ENTERPRISE Transportation Pooled Fund Study TPF-5 (231)

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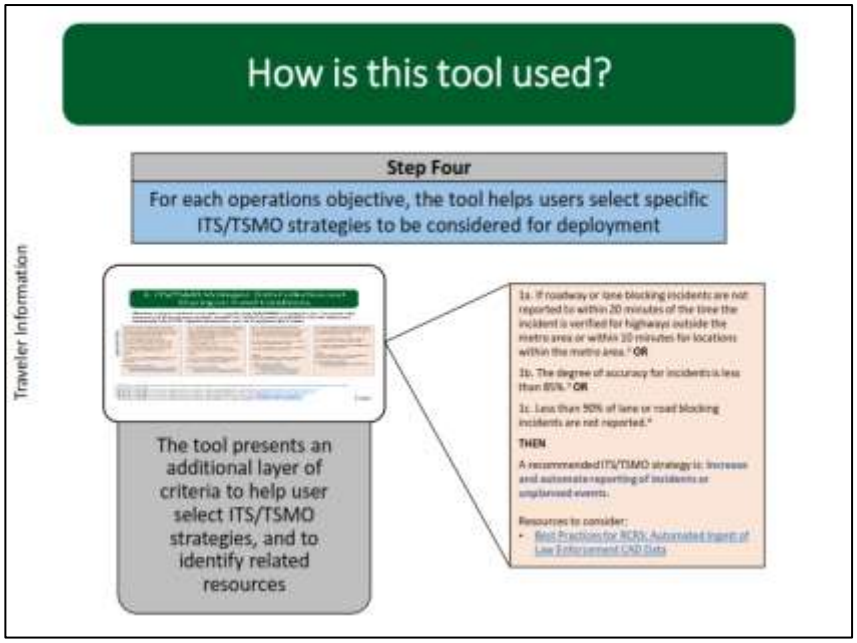

Integrating ITS to Enable TSMO in Planning and Operations

PROJECT SUMMARY REPORT

Prepared by

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Acknowledgements

This document was prepared for the ENTERPRISE Transportation Pooled Fund TPF-5(231) program. With agencies from North America and Europe, the main purpose of ENTERPRISE is to use the pooled resources of its members, private sector partners and the United States federal government to develop, evaluate and deploy Intelligent Transportation Systems (ITS).

Special thanks to the USDOT Planning for Operations Program and Wayne Berman for providing subject matter input throughout the project.

Project Champions

Rashmi Brewer, Minnesota Department of Transportation, and Doug Tomlinson, Pennsylvania Department of Transportation were the ENTERPRISE project champions for this effort. The project champions served as the overall leads for the project.

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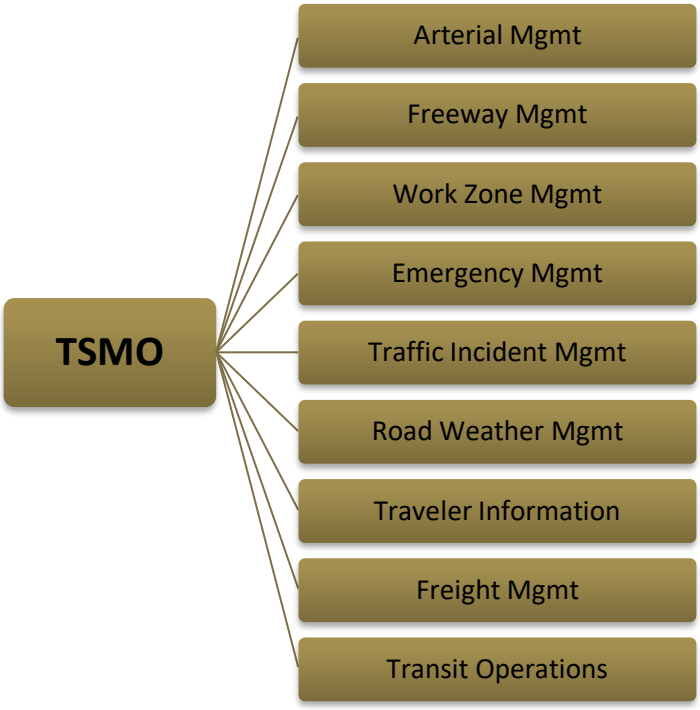
1.0 Introduction and Project Purpose

This project began with a focus on ITS and was revised to explore ITS as enabling technology for the broader applications of Transportation Systems Management and Operations (TSMO) in planning and operations. This reflects a more comprehensive view of ITS which allows agencies to collaborate in active management of the transportation system according to regional operations objectives.

TSMO is defined as an integrated program to optimize the performance of existing highway infrastructure through the implementation of systems, services, and projects that are designed to preserve capacity and improve safety, reliability and security of the transportation system. This includes regional operations collaboration and coordination of activities among transportation and public safety agencies in the categories noted in Figure 1.

Figure 1 ITS Service Areas Enabling TSMO



New TSMO strategies in these categories are continually being developed and the ITS technology that enables TSMO strategies continues to rapidly evolve. This makes it challenging for transportation planning and operations staff to stay abreast of the latest information and factor it into their processes. This project focused on identifying what resources are available to support the integration of ITS into planning and operations, and what level of awareness exists about such resources. The purpose of this project was to:

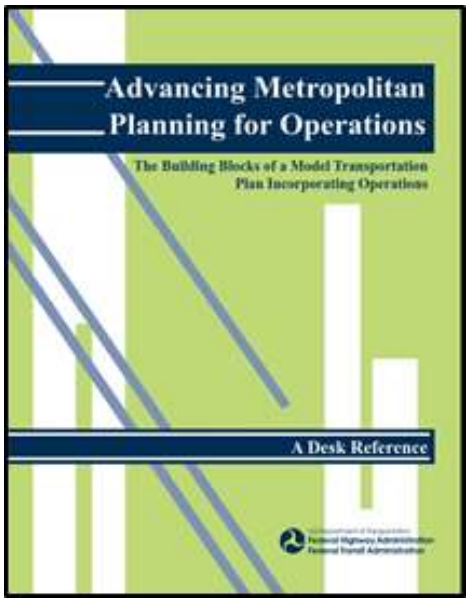
- Identify needs and information gaps in the ability to assess ITS alternatives for those involved in transportation planning and decision making;
- Assess what guidance exists for including ITS in operational plans; and,
- Determine if and what additional resources may be needed to support the integration of ITS with planning and operations.

This report summarizes the tool that was developed, outreach that was conducted to evaluate the tool, feedback that was received, and recommendations for consideration in further development of a tool for this purpose.

2.0 Research and Development of Tool

The first task for this project consisted of research to identify existing resources. Technical Memorandum 1, included as Appendix A to this report, summarizes the research and cataloged existing resources and current practices associated with integrating ITS with planning and operations. Emphasis was placed on identifying resources for planners that help determine when ITS or TSMO strategies may be warranted; how such strategies may factor into future infrastructure changes; and, what may be the potential costs and benefits of such strategies. For operations, research focused on guidance for developing plans to address congestion and safety issues using technology in both urban and rural environments.

In addition to cataloging existing resources, Technical Memorandum 1 served as a focal point for discussions with the USDOT Planning for Operations Program. The program supports the integration of TSMO strategies into the planning process for the purpose of improving transportation system efficiency, reliability, and options. It is led by the Office of Operations and Office of Planning, Environment, and Realty of the Federal Highway Administration (FHWA) in coordination with the Federal Transit Administration. The discussion with Planning for Operations identified what resources are being used by agencies, what the agency feedback has been, and what additional resources may still be needed. The discussion also modified the project focus from ITS specifically to TSMO more broadly with the understanding that most TSMO strategies are enabled by ITS.



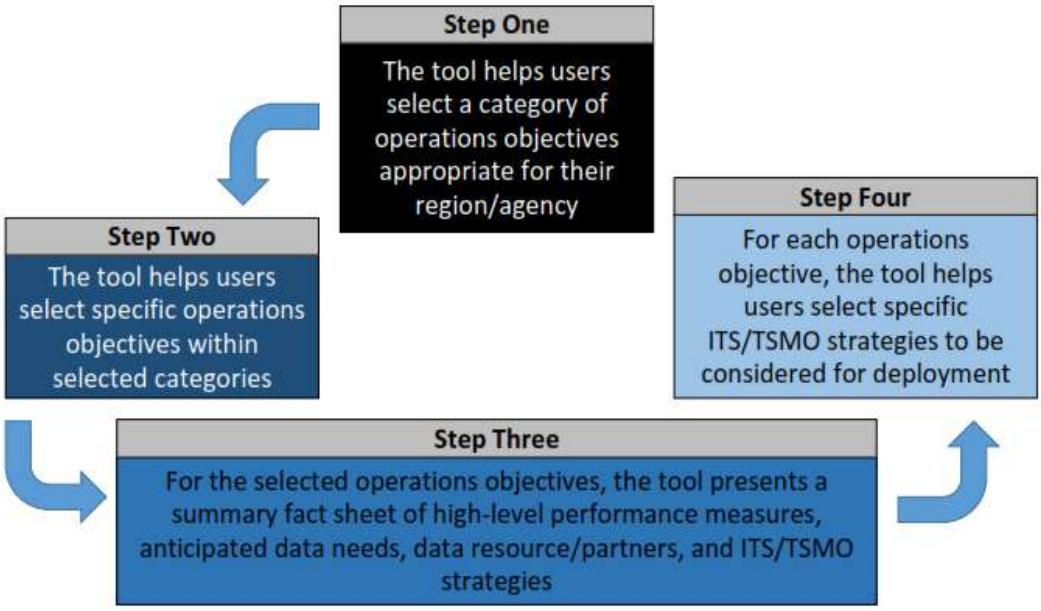
Technical Memorandum 2, included as Appendix B to this report, recommended that ENTERPRISE forgo the development of additional resources to support operations based on research results. With input from Planning for Operations, Technical Memorandum 2 also recommended that a decision support tool based on Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference could further support the consideration of TSMO strategies to solve transportation challenges. Developed in 2010, the Desk Reference is designed to enable transportation planners and their partners to build a transportation plan that includes operations objectives, performance measures, and strategies that are relevant to their region, that reflect the community's values and constraints, and that move the region in a direction of improved mobility and safety. It provides a broad menu of example operations objectives categorized by specific TSMO service areas, as well as broader categories of System Efficiency, System Reliability and System Options. For each operations objective, the Desk Reference provides fact sheets with high-level information about

performance measures, anticipated data needs, data resources and partners, TSMO strategies to consider, and safety-related impacts.

The content in the Desk Reference is limited to what was known and available at the time of its publication in 2010 and as such is somewhat outdated. The Desk Reference also stops short of helping the reader select the most appropriate operations objectives and ITS/TSMO strategies. To address these limitations, ENTERPRISE chose to develop a preliminary decision support tool that was fundamentally still based on the Desk Reference but with the intent to research and develop new selection criteria, strategies and reference resources to help users select the most relevant operations objectives and ITS/TSMO strategies to address their transportation challenges. The decision support tool is considered preliminary in nature because it was developed for only one service area – Traveler Information – to fit within the allowable project budget and to allow for evaluation. Development of the preliminary decision support tool became a research effort to understand the resources available, potential for, and risks that would be associated with developing a full decision support tool.

The tool presents information to the user through a series of four basic steps as illustrated in Figure 2. In Step One, criteria were developed in relation to the conditions that might warrant selection of one of the four categories of Traveler Information operations objectives – Customer Satisfaction; Data Collection and Sharing on Travel Conditions; Information Dissemination; and, Trip Planning Tools. The criteria include a series of "if/then" conditions to guide the user as they consider how their current situation might relate to a specific category of operations objectives.

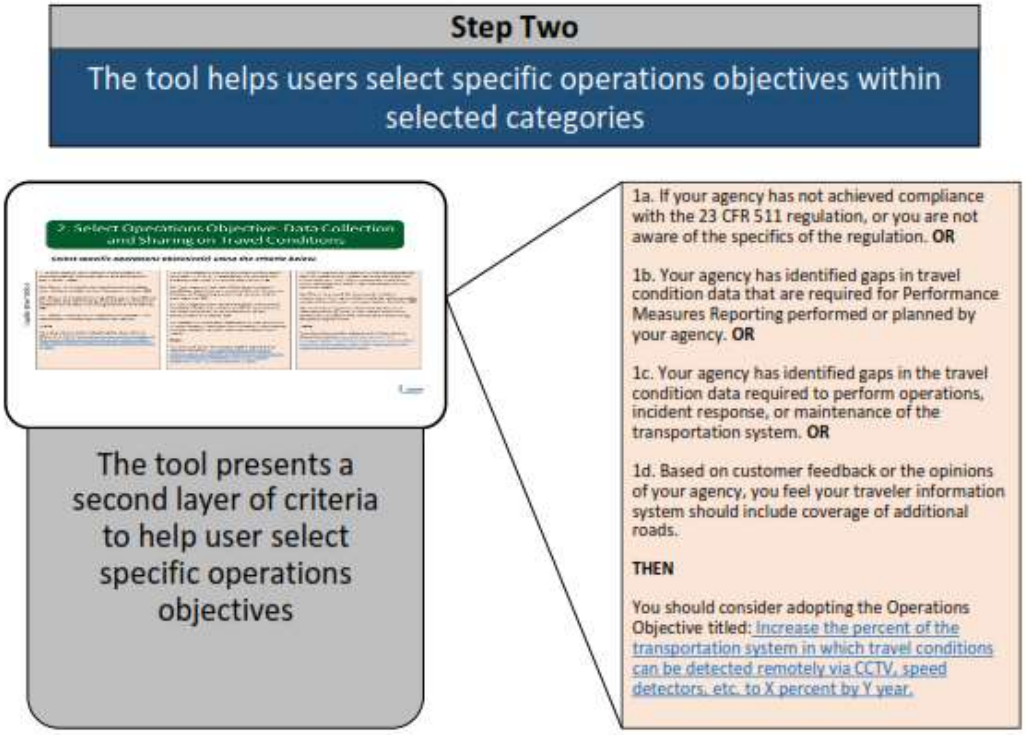
Figure 2 Four Basic Steps of Tool



Next, additional criteria were developed for Step Two to help the user consider and select specific operations objective within the selected category. For example, the Data Collection and Sharing on Travel Conditions category consists of three operations objectives for the user to choose from. The criteria continue to present the user with a series of "if/then" conditions for the three objectives as illustrated in

Figure 3. The intent is to again support user consideration of how their current situation would be served by one of the three specific operations objectives.

Figure 3 Step Two: Selection Criteria for Operations Objectives



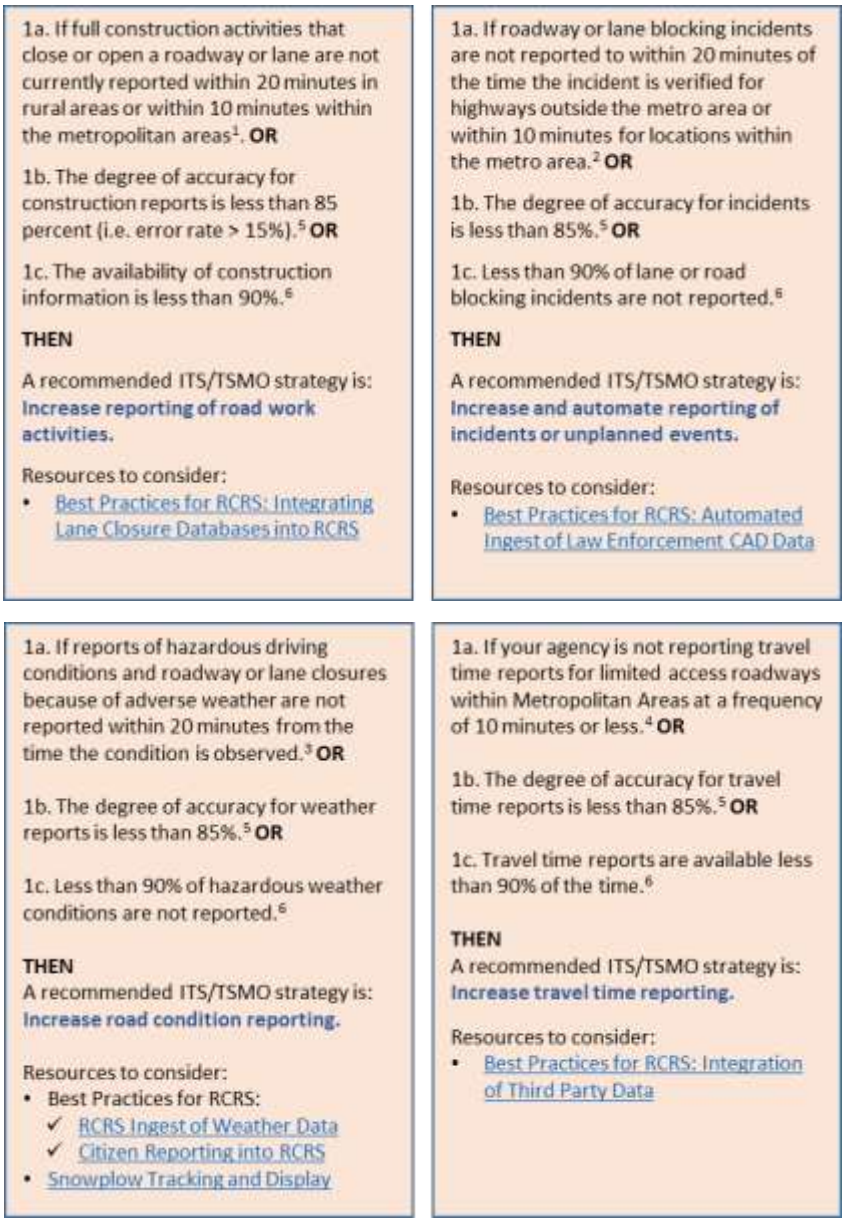
In Step Three, the user is presented with a fact sheet from the Desk Reference. As illustrated in Figure 4, the fact sheet provides the user with suggested performance measures and related information.

Figure 4 Step Three: Desk Reference Fact Sheet

Operations Objectives	• Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region to X percent by Y year. • **Increase the percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. to X percent by Y year.** • Increase the percent of modes in the region that share their traveler information with other modes in the region to 100 percent by Y year.
Performance Measures	• Percent of the transportation system in which travel conditions can be detected remotely via CCTV, speed detectors, etc. • Percent of transportation facilities whose owners share their traveler information with other agencies in the region. • Percent of modes in the region that share their traveler information with other modes.
Anticipated Data Needs	• Number of miles of roads or rails that are covered by remote detection. • Number of the transportation facilities in the region. • Count of jurisdictions sharing traveler information with other agencies in the region. • Count of modes in the region sharing traveler information with other modes.
Data Resources and Partners	• The data for these performance measures would come from querying each of the transportation facility owners/operators in the region on their detection systems and information sharing practices.
To learn about ITS/TSMO strategies to accomplish this operations objective, click here.	

After selecting a specific operations objective, Step Four then helps the user learn more about ITS/TSMO strategies that will support the objective that they have chosen. This step is where most new detail was developed for the tool. Identifying specific strategies was necessary for many of the operations objectives in the Desk Reference. As new ITS/TSMO strategies develop, such as those associated with Connected Vehicles, this section of the tool will need to be maintained. In addition to identifying specific strategies, resources were also cited and are hyperlinked within the tool for the user to easily access further information regarding the strategies. The resources were seen as important to help the user learn more about a particular strategy than what a title or brief statement could offer within the tool. Finding and maintaining these resources is another portion of the tool that will need to be maintained over time to continue providing value to the user.

Figure 5 Step Four: Potential ITS/TSMO Strategies



The tool, Integrating ITS/TSMO with Planning: Preliminary Decision Support Tool, is available online for more detailed reference in relation to the Traveler Information service area.

3.0 Outreach

Following development of the preliminary tool, outreach was targeted around select planning and operations representatives from Minnesota and Pennsylvania to allow for more in-depth group review and feedback on the tool. A one-page summary of the project was prepared and is included as Appendix C. The one-page summary served as an informational outreach piece for inviting representatives to participate in a review webinar that was arranged as the primary avenue for project outreach. The purpose of the review webinar was to:

- Present information about several existing resources available to support the integration of ITS into planning and operations,
- Review a new, preliminary tool that has been developed by ENTERPRISE as an addition to existing resources, and
- Obtain perspectives of potential users of this tool from key agency representatives in the areas of planning and operations.

The webinar agenda was structured to share information about the project, highlight existing resources identified through research, review the preliminary tool, and gather feedback. The planning and operations representatives who participated in the webinar were selected by the Project Champions and included staff from the multijurisdictional agencies listed in Table 1.

Table 1 Agencies Represented in Review Webinar

- Minnesota Department of Transportation (MnDOT) Office of Traffic, Safety and Technology
- MnDOT Regional Transportation Management Center
- MnDOT Metro District
- MnDOT Office of Statewide Planning and Transportation Data Analysis
- Metro Transit
- Fargo-Moorhead Council of Governments
- Pennsylvania Department of Transportation (PennDOT) Bureau of Maintenance and Operations
- Delaware Valley Regional Planning Commission
- Southwestern Pennsylvania Commission
- Lebanon County Planning Commission

Participants in the review webinar were polled at two points to gather feedback on their knowledge and use of existing resources, as well as their general impressions about the tool developed through this project. When asked if they were aware of the existing resources before the webinar, nearly half indicated they were and the resources they noted as having been used include:

- Planning for Operations website
- National Operations Center of Excellence website
- TSMO Guidance website
- Statewide Opportunities for Integrating Operations, Safety and Multimodal Planning

- Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach – A Guidebook
- Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference
- Tool for Operations Benefit/Cost Analysis (TOPS-B/C)

Following the overview of the tool, which explained what the tool could help users do and how it could be used, a second poll was issued to gather participants' impressions of the tool. Nearly all understood how the tool was intended to be used. Just over half of the participants believed the tool would help them consider ITS technology and TSMO strategies, and indicated there would be value in further developing the tool for other TSMO service areas (e.g. Incident Management, Freeway/Arterial Management). The next section of this report provides more detailed feedback from the review webinar participants.

4.0 Feedback and Recommendations

As previously noted, development of the preliminary tool evolved into a research effort to explore the feasibility of creating a more comprehensive decision support tool to guide users through the selection of operations objectives and relevant ITS and TSMO strategies most appropriate for their region. In addition to more detailed feedback from the review webinar, Tables 2 and 3 include observations made during the research and development of the tool. For each of the observations made, a recommendation is offered to guide any further development work associated with a decision support tool – by ENTERPRISE or any other entity. The observations documented in this section are intended to assist others with understanding the challenges, lessons learned, and recommendations to guide further development of such a tool.

Table 2 Review Webinar Observations and Recommendations to Guide Further Development

Observations from Review Webinar	Recommendations to Guide Further Development
1. Criteria for determining if operations objectives are appropriate may be too loose and result in users never answering "no" (e.g. comment regarding no agency being fully compliant with 23 CFR 511 but some agencies are very close and may not need an operations objective associated with it).	1.1. Explore an approach beyond "yes/no" selection of criteria to encourage users to rank on a scale the relevance of criteria according to their situation. This could offer a more objective method for selecting operations objectives (and potentially ITS/TSMO strategies) through prioritization. However, scaled criteria such as this will also require additional logic to establish threshold cut-offs.
2. Traveler information operations objectives (based on Desk Reference developed in 2010) are largely focused on expanding/enhancing services while most agencies are currently trying to understand	2.1. This a fundamental issue that may be relevant to all TSMO service areas as new technologies (e.g. CAV applications) emerge. Agencies may need operations objectives and strategies that help them consider expanding, minimizing and replacing.

Observations from Review Webinar	Recommendations to Guide Further Development
which services they can minimize/eliminate.	
3. Traveler Information service area may be less applicable to local transportation agencies since most are managed by state DOTs with established services.	3.1. The decision to focus on Traveler Information for the preliminary tool was made by ENTERPRISE. Other service areas, such as Arterial Management, may benefit local transportation agencies more.
4. A spreadsheet-based tool could be more efficient than the PowerPoint-based tool. For example, if a user answers "yes" to enough questions, they don't have to answer additional questions and the tool could show the results.	4.1. This project was focused on research into published results that could be extracted as criteria, as opposed to the sophistication of the tool format. An Excel or web-based tool may offer greater flexibility particularly if criteria is converted to a ranking method. However, additional user input on format should be gathered before changes are made.
5. One tool may not work for all TSMO service areas.	5.1. Because this project primarily focused on research into developing criteria vs. tool format, this is an area where additional user input on format should be gathered before changes are made.
6. Operations objectives are too loosely defined.	6.1. The decision was made for this project to use the operations objectives as they are defined in the Desk Reference, therefore this became an inherent limitation of the tool. If a full tool is developed, operations objectives from the Desk Reference should be more closely reviewed for updating to reflect current practice.
7. Having insight (e.g. case studies, best practices) on how peers are doing things would be valuable.	7.1. Expand resources associated with suggested ITS/TSMO strategies, making sure to include examples at various jurisdiction levels (e.g. city, county, MPO, state).

Table 3 Research and Development Observations and Recommendations to Guide Further Development

Observations from Research and Development	Recommendations to Guide Further Development
8. The operations objectives in the Desk Reference are from 2010 and do not represent the current state of practice	8.1. Correlate operations objectives with national goals for safety, congestion reduction, system

Observations from Research and Development	Recommendations to Guide Further Development
across the TSMO service areas. For example, "Increase number of 511 calls per year by X percent in Y years," is an outdated operations objective considering most agencies are today trying to reduce 511 calls, and the associated operating fees, in favor of traveler preferences to receive information via apps and social media.	reliability, etc. as a reference point and encourage customization based on the region where the objectives would be applied.
9. The performance measures in the Desk Reference are very general, outdated, and do not represent the current state of practice in performance management or the TSMO service areas.	9.1. Update performance measures to reflect national system performance measures (e.g. system reliability) that have been established, as well as current practices among state and local agencies.
10. There are limited ITS/TSMO strategies offered in the Desk Reference. Strategies were identified for Traveler Information as part of the research effort to explore if and how this issue could be addressed.	10.1. Further research will need to be completed into current and best practices associated with each of the TSMO service areas to provide more and relevant ITS/TSMO strategies for each operations objective.
11. There is limited evaluation-oriented information about the impacts of ITS/TSMO strategies, making it difficult to develop finite criteria for selecting strategies and associating them with operations objectives.	11.1. Much of the work that has been done in recent years related to ITS/TSMO strategies has not been well documented. Additional focused research into current practice and documented case studies are needed across all of the TSMO service areas to address fundamental questions about effectiveness.
12. Clear performance metrics are needed for the specific ITS/TSMO strategies.	12.1. The Desk Reference identified preliminary performance measures for operations objectives. More specific measures are needed to monitor progress toward selected objectives. Clear performance metrics are also needed for the specific ITS/TSMO strategies – metrics that will allow an agency to determine and clearly demonstrate return on its investment in various deployments. Guidance may also be needed to help agencies tie performance metrics for specific strategies back to larger-scale, more systemic performance measures associated with operations objectives.

Observations 11 and 12 are especially important findings from this project. Observation 11 is an important factor to consider in any further development of a decision support tool for selecting operations objectives and ITS/TSMO strategies. Based on the research conducted in this project, there are limited quantitative results documented from ITS/TSMO related projects that could be used in an algorithm-based tool that could recommend one strategy (or operations objective) over another. Published results on more qualitative lessons learned are also very limited. Additional focused research and case studies on current practice could help develop both more quantitative and qualitative information that would be needed in a decision support tool.

Observation 12 is another important factor to consider if the tool is further developed. Performance measures have evolved considerably since the Desk Reference was published in 2010 when very preliminary measures were originally suggested for the operations objectives. The increased federal emphasis on performance management has also increased the urgency to develop relevant metrics to understand and demonstrate progress toward performance targets and desired outcomes. To further illustrate this point, two short case studies are presented in Figures 6 and 7 to describe how PennDOT, in particular, has struggled with establishing clear performance metrics for both operations objectives and ITS/TSMO strategies.

Figure 6 PennDOT Case Study 1: Mapping Congestion Causes to Operations Objectives

PennDOT would like to understand the primary sources of congestion for each of the traffic operations planning regions within the state. Once the breakdown of congestion causes is better understood, PennDOT and its planning partners will be better able to identify operations objectives which target the specific causes. Based on the national-level congestion pie charts illustrated below, it is estimated that bottlenecks, traffic incidents, and inclement weather account for a total of 80% of urban congestion while traffic incidents and work zones account for 85% of rural congestion. Understanding these for a specific region would assist with mapping these factors to detailed operations objectives and supporting performance metrics so that the most appropriate objectives can be identified to achieve the optimal impact.

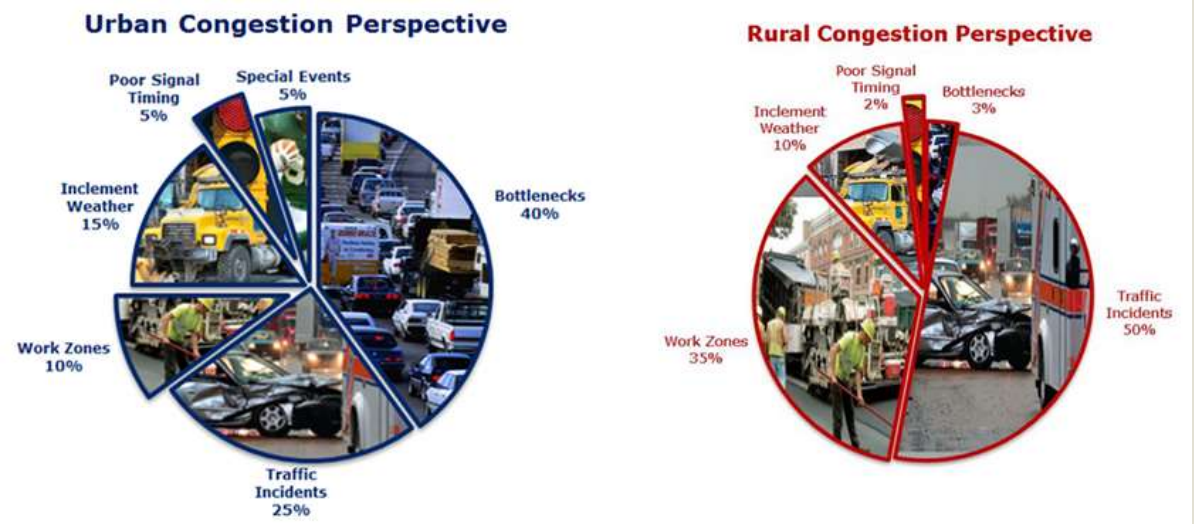
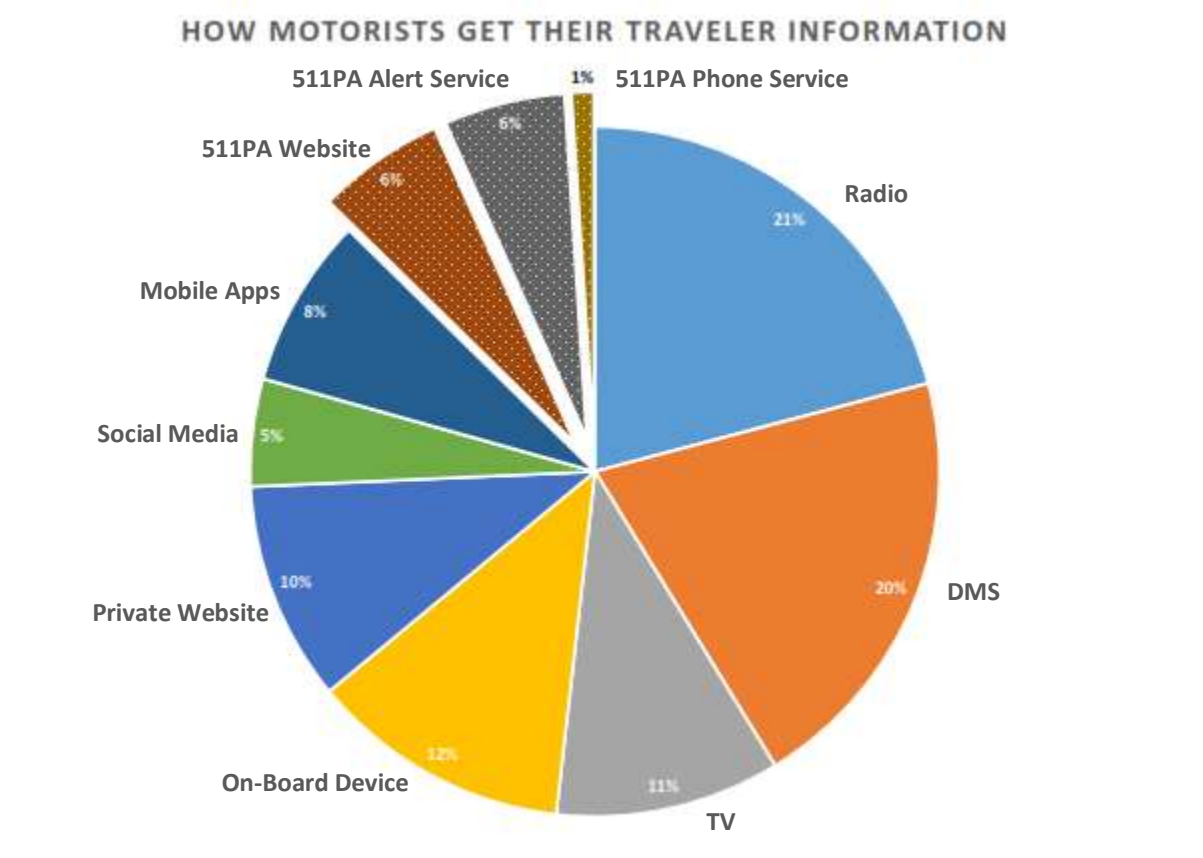
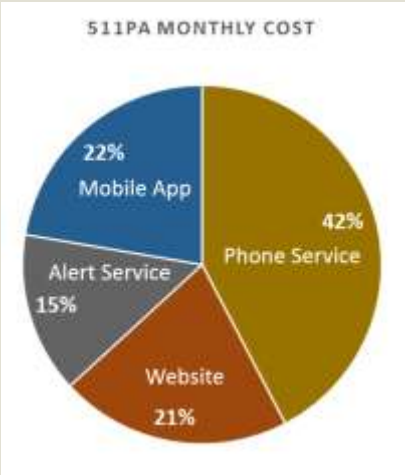


Figure 7 PennDOT Case Study 2: Determining Return on Investment for ITS/TSMO Strategies

PennDOT has an advanced network of ITS technology deployed statewide in support of numerous TSMO strategies and they are looking to establish clear performance metrics to better understand the return on their investment in these strategies. In 2013, PennDOT conducted a study of traveler information service use. As the figure below illustrates, most travelers get their information from the media (radio and TV), with DMS as a close second. Thirteen percent of those surveyed indicate that they get their information from PennDOT's 511 service. Note that since the survey, PennDOT has also developed a 511mobile application.



PennDOT also reviewed monthly operating costs associated with the 511 service. As illustrated in the 511PA monthly cost pie chart to the right, PennDOT discovered that while only one percent of travelers use the 511 phone service, a majority of the traveler information operating costs are attributed to that portion of the service. As such, PennDOT is considering the types of metrics that could help determine the point at which a service should be changed or eliminated. For example, when the cost per 511 call reaches $X, call volumes drop to Y, and the percent of people using a smart phone reaches Z, it may be time to eliminate the 511 phone service.



The following additional feedback was received from the USDOT Planning for Operations Program as the project was concluded. This feedback should also be taken into consideration if a decision support tool is further developed.

- Operations objectives and ITS/TSMO strategies often cut across several service areas. Recognizing that the preliminary tool was only developed for one service area – traveler information – additional thought should be given to if and how the tool could link operations objectives and ITS/TSMO strategies across multiple service areas.
- Including ITS/TSMO strategies related to the selected operations objectives could lead to a large database of strategies that would need to be developed and maintained in order to remain relevant and useful. Consideration should be given to how such a database would be maintained.
- USDOT has frequently been asked how the Desk Reference could be used to guide investment decisions or support the development of partnership agreements to reflect the more collaborative nature of transportation planning. The preliminary tool has been developed more for interaction from a single user. Further thought should be given to how the tool could accommodate a group of users who would typically collaborate on the selection of operations objectives and ITS/TSMO strategies.
- Sometimes a specific ITS/TSMO strategy is known and users may want need to identify how it supports operations objectives tied to a long range transportation plan. The tool should also allow users to work backwards, in a sense, to identify appropriate operations objectives related to specific ITS/TSMO strategies.
- In addition to ITS/TSMO strategies needing to support operations objectives, there should be further consideration of how strategies might be categorized according to an agency's TSMO capabilities. Strategies could be categorized according to the various levels of capability maturity, allowing agencies to select those most appropriate to their own capabilities.

5.0 Conclusion

This project identified needs and information gaps in the ability to assess ITS alternatives for those involved in transportation planning and decision making by researching existing resources and conducting outreach to select planning and operations staff. The research also identified what guidance exists for including ITS in operational plans, and it determined what additional resources may be needed to support the integration of ITS with planning and operations. As a result, the project developed a preliminary tool to explore the potential for such a tool to facilitate further consideration of ITS technologies and TSMO strategies in transportation planning and operations. The project focused on development of criteria to guide the selection of operations objectives and ITS/TSMO strategies. Following evaluation of the tool, recommendations were presented to guide any further development of such a tool that may be pursued in the future.

Appendix A: Integrating ITS with Planning and Operations Technical Memorandum 1: Research Summary

Integrating ITS with Planning and Operations
Technical Memorandum 1: Research Summary

September 1, 2015

Introduction

As intelligent transportation systems (ITS) continue to expand and evolve, planning for the deployment and operation of such systems is becoming increasingly critical to promote interoperability and enable future system expansion. For many years, USDOT has required state transportation agencies to develop and maintain an ITS architecture to guide the deployment of technology used for transportation. There are elements of the ITS architecture that correlate with traditional planning practices. However, there is sometimes limited coordination among staff responsible for the ITS architecture and planners working on future transportation projects. As such, this project will identify what resources are available to support transportation planning and proper consideration of technology alternatives in the decision making process.

Similarly, operational plans for transportation are commonly developed corridor-wide, metro-wide and statewide. These plans do not always include or adequately address technology which can leave devices (e.g. cameras, dynamic message signs) and data (e.g. traffic volume, roadway temperature) unused or underutilized. This project will assess what guidance exists for including technology in operational plans. Such guidance may be used to describe the placement of ITS devices, who will operate, maintain and own them, and how the devices will be used in daily or other operational scenarios.

ENTERPRISE questioned what resources are available to support the integration of ITS into planning and operations, and what level of awareness exists about such resources. The purpose of this project is to:

- Identify needs and information gaps in the ability to assess ITS alternatives for those involved in transportation planning and decision making;
- Assess what guidance exists for including ITS in operational plans; and,
- Determine if and what additional resources may be needed to support the integration of ITS with planning and operations.

This technical memorandum is a product of the first project task which focused on researching and cataloging existing resources and current practices associated with integrating ITS with planning and operations. Emphasis was placed on identifying resources for planners that help determine when ITS or technology strategies may be warranted; how such strategies may factor into future infrastructure changes; and, what may be the potential costs and benefits of such strategies. For operations, research focused on guidance for developing plans to address congestion and safety issues using technology in both urban and rural environments. The resources identified through research are presented in this memorandum.

In addition to cataloging existing resources, this memorandum will serve as a focal point for a discussion with the USDOT Planning for Operations Program. The discussion with Planning for Operations will focus

on identifying what resources are being used by agencies, what the agency feedback has been, and what additional resources may still be needed. The feedback from this meeting will be summarized in a second technical memorandum that will recommend a direction for the remaining ENTERPRISE project tasks. The remaining project tasks are intended to develop additional planning and operations resources, if needed, and to conduct outreach among the ENTERPRISE members to generate awareness of the resources available to support the integration of ITS into planning and operations.

Research Focus

Much has changed since this project was originally scoped in 2012. Most notably, the **Moving Ahead for Progress in the 21st Century (MAP-21)** Act was signed into law and prompted a wave of rulemaking and resource development to support the establishment of performance-based programs throughout state and local transportation agencies. Robust data has become a new commodity for agencies as they identify performance measures, set targets, measure progress and incorporate results into planning and operational activities. In late 2013, USDOT also released the **National Performance Management Research Data Set (NPMRDS)**, a national data set from a private sector probe data provider. The data set contains real actual, observed measurements for all traffic, freight traffic and passenger vehicle traffic. It may be used by state agencies and metropolitan planning organizations to measure travel times, identify travel patterns, or analyze incidents, for example. In addition to historical data for performance management, the **Real-Time System Management Information Program (23 CFR 511)** required states to establish real-time information programs for traffic and travel conditions on the Interstate system highways by November 2014. Programs are to be further expanded beyond the Interstate system to include other routes of significance within metropolitan areas by November 2016.

This has all stimulated a greater awareness of and interest in technology and ITS, particularly systems used for detection, monitoring and reporting. In fact, the greater concept of **Transportation Systems Management and Operations (TSM&O)** has evolved considerably over the past few years. The American Association of State Highway and Transportation Officials (AASHTO) reestablished the Subcommittee on Transportation Systems Management and Operations to serve as a focal point for promoting and supporting integrated implementation of TSM&O.

Figure 8 NOCoE Web Site
http://www.transportationops.org/

In partnership with the Institute of Transportation Engineers (ITE) and the Intelligent Transportation Society of America (ITS America), AASHTO also launched in January 2015, the **National Operations Center of Excellence (NOCoE)**. The NOCoE is designed to offer TSM&O resources to serve the transportation community. Its two primary components consist of an Operations Technical Service Program and a

web portal with a variety of TSM&O resources.

Figure 9 USDOT Planning for Operations Web Site
http://www.ops.fhwa.dot.gov/plan4ops/index.htm

Additionally, USDOT relaunched its Planning for Operations Program web site which serves as a resource for planners and operators to integrate TSM&O strategies into the planning process. Led by the Office of Operations and Office of Planning, Environment, and Realty of the Federal Highway Administration (FHWA) in coordination with the Federal Transit Administration (FTA), the Planning for Operations Program web site presents the bulk of its information by related focus areas and types of resources – with recommended resources helpful to specific audiences. It also provides a quick cross reference area describing how planning for operations relates to other transportation topics such as regional ITS architectures, ITS strategic plans, systems engineering and ITS project development.

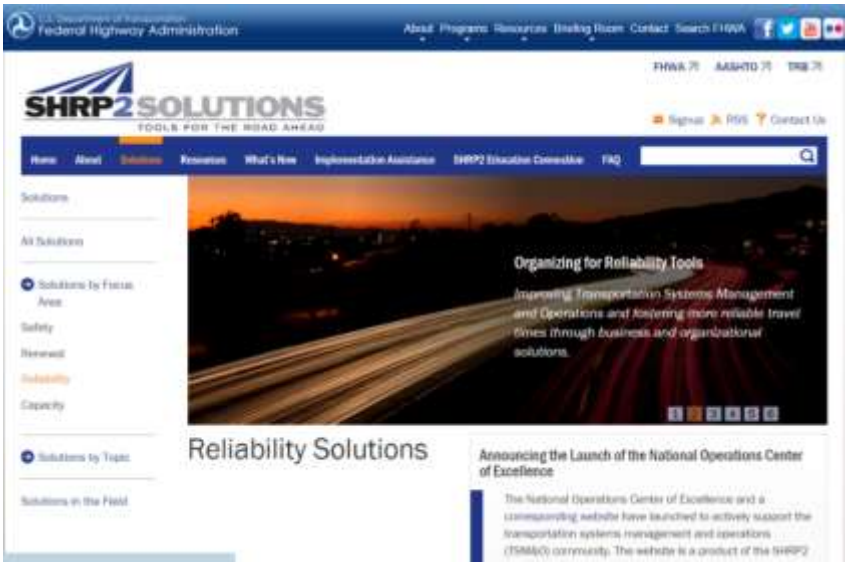


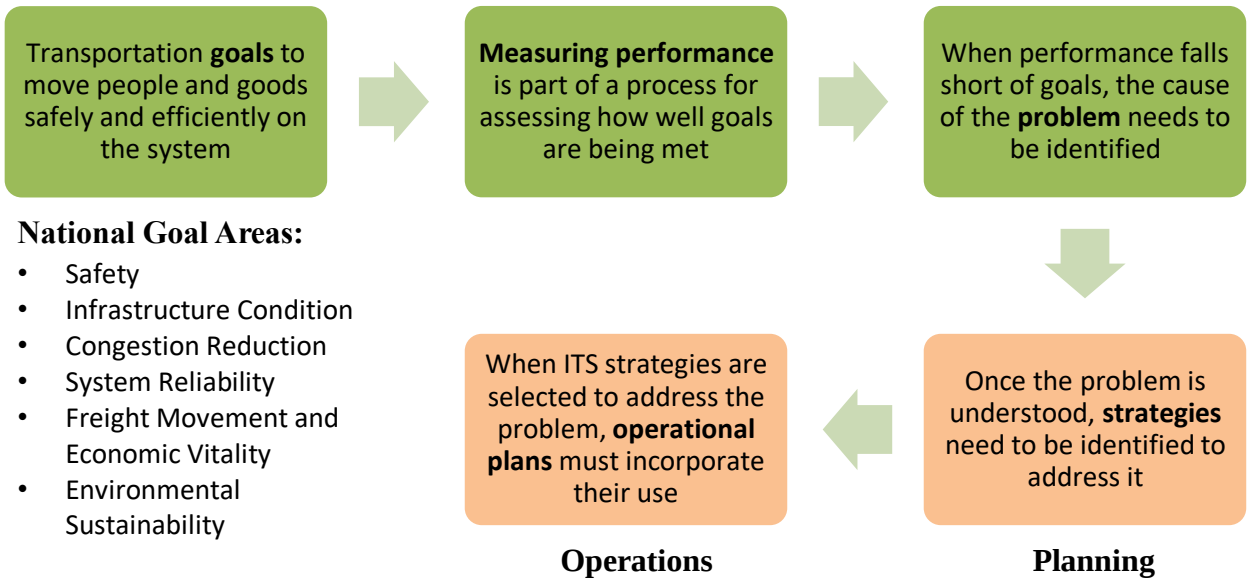
Figure 10 SHRP 2 Reliability Solutions https://www.fhwa.dot.gov/goSHRP2/Solutions/Reliability/List

The Planning for Operations and NOCoE offer access to numerous resources that support the integration of technology into planning and operations. Additional resources will continue to be developed through the Planning for Operations Program, as well as the second Strategic Highway Research Program (SHRP 2) Solutions Program. SHRP 2 Solutions continues to develop tools in several focus areas, including reliability. Under reliability, a number of tools have been developed specifically to support system management and operations. Some of the more prominent tools are further highlighted in the key findings.

Figure 4 presents a simple overview of how the research for this project was focused to catalog the resources that are available from USDOT, SHRP 2, NOCoE and others. The orange boxes in Figure 4 represent the focus specific focus of the research – emphasizing the identification of resources that

support the identification of ITS among the variety of strategies evaluated to address problems during the planning stage, as well as resources available to guide the incorporation of ITS strategies into operational plans.

Figure 11 Overview of Research Focus



The following key terms and definitions were also used throughout the research to maintain focus.

Planning: Involves setting agency goals and objectives; identifying needs; scoping strategies to address needs; evaluating alternatives; estimating costs; prioritizing potential strategies; and monitoring performance.[1]

Operations: Operations is the active day-to-day management of the movement and flow of vehicles on the transportation system using incident management systems, ITS technologies and related efforts.[2]

Transportation Systems Management and Operations (TSM&O): This is a set of strategies to anticipate and manage traffic congestion, and minimize the other unpredictable causes of service disruption and delay, thereby maintaining roadway capacity while improving reliability and safety. TSM&O is called by other names including, "Systems Operations and Management" (SO&M), "Intelligent Transportation Systems" (ITS), "Congestion Management Systems" and "Reliability Management."[3] Examples of TSM&O strategies often include:

- Traffic incident management
- Traveler information services
- Traffic signal and arterial management
- Transit priority systems
- Freight management
- Road weather management

[1] A Primer - Statewide Opportunities for Linking Planning and Operations
[2] A Primer - Statewide Opportunities for Linking Planning and Operations
[3] AASHTO TSM&O Guidance

Key Resources

In addition to those already noted, key resources identified through the research are presented in this section. For each resource, a brief description is provided along with links to further details available online or agency contacts with additional information.

There are two significant resources to highlight for their specific relevance to the focus of this research and overall scope of this task. Both are references developed in the past two years and, similar to this memo, they are intended to provide awareness and understanding of other resources available to support the rapid evolution of transportation planning and operations. The first, "Transportation Planning for Operations: Quick Guide to Practitioner Resources," was developed in 2013. The document highlights several resources commissioned by FHWA to support the integration of planning and operations at metropolitan, statewide and regional planning levels, and to support the development and analysis of operations within agencies. This technical memorandum follows a similar format to and includes several of the resources highlighted in the quick guide.

Transportation Planning for Operations: Quick Guide to Practitioner Resources (2013)

Available Online:
http://www.ops.fhwa.dot.gov/publications/fhwahop13049/fhwahop13049.pdf

This is a summary brochure that lists FHWA resources available including guidebooks, case studies, and workshops created with the input of transportation professionals to help improve planning for management and operation of transportation facilities. Resources are categorized by:

- Metropolitan planning for operations,
- Statewide planning for operations,
- Regional coordination and collaboration,
- Collaborative tools to integrate operations into planning,
- Analysis of management and operations, and
- Organizing for operations.

The second significant reference resource to note is "Program Planning and Development for Transportation System Management and Operations (TSM&O) in State Departments of Transportation," which was published in June 2014. Developed through NCHRP Project 20-07, the summary report provides an overview of the state of TSM&O practice based on literature review, interviews and practitioner's workshop.

Program Planning and Development for Transportation System Management and Operations (TSM&O) in State Departments of Transportation (2014)

Available Online:
http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-07(345)_FR.pdf

This is a summary report produced by project NCHRP 20-07. The objectives of this study 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." To make the best possible use of resources and to ensure that work would complement other TSM&O initiatives by FHWA, AASHTO and others, the scope was more narrowly defined to focus on strategic, program-level planning for state DOTs, and state leadership and support for TSM&O planning at all levels. The report contains an extensive list of references and highlights those most directly related to the project scope.

These two resources are significant to this project in terms of the role that ITS plays in operations and TSM&O strategies. In part, both attempts to address the need that drove this project – to understand what resources are available, under development or may still be needed to support the integration of new practices into old.

The remaining resources presented in this technical memorandum were selected and are highlighted specifically for their ability to guide the ENTERPRISE members on how to integrate ITS with planning and operations. The selected resources provide institutional guidance for changing business processes or organizational structure associated with planning and operations to better accommodate the integration of technology, or they provide guidance to support various aspects of planning and operations (e.g. alternatives analysis, benefit/cost analysis, travel demand forecasting, etc.) that allow for the consideration of technology options. Both the institutional and process oriented aspects of planning and operations influence how successfully ITS can be integrated within an agency. If planning processes do not support the evaluation of ITS alternatives they may never be considered as legitimate strategies to address transportation challenges. Furthermore, if the institutional makeup of an agency does not yet include an operations oriented philosophy, technology will not receive the resources necessary to operate and maintain it in a fashion that allows it to address the challenge it was deployed for. ITS components that operate together and as part of a system will enhance safety and mobility while reducing the possibility of costly, incompatible systems in the future.

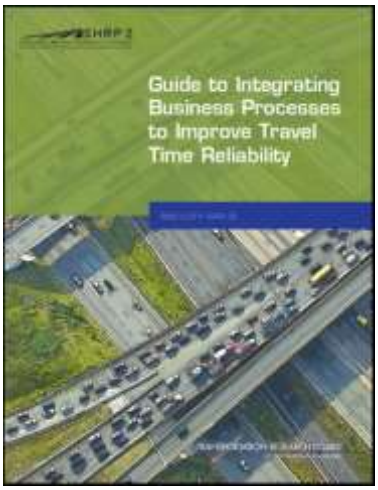
SHRP 2 L34: e-Tool for Business Processes to Improve Travel Time Reliability (2015)

Available Online:
http://onlinepubs.trb.org/onlinepubs/SHRP 2/SHRP 2_L34report.pdf

Building on the results of the SHRP 2 L01 project, the SHRP 2 L34 effort developed an interactive electronic tool (e-tool) that transportation agencies can use to evaluate their current business processes and to identify and remove barriers to implementing and sustaining improved processes to advance operations to enhance travel time reliability. The e-tool is primarily an electronic version of the business processes and guidance material developed in project L01. The e-tool guides users through a seven-step process to identify business process improvements in key TSM&O areas including: Incident Management; Work Zone Management; Planned Special Event Management; Road Weather Management; and, Traffic Control and Traffic Operations. The e-tool provides a mechanism to help agencies identify key components or enablers that can promote a more efficient process that may improve travel time reliability. By using the e-tool to document and represent the agency's processes, stakeholders can see the connections between the different components of their day-to-day operations and understand areas to improve their current business processes to improve operations.

SHRP 2 L01: Guide to Integrating Business Processes to Improve Travel Time Reliability (2011)

Available Online:
http://onlinepubs.trb.org/onlinepubs/SHRP 2/SHRP 2_S2-L01-RR-2.pdf



Effective traffic management and operations are the result of a number of different business processes working together. Business processes comprise two general types of activities: operational processes and institutional or programmatic processes. At the operations level, various processes evolve and are coordinated among those who are responsible for overseeing or carrying out operational initiatives. Processes at the programmatic level involve higher levels of decision makers and often more than one department or agency. This guide examines the integration of operational and programmatic business processes. It provides a step-by-step guide for agencies to assess their operational processes and identify opportunities to change or develop new processes. This guide also provides agencies with recommendations related to documenting and institutionalizing operational processes to improve their sustainability within the organization once they are effectively implemented. Finally, it summarizes the benefits and challenges associated with integrating and institutionalizing processes related to travel time reliability.

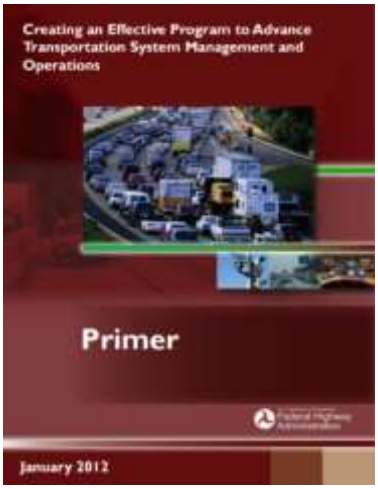
AASHTO TSM&O Guidance (2014)

Available Online:
http://www.aashtotsmoguidance.org/

This is an online self-assessment tool designed to provide direction to agencies via custom-tailored action plans for improving the performance-related effectiveness of TSM&O activities on a continuous basis. A Capability Maturity Model is used to show four levels of capability and guidance associated with business processes, systems and technology, performance measurement, culture, organization/workforce, and collaboration. The tool does not identify or prescribe specific TSM&O strategies and it is not a technical "how to" for TSM&O applications or best practices.

Creating an Effective Program to Advance Transportation System Management and Operations, Primer (2012)

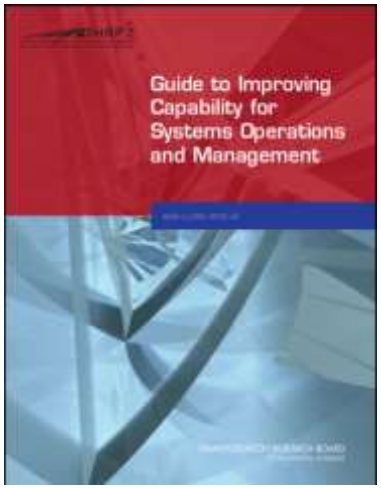
Available Online:
http://www.ops.fhwa.dot.gov/publications/fhwahop12003/fhwahop12003.pdf



The purpose of this primer is to raise awareness of the opportunities for improving the effectiveness of State and local Transportation System Management and Operations (TSM&O) activities. The primer provides high-level guidance focused on key program, process, and organizational capabilities that are essential to the development of more effective TSM&O strategy applications. It is aimed at program and activity-level managers responsible for TSM&O related activities in State, regional, and local transportation agencies. A capability maturity approach is presented in relation to the areas of business process, systems and technology, performance measurement, culture, organization and workforce, and collaboration.

SHRP 2 L06: Guide to Improving Capability for Systems Operations and Management (2011)

Available Online:
http://onlinepubs.trb.org/onlinepubs/SHRP 2/SHRP 2_S2-L06-RR-2.pdf



The guide is based on real-world experiences of transportation agencies, especially state departments of transportation (DOTs), across a range of levels of application of the conventional strategies that focus on NRC, which is responsible, on average, for about 50% of delays in metropolitan areas. The research included a review of key features of the typical congestion management program activities and the technical and business processes that characterize the more effective programs. From this analysis, the institutional preconditions most supportive of the more effective programs were identified and incorporated into the guide. The guide structure is based on an adaptation of the Capability Maturity Model widely used in the information technology industry to improve product quality and reliability. The basic concepts were adapted to provide transportation agency management with a tool to improve congestion management capabilities. The model starts with agency self-evaluation to determine the current state of play and provides related appropriate incremental strategies for evolving toward institutional arrangements most supportive of congestion management.

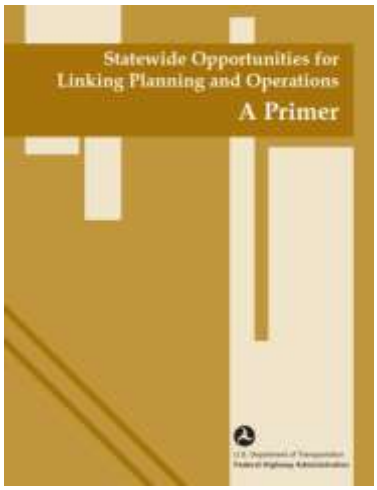
Statewide Opportunities for Integrating Operations, Safety and Multimodal Planning, Reference Manual (2010)

Available Online:
http://www.fhwa.dot.gov/planning/processes/statewide/practices/manual/manual.pdf

This reference manual is designed to assist managers and staff within state departments of transportation to integrate their functions and to partner with other agencies, such as metropolitan planning organizations, transit agencies and local jurisdictions to more effectively integrate operations, safety and planning. Specifically, this manual is designed as a “how to” reference that provides practical information on implementing these opportunities and case study examples with “toolkits” to help get started. The manual focuses on the business processes, institutional issues and human resource considerations that support integration at the statewide, regional, corridor and project levels.

Statewide Opportunities For Linking Planning and Operations: A Primer (2008)

Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf



The primer points out that traditional approaches to mitigating recurring congestion fail to address the increasing challenges associated with non-recurring congestion resulting from incidents, work zones, weather and special events. The primer is designed to raise awareness of benefits and opportunities for coordinating planning and operations activities within State DOTs. It is targeted at mid-level DOT planning and operations staff and provides:

- Descriptions of the relevance of planning to operations and operations to planning;
- Organization of materials, projects and documentation associated with the topic of linking planning and operations (as of 2008);
- Identification of gaps and opportunities for linking planning and operations at state DOTs;
- Description of steps that DOTs can take to better link planning and operations in several key areas, highlighted by case studies of state DOTs that have worked toward linking planning and operations; and,
- A self-assessment questionnaire that state DOT planning and operations staff can use to help them understand how well they are linking planning and operations.

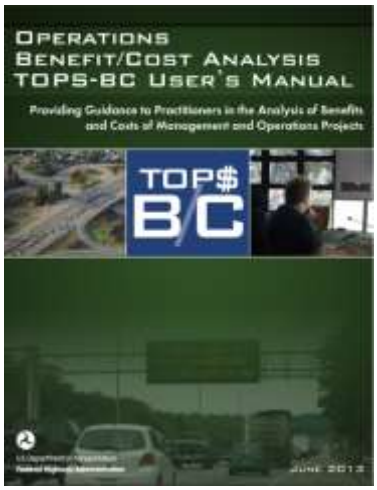
IDAS (ITS Deployment Analysis System)

Available Online:
http://www.fhwa.dot.gov/research/deployment/idas.cfm **and**
http://www.camsys.com/IDAS.htm

IDAS is a sketch-planning software analysis tool that was developed specifically to address the limited methods available to analyze the costs and benefits of ITS and operations strategies as part of the transportation planning process. The quantification of these costs and benefits is especially difficult for planners and engineers that use travel demand forecasting models to evaluate investments because these models cannot capture the benefits derived from ITS and operations technologies. IDAS operates as a post-processor to travel demand models, enabling the user to import data from a travel demand model into the IDAS software to recreate the transportation network under evaluation. IDAS provides the opportunity to build different network alternatives by enabling users to choose from a menu of ITS and operations components and then deploy the selected network components. As the user chooses various components, IDAS maintains a database of the impacts and costs of the components, based on national data. After all of the components are selected, users can program IDAS to perform an internal network assignment and mode choice analysis to estimate the changes in modal, route, and temporal decisions of travelers resulting from the ITS and operations technologies. IDAS can system wide performance measures including mobility, travel time reliability, crashes, emissions, fuel use, agency efficiency and productivity, capital, operating and maintenance costs, and benefit-cost ratios.

Operations Benefit/Cost Analysis TOPS-BC User's Manual (2013)

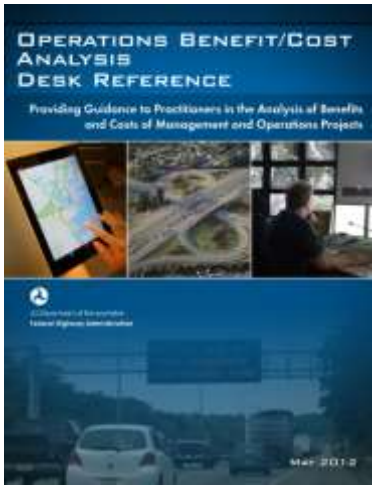
Available Online:
http://www.ops.fhwa.dot.gov/plan4ops/topsbctool/index.htm



The Tool for Operations Benefit/Cost (TOPS-BC) is a sketch-planning level decision support tool developed by the FHWA Office of Operations. It is intended to provide support and guidance to transportation practitioners in the application of benefit/cost analysis (BCA) for a wide range of Transportation System Management and Operations (TSM&O) strategies. The tool was developed based on guidance and input from planning and operations practitioners with the primary purpose to help in screening multiple TSM&O strategies and for providing "order of magnitude" BCA estimates. Although the tool contains default parameters, sketch methods for estimating impacts of investments (e.g., change in travel speeds or crashes), and procedures for monetizing those impacts, users are encouraged to use local data or data derived from more robust traffic, safety, or cost models. Even in these cases, however, TOPS-BC can be used to provide a framework for organizing and cataloguing the various benefit and costs elements.

Operations Benefit/Cost Analysis Desk Reference (2012)

Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop12028/fhwahop12028.pdf



This Desk Reference is intended to meet the needs of a wide range of practitioners looking to conduct benefit/cost analysis of operations strategies. The guidance provided in the Desk Reference includes basic background information on benefit/cost analysis, including basic terminology and concepts, intended to support the needs of practitioners just getting started with B/C analysis, who may be unfamiliar with the general process. Building off this primer base, the Desk Reference also describes some of the more complex analytical concepts and latest research in order to support more advanced analysts in conducting their analysis. Some of the more advanced topics include capturing the impacts of travel time reliability; assessing the synergistic effects of combining different strategies; and capturing the benefits and costs of supporting infrastructure, such as traffic surveillance and communications. This Desk Reference is supported by the Tool for Operations Benefit/Cost (TOPS-BC), a spreadsheet-based tool designed to assist practitioners in conducting benefit/cost analysis.

Applying a Regional ITS Architecture to Support Planning for Operations: A Primer (2012)

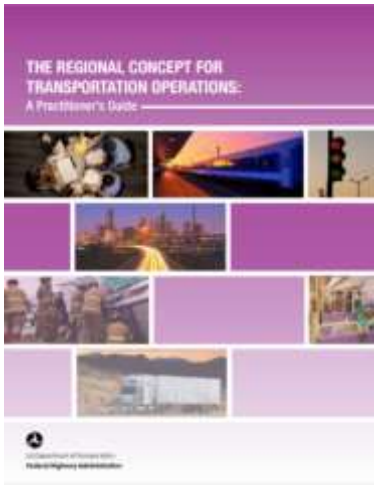
Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop12001/fhwahop12001.pdf

This primer offers transportation planners and operations managers a menu of opportunities for applying the regional ITS architecture to enhance planning for operations. Because many TSM&O strategies are underpinned by ITS, the coordination of planning for ITS among agencies at the institutional and technical level is an essential element to planning for operations. This primer focuses on the use of an "objectives-driven, performance-based" approach to planning for operations; an approach that increases the potential support from the regional ITS architecture given the approach's emphasis on data and performance measures. Opportunities to leverage the regional ITS architecture in support of planning for operations include:

- Sustain and build on the collaborative relationships from the regional ITS architecture development
- Consult the architecture to identify available sources of operations data to track measurable objectives
- Gather information on operations needs from the architecture and ITS stakeholders.
- Examine service packages in architecture when identifying ITS-based M&O strategies
- Include the architecture as part of the transportation improvement program (TIP) development process
- Use the architecture's operational concepts, functional requirements, and other contents to kick-start project development

The Regional Concept for Transportation Operations: A Practitioner's Guide (2011)

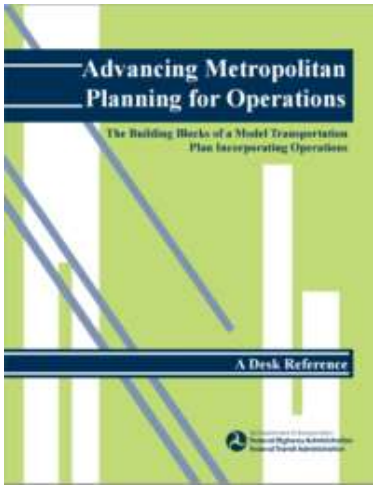
Available Online:
http://www.ops.fhwa.dot.gov/publications/fhwahop11032/fhwahop11032.pdf



This practitioner's guide is a collection of the observed successes and lessons learned from four metropolitan regions as they developed Regional Concepts for Transportation Operations (RCTOs), a management tool used by planners and operations practitioners to define a strategic direction for implementing effective regional transportation management and operations in a collaborative manner. This document provides information on how to develop and implement an RCTO effectively and efficiently by highlighting practices that have been used successfully to overcome challenges by the four implementing regions that forged ahead into this new territory. This guide offers lessons from these pioneering sites that can help other implementing regions to select the methods that are most effective in improving regional transportation system performance.

Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference (2010)

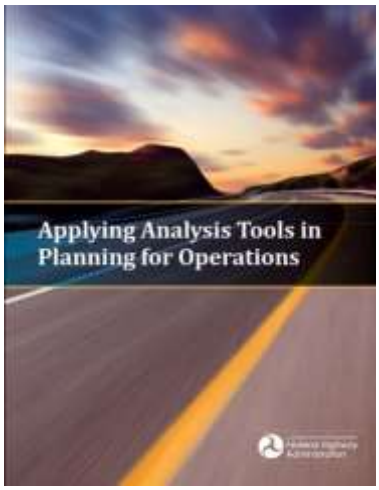
Available Online:
http://www.ops.fhwa.dot.gov/publications/fhwahop10027/fhwahop10027.pdf



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

Applying Analysis Tools in Planning and Operations (2009)

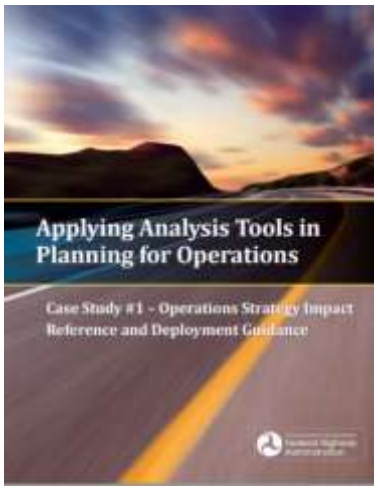
Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop10001/fhwahop10001.pdf



This brochure and four corresponding case studies were developed to help transportation agencies better understand how existing planning and operations analysis tools and methods may be used to better analyze, evaluate and report benefits of transportation operations strategies, including ITS. The tools explored include sketch planning, deterministic models, travel demand forecasting models, simulation, archived operations data, operations-oriented performance measures/metrics, and traffic signal optimization. The brochure also acknowledges, at the time of its publication in 2009, that there are limitations to the use of existing tools for evaluating operational strategies and a need to develop new tools that are capable of a more holistic evaluation of strategies and their impacts on the transportation system.

Applying Analysis Tools in Planning for Operations: Case Study #1 – Operations Strategy Impact (2009)

Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop10002/fhwahop10002.pdf



This is one of four case studies prepared to illustrate the application of traditional analysis tools to evaluate operations strategies. This particular case study compiled information on various ITS operations strategies in order to promote a greater understanding of the likely performance impacts based on national averages as well as individual regional deployments. Deployment guidance was also developed based on specific thresholds or rules-of-thumb that have been established to help practitioners identify conditions that warrant deployment of particular operations strategies. The deployment guidance and impacts summary provided in this case study are intended to answer the questions: "what situations are most conducive to operational strategy deployments" and "what are the likely impacts of the strategies under consideration." Data used to populate the impacts summary and deployment guidance were primarily taken from the ITS Benefits Database and IDAS.

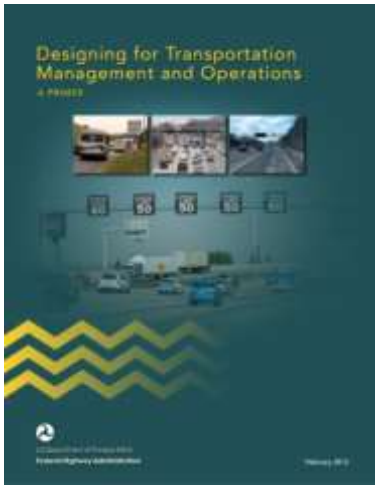
Understanding the Contributions of Operations, Technology and Design to Meeting Highway Capacity Needs (2014)

Available Online:
http://onlinepubs.trb.org/onlinepubs/SHRP 2/SHRP 2_S2-C05-RW-1.pdf

Effectively evaluating the wide range of operational improvement strategies that are available is not a trivial matter, particularly when their performance is to be compared against the construction of new lanes. This report summarizes the results of a capacity project undertaken to advance the state of practice in travel demand forecasting. The objectives of this project were to (a) quantify the capacity benefits, individually and in combination, of operations, design, and technology improvements at the network level for both new and existing facilities; (b) provide information and tools to analyze operational improvements as an alternative to traditional construction; and (c) develop guidelines for sustained service rates (SSRs) to be used in planning networks for limited access highways and urban arterials (2). The project selected 25 operational strategies to assess how effectively they meet highway capacity needs.

Designing for Transportation Management and Operations: A Primer (2013)

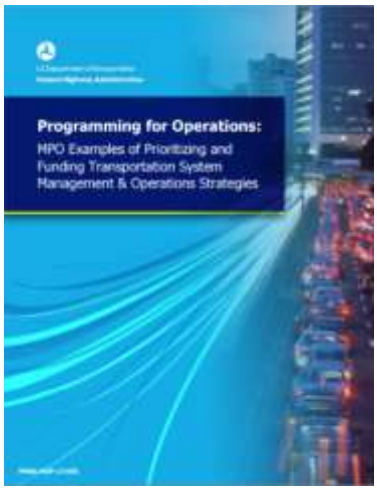
Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop13013/fhwahop13013.pdf



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.

Programming for Operations: MPO Examples of Prioritizing and Funding TSM&O Strategies (2013)

Available Online:
http://ops.fhwa.dot.gov/publications/fhwahop13050/fhwahop13050.pdf



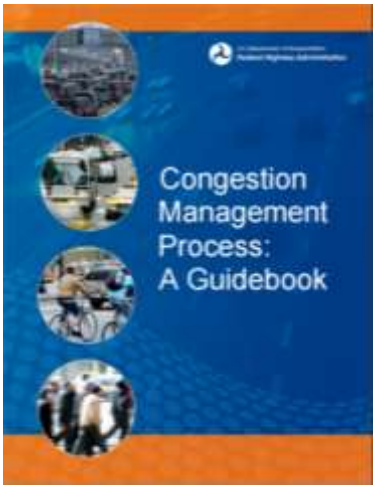
This document discusses how MPOs have incorporated TSM&O projects into the programming phase of transportation investment decision making in metropolitan areas. Based on a sample of practices from MPOs that have emphasized operations strategies in the planning process, this document highlights findings on:

- Sources of funding that are being used for TSM&O strategies.
- Methods for prioritizing strategies for funding.
- Staff resources devoted to TSM&O-related activities.
- Initial lessons learned about effective practices.

This report includes case studies of practices related to programming TSM&O strategies from nine MPOs around the country.

Congestion Management Process Guidebook (2011)

Available Online:
http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/cmpguidebk.pdf



This publication is a guidebook designed to provide information on how to create an objectives-driven, performance-based congestion management process (CMP). This guidebook describes a flexible framework of eight actions that should be included in the development of a CMP. It also highlights the role of the CMP in addressing multiple objectives, including livability, multimodal transportation, linkages with environmental review, collaboration with partners and stakeholders, demand management and operations strategies, and effective practices for documentation and visualization.

In addition to the resources noted above, there are numerous examples of agency operational practices – published and unpublished – available through USDOT, SHRP 2 and NOCoE. Highlighted here are very recent practices from two ENTERPRISE member agencies – the Pennsylvania Department of Transportation (PennDOT) and Ministry of Transportation in Ontario.

Agency Practice: PennDOT Corridor Modernization – Planning for Operations Guidebook

Agency Contact:
Doug Tomlinson, PennDOT, dtomlinson@pa.gov, 717-787-3657

From 2005-07 PennDOT created nine initial system operations plans. In 2014 they refocused their effort on corridors with emphasis on congestion management. The department identified different tiers of roads to develop common expectations and consistency, while engaging business areas across PennDOT to establish goals and performance measures using RITIS and PEMS for data analysis. The efforts focused on identifying the best operational strategies and understanding benefit/cost analysis. The resulting "Planning for Operations Guidebook" is intended to introduce PennDOT's statewide approach for operations planning, describe how this approach fits within the existing planning context, and present how this process can be applied at both the state and regional level. The Guidebook focuses on an objectives-driven, performance-based approach using established system performance measures, and incorporates the concepts established by Corridor Modernization to create guidance that is usable by business areas and planning partners alike. The audience includes the professionals responsible for transportation planning and operations within the state working for or on behalf of PennDOT, planning partners, or local municipalities. The goal is for stakeholders to be able to reference this document throughout the development and implementation of their plans and programs. The Guidebook will also include specific guidance for development of Regional Operations Plans and Business Area Operation Plans.

Agency Practice: 2015 Pan Am / Parapan Am Games – Traffic Operations Infrastructure Plan
Agency Contact: **Dennis Tessarolo, Ministry of Transportation, dennis.tessarolo@ontario.ca, 416-235-4834**
In July-August 2015, Ontario will host the 2015 Pan Am / Parapan Am Games. The Games are expected to draw 7,600 athletes and 250,000 visitor to Ontario. To manage transportation during the Games, the Ministry of Transportation established a methodology for prioritizing venue corridors based on thresholds around event criteria of mobility, safety and Pan Am deployment. Data was gathered for venue corridors, scored and weighted to develop a Deployment Density Class (DDC) prioritization. DDC was used to identify ITS infrastructure needs by corridor type (e.g. freeway, major highway, arterial and rural road). The results were then used to deploy ITS infrastructure at key locations to manage transportation during the Games.

Conclusion

The integration of technology into planning and operations continues to be a strong focal point for USDOT. The Planning for Operations Program noted earlier has plans to develop additional resources that will further support the integration of technology and TSM&O into traditional transportation planning and operations processes. This technical memorandum highlights some of the more prominent resources available today to support the integration of technology into transportation planning and operations. Next, ENTERPRISE will collaborate with the Planning for Operations Program to determine what, if any, decision-support tools this project can contribute to the rapidly evolving work in this area. The results of that collaboration will be presented in a second technical memorandum which will recommend an approach for the remaining tasks of this ENTERPRISE project.

Appendix B: Integrating ITS with Planning and Operations Technical Memorandum 2: Gaps to Address

Integrating ITS with Planning and Operations
Technical Memorandum 2: Gaps to Address

November 24, 2015

Introduction

This project is focused on identifying what resources are available to support the integration of ITS into planning and operations, and what level of awareness exists about such resources. The purpose of this project is to:

- Identify needs and information gaps in the ability to assess ITS alternatives for those involved in transportation planning and decision making;
- Assess what guidance exists for including ITS in operational plans; and,
- Determine if and what additional resources may be needed to support the integration of ITS with planning and operations.

The first technical memorandum for this project focused on cataloging existing resources and current practices associated with integrating ITS with planning and operations. Emphasis was placed on identifying resources for planners that help determine when ITS or technology strategies may be warranted; how such strategies may factor into future infrastructure changes; and, what may be the potential costs and benefits of such strategies. For operations, research focused on guidance for developing plans to address congestion and safety issues using technology in both urban and rural environments.

In addition to cataloging existing resources, the first memorandum served as a focal point for a discussion with the USDOT Planning for Operations Program. The program supports the integration of transportation systems management and operations (TSM&O) strategies into the planning process for the purpose of improving transportation system efficiency, reliability, and options. It is led by the Office of Operations and Office of Planning, Environment, and Realty of the Federal Highway Administration (FHWA) in coordination with the Federal Transit Administration.[4] The discussion with Planning for Operations identified what resources are being used by agencies, what the agency feedback has been, and what additional resources may still be needed. The discussion also modified the project focus from ITS specifically to TSM&O more broadly with the understanding that most TSM&O strategies are enabled by ITS. TSM&O is specifically defined as 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. TSM&O includes actions such as traffic detection and surveillance, corridor management, freeway management, arterial management, active transportation and demand management, work zone management, emergency management, traveler information services,

[4] USDOT Planning for Operations Glossary, http://www.ops.fhwa.dot.gov/plan4ops/index.htm, accessed on November 12, 2015.

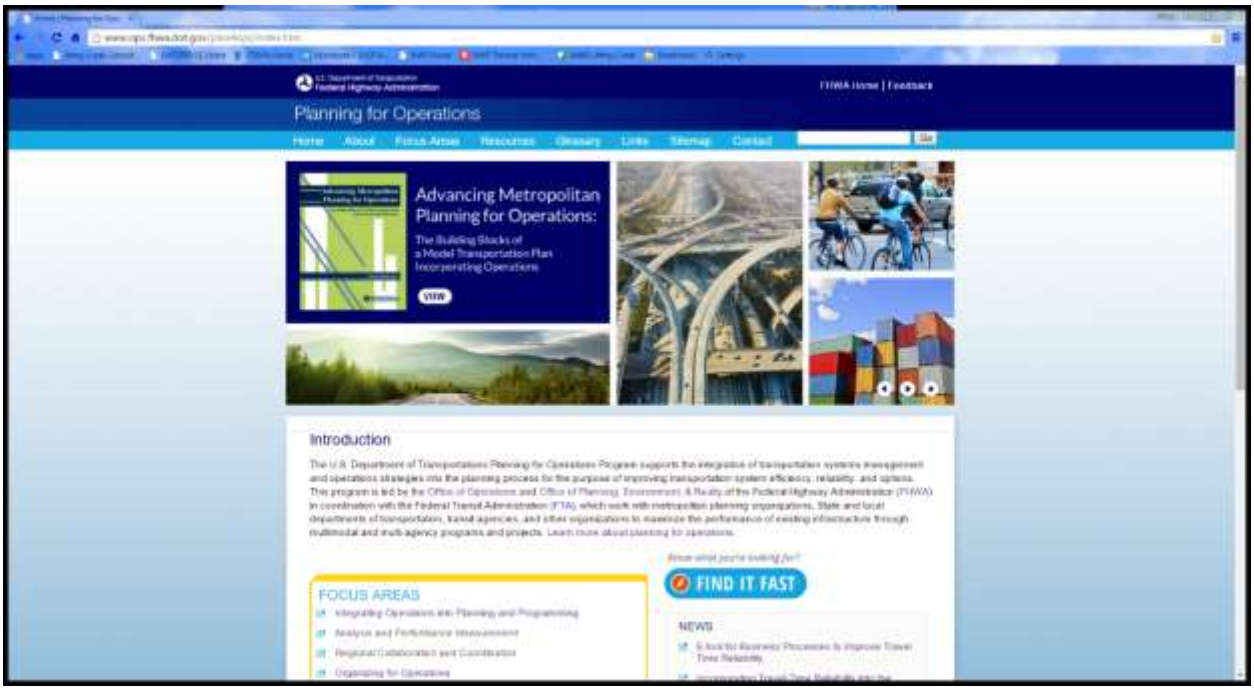
congestion pricing, parking management, automated enforcement, traffic control, commercial vehicle operations, and freight management – much of which depends on ITS as enabling technology.[5]

This second technical memorandum summarizes the meeting with Planning for Operations, and it recommends a direction and scope for the remaining ENTERPRISE project tasks. The remaining project tasks are intended to develop additional planning and operations resources, if needed, and to conduct outreach among the ENTERPRISE members to generate awareness of the resources available to support the integration of TSM&O into planning and operations.

Meeting with Planning for Operations

As noted in the first memorandum and illustrated in Figure 1, USDOT relaunched its Planning for Operations web site in 2015. The site serves as a resource for planners and operators to integrate TSM&O strategies into the planning process. It presents the bulk of its information by related focus areas and types of resources – with recommended resources helpful to specific audiences. It also provides a quick cross reference area describing how planning for operations relates to other transportation topics such as regional ITS architectures, ITS strategic plans, systems engineering and ITS project development.

Figure 12 USDOT Planning for Operations Web Site – www.ops.fhwa.dot.gov/plan4ops/index.htm



Based on the depth of information provided on this site, ENTERPRISE contacted Planning for Operations program manager, Wayne Berman, to arrange a meeting. On September 29, ENTERPRISE project champions – Rashmi Brewer, MnDOT and Doug Tomlinson, PennDOT – met with Mr. Berman to discuss the scope of ENTERPRISE project; current and upcoming activities led by Planning for Operations; and potential tools needed to support ITS integration. After discussing the ENTERPRISE project scope, Mr. Berman explained that the Planning for Operations program has evolved considerably over the last several

[5] USDOT Planning for Operations Glossary, http://www.ops.fhwa.dot.gov/plan4ops/glossary.htm, accessed on November 12, 2015.

years from finding ways to encourage planning and operations staff to work together at a regional level, and then at the state level. It was found that plans were very project-based and focused on ITS devices vs. system-based on TMS&O strategies (which include ITS). The program shifted focus to an objectives driven perspective that encourages a more systemic approach to planning and operations. The program has developed a wide variety of primers, tools and best practice and case study documents – many of which were highlighted in the first memorandum for this project. After considering the nature of the ENTERPRISE project and the work completed to-date by Planning for Operations, Mr. Berman suggested that ENTERPRISE consider developing a decision support tool based on *Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference*.

Developed in 2010, the desk reference is designed to enable transportation planners and their partners to build a transportation plan that includes operations objectives, performance measures, and strategies that are relevant to their region, that reflect the community's values and constraints, and that move the region in a direction of improved mobility and safety. It offers practitioners a menu of options for incorporating operations into their plans through an organized collection of sample operations objectives and performance measures. It also features excerpts from a model metropolitan transportation plan, illustrating the results of an objectives-driven, performance-based approach to planning for operations.

In addition to the discussion with Planning for Operations, the ENTERPRISE board requested further review of the results of a series of TSM&O workshops that were sponsored by the Second Strategic Highway Research Program (SHRP 2) under the Reliability Focus Area. There were 40 state and regional workshops were held throughout the country from 2011-2014. The workshops emphasized the six dimensions of the TSM&O Capability Maturity Model (CMM) and corresponding self-assessments of participants' own maturity. According to the summary report,[6] 23 of the workshop locations completed self-assessments. Most assessed themselves as being at level 1 or 2 in regard to Business Process. There are very few statewide TSM&O-specific plans that go beyond isolated ITS deployments and an equally limited number of Metropolitan Planning Organizations (MPOs) with a TSM&O-related plan or budget element. TSM&O planning and budgeting have been largely limited to specific projects or initiatives. In addition, TSM&O as a program has very limited visibility in statewide and MPO comprehensive plans and programs – although valuable guidance is available.

Section 4 of the summary report presents a list of needs for research, guidance and training at the national level according to the six CMM dimensions. A few planning related needs under Business Processes and

[6] Organizing for Reliability – Capability Maturity Model Assessment and Implementation Plans, Executive Summary, http://ops.fhwa.dot.gov/docs/cmmexesum/cmmexsum.pdf, USDOT FHWA, May 2015.

Collaboration (noted below), further support the Planning for Operations recommendation for ENTERPRISE to develop a decision support tool.

Under Business Processes dimension:

> "Develop guidance and best practice examples related to TSMO program planning, including example plans."
>
> "Identify, collect and circulate best practices on integrated TSMO in standard DOT project development processes."

Under Collaboration dimension:

> "Develop methods for accommodating TSMO activities and their resource requirements in both conventional statewide and metropolitan planning."

Approach to Remaining Project Tasks

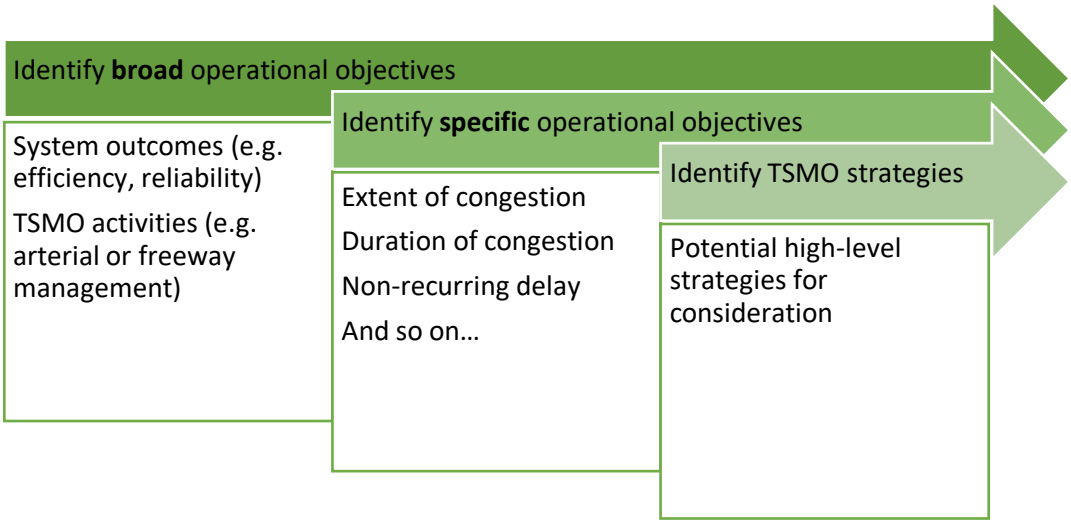
As illustrated in Table 1, the original scope of the ENTERPRISE project had four tasks with distinct milestones and budget to develop additional planning and operations resources.

Table 4 Budget for ENTERPRISE Integrating ITS with Planning and Operations

Task	Milestone	Budget
Task 1	Milestone #1: Tech Memo #1: Summary of Tools & Current Practices ***DONE***	$24,000
	Milestone #2: Tech Memo #2: Definition of gaps to be addressed by project ***DONE***	$16,000
Task 2	Milestone #3: Decision Support Tool (Developed New or Find and Modify existing)	$24,000
Task 3	Milestone #4: Guidance to support ITS in operational plans developed and piloted in Initial Location ***POSTPONE***	$50,000
	Milestone #5: Guidance to support ITS plans piloted in additional locations ***POSTPONE***	$34,000
Task 4	Milestone #6: Develop outreach materials	$16,997
	Total	$166,997

The decision support tool suggested by Planning for Operations may be developed under Task 2. The budget for Task 2 will allow for a basic spreadsheet-based tool to be developed using existing content from the document, *Advancing Metropolitan Planning for Operations – The Building Blocks of a Model Transportation Plan Incorporating Operations (A Desk Reference)*. Figure 2 illustrates the basic information from the existing content that will be incorporated into the decision support tool. The intended purpose of the tool will be to support high-level planning considerations based on objectives associated with addressing system outcomes or specific TSM&O activities. It will support planners with identifying their operational objectives and then identify potential TSM&O strategies related to those objectives. For each strategy, sample performance measures, anticipated data needs and data resources will be provided using the fact sheets included in the desk reference.

Figure 13 Basic Design for High-Level Decision Support Tool



The decision support tool will be constructed in a series of layers as illustrated in Figure 2. The first layer(s) will determine what broad operational objectives the agency has. This will be accomplished with a series of questions to identify whether the objectives are system-oriented as opposed to activity-based. The next layer(s) will include more detailed questions to gather additional information about the specific system or activity-based outcomes that are desired (e.g. reduce extent of congestion, reduce time between incident verification and posting traveler alerts). The final layer(s) will include suggestions of potential TSM&O strategies and the high-level details (e.g. sample performance measures, anticipated data needs).

As layers of the tools are developed, examples will be shared with the Project Champions and others as requested for their feedback on format, content, etc. In addition to the Project Champions, feedback is likely to be sought from the Planning for Operations program and select planning and operations staff within the ENTERPRISE member agencies. When the decision support tool is fully drafted it will be similarly reviewed. As reviews are completed, a running list of comments will be maintained to indicate which will be addressed within the scope and budget for Task 2 that is described in this memorandum. For those comments determined to be beyond the scope and budget at this time, they will be reevaluated with the Project Champions and ENTERPRISE Board upon completion of the tool to determine how and when they may be addressed in the future.

As noted in Table 1, it is recommended that ENTERPRISE postpone Task 3 based on the research conducted. The $84,000 budget associated with this task could potentially be redirected from Task 3 to Task 2 at later date to address comments previously noted as beyond the original scope and budget of Task 2. Such modifications could expand on the detail and capability of the proposed decision support tool. The budget from Task 3 could also be redirected to the overall ENTERPRISE program for other projects.

Conclusion

As suggested by the Planning for Operations program, this memorandum outlines the next steps for developing a decision support tool that will further integrate TSM&O (which includes ITS as enabling technology) into planning activities. The tool will be developed within the original scope and budget for

Task 2 of the ENTERPRISE Integrating ITS with Planning and Operations project. It will be basic spreadsheet-based tool, developed using existing content from the document, *Advancing Metropolitan Planning for Operations – The Building Blocks of a Model Transportation Plan Incorporating Operations (A Desk Reference)*. The tool will support high-level planning considerations based on objectives associated with addressing system outcomes or specific TSM&O activities.

Appendix C: Project One-Pager

ENTERPRISE

April 2016

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Integrating ITS to Enable TSMO in Planning and Operations

Introduction

This project began with a focus on ITS and was revised to explore ITS as enabling technology for the broader applications of Transportation Systems Management and Operations (TSMO) in planning and operations. This reflects a more comprehensive view of ITS which allows agencies to collaborate in active management of the transportation system according to regional operations objectives.

TSMO is defined as an integrated program to optimize the performance of existing highway infrastructure through the implementation of systems, services, and projects that are designed to preserve capacity and improve safety, reliability and security of the transportation system. This includes regional operations collaboration and coordination of activities among transportation and public safety agencies.

ITS Service Areas Enabling TSMO

Project Summary

New TSMO strategies are continually being developed and technology continues to rapidly evolve. This makes it challenging for transportation planning and operations staff to stay abreast of the latest information and factor it into their processes.

ENTERPRISE recognized that planning and operations staff may not have adequate tools to support their decision making regarding which TSMO strategies may be appropriate to address certain transportation challenges. For example, a planner in a regional office may be reviewing a growing freeway congestion issue and may not know how best to determine if the most appropriate TSMO strategy is managed lanes or ramp metering.

This project has identified resources that are currently available to support the consideration of TSMO operations objectives and strategies. With input from the USDOT Planning for Operations Program, it was determined that a decision support tool based on ***Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference*** would further support the consideration of TSMO strategies to solve transportation challenges. Additional selection criteria, strategies and reference resources will be incorporated into the tool along with existing material from the Desk Reference. The decision support tool will be initially developed for one TSMO area – Traveler Information – to allow for evaluation before developing other TSMO areas.

For more information: Rashmi Brewer, MnDOT, 651-234-7063 or Doug Tomlinson, PennDOT, 717-787-3657