, discuss and disseminate public transportation ideas and issues . . . Links to planning resources.
Intelligent Transportation Systems	https://sites.google.com/site/trbitscommittee/	Concerned with ITS systems-level issues, including conceptual system planning and design, integration of technologies and approaches from various sub-disciplines within ITS, applications to all modes of ground transport and to facilitate intermodal integration . . .
Freeway Operations	http://www.trb-freewayops.org/	Promoting, implementing, operating and maintaining traffic management systems and strategies, including ITS, to enhance the efficiency, safety and environmental conditions on freeways and in freeway corridors. Reports and other resources: http://www.trb-freewayops.org/reports.html
Maintenance and Operations Management	https://sites.google.com/site/trbcommitteeahd10/	Focused on managing the maintenance and operations of highway transportation facilities. Reports and presentations https://sites.google.com/site/trbcommitteeahd10/Welcome/files
Transportation Demand Management	http://www.trbtdm.org/	Identifies, stimulates, reviews and reports research related to social, economic, public policy, psychological, and management aspects of transportation demand management

Appendix H
Advance Materials
for
Workshop on TSM&O Program Planning and Development
for
State DOTs

Definitions

Many of the terms and phrases likely to be used during the TSM&O Workshop do not have precise or universally accepted definitions. Consensus definitions are not necessary to achieve the research objectives, but it seems advisable to address some of the most important terminology in advance and perhaps allow time at the workshop to consider the range of meanings and implications for TSM&O program planning and development. Accordingly some definitions are examined below.

Transportation Systems Management and Operations (TSM&O)

What is “TSM&O”? Is it just ITS renamed? Is it the same thing as “Operations” or “Systems Operations and Management”? Is it everything other than adding new lanes? MAP-21 included a formal definition that is shown in Table 1, alongside an earlier definition from FHWA’s *Planning for Operations Glossary*. The side-by-side comparison highlights some differences, indicating that the underlying concepts of TSM&O are still evolving.

Both definitions in Table 1 include a list of “actions” or “improvements” that are meant to be included under the term “transportation systems management and operations.” The MAP-21 list of inclusion is more extensive. Note that the MAP-21 definition refers to the inclusions as “actions” whereas the glossary definition refers to them as “improvements to the transportation system.” Most of the terms used to describe “actions” or “improvements” (e.g., freeway management, work zone management) are identical in both lists. Some of the terms used are the same as those used to describe “service packages” in ITS architectures (<http://www.iteris.com/itsarch/html/mp/mpindex.htm>).

From the perspective of TSM&O program planning for a state DOT, Table 2 offers some questions that a DOT might ask in deciding whether to adopt the MAP-21 definition. For that purpose, the first sentence of the MAP-21 definition is broken down into key phrases in Table 2.

Table 1. Comparison of Two Definitions of “Transportation Systems Management and Operations”

(Differences are highlighted)

MAP-21*	<i>Planning for Operations, Glossary</i> (FHWA)**
<p>The term ‘transportation systems management and operations’ means integrated strategies to optimize the performance of existing infrastructure through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of the transportation system.</p>	<p>Transportation Systems Management and Operations (TSM&O): An integrated program to optimize the performance of existing infrastructure through the implementation of systems, services, and projects designed to preserve capacity and improve security, safety, and reliability.</p>

<i>The term 'transportation systems management and operations' includes actions such as . . .</i>	<i>The term includes improvements to the transportation system such as . . .</i>
Traffic Detection and Surveillance	Traffic Detection and Surveillance
Corridor Management	Arterial Management
Freeway Management	Freeway Management
Arterial Management	Demand Management
Active Transportation and Demand Management	Work Zone Management
Work Zone Management	Emergency Management
Emergency Management	Electronic Toll Collection
Traveler Information Services	Automated Enforcement
Congestion Pricing	Traffic Incident Management
Parking Management	Roadway Weather Management
Automated Enforcement	Traveler Information Services
Traffic Control	Commercial Vehicle Operations
Commercial Vehicle Operations	Traffic Control
Freight Management	Freight Management
and Coordination of Highway, Rail, Transit, Bicycle, and Pedestrian Operations	Coordination of Highway, Rail, Transit, Bicycle, and Pedestrian Operations
<i>Coordination of the implementation of regional transportation system management and operations investments (such as . . .</i>	
Traffic Incident Management	
Traveler Information Services	
Emergency Management	
Roadway Weather Management	
Intelligent Transportation Systems	
Communication networks, and information sharing systems) . . .	
requiring agreements, integration, and interoperability to achieve targeted system performance, reliability, safety, and customer service levels	

* 23 USC 101(a)(30)

** <http://www.plan4operations.dot.gov/glossary.htm>

Table 2. Questions Prompted by Phrases in the MAP-21 Definition of TSM&O

Phrases from MAP-21 Definition	Questions for TSM&O Program Planning for State DOTs
The term ‘transportation systems management and operations’ means integrated strategies . . .	<p><i>What are the implications of this definition which refers to “strategies” compared to the earlier definition that refers instead to an integrated “program”?</i></p> <p><i>What are the implications of “integrated”?</i></p>
to optimize the performance of existing infrastructure . . .	<p><i>Note the word “existing.” Should a DOT’s TSM&O program also influence the planning and design of “new” infrastructure?</i></p> <p><i>What are the key measures for “performance of existing infrastructure”?</i></p>
through the implementation of multimodal and intermodal, cross-jurisdictional systems, services, and projects . . .	<p><i>What are the implications for a state DOT that owns only the state highway system and has limited authority and responsibility for other modes?</i></p>
designed to preserve capacity . . .	<p><i>Is “capacity” the primary measure of “infrastructure performance”?</i></p>
and improve security, safety, and reliability of the transportation system.	<p><i>Are these three objectives secondary to preserving capacity?</i></p> <p><i>Does this imply an equal balance among the three—“security, safety, and reliability”?</i></p> <p><i>What are the implications relative to other “programs” in the DOT and other agencies that address security, safety, and reliability?</i></p>

Both of the definitions in Table 1 seem most applicable in the context of regional planning and coordination for “multimodal and intermodal, cross-jurisdictional” programs. The MAP-21 definition specifically includes “coordination of the implementation of regional transportation system management and operations investments.” In most regions, the state DOT is one of many participants in regional planning and coordination, but not the lead agency. State DOTs may want to use the MAP-21 definition as a guide, but adopt their own, more tailored version.

Operations

FHWA's *Planning for Operations Glossary* provides the following definition of "Operations":

The provision of integrated systems and services that make the best use of existing transportation systems in order to preserve and improve customer-related performance. This is done in anticipation of, or in response to, both recurring and non-recurring conditions. Operations includes a range of activities in both urban and rural environments, including: routine traffic and transit operations, public safety responses, incident management, snow and ice management, network/facility management, planned construction disruptions, and traveler/shipper information.

The World Road Association-PIARC defines "Road Network Operations" as follows:¹

Road network operations can be defined as all traffic management and user support activities intended to permit, improve, or facilitate the use of an existing network, whatever its conditions of use.

Road network operations concerns all activities directly related to the concept of service to the user of a road network (person, freight transporters, and public transport operator) and to service improvement. It therefore differs from:

- *improvement* of the infrastructure, which consists in equipping it and adjusting its geometric and physical characteristics;
- *maintenance* of the infrastructure, designed to ensure the preservation, quality of use and renewal of road assets;
- *traffic policing powers* that concern general or local rules of road use, whether permanent or temporary.

However, the word "operation" is used in state DOTs with a wide range of meanings and implications. Consider, for example: Planning, design, and **operation**; maintenance **operations**; transit **operations** and safety; intersection **operations**; Concept of **Operations**; State Emergency **Operations** Center; asphalt paving **operations**; **Operation** Lifesaver; aircraft **operations**; Intelligent Transportation Systems (ITS) **operations**; toll **operations**; days and hours of **operation**; system management **operations**; and, in a very few DOTs, Transportation Systems Management and **Operations**.

Many DOT organizational charts show "Operations" divisions with subordinate units responsible for a much wider range of functions than are included in the Table 1 definitions of TSM&O. "Operations" seems to be used in organizational structures more in reference to *departmental* operations than to *transportation system* operations. See for instance:

¹ Road Network Operations Handbook, http://road-network-operations.piarc.org/index.php?option=com_content&task=view&id=51&Itemid=72&lang=en

- Maryland SHA: <http://roads.maryland.gov/OC/SHAorgchart282013.pdf>
- MnDOT: <http://www.dot.state.mn.us/information/orgchart.html>
- NCDOT: <http://www.ncdot.gov/download/about/structure/NCDOTOrgChart.pdf>
- ODOT: <http://www.dot.state.oh.us/policy/Pages/ODOTTableofOrganization.aspx>

Program

The word “program” is widely used in state DOTs, as both a noun and a verb, in many different contexts.

A few examples:

- | | |
|---|---|
| • Federal-Aid Highway Program | • Program of Projects |
| • Governors Highway Safety Program | • State Transportation Improvement Program |
| • Logo Sign Program | • Office of Planning and Programming |
| • Ridesharing Program | • Prepaid Toll Program |
| • Bicycle and Pedestrian Program | • Program Allocations |

In the list above, note especially the “Office of Planning and Programming.” In that case, “programming” involves selecting and scheduling projects for implementation/funding.

Many more examples are available. The homepages for many DOTs include prominent tabs for “Programs” or “Programs and Services” or even “Projects and Programs.” See, for instance, these links to the [Kentucky Transportation Cabinet](#), [Michigan DOT](#), [New York State DOT](#), and the [North Carolina DOT](#).

For the purposes of the research and the workshop, the following three definitions help to define the applicable concept of “program.” They also illustrate the challenges of a precise definition:

- Program: A system of services, opportunities, or projects, usually designed to meet a social need.²
- Program: A coordinated, inter-related set of strategies, procedures, and activities, all intended to meet the goals and objectives articulated in vision statements and policies.³
- Program: Generally, an organized set of activities directed toward a common purpose or goal that an agency undertakes or proposes to carry out its responsibilities.⁴

One of the workshop objectives is to more clearly define a “TSM&O Program” by identifying, categorizing, and exploring the essential components of such a program.

² *American Heritage College Dictionary*

³ FHWA, *Freeway Management and Operations Handbook*, September 2003 (updated 2006)

⁴ Definition used by the GAO in the *Federal Program Inventory* (in response to the 2010 Government Performance and Results Modernization Act) which includes this statement: “Within this broad definition, agencies and their stakeholders currently use the term ‘program’ in different ways. Agencies have widely varying missions and achieve these missions through different programmatic approaches, so differences in the use of the term ‘program’ are legitimate and meaningful.”

Strategy

The word “strategy,” from a Greek word meaning “generalship,” is often used in a military context, but the word is also widely used in business, government, and the non-profit sector. It is also used as an adjective for other words (e.g. strategic planning, strategic management, and strategic thinking). Some definitions distinguish between *strategy* and *tactics*.

Several definitions that may be useful for the purposes of TSM&O program planning are shown below, in decreasing order of brevity:

- Strategy: What to do to carry out the mission.⁵
- Strategy: A method or plan chosen to bring about a desired future, such as achievement of a goal or solution to a problem.⁶
- A business strategy is a set of guiding principles that, when communicated and adopted in the organization, generates a desired pattern of decision making. A strategy is therefore about how people throughout the organization should make decisions and allocate resources in order to accomplish key objectives.⁷
- Strategy is . . . perspective, position, plan, and pattern. Strategy is the bridge between policy or high-order goals on the one hand and tactics or concrete actions on the other . . . Strategy is a term that refers to a complex web of thoughts, ideas, insights, experiences, goals, expertise, memories, perceptions, and expectations that provides general guidance for specific actions in pursuit of particular ends.⁸

However, all of the above notwithstanding, “strategy” can also be defined as “a specific activity that is designed to help achieve an objective.”⁹ That definition applies in some of the literature reviewed as part of this project, which uses “strategies,” “operational strategies,” and “strategic applications” to describe incident management, corridor management, road weather management, work zone traffic management, special-events planning and management, and active traffic management. (MAP-21 describes these examples as “actions” or “investments” rather than strategies. Other sources refer to these as “activities,” “actions,” “services” or “service packages.”)

⁵ James L. Mercer, *Strategic Planning for Public Managers*, 1991

⁶ BusinessDictionary.com, <http://www.businessdictionary.com/definition/strategy.html> (As of January 28, 2014)

⁷ Michael Watkins, HBR Blog Network Demystifying Strategy: The What, Who, How, and Why, September 10, 2007 <http://blogs.hbr.org/2007/09/demystifying-strategy-the-what/>

⁸ Fred Nickols, Strategy: Definitions and Meaning, Distance Consulting LLC, 2012 http://www.nickols.us/strategy_definition.htm (As of January 28, 2014)

⁹ Florida DOT, Transportation Glossary of Terms and Acronyms, August 2013 <http://www.dot.state.fl.us/planning/glossary/glossary.pdf>

Thus, in discussing TSM&O it will be important to distinguish between, on one hand, overarching *departmental strategy* to guide decision making and accomplish mission and vision and, on the other hand, an *operational strategy* to accomplish a specific objective

Maintenance

It may also be important to distinguish between “maintenance” and “Maintenance,” with the later referring to the functions performed by the Maintenance organizational unit(s), at the headquarters and region/district/division levels. In most DOTs the Maintenance units have decades of experience and substantial resources and expertise for delivering services, projects and activities that fall under the umbrella of “TSM&O.” Examples include roadway weather management, traffic incident management, and emergency management. Maintenance units carry out many day-to-day activities that impact transportation system operations. Further, Maintenance personnel often have direct and ongoing working relationships with many of the most important partners for TSM&O, including law enforcement agencies, local public works and transportation agencies, and emergency managers.

Most of the organizational charts cited above in the discussion of “Operations” have “Operations” and “Maintenance” closely aligned. Here are some additional examples of such organizational connections:

- Alabama DOT: <http://www.dot.state.al.us/maweb/index.htm>
- Iowa DOT: http://www.iowadot.gov/pdf_files/dot_organ_chart.pdf
- MDOT: http://www.michigan.gov/mdot/0,1607,7-151-9623_26663_27353---,00.html
- PennDOT: <ftp://ftp.dot.state.pa.us/public/Bureaus/bop/orgchart.pdf>

Integration, Coordination, and Collaboration

These three words—integration, coordination, and collaboration—are used frequently in the TSM&O literature. For the most part, the common meanings are applicable, but some subtleties may be important.

“Integration” is commonly defined using terms such as “an act or instance of incorporating or combining separate parts into a unified whole.” In the TSM&O context, the reference may be to IT system integration; or to merging separate decision-making processes into a unified process; or to merging separate services, projects, or activities. The *Freeway Management and Operations Handbook* describes “integration” as:

A bridging function between all of the various components, activities, and related attributes that comprise and impact the surface transportation network. The goal of integration is to bring the management and operation of the surface transportation network into a unified whole, thereby making the various transportation modes and facilities perform better and work together.

Perhaps the most important use of “integration” for the purposes of this research is when referring to the integration of TSM&O concepts, goals, objectives, and strategies into all of the DOT’s functions and business processes. Not just adding TSM&O as new, free-standing departmental activity, but *integrating* TSM&O throughout the department—integrating TSM&O in departmental strategic planning, the responsibilities and practices of all organizational units, and business processes at all levels.

The words “collaboration” and “coordination” as well as “cooperation” are sometimes used interchangeably. The FHWA *Planning for Operations Glossary* defines collaboration, using cooperation as part of the definition, as follows:

Any cooperative effort between and among governmental entities (as well as with private partners) through which the partners work together to achieve common goals. Such collaboration can range from very informal, ad hoc activities to more planned, organized and formalized ways of working together. The collaborative parties work toward mutual advantage and common goals. They share a sense of public purpose, leverage resources to yield improved outcomes, and bridge traditional geographic, institutional, and functional boundaries.

However, it may be useful to distinguish between cooperation, coordination, and collaboration. The distinctions can be significant in a DOT’s TSM&O program. The following descriptions are offered:¹⁰

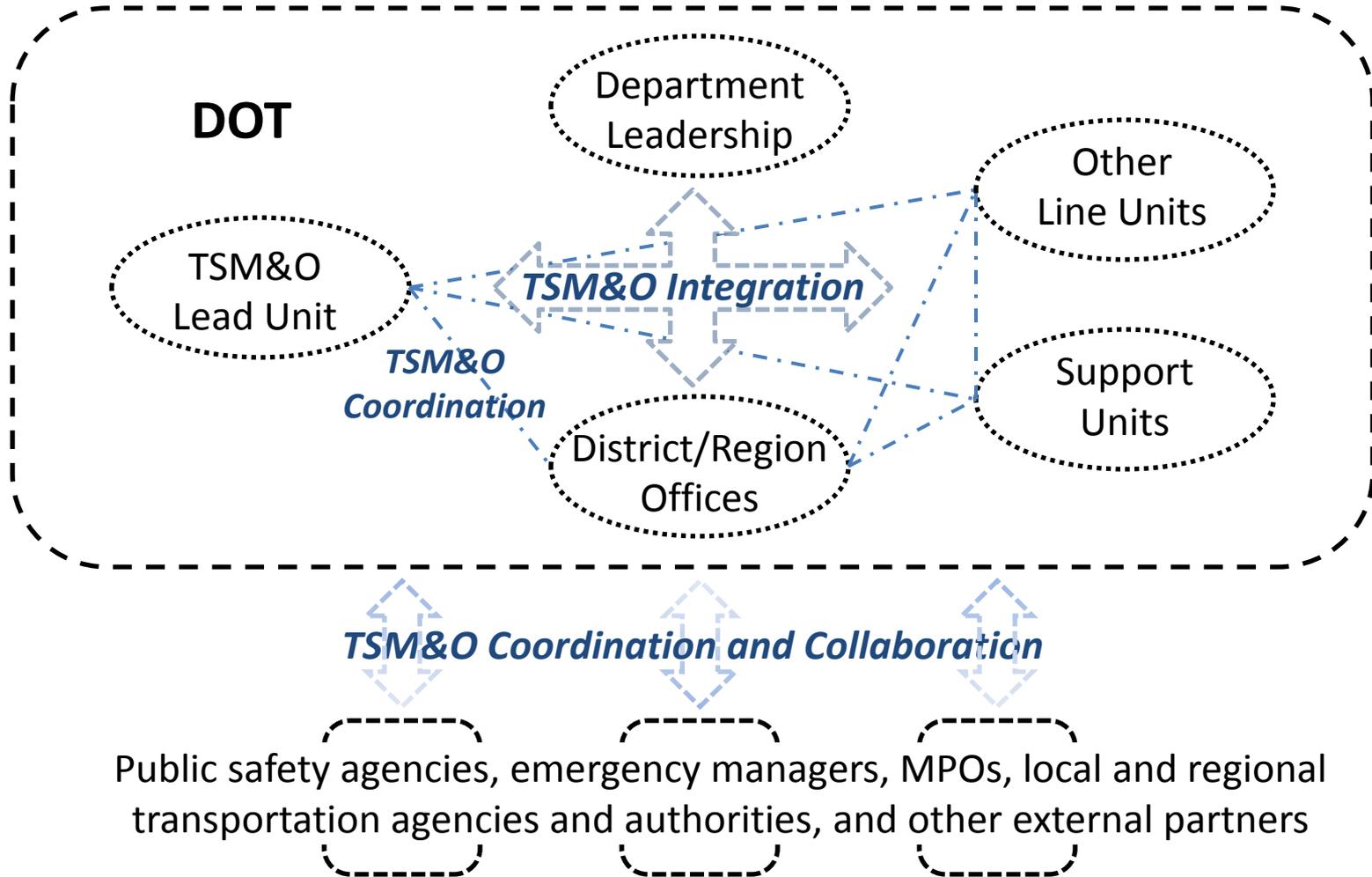
Cooperation is important where organizations (and organizational units) need to exchange relevant information and/or resources in support of each other’s goals, rather than a shared goal. Organizational mission and goals are not important. No joint planning is required. Authority and accountability rests with each organization.

Coordination is sharing information and resources, sometimes agreeing to sequence decisions or actions, so that each party can accomplish their part in support of a mutual objective. It is about teamwork in implementation. Not creating something new. Mission and goals of the organizations need to be compatible. Some topic-specific planning may be required. Some sharing of leadership and control and some shared risks.

Collaboration is working together to create something new in support of a shared vision. It is not an individual agency/unit initiative. Something new is created to accomplish the shared vision. Common, new goals and objectives are created. Comprehensive planning is required. Leadership is dispersed and control is shared and mutual. Resources are pooled. Equal risks are shared.

¹⁰ Adapted from “Let’s Stop Confusing Cooperation and Teamwork with Collaboration,” Jese Lyn Stoner’s Blog, Seapoint Center for Collaborative Leadership, as found at <http://seapointcenter.com/cooperation-teamwork-and-collaboration/> (As of January 18, 2014) and from *Collaboration: What Makes It Work* (Mattessich et al., 2001, p. 61), adapted from works of M. Blank, S. Kagan, A. Melaville, and K. Ray, as found at: <http://www.conservationgateway.org/Files/Pages/cooperation-coordination-.aspx> (As of January 18, 2014)

State DOT Program for TSM&O: Organizational Features and Critical Interfaces



Excerpt from: **AASHTO TSM&O One-Minute Guidance Evaluation**

http://www.aashtotsmoguidance.org/one_minute_evaluation/

Dimension	Level 1	Level 2	Level 3	Level 4
Business Processes <i>(Planning, programming, budgeting, implementation)</i>	Processes related to TSM&O activities ad hoc and un-integrated	Multiyear statewide TSM&O plan and program exists with deficiencies, evaluation, and strategies	Programming, Budgeting, and project development processes for TSM&O standardized and documented	Processes streamlined and subject to continuous improvement
Systems & Technology <i>(Systems engineering, standards and technology interoperability)</i>	Ad hoc approaches outside systematic systems engineering	Systems engineering employed and consistently used for ConOps, architecture and systems development	Systems and technology standardized, documented and trained statewide, and new technology incorporated	Systems and technology routinely upgraded and utilized to improve efficiency performance
Performance Measurement <i>(Measures, data & analytics and utilization)</i>	No regular performance measurement related to TSM&O	TSM&O strategies measurement largely via outputs, with limited after-action analyses	Outcome measures identified and consistently used for TSM&O strategies improvement	Mission-related outputs/ outcomes data routinely utilized for management, reported internally and externally, and archived
Culture <i>(Technical understanding, leadership, outreach, and program authority)</i>	Value of TSM&O not widely understood beyond champions	Agency-wide appreciation of the value and role of TSM&O	TSM&O accepted as a formal core program	Explicit agency commitment to TSM&O as key strategy to achieve full range of mobility, safety and livability/ sustainability objectives
Organization/Workforce <i>(Organizational structure and workforce capability development)</i>	Fragmented roles based on legacy organization and available skills	Relationship among roles and units rationalized and core staff capacities identified	Top level management position and core staff for TSM&O established in central office and districts	Professionalization and certification of operations core capacity positions including performance incentives
Collaboration <i>(Partnerships among levels of government and with public safety agencies and private sector)</i>	Relationships on informal, infrequent and personal basis	Regular collaboration at regional level	Collaborative interagency adjustment of roles/responsibilities by formal interagency agreements	High level of operations coordination institutionalized among key players –public and private

TSM&O STATE OF THE PRACTICE

Draft

This material represents the view of the author – based on SHRP2 L06 research, the findings of TSM&O CMM Workshops, related activities at the Operations Academy and Regional Operations Forums and the Workshop Facilitator Guide.

Background

SHRP2 L06 research identified the key differentiators regarding more vs. less effective TSM&O activities. The research indicated that business processes and institutional arrangements appeared to be the principal factors that distinguished agency capability for continuous improvement of TSM&O.

Based on these findings process was developed to determine the current state of play regarding TSM&O capabilities within a state or region based on self-assessment by the state DOT and/or MPOs and implementation partners (public safety, local government, etc.).

The self assessment process was structured into a TSM&O capability maturity model framework using six key dimensions along with levels of capability defined by specific criteria observed to differentiate degrees of capability.

TSM&O CMM workshops involving state DOTs and their partners have been conducted in approximately 30 states and metropolitan regions, sponsored either by SHRP2, FHWA/AASHTO or individual states. The TSM&O CMM process has also been used in the Operations Academy and Regional Operations Forums and findings have also been embodied in the AASHTO TSM&O Guidance website and incorporated into the development of the TSM&O Knowledge Transfer System website and the National Operations Center of Excellence concept.

The Capability Maturity Self-assessment Framework

Based on the research, the workshops are structured in terms of six key areas of capability:

1. *Business processes* including formal scoping, planning, programming, and budgeting (resources)
2. *Systems and technology* including use of systems engineering, systems architecture standards, interoperability, and standardization
3. *Performance measurement* including measures definition, data acquisition, and utilization
4. *Culture* including technical understanding, leadership, outreach, and program legal authority
5. *Organization and staffing* including programmatic status, organizational structure, staff development, and recruitment and retention
6. *Collaboration* including relationships with public safety agencies, local governments, MPOs and the private sector

For each of these dimensions, the self-evaluation utilizes four criteria-based “levels” of capability that indicate the general direction of managed change to establish a stronger basis for improved TSM&O capability:

- *Level 1 – “Performed”* --Activities and relationships largely ad hoc, informal and champion-driven, substantially outside the mainstream of other DOT activities
- *Level 2 – “Managed”* --Basic strategy applications understood; key processes’ support requirements identified and key technology and core capacities under development, but limited internal accountability and uneven alignment with external partners
- *Level 3 – “Integrated”* --Standardized strategy applications implemented in priority contexts and managed for performance; TSM&O technical and business processes developed, documented, and integrated into DOT; partnerships aligned
- *Level 4 – “Organized”* -- TSM&O as full, sustainable core DOT program priority, established on the basis of continuous improvement with top level management status and formal partnerships

The workshops consist of a facilitated self-identification of current strengths and weaknesses in each dimension and a consensus determination regarding the current level of capability for that dimension. These serve as the basis for the participants' determination of the actions needed to improve to the next level of capability in each dimension – with highest priority on the dimension self-rated to be the lowest. In the current (2014) round of FHWA/AASHTO-sponsored CMM workshops, an additional step has been added through which the facilitation team helps the host agency convert the workshop-suggested actions into an implementation plan, pursuant to an agreement of support from FHWA and AASHTO.

TSM&O State of the Practice – General

In each of the six dimensions there is a wide variation in state of play among the agencies (both state DOTs and MPOs) that hosted workshops. In many cases, there has been visible change and strong staff leadership – fully aware of best practice and working within their institutional context to develop the essential capabilities. Within individual states, progress in improving capabilities across the six dimensions has been uneven, but many states have one or two areas where significant capability improvement has been made. Nevertheless there is often a significant gap between best practice and average practice across states. The SHRP2 Reliability Program and related supporting activities from FHWA and AASHTO have raised awareness and provided important assistance. FHWA and AASHTO have expanded their support via implementation plans in the current round of CMM applications.

TSM&O State of the Practice – By Dimension

In the material below, the state of the practice discussion has been organized by the six dimensions of capability. For each dimension, general observations are presented followed by the typical action items participants suggest in response to overcoming capability weaknesses identified. In general, the capability levels “averaged” about Level 2 with many agencies beginning to develop a formal managed approach to TSM&O in some dimensions. A few have integrated certain dimensions (Level 3). All workshop participants appear to recognize the value of CMM structure as a device to guide strategies to improve their capabilities. In states who were early participants in the CMM workshop program there appears to have been significant changes since the workshop – especially in organization and program planning. The observations below reflect the candor characteristic of participants

Note: Some examples of states' current good practice are cited – based on these state DOT's own self-assessment. These are not intended to be a complete or exclusive list of examples. There is a wide variation – even within given states.

Business Processes

TSM&O is rarely conceived of as a program that requires a “plan”. Implementation is largely on an ad hoc basis, including the funding

There are few clear models of a comprehensive program plan for TSM&O developing a systematic road map and action that link DOT goals, objectives and performance measures with non-recurring congestion-related problems and related strategies and their conops, systems, roles, procedures and investments – capital, operating and maintenance – required. Such TSM&O “program plans” are rare – either on a statewide or regional basis – although there are a few recent examples (WA, CA, WI, NV, MD, NC). Several states have older statewide ITS plans (and architectures) developed in the past 5–10 years in response to federal funding requirements—that provide a value point of departure – but these are often in need of updating.

TSM&O investments are rarely integrated into the conventional statewide (STIP) or metropolitan (TIP) plans and budgets. In addition, state planning staff typically has a limited knowledge regarding TSM&O payoffs and costs, and “operators” are often not directly involved in the formal planning process. Few states have an explicit budget line item devoted to TSM&O: funding is opportunistic, ad hoc and intermittent. One of the reasons appears to be that TSM&O is not considered a formal state DOT “program” that requires a continuing multiyear capital budget, comparable to new capacity or maintenance. In addition there is a TSM&O staff perception that overall investment levels are static (and funds for TSM&O highly constrained) – “so why plan?”

TSM&O staff is not typically at an organizational level to consistently participate in budget discussions. In fact, facing the competition for funds, some staffs find it advantageous to bury TSM&O costs in other major capital projects. Where the information is available, TSM&O expenditures are typically in the +/- 2-3 percent range of a department's overall budget.

Lack of "program" status appears at times to lead to uncoordinated or fragmented ITS implementation, and the lack of planning often makes it difficult to make a systematic business case for needs and costs – not just for capital improvements, but for ITS maintenance, technology upgrading, and staffing – and leaves these components vulnerable to being the first cut from an overall capital project when cost reductions are necessary. The absence of predictable and sustainable budgeting on a systematic lifecycle basis in most agencies hampers effective program development as well as the ability to upgrade and maintain current systems. In addition, there are instances of "plateauing" in some states that were early adopters. Having implemented many of the "low-hanging fruit strategies (especially on freeways) there is a natural reluctance to take on the collaborative complexities of interjurisdictional strategies such as arterial traffic operations.

While statewide TSM&O programming planning is rare, a greater amount of planning and budgeting takes place at the state DOT district or corridor level as evidenced by corridor projects – including integrated corridor management (ICM) – in MI, CO, CA, NH, WA, FL, KS and others. In addition, there are examples of several formal planning efforts at the metro level under MPO initiative with state DOT cooperation (including DVRPC, DRCOG, SANDAG, MAG, FAST, MWCOG, Portland Metro, MTC) – especially where arterial improvements are a key concern. However, these plans are not always built around a clear sense of resource availability and the level of state/local coordination varies widely.

Typical participant-suggested actions for advancement to the next level of capability include:

- Convene or utilize an integrated/inclusive working group/planning committee (including representation from local jurisdictions, public safety community, other modes, etc. as appropriate) to define the appropriate ingredients for a TSM&O program planning activity (setting a vision, policies, strategies, conops, resources work program, etc.)
- Based on existing state of play, identify key priorities and develop initial statewide/ district or regional plan(s) for TSM&O infrastructure and real-time operations
- Incorporate local and regional plans and build/expand on success of corridor level planning – such as using formal ICM plans to "pilot" program planning
- Develop a multiyear budget (capital, staffing, maintenance)
- Incorporate the use of performance data and cost-benefit outcomes in formulating planning documents and justifying continued/increased expenditures
- Extend efforts to make the "business case" for operations using existing performance data on project outcomes/benefits and tailoring communications to the public and policymakers
- Ensure inclusion and specificity for ITS/operations options at all stages of project development

Systems and Technology

A systems engineering approach is typically followed in most states. Statewide and/or regional ITS architectures or concepts of operations usually exist (typically following FHWA guidance), although are often more than a few years old. States have basic competence in this area but rely on consultants for architecture development and more complicated systems engineering. Participants frequently admit a need to update them or that an update is currently underway; however low levels of federal funds used for ITS have reduced the impact of federal requirements, and the generally modest pace of deployment has reduced the apparent necessity for upgrades.

In multijurisdictional environments, concepts of operations are sometimes used to mobilize participants or followed up in terms of procedures and protocols, but common architectures (with local governments) may not yet be developed. There are also legacy technologies that are not completely standardized or documented (a problem given staff turnover). The need for integration/documentation is recognized. Keeping up-to-date with rapidly advancing technologies is a challenge.

Interoperability is often a problem with regard to both data and voice communications, with cost a major barrier to improvements in the latter. This is especially a concern in multijurisdictional environments (local governments, public safety agencies) that present special challenges of interregional data sharing or communication challenges due to a lack of interoperability, standardization, or formalization among partners. Several states are updating their basic data sharing platforms under the impetus of greater attention to performance tracking and reporting and use of externally supplied (private) travel data. As the focus of state DOT involvement expands to arterials and growing involvement with traffic operations technology, limited staff expertise (state and local) is a challenge.

Separate state departments of information technology (IT) have been cited as a significant barrier to state DOT efficient procurement, and low bid constraints hamper standardization. Some states have remarked on deployment successes using best value procurement, although these have been applied to software or systems and not to equipment. Overall, procurement processes are just as much or greater an obstacle to keeping deployments up-to-date as are technical capacities or financial resources.

Finally, many workshop attendees have remarked on an inconsistent approach to and insufficient consideration of resources for device maintenance, once deployed (relates to the Business Processes Dimension).

Typical participant-suggested actions for advancement to the next level of capability include:

- Convene workshop or collaborative group to update a statewide/regional architecture; use such a platform to identify issues/solutions at integrated corridor level
- Review national best practices and/or conduct a peer exchange on technologies/software/protocols/procurement processes as appropriate
- Establish/formalize a data-sharing platform and protocols
- Integrate interoperability/communication standards into the systems engineering process
- Integrate ITS device/systems maintenance into the systems engineering process
- Engage and build relationships with IT personnel on purpose and benefit of TSM&O projects; identify strategies for better communication
- Develop a strategy to access needed IT capabilities (hire or retain)

Performance Measurement

Most states are conscious of the impending requirements of MAP-21, and performance measures are much discussed in professional circles. The majority of the states track and compile some data on a statewide basis, especially related to incident clearance time and road weather treatment. Available performance measures are confined largely to output data, such as incident response and clearance times.

Professional staff is aware of the importance of developing customer-related outcome measurement to making the business case for TSM&O -- either on a standalone or alternative investment context -- to decision makers and the public. In this they are hampered by the lack of systematic data and analytics related to the obvious performance measures for non-recurring congestion, such as travel time, reliability, and safety. Given the impending MAP-21 requirements, most states are in the early stages of identifying outcome measures and several are acquiring private sector probe data to support them. DOTs with extensive toll operations are capitalizing on tags as probes.

While there is considerable discussion of measures, the internal demand for performance information in support of improved operations is not widespread. Incident after-action briefings (using output measures) are increasingly common, but a systematic approach to use data to manage operational performance (parallel to asset management) is not widely evident. One key challenge is rationalizing data sources and performance measures across multijurisdictional regions or modes, where agreement on the "right" performance targets and related measures may be a challenge. A related and frequent example of this is gaining agreement between DOTs and the public safety community on common definitions for traffic incidents, especially related to their timeline delineations.

States that show TSM&O activity data on internal or external dashboards include VA, WA, GA, MN, WI, MO, and OR. However, agency accountability for TSM&O program performance is not yet a widespread operative management concept. Even for simple output data, limitations of analytical methods, tools, and staff inhibit the application for reporting up the chain of command for systematic program performance review.

A promising development is that several states report using more comprehensive performance measurement on specific major projects such as corridor improvements (NH, MI, CA, AZ, FL, CO). These instances present opportunities to pilot promising approaches to data collection and utilization, such as expanding a successful work zone performance measurement and reporting initiative (e.g. travel times, safety) on a broader, more comprehensive scale, in part by leveraging the demonstrated success of the initiative to secure required resources and technical support. FHWA's work zone and incident management outreach is having a significant impact in this regard.

Typical participant-suggested actions for advancement to the next level of capability include:

- As a starting point, review and capitalize upon MAP-21 performance measure requirements and/or review peer state best practice regarding PMs and their application
- Develop goals and objectives for both output and outcome measures to be used to support internal (corporate) management activities, making the business case for TSM&O (to leadership/decision makers as well as the public), and customer service (public) functions
- Review existing/identify applicable performance measures by audience/mode/system
- Review existing/identify performance measure data sources (including 3rd party)
- Review existing/identify performance measure collection responsibility and reporting media
- Establish common terminology, definitions, measures, and analytics
- Utilize a pilot project (such as a corridor) to develop new approaches

Culture

The mainstreaming of TSM&O in state DOT culture requires agency-wide understanding of the business case, senior manager leadership, visible policy and a recognition of the requirements to support development of all the key dimensions of capability related to business process, organizational development and collaboration.

The “business case” for TSM&O is increasingly recognized in concept but is hampered by the lack of persuasive material regarding cost-effectiveness and potential to impact congestion, incident-related delay, reliability and safety. This has inhibited the ability of DOTs and MPOs to gain the understanding and support of policy makers accustomed to support visible capacity improvements.

Some increased focus on TSM&O is being stimulated in part by the increased attention to performance measurement (MAP-21) and through availability of SHRP2 Reliability products, FHWA workshop and implementation planning support, and association-based peer-to-peer activities.

State DOT CEOs are understandably preoccupied with challenges associated with the legacy missions of capital project delivery and system preservation – especially in the context of current resource constraints and public attention focused on visible capacity improvements. Even for career senior management, direct exposure to ITS technology and 24X7 real-time operations mindset and dependency on external collaboration is limited, reflecting the dominant civil engineering culture. Given the level of decentralization in state DOTs for program delivery, the lack of institutional mechanisms to expose district and regional staff to broad professional dialogue, peer interchange and direct federal contact tends to inhibit culture change where it is much needed.

TSM&O typically lacks formal core state DOT program status. TSM&O improvements have often been in the form of ad hoc projects, without a clear program focus. It is often missing in statements of agency mission or objectives, is not included in multiyear plans, programs or budget (in fact few states know what they are spending on TSM&O). Some early TSM&O advances were dependent on individual middle management champions – rather than managed change – and appear to have lost momentum with the departure of those individual. Fully “mainstreaming” TSM&O as a formal top level agency program is rare – although several

states have increased the visibility in policy (WA, CA, WI, FL, MD, VA, MO) and many others are moving in that direction.

Typical participant-suggested actions for advancement to the next level of capability include:

- Develop a persuasive business case – including both internal and external visions or “stories” of TSM&O benefits, leveraging past successes (specific strategy applications, projects, major events) and/or national best practice and research findings
- Using the above, develop a strategy for conducting internal and external TSM&O outreach by identifying and evaluating media outlets and dissemination opportunities including marketing, branding, and terminology
- Align agency public relations strategies with TSM&O program, its importance, purpose, and successes
- Introduce TSM&O into DOT/MPO policy, planning, programming and budgeting as a key focus
- Capitalize on existing collaborative forums to promote operations and make a recurring agenda item

Organization and Staffing

TSM&O activities in most states are extremely champion-dependent with small, dedicated, hard-working staffs that depend on on-the-job training and effective “intrapreneurship” within their jurisdictions. Decentralization of TSM&O service delivery is the rule in the larger states (such as VA, CA, TX), with wide variation in the level of involvement of HQ staff. In larger states, districts often have their own TMCs, where TSM&O service delivery coordination and focus takes place, often together with collocated public safety and local government partners. States with fewer large metropolitan areas (such as OR, MD, NH) concentrate TSM&O expertise and activities in headquarters via statewide TMCs, with small operational staffs and greater statewide responsibility.

While there is still considerable “siloeing” of related units in some states, reorganization and consolidation is occurring. There is often an organizational distinction between units with “operational” vs. “engineering” responsibilities. For example, for historical reasons, ITS (with its engineering focus) is often separate from a TMC (with its real-time focus), and traffic engineering and ITS maintenance are often separate responsibilities. There is some variation in the level of consolidation and reporting relationships among TSM&O-related functions such as TMC and incident management, traffic engineering, service patrol, ITS/systems, etc.

Several state DOTs have created new TSM&O-related divisions (by various names) with direct reporting to the chief operating officer (including TN, NJ, NC, NV, NH, WI, MI, CO). Otherwise, TSM&O is typically charted at the third or fourth level at headquarters and third level at districts. In some cases, the senior manager with TSM&O responsibility may have overall charge of all day-to-day highway “operations” (right of way, equipment, etc.) as well as “maintenance” statewide or district-wide, leaving limited time (and resources) for TSM&O.

Staffing constraints due to limited or reduced slots, recruitment and retention challenges, and the retirement of knowledgeable individuals are a significant concern among many DOTs. There is almost no relevant education and training offered at institutions of higher education that would introduce young professionals to TSM&O. Within DOTs, a lack of formal staff position descriptions and succession plans for both technical and management staff is common. In some states, civil service and union practices inhibit the ability to develop succession plans and targeted training, and also constrain the hiring of staff with special technical qualifications. Staffing constraints and the need for special expertise has led to increasing use of outsourcing in areas like systems development, TMC staffing, ITS device maintenance, safety service patrol,

The upward career vector for staff specializing in operations (and lacking PE qualifications) is sometimes unclear. DOTs report entry level staff with these backgrounds often use department employment as a stepping stone to better career options –such as in the private sector – or move to the private sector. Some states report retention challenges as younger staff (millennials) value career flexibility and varied opportunities over long-term institutional career commitments. At the same time, the technical knowledge (computer/electrical) required of many TSM&O application systems is specialized, and the private sector offers many more lucrative opportunities to apply them.

Typical participant-suggested actions for advancement to the next level of capability include:

- Evaluate organizational structure (HQ, divisions, key partner relationships) with respect to TSM&O capabilities/program and create an inventory of existing/needed skills
- Evaluate job description credentials/experience requirements for current applicability and develop position descriptions that satisfy needed TSM&O core capabilities (potentially using national best practice)
- Develop strategies and requirements for acquiring skills through appropriate means/sources (reassign, hire, outsource), supported by appropriate cost-benefit analysis or justification of staffing levels/paths
- Support the business case for increased staffing by indicating benefits and payoffs; illustrate the consequences of staffing shortfalls
- Develop succession plans
- Identify and develop training needs and programs internally and among partners

Collaboration

Collaboration – public-public and public-private – is more essential to TSM&O than other departmental activities owing to divided jurisdiction and dependency on technical expertise. Workshop discussion of collaboration has usually centered on incident management, special events, traffic control devices/signals, and the sharing of data—and to some extent planning. Data sharing can relate specifically to one of these collaborative subjects (e.g. CAD data for incident management) or more generally, such as access to travel time probe data.

There is mixed experience regarding the need for—and formality of—public-public collaboration, especially in incident management where effective working relationships with public safety and local government entities are critical. In most states, either police or fire has incident command and controls towing and recovery, traffic direction and often safety service patrol (SSP) – and DOTs must develop working relationships that can incorporate transportation service into the public safety mission.

Several states have effective MOUs between their DOT and law enforcement (WA, NH, GA, NJ and several others) and active IM task forces (which, however, are highly champion dependent). However, relationships with public service agencies tend to be at the district level and vary in terms of formality—although workshop participants often maintain that the informal approach is working. Participants recognize the need for formalization but acknowledge the limited leverage of middle management in obtaining agency-level formal agreements. In some states with strong home rule governance or multijurisdictional rural regions, fire and police may operate without notification of the state or without regard to the broader implications of an incident beyond their relatively narrow jurisdictional boundaries. These situations create challenges to effective collaboration and incident management.

IM training, itself, has often played a key role in bringing law enforcement, fire and emergency services together with DOTs. GA and TX are two examples where a multiagency IM team or committee has been cited as the driving force behind successful regional collaboration, coming together to conduct after-action debriefings and/or co-training. National traffic incident management first responder training, developed by SHRP2, has also been cited in several locations as a catalyst to improving collaboration in a multiagency context. TMC collocation has also led to strong collaboration, centralizing incident management command or facilitating the sharing of data, resources, and experience. A focus on a specific travel corridor (e.g. a critical Interstate corridor for freight movement) or a special event (e.g. National Conventions) has also solidified working relationships, and in many cases, formalized them. On the other hand, a frequent detractor to successful collaboration is a lack of common performance measures or incentives for collaborating.

State-local collaboration remains a challenge. Data sharing across modes (transit) or at the arterial level (traffic control devices) remains a common challenge. Multiple layers of bureaucracy, lack of an appropriate platform or forum (convener) for sharing across multiple jurisdictions, or incompatible systems/software contribute to these issues. In addition different levels of financial capacity among the jurisdictions is often a major inhibitor. There are some interesting examples of partnering regarding financial resources, including

state DOT support of law enforcement (NJ) and use of incentive payments to encourage timely towing and recovery (GA).

Formal relationships with MPOs regarding TSM&O planning and programming are rare—and typically reflect MPO planning initiatives. In the more urban DOT districts, state DOT staffs increasingly recognize the need for MPO involvement, both to access resources and to serve as a forum for interjurisdictional systems, especially as the DOTs' interests expand to include an arterial focus.

Typical participant-suggested actions for advancement to the next level of capability include:

- Formulate new, review, or renew existing partnership agreements and agree on their specificity and application
- Formalize an interjurisdictional collaboration forum, committee, or program
- Identify and apply elsewhere collaborative best practice gained from: existing special event management; a specific travel corridor focus; a specific region; a specific forum, committee, or program; or national best practice examples
- Develop local jurisdiction and law enforcement notification protocols for incidents, operational changes, etc.
- Develop arterial IM plans, procedures, and protocols; potentially include as an agenda item at incident management meetings
- Investigate incentive/disincentive towing program application, including from use in peer states

Appendix I
Results of the Pre-Workshop Survey

1. Do you represent:

		Response Percent	Response Count
State DOT		56.0%	14
Regional Agency		24.0%	6
Other		20.0%	5
answered question			25
skipped question			1

2. Your total number of years of professional experience (please round to the nearest whole number):

	Response Average	Response Total	Response Count
Years	25.76	644	25
answered question			25
skipped question			1

3. Total years of professional experience directly related to TSM&O

	Response Average	Response Total	Response Count
Years	14.52	363	25
answered question			25
skipped question			1

4. Please check all of the following that apply to you personally

		Response Percent	Response Count
Operations Academy graduate		27.3%	6
Completed TIM Training		40.9%	9
Member of the TIM Network		36.4%	8
Completed NHI training course related to TSM&O		45.5%	10
TSM&O presenter at professional meeting, webinar, or training course		59.1%	13
Appeared before a legislative or policy committee to address TSM&O		50.0%	11
Representative on committee or task force for ITS America (National or Chapter)		36.4%	8
Member of APA		9.1%	2
Member of ITE		54.5%	12
Member of ASCE		9.1%	2
Member of APWA		0.0%	0
Member of IAEM		0.0%	0
Member of IMSA		0.0%	0
Participant in Regional Operations Forum		50.0%	11
Participant in a Capability Maturity Workshop		72.7%	16
	Other (please specify)		7
answered question			22
skipped question			4

5. Certifications

		Response Percent	Response Count
AICP		7.1%	1
P.E.		92.9%	13
PTOE		28.6%	4
PTP		0.0%	0
	Other (please specify)		0
answered question			14
skipped question			12

6. Education

		Response Percent	Response Count
Civil Engineering		62.5%	15
Other engineering field		12.5%	3
Urban/Regional Planning		33.3%	8
Business Management		4.2%	1
Information Technology/Management		0.0%	0
	Other: (please specify)		6
answered question			24
skipped question			2

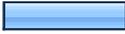
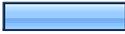
7. Member of TRB Committee(s)

		Response Percent	Response Count
RTSMO		52.9%	9
Freeway Operations		23.5%	4
Intelligent Transportation Systems		17.6%	3
Maintenance and Operations Management		17.6%	3
Transportation Demand Management		5.9%	1
Statewide Multimodal Planning		0.0%	0
Other committee related to Planning		11.8%	2
Other committee related to Freight		0.0%	0
Other committee related to ETO or Security		5.9%	1
Cooperative Research Program (CRP) Panel for TSM&O-related project		23.5%	4
SHRP 2 TCC or ETG		17.6%	3
answered question			17
skipped question			9

8. Member of AASHTO Committee(s)

		Response Percent	Response Count
Subcommittee on Systems Operation and Management		71.4%	10
Standing Committee on Planning		7.1%	1
Subcommittee on Maintenance		14.3%	2
Subcommittee on Asset Management		0.0%	0
Special Committee on Transportation Security and Emergency Management		14.3%	2
Standing Committee on Performance Management		0.0%	0
Subcommittee on Traffic Engineering		42.9%	6
Standing Committee on Highway Transport		7.1%	1
Other AASHTO Committee or Subcommittee related to TSM&O		7.1%	1
		answered question	14
		skipped question	12

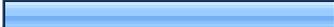
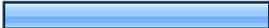
9. Please indicate which of the following your organization is a member of:

		Response Percent	Response Count
AMPO		31.8%	7
AASHTO		72.7%	16
APTA		18.2%	4
ITS America (National or State Chapter)		68.2%	15
I-95 Corridor Coalition		18.2%	4
IBTTA		13.6%	3
NADO		0.0%	0
NARC		13.6%	3
Other organization related to TSM&O (please specify)			3
answered question			22
skipped question			4

10. For each of the following resource allocations in your state DOT, please compare the current year to five years ago:

	Current year is lower	Slightly higher or about the same	Moderately higher	Current year is much higher	Rating Average	Rating Count
Annual Operating Budget for TSM&O	10.0% (2)	55.0% (11)	20.0% (4)	15.0% (3)	2.40	20
Annual Capital Budget for TSM&O	10.5% (2)	42.1% (8)	31.6% (6)	15.8% (3)	2.53	19
FTEs (state employees and contractors) in the headquarters unit with primary TSM&O responsibilities	27.8% (5)	44.4% (8)	5.6% (1)	22.2% (4)	2.22	18
Total FTEs (state employees and contractors) working on TSM&O throughout the department	27.8% (5)	44.4% (8)	16.7% (3)	11.1% (2)	2.11	18
answered question						20
skipped question						6

11. How much overall progress has your state DOT made with transportation systems management and operations over the past five years?

		Response Percent	Response Count
Lost momentum		0.0%	0
Overcame some setbacks		5.0%	1
Some progress in some facets		50.0%	10
Important progress in most facets		40.0%	8
Remarkable progress in all facets		5.0%	1
answered question			20
skipped question			6

12. The left-hand column below contains a list of TSM&O-related services, projects, and activities. Please select the description that most closely describes the status of each within your state DOT. (* Referred to in the MAP-21 definition of TSM&O as an "action" or an "investment.")

	Not applicable	Coordinated with TSM&O program as needed	Closely coordinated with TSM&O program	Integral component of TSM&O program	Rating Count
Traffic Detection and Surveillance*	5.0% (1)	10.0% (2)	15.0% (3)	70.0% (14)	20
Corridor Management*	15.0% (3)	25.0% (5)	30.0% (6)	30.0% (6)	20
Freeway Management*	5.0% (1)	5.0% (1)	25.0% (5)	65.0% (13)	20
Arterial Management*	5.0% (1)	30.0% (6)	30.0% (6)	35.0% (7)	20
Active Transportation and Demand Management*	25.0% (5)	35.0% (7)	15.0% (3)	25.0% (5)	20
Work Zone Management*	0.0% (0)	35.0% (7)	40.0% (8)	25.0% (5)	20
Congestion Pricing*	57.9% (11)	26.3% (5)	5.3% (1)	10.5% (2)	19
Parking Management*	60.0% (12)	30.0% (6)	0.0% (0)	10.0% (2)	20
Automated Enforcement*	85.0% (17)	10.0% (2)	0.0% (0)	5.0% (1)	20
Traffic Control*	5.3% (1)	57.9% (11)	26.3% (5)	10.5% (2)	19
Commercial Vehicle Operations*	15.0% (3)	60.0% (12)	25.0% (5)	0.0% (0)	20
Freight Management*	20.0% (4)	65.0% (13)	15.0% (3)	0.0% (0)	20
Coordination of Highway, Rail, Transit, Bicycle, and Pedestrian Operations*	20.0% (4)	70.0% (14)	5.0% (1)	5.0% (1)	20
Traffic Incident Management*	0.0% (0)	10.0% (2)	20.0% (4)	70.0% (14)	20
Traveler Information Services*	5.0% (1)	5.0% (1)	15.0% (3)	75.0% (15)	20
Emergency Management*	5.0% (1)	20.0% (4)	25.0% (5)	50.0% (10)	20
Roadway Weather Management*	0.0% (0)	30.0% (6)	40.0% (8)	30.0% (6)	20
Intelligent Transportation Systems*	0.0% (0)	5.0% (1)	15.0% (3)	80.0% (16)	20

Special Event Planning & Management	5.0% (1)	25.0% (5)	25.0% (5)	45.0% (9)	20
Traffic Signal Operations and Maintenance	15.0% (3)	10.0% (2)	50.0% (10)	25.0% (5)	20
Highway and Intersection Lighting	25.0% (5)	40.0% (8)	15.0% (3)	20.0% (4)	20
Roadway Signing and Marking	15.0% (3)	40.0% (8)	20.0% (4)	25.0% (5)	20
Managed Lanes	35.0% (7)	15.0% (3)	25.0% (5)	25.0% (5)	20
Financial Assistance and Support for Non-Highway Modes	35.0% (7)	55.0% (11)	0.0% (0)	10.0% (2)	20
Demand Management	25.0% (5)	50.0% (10)	20.0% (4)	5.0% (1)	20
Access Management	15.0% (3)	65.0% (13)	5.0% (1)	15.0% (3)	20
Operational Safety Improvements	5.0% (1)	55.0% (11)	25.0% (5)	15.0% (3)	20
Transportation System Security	15.0% (3)	60.0% (12)	20.0% (4)	5.0% (1)	20
Coordination with Regional TSM&O Programs	5.0% (1)	30.0% (6)	30.0% (6)	35.0% (7)	20
answered question					20
skipped question					6

13. Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Rating Count
My state DOT's mission, vision, goals, and objectives for TSM&O are clear, meaningful, and widely known.	5.3% (1)	10.5% (2)	42.1% (8)	36.8% (7)	5.3% (1)	19
The TSM&O goals and objectives were developed as part of the department's strategic planning process.	0.0% (0)	10.5% (2)	31.6% (6)	42.1% (8)	15.8% (3)	19
My state DOT has meaningful performance measures for TSM&O.	0.0% (0)	21.1% (4)	36.8% (7)	42.1% (8)	0.0% (0)	19
TSM&O concepts and principles have been fully integrated in decision making throughout the department.	5.3% (1)	42.1% (8)	52.6% (10)	0.0% (0)	0.0% (0)	19
My state DOT has a single organizational unit in headquarters with primary responsibility for TSM&O.	10.5% (2)	21.1% (4)	5.3% (1)	42.1% (8)	21.1% (4)	19
The relative responsibilities of headquarters and region/district offices for TSM&O are well-defined and mutually respected.	5.3% (1)	26.3% (5)	21.1% (4)	47.4% (9)	0.0% (0)	19
The past success of TSM&O in my state DOT would not have been possible without key champions and sponsors.	0.0% (0)	0.0% (0)	5.3% (1)	31.6% (6)	63.2% (12)	19
Senior leaders throughout my state DOT are enthusiastic in their support of TSM&O.	0.0% (0)	15.8% (3)	15.8% (3)	47.4% (9)	21.1% (4)	19
Many state elected officials and other policy makers see TSM&O as a band-aid.	5.3% (1)	21.1% (4)	63.2% (12)	10.5% (2)	0.0% (0)	19
My state DOT has adequate financial resources committed to	26.3% (5)	42.1% (8)	21.1% (4)	10.5% (2)	0.0% (0)	19

TSM&O.						
My state DOT has adequate human resources committed to TSM&O.	15.8% (3)	52.6% (10)	26.3% (5)	5.3% (1)	0.0% (0)	19
My state DOT has adequate technology committed to TSM&O.	0.0% (0)	47.4% (9)	10.5% (2)	42.1% (8)	0.0% (0)	19
My state DOT has adequate infrastructure to support TSM&O.	0.0% (0)	47.4% (9)	26.3% (5)	26.3% (5)	0.0% (0)	19
My state DOT is very persuasive in explaining the benefits of state funding for TSM&O.	0.0% (0)	47.4% (9)	36.8% (7)	15.8% (3)	0.0% (0)	19
My state DOT has effective business processes for TSM&O marketing and outreach within the department.	5.3% (1)	36.8% (7)	42.1% (8)	15.8% (3)	0.0% (0)	19
The department has effective business processes for TSM&O marketing and outreach for external stakeholders.	0.0% (0)	63.2% (12)	31.6% (6)	5.3% (1)	0.0% (0)	19
My state DOT is providing effective leadership and support for TSM&O at the local and regional levels.	0.0% (0)	21.1% (4)	36.8% (7)	42.1% (8)	0.0% (0)	19
answered question						19
skipped question						7

14. A TSM&O Program Plan could serve many different purposes. For the list of potential purposes in the left-hand column below, please evaluate the potential benefit for your state DOT.

	Waste of time	Limited benefit	Beneficial	Major benefit	Critically needed	Rating Count
Define (or clarify) program goals, objectives, and performance measures	0.0% (0)	0.0% (0)	10.5% (2)	57.9% (11)	31.6% (6)	19
Describe, contextualize, and interconnect program components and subcomponents	0.0% (0)	5.3% (1)	31.6% (6)	52.6% (10)	10.5% (2)	19
Establish (or clarify) organizational roles, responsibilities, and strategic relationships (internal and external)	0.0% (0)	0.0% (0)	31.6% (6)	31.6% (6)	36.8% (7)	19
Recommend and prioritize actions to improve program components	0.0% (0)	0.0% (0)	31.6% (6)	42.1% (8)	26.3% (5)	19
Commit specific resources to accomplish priorities	0.0% (0)	0.0% (0)	26.3% (5)	42.1% (8)	31.6% (6)	19
Inform and influence departmental stakeholders, TSM&O partners, policy makers, and customers	0.0% (0)	5.3% (1)	26.3% (5)	57.9% (11)	10.5% (2)	19
answered question						19
skipped question						7

15. Does your state DOT have what you consider to be a “TSM&O Program Plan” or at least parts of such a plan?

		Response Percent	Response Count
Yes		63.2%	12
Not to my knowledge		36.8%	7
answered question			19
skipped question			7

16. If your response to Question 15 was “Yes,” please indicate the extent to which the TSM&O Program Plan (or partial plan) addresses each of the listed components:

	Not included	Included but missing some key aspects	Included with minor gaps	Complete, in depth inclusion	Rating Count
Mission, Vision, Goals, Objectives, and Performance Measures	0.0% (0)	53.8% (7)	38.5% (5)	7.7% (1)	13
Leadership and Organization (including coordination, collaboration, and integration)	0.0% (0)	46.2% (6)	53.8% (7)	0.0% (0)	13
Resources (Financial, Human, Technology, Infrastructure)	23.1% (3)	30.8% (4)	38.5% (5)	7.7% (1)	13
Business Processes (e.g. Planning, Budgeting, Communication and Marketing, Procurement)	15.4% (2)	38.5% (5)	46.2% (6)	0.0% (0)	13
Packages of Services, Projects, and Activities	7.7% (1)	38.5% (5)	46.2% (6)	7.7% (1)	13
answered question					13
skipped question					13

17. Please indicate the extent to which you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Rating Count
My state DOT has a compelling vision for the department's TSM&O program.	0.0% (0)	15.8% (3)	36.8% (7)	42.1% (8)	5.3% (1)	19
Continued success with TSM&O will depend heavily on departmental champions and sponsors.	0.0% (0)	5.3% (1)	5.3% (1)	47.4% (9)	42.1% (8)	19
TSM&O issues and opportunities need to be more thoroughly addressed as part of my state DOT's strategic planning process.	0.0% (0)	5.3% (1)	5.3% (1)	52.6% (10)	36.8% (7)	19
Organizational changes are needed in my state DOT to move safety and security programs more under the umbrella of TSM&O.	0.0% (0)	21.1% (4)	21.1% (4)	42.1% (8)	15.8% (3)	19
Other organizational changes are needed in my state DOT to improve the effectiveness and efficiency of TSM&O.	0.0% (0)	10.5% (2)	21.1% (4)	47.4% (9)	21.1% (4)	19
My state DOT is missing significant opportunities to advance TSM&O in consort with other initiatives.	0.0% (0)	26.3% (5)	26.3% (5)	36.8% (7)	10.5% (2)	19
My state DOT is trying to implement too many new ideas and mandated changes in too short a period of time.	0.0% (0)	31.6% (6)	47.4% (9)	10.5% (2)	10.5% (2)	19
Most of the MPOs in my state do not have adequate resources to deal with all of the new ideas and mandates that compete for attention with TSM&O.	0.0% (0)	0.0% (0)	52.6% (10)	31.6% (6)	15.8% (3)	19
My state DOT has articulated a compelling vision for TSM&O throughout the state.	0.0% (0)	42.1% (8)	36.8% (7)	15.8% (3)	5.3% (1)	19
answered question						19

		skipped question	7
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18. How optimistic are you about your DOTs progress with transportation system management and operations over the next five years?

		Response Percent	Response Count
Very pessimistic		0.0%	0
Pessimistic		5.3%	1
Unsure		10.5%	2
Optimistic		57.9%	11
Very optimistic		26.3%	5
		answered question	19
		skipped question	7

19. Internal Strength (existing within the DOT):

	Response Count
	18
	answered question 18
	skipped question 8

20. Internal Weakness (existing within the DOT):

	Response Count
	18
	answered question 18
	skipped question 8

Survey Questions 19-21

Strengths, Weaknesses, Opportunities, and Threats (SWOT)

Internal Strengths

- 1) Support from local FHWA Division office and some MPOs.
 - 2) Still champion driven, however, we are working on a strategic plan and creating processes to create a TSMO project pipeline.
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Internal champions for TSMO exist - to a degree. Traffic Operations and Emergency/Incident Management are separate divisions. They are under the same bureau (Maintenance and Operations), but operate separately. The Operations side has champions and "gets" TSMO, whereas the IM side does not.

Internal technical expertise.

Existing infrastructure.

Innovative culture.

Recognition across organizational division leadership of the value of TSMO strategies. Level of expertise in key areas.

Openness to increased and enhanced TSM&O initiatives at many of the regional offices.

Commitment to cost-effectiveness in capital programming (e.g., emphasis on preventive maintenance) which could serve as a basis for increased TSM&O commitment as the most cost-effective means to improve performance (which preventive maintenance does not).

Regional agencies see value of TMSO and are interested in helping.

Have established organizational structure that embeds TSMO into org structure and culture of DOT.

Org structure combines or closely ties those most effective at achieving operations - ITS, operations, maintenance, traffic and safety engineering.

Have developed strategic plan for TSMO Division complete with M, V, G, and strategies

Have conducted TSMO staffing and resources assessment to achieve MVG

Have developed an Operations Project Clearance to build culture of Operations.

Clear TSM&O Policy direction in the state transportation plan. Executive level support.

Policy guidance developed -- Transportation Management System Master Plan and new Transportation System Management Policy going through internal review.

Increased investment in TMS elements and support for additional investment growing . . . *innovative program*, and implementing organizational changes to corridor based mgmt in *pilot project*. Our DOT Strategic Plan had a new System Performance Goal in draft, supporting above programs...but now direction is being changed.

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Senior staff buy-in, within the last few years I have noticed more involvement, interest and support from senior-level decision makers at the DOT in the headquarters office.

TSM&O will need to be championed by the agency's executive leaders with a focus to mainstream TSM&O throughout its organization's business practices.

We have developed and implemented a performance management system (not just performance measures), that has significantly raised the awareness, importance and integration of TSM&O activities throughout the department. The system has allowed us to rapidly learn and apply system performance data (speed, delay, etc.) at all levels of the department, and has bridged the gap between strategic planning and strategic execution (actually getting stuff done).

We are poised to create a strong and integrated TSM&O program within the agency, with support at the highest levels within the agency.

The creation of a TSM&O Division on par with other department divisions.

Multiple champions of TSM&O at the Deputy Director and Assistant Director level within the department, in addition to a small but growing support of TSM&O in pocket areas.

Programs where opportunities to expand TSM&O exist, such as the . . . *examples*

There is longstanding and broad senior leadership within TSM&O program areas

Upper management support of TSM&O

Secretary is leading charge.

Internal Weaknesses

1) Some areas such as Traffic Engineering and Emergency Management are still not part of TSMO group.

2) We are still putting out fires and have funding for that, however there is no stable funding for implementing new TSMO strategies.

SMO is divided. Traffic Operations and Incident Management need to be combined.

Competing needs.

Staffing limitations/capacity.

Investment development processes need revising in order to mainstream TSMO. TSMO training and development. TSMO knowledge at a line levels across non TSMO programs.

No champion for TSM&O at executive level - not against it but certainly not going to prioritize it over other more traditional activities.

No distinct office/group to advance TSM&O initiatives and coordinate or, preferably, integrate across other offices/groups. Accordingly, there is no TSM&O Program Plan to ensure consistency and emphasize the need for advancement at the regional offices where implementation takes place.

Unclear on what to take...the problems is so big, it is hard to break it up into manageable pieces.

Need to further explore planning for operations opportunities; train MPOs in the strategies of operations

Need to develop system performance measures - including data collection, analysis, and measure
Need to continue to link regional efforts to statewide/HQ efforts - M,V,G to implementation

Quantity of staff for supporting TSM&O equipment at the roadside as well as supporting software and systems.

Recent *special* report and change in our Mission, vision and goals is causing uncertainty with regard to where TSMO is supported along with sustainable goals.

DOT culture still capital delivery organization but support for TSMO building in pockets of org.

Resources, the Districts do not have enough operating budget to maintain their devices to operate at an optimal level and do not have time to create a vision for TSM&O. They spend all their time putting out fires.

Agency is more focused on capital delivery but doesn't make TSM&O an equally prominent priority.

The connection to the statewide and MPO planning component of TSM&O is still weak. I think this is in part because of 1) the lack of federal funding to support on-going operations activities, and 2) the onerous and inflexible federal planning regulations, which do not align well with the dynamic needs and rapid technological advancements of many TSM&O strategies.

Due to staffing vacancies and increasing expectations our progress has been slower than desirable to move ahead quickly with an integrated TSM&O program.

Weak regional office support for the direction of TSM&O efforts from headquarters division.

Lack of time on the part of TSM&O and Planning staff to connect concepts and programs within the Planning group's area of responsibility.

Strong emphasis on pavement & bridge quantity delivery through highway construction conflicts with more sophisticated approaches to balancing and integrating TSM&O infrastructure and service developments.

Initial development of commitment with resources (people). Currently challenged with employee cap issue; possibly looking at reduction.

Operations staff have not bought into a Planning-Operation Partnership

External Opportunities

Like other states, *the state office of information technology* is one of the biggest issues. Their focus is network and IT infrastructure safety, while we just want to be able to build intelligence in our systems.

Still difficult to break barriers between sister agencies and regional transportation partners.

More direction on TSMO integration to get buy-in from top officials and policy makers. This would influence funding and collaboration with other transportation agencies. And for that matter, more TSMO support from other transportation agencies since TSMO is more than just DOT business.

Recognition of TSMO strategies at a national level. Development of performance measures and analysis tools that better reflect TSMO impacts.

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Aging workforce and need to fill currently open positions - many of the new employees will be younger and more fully embrace the potential of technology as an "enabler" for improved performance through TSM&O.

Continually improving technologies in the private sector that could be harnessed for increased TSM&O capabilities at the state DOT - vehicles with technologies that can connect to not only each other but also infrastructure.

Pervasiveness of mobile technologies is making some parts of TMSO easier and cheaper to implement.

More and continued collaboration with operations stakeholders - MPOs, TIM responders, local coalitions.

DOTs must take advantage of technologies - in-car, on-phone and be prepared to adapt to those.

Continued improvements to the available technology.

Push on Capability Maturity Model by FHWA/AASHTO and others is good

Regional and Local partners interested in actively managing system - learning from federal pilots

Partnerships, the DOT (both the Districts and Headquarters) have a great working relationship to implement TSM&O as well as strategize new ideas and deployments for TSM&O. This is from high-level management to implementation staff level. These partnerships are with the MPO's, transit agencies and toll authorities within the region and state.

Through DOT executive level leadership, promote and educate externals of the value and benefits of TSM&O, not only via its own system but encourage partnerships with regional operational agencies and their systems. Focus on an integrated approach, rather than my system and their system. Many regions are stepping up to fund transportation improvements due to the limited federal and state transportation funds through local sales tax measures.

Development of connected and autonomous vehicle technology is driving the creation and need to manage big data. This will further our ability to get data, relatively cheaply, to better manage the system and may drive a need for public/private partnerships to effectively manage the system as a whole.

The public has responded positively overall to increased TSM&O services.

Strong TSM&O support from major MPOs.

Existing congestion levels and potential for continued growth in the *metro area* will emphasize and even require the need for increased TSM&O statewide.

Statutory and budgetary language needs to reflect broad performance-based allocation of financial and human resources within state and local transportation programs.

MPO support.

Education of the Public and State Officials

External Threats

Security.

No consistent national vision to push TSMO. No funding to continually support O&M.

Funding

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Funding for transportation projects and activities is extremely limited and expected to continue to be so, resulting in, at best, hesitation and, at worst, opposition to major changes in investment priorities.

Limited capacity among local partners (cities, counties, MPOs) to raise the profile of TSM&O among elected officials and other decision makers as part of their own activities. In short, constituents are not asking for more TSM&O much less demanding it.

Lack of political champion to make this as important as capital programs.

Maybe not entirely beyond DOT control, but unification of purpose and objective of key corridors. While a transportation system and corridor must balance many needs of stakeholders, ultimately it must move traffic efficiently. Managing this unified vision is slippery.

Anticipated growth of state population in future is tremendous and threatening.

Overall transportation funding situation.

Environmental sustainability efforts overshadowing the highlighting of possible benefits of TSMO toward sustainability. TSMO not viewed as meeting state environmental goals; only demand management and multimodal aspects supported, not how the system works together as a whole or delay/reliability/safety benefits.

Integration, the region and the state are made up of numerous stakeholders and we all have to do our part. We also all need to be more willing to share the responsibilities to allow corridors to operate like corridors and not as individual modes. Integration of systems and sharing of information (including command and control) continue to be a challenge.

Political demand for mobility, as it is key to a strong economy.

When TSM&O programs and activities are working well, there is no apparent need for it - it becomes transparent and could easily lose public and political support.

There is an immediate need for even closer collaboration between law enforcement agencies and the DOT for our common TSM&O activities and collaboration.

Lack of political support for some TSM&O strategies.

The governor and the Transportation Board members are primarily focused on project delivery and jobs, which could impact continued levels of funding for TSM&O programs.

While presenting on our FSP program recently, I was asked if the NHS funds we use for the FSP program could be spent on construction projects, and the answer was yes. So far, we have done a reasonable job of explaining the benefits and value of programs like TIM and FSP and the beneficial role they play in freeway operations, but the 2014 elections will result in member turnover, and depending on the individuals elected (governor, lieutenant governor and controller), direction for funding could change.

Programmatic emphases (highway safety, freight network, etc.) can alternately be presented as complementary to or in competition with TSM&O objectives and program activities. If the former, TSM&O will lose relative emphasis & visibility over time.

Employee cap; legislatively bound to number of employees.

Worst first is how public usually responds.