

Project No. NCHRP 20-07 (392)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO) OPERATIONS GUIDE DEVELOPMENT PLAN

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
of
The National Academies of Sciences, Engineering and Medicine

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June 2017

ACKNOWLEDGMENT OF SPONSORSHIP

This work was conducted for the National Cooperative Highway Research Program (NCHRP) Project 20-07, “Research for AASHTO’s Standing Committee on Highways.” The NCHRP is supported by annual voluntary contributions from the state Departments of Transportation. Project 20-07 is intended to aid the American Association of State Highway and Transportation Officials (AASHTO) in the development of guides, standards, policies, and other AASHTO activities. Task 392’s objectives were to (1) investigate the focus for, potential use and topics to be included within the context of an “Operational Standards for Highway Infrastructure” document and (2) develop a roadmap for conducting research needed in order to develop such a document. The task was in response to a request from the AASHTO Committee on Transportation System Operations.

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1 INTRODUCTION

This report documents a plan for developing the technical and institutional-related materials for a national Transportation Systems Management and Operations Guide under the auspices of the American Association of State Highway and Transportation Officials (AASHTO). The initial version of the Guide will be developed under the National Cooperative Highway Research Project (NCHRP) Project 03-126, *Operational Standards for Highway Infrastructure*. This report includes a detailed roadmap for guiding development activities for the initial version of the Guide and beyond to its full version.

1.1 BACKGROUND

As the nation's surface transportation evolves to meet safety, mobility, and reliability challenges, a range of emerging and innovative operational strategies is being applied by state and local transportation agencies. These strategies may have different infrastructure requirements, and many times influence and require variances in traditional geometric designs elements. Considering the evolving needs of state and local transportation agencies seeking to develop and deploy Transportation Systems Management and Operations (TSM&O) strategies that will likely affect many traditional agency practices and processes, including traditional design standards, it is understood that a range of steps may be taken assist them, including:

- Identification of a range of agency processes that may be needed to optimize transportation operations, and to allow operational improvements to be implemented more effectively, compete on equal footing with traditional capital improvement projects, and be better understood by agency personnel.
- Identification of operational strategies and associated elements that should be considered “standard” capabilities of the highway system.
- The integration of operational strategies, geometric attributes, and analysis techniques to consider new approaches in determining highway design criteria and system elements.
- Consideration of how these efforts could be served by the development of an AASHTO Operations Guide.

1.2 DEVELOPMENT METHODOLOGY

The methodology used to develop this plan placed significant emphasis on engagement of operations professionals to help identify what is necessary for inclusion in the Operations Guide and the proper delivery methods. To accomplish this, a variety of activities were initiated to maximize engagement of operations professionals including:

- Comprehensive Literature Review – Focused on review of state and local transportation agencies' policies and guidance as it relates to design standards for emerging operational approaches and transportation infrastructure uses. This included operational programs and operational needs from state and local transportation agencies. This effort helped to determine the applicability of these resources for the Operations Guide.

- Operations Staff Workshop – Designed to gather input from operations professionals on what the Operations Guide should cover, what needs they have for the Operations Guide, and what research is required to develop it. This workshop was conducted as part of the 2016 Joint Annual Meeting of the AASHTO Subcommittee on Transportation Management and Operations (STSMO), and the Transportation Research Board Regional Transportation Systems Operations (RTSMO) August 1-5, 2016 in Denver, Colorado.
- Telephone Interviews – Focused on engaging operations professionals who have successfully implemented operational strategies and approaches that considered non-traditional approaches to infrastructure. Telephone interviews were conducted in early fall 2016.
- Webinar – Designed to engage operations staff members who were unable to attend the workshop at the AASHTO STSMO Annual Meeting. This interactive webinar allowed participants to provide feedback on what should be included in the Operations Guide.

1.3 PURPOSE AND OBJECTIVES FOR DEVELOPING AN OPERATIONS GUIDE

It is important to note that successful TSM&O programs and strategies are enabled through a multi-disciplinary approach. Accordingly, ongoing efforts to advance TSM&O efforts are spread across multiple programs and offices within the United States Department of Transportation (US DOT). To maximize the effectiveness of the Operations Guide, it will be critical that the technical development efforts conducted through NCHRP Project 03-126 and future development efforts are communicated and coordinated with various offices, as well as other ongoing national research activities.

1.4 INTENDED AUDIENCES FOR THE GUIDE

The intended audience of the Operations Guide encompasses individuals who should be involved in the lifecycle of any operations initiative including planning, conceptual design, final design, development, implementation, operations, and maintenance. Further, the Operations Guide is designed to be used by a number of disciplines in various levels of an organization including staff level, management, and leadership.

1.5 OPERATIONS GUIDE DEVELOPMENT PLAN SUMMARY

The plan for developing the Operations Guide is structured around four program areas: Program Management, Initial Version of the Operations Guide Development, Future Technical Development, and Communications Plan and Media Development, all described below.

Program Area 1 – Program Management

Program management activities conducted during the development and update of the Operations Guide focus on engagement of the TSM&O community, and execution and coordination of other technical development activities critical to the Operations Guide’s successful delivery. A key component of these activities is collaboration with efforts to update *A Policy on Geometric*

Design of Highways and Streets. This also includes engaging a contractor to research and develop approaches for communicating the information contained in the Operations Guide.

Program Area 2 – Initial Version of the Operations Guide Development

The technical development activities needed to draft the Operations Guide focus on creating the initial set of technical and institutional related materials for the Operations Guide. These development activities include an assessment of the trends that will help to guide the future development of new materials, and updates of previously developed Operations Guide materials.

Program Area 3 – Future Technical Development

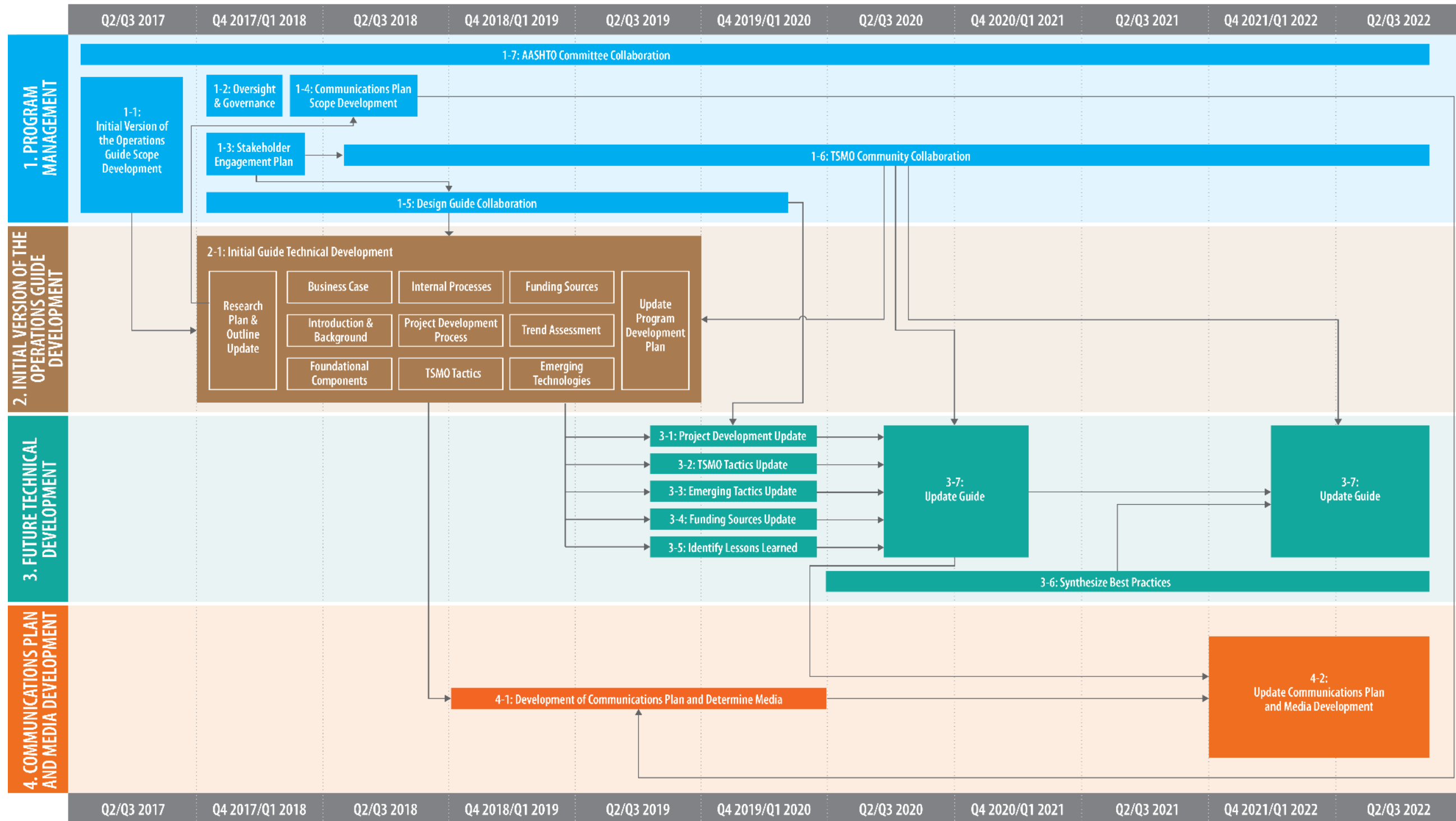
Future technical development activities are those that fall outside the scope of the development of the initial version of the Guide. This could be due to current funding availability, or because they involve rapidly emerging approaches that will generate useful materials for the user community in the near future.

Program Area 4 – Communications Plan and Media Development

Effective communication strategies are critical to engage the broad range of Operations Guide users. This program area will be used to plan, develop, and implement communications strategies for the materials developed in both Program Area 2 (Initial Version of the Operations Guide Development, and Program Area 3 (Future Technical Development).

Figure 1 provides an illustration of the timing, dependencies, and relationships of the projects and tasks detailed in this plan.

Figure 1 Roadmap for Developing Operations Guide



2 PROGRAM AREA 1 – PROGRAM MANAGEMENT

2.1 PROGRAM AREA DESCRIPTION

The development and sustainment of the Operations Guide requires a number of programmatic activities to ensure the successful delivery of the Guide’s initial version, the communications plan and media development, and future Guide updates and development activities. These activities include planning, executing, controlling, and engaging a range of stakeholders who are critical to the success of the Operations Guide.

2.2 PROGRAM AREA OBJECTIVE

The objective of this program area is to conduct a range of program management activities that are critical to the successful delivery of Program Area 2 – Initial Version of the Operations Guide Technical Development, Program Area 3 – Future Technical Development, and Program Area 4 – Communications Plan and Media Development.

2.3 PROJECTS

2.3.1 PROJECT 1-1: INITIAL VERSION OF THE OPERATIONS GUIDE SCOPE DEVELOPMENT

Revisit Project 20-07(392) recommendations and roadmap and formulate a workplan sufficient to achieve a first “draft” of the Guide, i.e. a critical mass of initial projects is complete and the results reflected in preparation of the first draft. The project panel will undertake this effort.

2.3.2 PROJECT 1-2: OVERSIGHT AND GOVERNANCE

This project will define the structure for managing the research activities needed to develop, update, and sustain the Guide; compiling and publishing the Guide; determining the appropriate juncture for convening this oversight group; and leveraging participants as champions for the Guide’s adoption and dissemination. This project will also establish methodology and responsibility for maintaining and updating the Guide (not 03-126) on a permanent basis. Funding alternatives will also be identified and recommended as part of this project. The oversight group should have key input on the following:

- Determining and recommending a process for state adoption (using input from this activity’s research into successful adoption models).
- Conducting coordination with parallel efforts such as update to the Green Book.
- Determining the process for making and issuing Guide updates.

2.3.3 PROJECT 1-3: STAKEHOLDER ENGAGEMENT

In conjunction with the governing body, develop a stakeholder engagement plan that covers 03-126 technical development efforts, future technical development efforts of the Guide, and longer-term upkeep and updates. Stakeholder engagement should be the responsibility of the oversight group, but may ultimately be delegated to a national association. Responsibilities include championing the application of the Guide (defining and reaching key targets like design staff, i.e.

who are the audiences and why), dissemination, soliciting feedback, capturing issues that would keep it current. Engagement to executive audiences who will also serve as conduits for championship and adoption should take place, including determining what aspects of the Guide is suitable for them.

2.3.4 PROJECT 1-4: COMMUNICATIONS PLAN SCOPE DEVELOPMENT

Research and develop a Guide presentation plan that includes format/media, as well as how users navigate/apply the Guide in practice (Green Book update is addressing this), and branding.

- Research/recommend format for the Guide including the specific media, availability (e.g. traditional text, web-based, multimedia).
- Research/recommend a brand strategy addressing, i.e. purpose, look and feel (style), logos, tagline/key phrases, communication (see Project 1-3 stakeholder engagement).

The communications plan scope should be developed by the panel who will oversee development of the communications plan.

2.3.5 PROJECT 1-5: A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS COLLABORATION

Effort to coordinate with development of updated Policy on Geometric Design of Highways and Streets (the Green Book) and other design guidance. This effort will start with the initial development of the Guide, but must continue at least through the first update of the Guide and the completion of the updated Green Book.

2.3.6 PROJECT 1-6: TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS COMMUNITY COLLABORATION

Sustained collaboration with the transportation operations community is a key factor in the successful development of the initial version of the Guide, the communications plan and media development, and future Guide updates and development activities. The sustained engagement of the operations community will help ensure that products developed as part of the various program areas meet the needs of intended users of the Operations Guide. Groups in the operations community that will be collaborated with include (but are not limited to) the following:

- National Operations Center of Excellence (NOCoe)
- Institute of Transportation Engineers (ITE) Transportation Systems Management & Operations (TSM&O) Council
- Transportation Research Board (TRB) Committees

2.3.7 PROJECT 1-7: AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS COMMITTEE COLLABORATION

Throughout the development and subsequent updates of the Operations Guide, close collaboration with AASHTO committees and subcommittees will be crucial. Input from many

ASSHTO committees will help the Guide reflect the needs of a broad set of stakeholders. The collaboration will also allow concepts from the Operations Guide to be considered for inclusion in the other committees' work products. Initial collaboration has occurred with the following committees:

- Subcommittee on Safety Management
- Subcommittee on Design
- Standing Committee on the Environment

Collaboration will be needed with additional committees, such as the Subcommittee on Traffic Engineering and the Standing Committee on Performance Management. Part of this project will be to determine the committees that should be included in collaboration efforts. Specific types and frequency of collaboration will vary by committee and the activities they have underway. For example, relatively frequent collaboration (perhaps once a quarter) will be needed with the Subcommittee on Design while they are updating "A Policy on Geometric Design of Highways and Streets" (the Green Book). This project should also identify the methods and frequency of collaboration with each committee identified.

2.4 PROGRAM AREA 1 DELIVERABLES

Program Area 1 deliverables are:

- Final Scope for the Initial Development of the Guide
- Oversight and Governance Structure
- Stakeholder Engagement Plan
- Communications Plan Scope

3 PROGRAM AREA 2 – INITIAL VERSION OF THE OPERATIONS GUIDE DEVELOPMENT

3.1 PROGRAM AREA DESCRIPTION

This program area consists of a single project to develop the initial set of technical and institutional-related sections for the operations guide. Topics covered in this technical development activity are:

- Background on TSM&O
- Underlying Development Efforts
- Business Case for TSM&O
- TSM&O Foundational Components
- TSM&O Tactics
- Emerging Technologies
- TSM&O Funding Strategies
- Internal Processes to Support Operations
- Incorporating Operational Strategies into the Project Development Process (Process-Oriented)
- Incorporating Operational Strategies into the Project Development Process (Project-Oriented)

Critical to this program area’s success is coordination with Program Area 4 – Communications Plan and Media Development.

The proposed annotated outline for the Guide is included as an Attachment to this document. More detail on each section of the Guide is included in the outline.

3.2 PROGRAM AREA OBJECTIVE

The object of this project is to develop the initial set of technical and institutional-related materials for and the initial version of the Operations Guide.

3.3 PROJECT 2-1 – INITIAL GUIDE TECHNICAL DEVELOPMENT

Detailed below are tasks for Project 2 – 1: Initial Guide Technical Development.

3.3.1 RESEARCH PLAN AND OUTLINE UPDATE

To ensure that the Operations Guide always meets user needs, it is important that the initial outline is reviewed and updated as necessary. This review process will be initiated after the oversight group has been established to ensure that their input is included in technical development activities in the future. In addition, as technical development activities for the initial version of the Guide are completed, it will also be necessary to review this Development Plan and update it accordingly.

3.3.2 TSM&O BUSINESS CASE

Although many transportation agencies embrace the need for TSM&O, there continues to be a need to articulate the business case for establishing, expanding, and sustaining a TSM&O function and program. Competition for limited transportation funds will continue, and operations staff will need to articulate their case for a strong operations focus and investment. The Operations Guide will include a section on the need for developing a business case and guidance in developing it. This section will incorporate lessons learned from lead agencies in developing operations programs and research and guidance documents that cover TSM&O business cases and business case development. Key aspects to be covered in this section include:

- Defining TSM&O.
- Communicating the benefits both to the efficiency of the agency and to the cost effective delivery of services that the agency provides to the public.
- Linking operations programs to missions of transportation agencies.
- Linking operations programs to customer expectations.

3.3.3 INTRODUCTION AND BACKGROUND

This task develops the introduction and background sections of the initial version of the Operations Guide. This section will define scope of the Guide and TSM&O programs, and provide a description of how operations programs (and the emphasis on them) evolved. It should also describe some of the foundational projects and research that led to the evolution of and emphasis on operations programs. It should also set the context of the Guide to focus on multimodal network management and performance optimization. The importance of high quality data and analytical methods to support performance-oriented decisions will be described.

3.3.4 FOUNDATIONAL COMPONENTS

Detailed descriptions of TSM&O foundational components will be developed as part of this task. Foundational components support a range of operational strategies; they enable the expansion of operational capabilities and regional coverage. Foundational components include:

- Operational Performance Monitoring – Information and data that are necessary for robust performance monitoring, the data analytics, and information management systems that support decision-making. This includes activities at a Transportation Management Center (TMC), system monitoring, and traveler information dissemination.
- Managing Recurring Situations – Including freeway management, arterial management and traffic signal operations, and non-motorized strategies for pedestrian and bicycle mobility and safety.
- Managing Non-Recurring Situations – Including Traffic Incident Management, Road Weather Management, Planned Special Event Management, and Work Zone Management.

3.3.5 TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS TACTICS

This task will be used to develop detailed summaries of TSM&O tactics. Tactics will be described in these terms:

- General overview
- Operational strategies
- Demonstrated benefits
- Example deployments
- Supporting resources for Operations Guide users

Tactic summaries developed under this task will be described in three categories: Fundamental, Active and Advanced, and Emerging. (Because there is not as much experience with emerging tactics and they are evolving rapidly, they will be included in a separate project and organized differently from the rest of the tactic summaries.)

Tactics described will include:

Fundamental Tactics

- Traffic Signal Systems
- Ramp Metering
- Traffic Incident Management
- Road Weather Management
- Planned Special Event Management
- Work Zone Management
- Transit Strategies
- Freight Operations

Active and Advanced Tactics

- Active Traffic Management (ATM)
- Integrated Corridor Management (ICM)
- Managed Lanes
- Active Demand Management (ADM)
- Active Parking Management
- Pedestrian and Bicycle Strategies

It is important to note that because of the evolutionary nature of TSM&O tactics, they will have to be updated as part of Program Area 3 – Future Technical Development Activities.

3.3.6 EMERGING TECHNOLOGIES

Technologies that support a range of TSM&O strategies continually emerge. This task will identify and document emerging technologies. To accomplish this, a comprehensive literature search will be conducted, as well as focused engagement with agencies that have implemented (or will do so soon) the identified technologies. Documentation of the emerging technologies will include (but is not be limited to) the following:

- Operational strategies the technologies enable
- Demonstrated benefits of technology deployments
- Examples of deployments

3.3.7 FUNDING SOURCES

Securing adequate funding is critical to the ongoing success of TSM&O programs. Funding is required for TSM&O-related activities including (but not limited to) capital improvements, systems maintenance and operations, promotion of services, and staffing. This task will examine funding sources that may be used to support TSM&O activities. Recent funding sources will be identified as examples, but it is important to guide the reader toward resources and processes for identifying project-specific or tactic-specific federal funding sources at the time of planning, design, or implementation. Examples of federal funding that could be described include:

- Infrastructure for Rebuilding America (INFRA) grant program
- Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant program
- Surface Transportation System Funding Alternatives (STSFA) grant program

This task will also examine and document innovative approaches local and regional jurisdictions have used to raise funds to support TSM&O activities through approaches that include local taxation and regional toll revenue.

3.3.8 INTERNAL PROCESSES

This task provides an overview of organizational, institutional, and business process capabilities that are necessary to implement and manage an effective operations program and the reasons they are important. It will summarize the application of the capability maturity model to improving TSM&O effectiveness and the existing CMM and CMF resources available through FHWA and AASHTO. Critical and emerging issues will be identified and described, including:

- TSM&O program planning
- Integration of TSM&O into project development processes
- Integration of systems engineering principles in agency processes
- Data, data management, and data analytics
- Workforce development
- Performance management

Traditional operations-related processes should also be covered. These include such activities as:

- Traffic Operations Programs
- Traffic Operations/ITS Strategic Plans
- Planning, developing, and implementing operational strategies, not part of capital projects

To derive and document this information, operating agencies and regional authorities that have employed various processes for facilitating the planning, implementation and operations of TSM&O strategies will be engaged.

3.3.9 PROJECT DEVELOPMENT PROCESS

The initial version of the Operations Guide will concentrate on concepts and examples; it will describe the importance of defining project purpose and need in operational terms, and how operational strategies can help address these purposes and needs. Operational strategies must be incorporated in project scoping, geometric design decisions, safety and mobility analyses, construction phasing, and many more aspects of project development. This includes situations where stand-alone TSM&O alternatives are being considered to improve operations, and when TSM&O is an element within traditional infrastructure project.

This task will identify and document standard operational strategies that should be considered as part of any capital project. This process will entail engaging a number of operating agencies that have adopted standard TSM&O strategies that are included in any capital project and referencing their design guidance. Agencies that will be engaged as part of this process will be identified through collaboration with the National Operations Center of Excellence (NOCoE), Institute of Transportation Engineers (ITE) TSM&O Council, and various Transportation Research Board (TRB) Committees. A comprehensive literature search will also be conducted to identify additional agencies not identified through collaboration with the various committees.

3.3.10 TREND ASSESSMENT

This task will be used to identify and document trends that are impacting the development, implementation, and operation of TSM&O strategies. As an example, in the coming years connected and automated vehicles will increasingly impact TSM&O strategies. Trends will be identified through collaboration with the NOCoE, ITE TSM&O Council, and various TRB Committees. A comprehensive literature search will also be employed to identify trends.

3.3.11 UPDATE PROGRAM DEVELOPMENT PLAN

This task will update the Operations Guide Development Plan. This will help guide development activities not covered in Program Area 2 – Initial Version of the Operations Guide Development. This task is necessary to identify how different early adopter agencies are incorporating TSM&O activities into their processes, highlighting those that focus on operational performance. This task will also include a synthesis of how agencies are making operational strategies and tactics mandatory elements of capital projects.

3.4 PROGRAM AREA 2 DELIVERABLES

Deliverables for this project are:

- Initial set of technical and institutional related materials for the Operations Guide
- Initial version of the Operations Guide
- Updated Project Development Plan

4 PROGRAM AREA 3 – FUTURE TECHNICAL DEVELOPMENT

4.1 PROGRAM AREA DESCRIPTION

The development of a complete and comprehensive Operations Guide exceeds the planned scope and budget for the initial Operations Guide development project. The need to conduct additional technical development outside the scope of the initial version is necessitated by a range of factors that include:

- The range of technologies and strategies that support TSM&O strategies continue to evolve. Ongoing deployments of such technologies provide an opportunity to derive lessons learned and best practices that are of continuing value to the TSM&O community.
- Federal funding opportunities and local funding strategies will continue to evolve over time.
- The range of topics and comprehensive nature of the Operations Guide exceed the budget planned for the initial version of the Operations Guide project.

4.2 PROGRAM AREA OBJECTIVES

The objective of this program area is to develop additional technical and institutional-related materials for the Operations Guide that fall outside the scope of the initial Operations Guide project.

4.3 PROJECTS

Detailed below are technical development activities for Program Area 3 – Future Technical Development. Some projects listed below could be combined, depending upon funding opportunities and the desires of future project panels, or undertaken individually.

4.3.1 PROJECT 3-1: PROJECT DEVELOPMENT UPDATE

As more agencies integrate TSM&O into their project development process and as philosophy and technology evolve, additional knowledge will be gained about how to most effectively incorporate operations-oriented projects, and decision-making in their project development processes. These factors will necessitate additions or updates to the Operations Guide sections on project development. New lessons learned will lead to best practices and best practices will lead to more institutionalization of those practices. This project will synthesize best practices and lessons learned into updated guidance on incorporating operations in project development processes. An initial literature review should be undertaken as part of this process. It will also be important to survey operating agencies and interview agency leaders responsible for integrating operations into project development.

4.3.2 PROJECT 3-2: TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS TACTICS UPDATE

TSM&O tactics will continue to evolve. This effort will focus on updating TSM&O tactics that were defined as part of development of the initial Guide. At a minimum, the tactics will include:

- Active Traffic Management (ATM)
- Integrated Corridor Management (ICM)
- Traffic Signal Systems
- Freight Operations
- Managed Lanes
- Ramp Metering
- Traffic Incident Management
- Road Weather Management
- Planned Special Events
- Work Zone Management
- Active Demand Management
- Active Parking Management
- Pedestrian and Bicycle Strategies
- Transit Strategies

TSM&O Strategies will be defined in terms of the following:

- Functional overview
- Demonstrated benefits
- Examples of strategies
- References for additional information

4.3.3 PROJECT 3-3: EMERGING TACTICS UPDATE

Processes, methods, and technologies that form the basis of a TSM&O program will continue to rapidly evolve. Accordingly, it will be necessary to update materials in the initial Guide with current technological and process development information. A comprehensive literature review and technology scan will be conducted to procure this information; it is likely that information will also be derived from interviews with technology deployers and operations program managers. Emerging tactics will be defined in terms of the following:

- Operational strategies the tactics enable
- Demonstrated benefits of technology deployments and changes in processes
- Examples of deployments and processes
- Available resources

4.3.4 PROJECT 3-4: FUNDING SOURCES UPDATE

Securing adequate funding is critical to development and sustainment of TSM&O programs. This task will update federal funding sources that may be used to support TSM&O activities; it will also provide updates on how federal funding sources have been used to support TSM&O implementation. These programs include (but are not limited to) the following:

- Infrastructure for Rebuilding America (INFRA) grant program.
- Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant program.
- Surface Transportation System Funding Alternatives (STSFA) grant program.

This task will also update innovative approaches local and regional jurisdictions have used to raise funds to support TSM&O activities through approaches that include local taxation and regional toll revenue.

4.3.5 PROJECT 3-5: IDENTIFY LESSONS LEARNED

This task will research and document lessons learned by operating agencies and regional authorities that have planned, developed, implemented, and are operating a range of TSM&O tactics. Agencies and regional authorities that will serve as a focal point of this research will be identified through collaboration with the steering committee, and through a comprehensive literature search. Interviews with program leaders will also be included.

4.3.6 PROJECT 3-6: SYNTHESIZE BEST PRACTICES

This task will research and document best practices experienced by operating agencies and regional authorities that have planned, developed, implemented, and are operating a range of TSM&O tactics. Agencies and regional authorities that will serve as a focal point of this research will be identified through collaboration with the steering committee, and through a comprehensive literature search.

4.3.7 PROJECT 3-7: UPDATE GUIDE

This task will consist of periodically updating the Guide (or sections of the Guide) as research is completed.

4.4 PROGRAM AREA 3 DELIVERABLES

Program Area 3 deliverables are:

- Research reports on revised or updated project development processes
- Research and synthesis reports on updated emerging tactics
- Funding source update
- Synthesis of lessons learned
- Research to identify best practices
- Periodic update of Guide as new material is developed

5 PROGRAM AREA 4 – COMMUNICATIONS PLAN AND MEDIA DEVELOPMENT

5.1 PROGRAM AREA DESCRIPTION

This program area consists of two projects to develop a communications plan for delivering the Guide materials developed as part of its initial version, and then update that plan as needed considering future technology development activities. This program area also includes developing initial communications strategies and methods.

5.2 PROGRAM AREA OBJECTIVES

The program area objective is to plan, develop, and implement communications strategies and methods for the materials developed, as part of the development of initial version of the Operations Guide and subsequently updated under Program Area 3.

5.3 PROJECTS

Detailed below are development activities for Program Area 4 – Communications Plan and Media Development. Some of the projects could be combined depending upon funding opportunities and the desires of future project panels, or undertaken individually.

5.3.1 PROJECT 4-1: DEVELOPMENT OF COMMUNICATIONS PLAN AND DETERMINE MEDIA

The communications plan will encompass the goals, objectives, and tools for all strategies and methods of communicating, including (but not limited to) a website and print materials. The communications plan will describe at a minimum:

- Ways in which the communications goals and objectives can reasonably be accomplished.
- The target audiences for the various communications strategies.
- How the objectives will be achieved, including communication approaches and a timetable for achieving them.
- How the communications strategies will be assessed to ensure that goals and objectives are being achieved.

Critical to the communications plan's success is collaboration with the development of materials conducted during the development of the Guide's initial version.

5.3.2 PROJECT 4-2: UPDATE COMMUNICATIONS PLAN AND MEDIA DEVELOPMENT

Under this project, the communications plan will be updated to reflect new information developed under Program Area 3.

5.4 PROGRAM AREA 4 DELIVERABLES

Program Area 4 deliverables are:

- Operations Guide Communications Plan
- Update to the Communications Plan

ATTACHMENT A – TRANSPORTATION OPERATIONS GUIDE ANNOTATED OUTLINE

A. CHAPTER 1 - INTRODUCTION

1. Background on Transportation System Management and Operations (TSM&O)

- a) What is TSM&O?
- b) TSM&O is a paradigm shift for agencies, required of them to become operations-focused organizations.
 - Focus on multimodal network management and performance optimization.
 - The need for high quality data and analysis methods to support operations performance-oriented decisions.
 - The programmatic and tactical strategies described in this Guide are intended to further this operational focus and network performance optimization.
- c) There are some typical components and operations strategies that provide a foundation for operational focus and network optimization.
- d) Purpose of this Operations Guide

2. Supporting TSM&O Efforts

Describe the structure and framework that has been developed that agencies can use to support their TSM&O efforts. These include information on TSM&O programs and components, strategic and program planning, supporting infrastructure, and the need to integrate TSM&O efforts with other agency programs and processes.

- a) SHRP2 Reliability
 - Describe the role of SHRP 2 products in TSM&O, including Capability Maturity Model (CMM) applications, Reliability Data and Analysis Tools.
- b) Capability Maturity Frameworks (CMFs)
- c) Planning for Operations
- d) TSM&O Program Planning
- e) Managing Performance (Transportation Performance Management)
- f) Emerging Concepts Supporting TSM&O, Including Smart Communities, Connected Corridors, and Connected and Automated Vehicles

3. Business Case for TSM&O

A TSM&O business case articulates the purpose and benefits for making investments in TSM&O capabilities and strategies to a variety of audiences, both internal and

external to an agency. The section defines a TSM&O business case in the context of the structure and framework described in section B, explains its importance, identifies typical components, and identifies audiences and how to tailor the business case to each. Makes reference to recommended or typical persuasive qualitative and quantitative material and sources. These include the ITS JPO Cost and Benefits Database, future reference to FHWA “Making the business case for institutional/organizational/process changes for TSM&O,” and further development of the FHWA TSM&O strategy Capability Maturity Frameworks that includes identification of value/benefit for improving TSM&O capabilities.

4. Need for the Guide

5. Relationship to Other Resources

- a) AASHTO Green Book Update
- b) Other Guidance and “Toolboxes”
 - Refer to documents and types of documents that readers can access for additional information. Includes guidance documents, case studies, training, outreach material, and tools.
- c) National Operations Center of Excellence
- d) Other Organizations and Resources
 - Reliability Data and Analysis Tools
 - Transportation Performance Management Framework

6. Organization of the Guide

- a) Include Incremental Approach to its Development
- b) Cross-cutting and Synergistic Aspects to Guide Topics
- c) Audiences and Ways to Navigate the Guide

1 PART 1 - TSM&O PROGRAM

A. CHAPTER 2 - TSM&O DESCRIPTION

This chapter will describe what TSM&O is in more depth at the programmatic level. It will include discussion and definition of the following at a minimum, but will provides a fuller picture of TSM&O than can be provided in the Introduction.

1. What is a TSM&O program?

2. TSM&O Program and Strategic Plans

Include a discussion of how agency specific plans can integrate with regional TSM&O planning efforts.

3. Operational strategies, including ITS and traffic management

4. Performance monitoring

B. CHAPTER 3 - TSM&O FOUNDATIONAL COMPONENTS

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

Essential TSM&O activities for agencies to justify using and successfully apply guidance in this document. Answers the question, Why are foundational components necessary?

- Supports traditional and innovative operational strategies that support and enhance the ability of agencies to better manage the performance of the transportation network.
- Enables the expansion of operational capabilities and regional coverage.

1. Operational Performance Monitoring

- a) Description of operational performance monitoring. Includes data that is necessary for robust performance monitoring, the data analytics and information, and information management systems that support decision-making, such as:
 - System operations management
 - Traveler (passenger and freight) information and reaction
 - Maintenance and asset management
 - Infrastructure systems planning and management
- b) The Transportation Management Center (TMC) is an important component of transportation management. Functions of the TMC include:
 - Video surveillance of roadway network.
 - Collection and processing of data.
 - Fusion of data with other operational and control data.
 - Dissemination of information to travelers, regional partners, and the media.
 - Identification, implementation, and control of operational strategies.
- c) System Monitoring - Collecting information needed to perform a range of transportation network management functions:
 - Measuring traffic flow and environmental conditions.
 - Formulating control decisions.

- Disseminating traveler information.
 - Monitoring and evaluating system performance.
 - Supporting other transportation management and operations functions such as incident detection and verification, planned special event and emergency management, ramp management, and transportation planning.
- d) Traveler Information Dissemination - Use of a range of strategies and technologies to disseminate information relating to a range of operational conditions including:
- Congestion
 - Traffic incidents
 - Work zones
 - Road closures
 - Transit service changes

2. Managing Recurring Situations – Traffic Management

- a) Freeway Management
- b) Arterial Management/traffic signal systems
- c) Non-motorized - strategies to provide enhanced pedestrian and bicycle mobility and safety

3. Managing Non-recurring Situations

- a) Traffic Incident Management - Planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible.¹
- b) Road Weather Management - Predict weather changes, identify threats to the highway system, and proactively respond with operational strategies.
- c) Planned Special Event Management - Planning for and managing a public activity with a scheduled time, location, and duration that may affect the normal operation of the surface transportation system due to increased travel demand and/or reduced capacity attributed to event staging.
- d) Work Zone Management - Minimize traffic delays, maintain motorist and worker safety, completing roadwork in a timely manner, and maintain access for businesses and residents.

C. CHAPTER 4 - INTERNAL PROCESSES TO SUPPORT OPERATIONS (CAPABILITIES, NOT TECHNICAL EXPERTISE)

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

Primarily based on CMM concepts, guidance, and tools (e.g. TSM&O program planning, systems engineering, performance measurement).

1. Provides an overview of what organizational, institutional, and business process capabilities are necessary to conduct effective TSM&O, and why they are important. Summarizes the application of the capability maturity model to improving TSM&O effectiveness and the existing CMM and CMF resources available through FHWA and AASHTO.

- a) CMM digest packaged as determined
 - Summary of CMM dimensions, levels, evaluation tools, and guidance as determined through 03-126. Minimum reference to AASHTO TSM&O

¹ http://ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm

Guidance website, FHWA Capability Maturity Frameworks (Road Weather Management, Planned Special Event management, Traffic Incident Management, Traffic Management, Traffic Signal Management, Work Zone Management), and Office of Operations-supported facilitated workshops and Implementation Plan development. Inclusion of appropriate reference to the Highway Safety Manual.

b) Functional mapping of TSM&O in “old-style” versus “operations-oriented” DOTs explaining how TSM&O can permeate an agency

- Illustration of and rationale for agency transformation from a highway capital project oriented agency (construction and maintenance) to one that places emphasis on operations (priority on making maximum use of existing capacity and addressing operational issues). Note ways to overcome silos and include disciplines on projects that do not normally engage on operational improvements. Consider annotated examples of agency organizational charts and examples of operations-oriented reorganizations.

c) Critical and emerging issues

Highlights the most critical and evolving internal processes to support operations.

- TSM&O program planning
 - Definition, purpose, summary of existing research and guidance (NCHRP 20-07, Tasks 345 and 365, forthcoming FHWA primer/guidance), example agency program plans (need, application, and variation in approach/content).
- Integration of TSM&O into project development process
 - Process- and project-oriented methods for systematic consideration of TSM&O in agency project development.
- Systems engineering
 - Need and application to the project development process.
- Data and data management functions
 - Emerging issues with data and its application to operations (use in decision-making, CV, privacy, security, acquisition – collect versus buy).
- Workforce development
 - Relationship between demands of conducting successful operations and the workforce to support it (higher education, career tracks, training). NOCoE Workforce Summit and NCHRP 20-07/408 Transportation System Management and Operations (TSMO) Workforce: Skills, Positions, Recruitment, Retention, and Career Development work.

- Include alternative ways to provide workforce, including employees, contracting out for services, and ways to leverage private sector capabilities.
- Performance measurement
 - Use to determine effectiveness of TSM&O activities, federal requirements summary, and example levels of application depending on agency context.
- d) Agency examples of CMM applications and outcomes
 - Highlights of best practices illustrating the use of CMM and internal process improvement to improve TSM&O programs, foundational components, and technical strategies. Draw from SHRP2 Implementation/FHWA Organizing for Reliability support, CMM Dimension white papers, and other available CMM and CMF Implementation Plans, new outcomes from continued dissemination of tools and new products.

D. CHAPTER 5 - INCORPORATING OPERATIONAL STRATEGIES INTO THE PROJECT DEVELOPMENT PROCESS (PROCESS ORIENTED)

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. **Definition of project purpose and need and consideration of how operational strategies help achieve them (practical design). This section will include a discussion of the direction being pursued by the new updates to the Green Book. It will discuss the importance of determining “standardized” approaches that incorporate mitigation of potential negative impacts, instead of the need to go through a “deviation” approval process.**
 - a) Example TSM&O project goals with focus on mobility and safety. This sets the stage for needs that might be addressed in a practical design approach.
 - b) Best/effective practice on applying practical design to operational solutions.
 - Cost effective approach that should align with operational objectives and strategies.
 - c) Adoption of applying practical design to operational solutions as a formal business process.
2. **Incorporation of operational strategies into the project development process (e.g. project scoping, geometric design decisions, safety and operational analyses, construction phasing decisions).**
 - a) Making the business case for TSM&O infrastructure needs.
 - Using cost and benefits information to justify TSM&O solution applications.

- National lessons learned, best practices, ITS JPO database and TOPS-BC.
- b) How safety and mobility analysis outcomes can suggest application of TSM&O strategies.
 - TSM&O strategies primarily are geared toward safety and mobility.
 - Example TSM&O strategies that support safety and mobility.
 - c) Procurement vehicle options to support operational functions (e.g. SSP, TMC, ITS maintenance).
 - d) Implications of procurement strategies for TSM&O (including P3 and outsourcing).

E. CHAPTER 6 - INCORPORATING OPERATIONAL STRATEGIES INTO THE PROJECT DEVELOPMENT PROCESS (PROJECT ORIENTED)

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. Standard Strategies Supporting Operations that Should be Considered for Inclusion in Capital Projects (detection, surveillance, etc.)

- a) Identification of standard strategies by criteria.
- b) Deployment context (e.g. urban vs. rural, existing TSM&O system/capabilities).
- c) Agency performance objectives alignment.

2. Typical Designs for Operational Features and Strategies (organized by asset class or operational strategy)

- a) Design guidance as determined.

3. Refer to SHRP2 L07 “Design Guide for Addressing Nonrecurrent Congestion”

F. CHAPTER 7 - TSM&O FUNDING SOURCE OVERVIEW

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. Dedicated Local Funding

- a) Portland, OR
- b) Maricopa County Association of Governments
- c) San Diego Association of Governments
- d) North Central Texas Council of Governments

2. Federal Funding Sources. Federal funding for transportation has been an important catalyst for improving the transportation network and its performance. The specific federal programs will evolve over time. It is important for agencies to leverage their efforts with federal support and Federal funding to further multi-modal network management and performance optimization. Examples of federal funding opportunities are shown below to provide context.

- a) Congestion Mitigation and Air Quality Improvement (CMAQ) - The FAST Act continues the CMAQ program and provides \$9.663B for FY 2017-2020.
- b) Highway Safety Improvement Program (HSIP) – The FAST Act continues the HSIP program and provides \$9.36B for FY 2017-2020.
- c) National Highway Performance Program (NHPP) – The FAST Act continues the NHPP program and provides \$94.067B for FY 2017-2020.
- d) Surface Transportation Program (STP) – The FAST Act continues the STP program and provides \$47.105B for FY 2017-2020.
- e) The Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD) provides \$67.5M in FY 2017-2020 for cutting-edge transportation technologies that help reduce congestion and improve safety.²
- f) Infrastructure for Rebuilding America (INFRA) Grants provide approximately \$1.5 billion available to projects to help rebuild infrastructure.³
- g) FTA Program & Bicycle Related Funding Opportunities
 - Metropolitan & Statewide and Nonmetropolitan Transportation Planning - Eligible bicycle activities include planning for bicycle facilities in a state or metropolitan transportation network.

² <https://www.fhwa.dot.gov/fastact/factsheets/technologyinnovationfs.cfm>

³ <https://www.transportation.gov/buildamerica/infragrants>

- [Urbanized Area Formula Program](#) - Eligible activities include bicycle routes to transit, bike racks, shelters and equipment for public transportation vehicles
- [Fixed Guideway Capital Investment Grants](#) - Eligible activities include bicycle racks, shelters and equipment
- [Bus and Bus Facilities Formula Grants](#) - Eligible activities include bicycle routes to transit, bike racks, shelters and equipment for public transportation vehicles

2 TACTICAL LAYER

Define TSM&O tactics and provide descriptions

A. CHAPTER 8 - FUNDAMENTAL TACTICS

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. Traffic Signal Systems – Traffic Signal Management involves organizing for the planning, maintenance, design, and operation of signalized intersections and traffic signal systems.

Demonstrated Benefits	Examples	References
Reduced Environmental impacts	Weather-responsive traffic signal control system, Ogden, UT	http://ops.fhwa.dot.gov/publications/fhwahop15038/index.htm
Reduced Delay	Advanced traffic signal controllers and an adaptive decision support system, New York, NY	http://ops.fhwa.dot.gov/publications/fhwahop11027/index.htm
Reduced Fuel Consumption	Adaptive traffic signal controllers, Gresham, OR	http://ops.fhwa.dot.gov/publications/fhwahop09055/index.htm

2. Ramp Management and Control – This includes ramp metering, ramp closure, special use ramps, and ramp terminal treatments. The primary focus is on ramp metering, which is comprised of traffic signals installed on freeway on-ramps to control the frequency at which vehicles enter the flow of traffic on the freeway.

Demonstrated Benefits	Examples	References
Traffic Speed Increase	Seattle, WA	http://ops.fhwa.dot.gov/freewaymgmt/ramp_metering/index.htm
Travel Time Reduction	Denver, CO	http://ops.fhwa.dot.gov/freewaymgmt/ramp_mgmt.htm
Collision Reduction	Minneapolis/St. Paul, MN	http://ops.fhwa.dot.gov/publications/ramp_mgmt_handbook/manual/manual/pdf/rm_handbook.pdf
Emissions Reduction ⁴	Portland, OR	

⁴ <http://ops.fhwa.dot.gov/publications/fhwahop14020/sec1.htm>

3. **Traffic Incident Management** – Planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible.⁵

Demonstrated Benefits	Examples	References
Congestion Reduction Economic Savings Fuel Savings Increased Incident Clearance Times Secondary Crash Reduction Increased Responder Safety Reduced Morbidity Rates	Maryland DOT's Coordinated Highways Action Response Team (CHART) The Hudson Valley's Highway Emergency Local Patrol (H.E.L.P) Virginia Department of Transportation Safety Service Patrol (SSP) Washington State Department of Transportation Incident Response Team (IRT)	http://ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm http://timnetwork.org/

⁵ http://ops.fhwa.dot.gov/eto_tim_pse/about/tim.htm

4. **Road Weather Management** – Weather-responsive traffic management (WRTM) strategies that utilize mobile road weather data (using field devices and vehicles) for traveler information, traffic control, and winter maintenance activities.

Operational Strategies	Demonstrated Benefits	Examples	References
<p>Advisory strategies provide information on prevailing and predicted conditions to both transportation managers and motorists. Control strategies alter the state of roadway devices to permit or restrict traffic flow and regulate roadway capacity. Treatment strategies supply resources to roads to minimize or eliminate weather impacts.</p>	<p>Improved safety due to reduced crash risk Increased mobility due to restored capacity, delay reductions, and more uniform traffic flow Increased productivity due to reduced labor, treatment material, and equipment costs</p>	<p>Iowa DOT Salt Use Dashboard Arizona DOT DUST Warning System Texas DOT High Water Detection System Pennsylvania DOT Interstate Restriction System Michigan DOT Statewide Evaluation and Strategy</p>	<p>Best Practices for Road Weather Management, Version 3.0 - http://ops.fhwa.dot.gov/publications/fhwahop12046/fhwahop12046.pdf http://ops.fhwa.dot.gov/weather/index.asp</p>

5. **Planned Special Event Management** – Managing travel for planned special events involves advanced operations planning, stakeholder coordination and partnerships, developing a multi-agency transportation management plan, raising awareness of general public and event patrons of potential travel impacts, and coordinating agency services and resource sharing.⁶

Operational Phases	Demonstrated Benefits	Examples	References
Program Planning Event Operations Planning Implementation Activities Day-of-Event Activities Post-Event Activities	Reduce traffic congestion Improve mobility Improve travel safety Form partnerships and build trust Promote interagency coordination, resource utilization and sharing Incorporate new procedures, plans, and practices into day-to-day agency operations	2009 G20 Summit, Pittsburg, PA 2008 Democratic Convention, Denver, CO	Intelligent Transportation Systems for Planned Special Events: A Cross-Cutting Study - http://ntl.bts.gov/lib/30000/30400/30470/14436.pdf http://ops.fhwa.dot.gov/eto_tim_pse/about/pse.htm National Special Security Events: Transportation Planning for Planned Special Events - http://ops.fhwa.dot.gov/publications/fhwahop11012/fhwahop11012.pdf

⁶ http://www.ops.fhwa.dot.gov/publications/fhwaop04034/fact_sheet.htm

6. **Work Zone Management** – Minimize traffic delays, maintain motorist and worker safety, complete roadwork in a timely manner, and maintain access for businesses and residents.

Operational Strategies	Demonstrated Benefits	Examples	References
Coordinating Road Projects Incident Management Lane Closure Policies Traffic Control Use of ITS Work Zone Speed Management	Reduction in delay Enhanced safety performance of the roadway Diversion of travelers to other facilities during construction	I-70, Indiana – Super 70 Project ⁷ I-70 Blanchette Bridge, Saint Louis, MO ⁸ I-494 MN ⁹	http://www.ops.fhwa.dot.gov/wz/its/ http://ops.fhwa.dot.gov/wz/its/wz_its_benefits_summ/wz_its_benefits_summ.pdf http://www.ops.fhwa.dot.gov/wz/outreach/wz_training/wz_guides_documents.htm

⁷ http://www.ops.fhwa.dot.gov/wz/its/wz_its_benefits_summ/wz_its_benefits_summ.pdf

⁸ <http://www.itsbenefits.its.dot.gov/ITS/benecost.nsf/ID/7D5F387E1F95615A85257DD9004EA3C1?OpenDocument&Query=Home>

⁹ <http://www.itsbenefits.its.dot.gov/ITS/benecost.nsf/ID/E6C4200F4FC77FF885257AB700689894?OpenDocument&Query=Home>

7. Transit Strategies Transit Strategies – Technologies and strategies to provide enhanced transit mobility and safety.

Operational Strategies	Demonstrated Benefits	Examples	References
Transit priority at signalized intersections, including queue jump Transit lanes Transit facilities Bus on shoulder Transit incentives	Reduced demand on congested facilities Better balanced demand across modes More efficient travel Enhanced travel options for the aging, and those with disabilities. Reduced environmental impacts	Bus Rapid Transit – Minneapolis, MN Transit Signal Priority – Staten Island, NY Transit-Oriented Development - Rosslyn-Ballston Corridor – Arlington, VA	https://todresources.org/ https://www.transit.dot.gov/funding/funding-finance-resources/transit-oriented-development/tod-research-publications https://www.transit.dot.gov/research-innovation/research-innovation-reports-and-publications

8. Freight Operations – Technologies deployed to improve freight system efficiency and productivity, increase global connectivity, and enhance freight system security against common threats and terrorism.

Operational Strategies	Demonstrated Benefits	Examples	References
<p>Gateway facilitation - Applications that improve operations at terminals, inspection stations, and border crossings.</p> <p>Driver identification and validation - Intelligent freight technology and process innovations that enhance security and facilitate gate and reception processes.</p> <p>Compliance facilitation - Applications that facilitate both state highway and NAFTA land-border crossing inspections.</p> <p>Weigh-in-Motion – Technological approach that enables calculation of truck weights without stopping on fixed scales.</p> <p>Freight status information - Applications aimed to facilitate the exchange of information about freight shipments among commercial and government stakeholders.</p> <p>Network status information – Applications that provide carriers with information related to the operational conditions of the roadways.</p>	<p>Increased efficiency and productivity</p> <p>Improved reliability of service</p> <p>Improved shipment and service integrity¹⁰</p>	<p>OR</p> <p>WA</p> <p>GA</p>	<p>http://ops.fhwa.dot.gov/freight/about.htm</p>

¹⁰ http://ops.fhwa.dot.gov/freight/intermodal/freight_tech_story/freight_tech_story.htm#gateway

B. CHAPTER 9 - ACTIVE AND ADVANCED TACTICS

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. Active Traffic Management (ATM) – ATM is dynamically managing recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions.

Operational Strategies	Demonstrated Benefits	Examples	References
Part-Time Shoulder Use Adaptive Ramp Metering Adaptive Traffic Signal Control Dynamic Junction Control Contraflow Lane Reversal Dynamic Shoulder Lanes/ Part-Time Shoulder Use Dynamic Speed Limits. Queue Warning. Transit Signal Priority.	Reduced travel times Delay reduction Crash reduction Reduced emissions	I-66 ATM Northern VA Minneapolis Smart Lanes Washington State Smarter Highways I-70 Rolling Speed Harmonization in CO Minneapolis, MN (Bus on Shoulder) US 2 in Washington State (Static Shoulder Use) I-66 in Northern VA (Dynamic Shoulder Use) I-35W in Minneapolis, MN (Dynamic Shoulder Use)	http://ops.fhwa.dot.gov/atdm/approaches/atm.htm http://international.fhwa.dot.gov/pubs/pl07012/ http://utcm.tamu.edu/publications/final_reports/Kuhn_10-01-54_Interim.pdf

2. Integrated Corridor Management (ICM) – ICM optimizes use of available infrastructure by directing travelers to underutilized capacity in a transportation corridor.

Operational Strategies	Demonstrated Benefits	Examples	References
<p>Motorists shifting their trip departure times, routes, or modal choices</p> <p>Dynamically adjusting capacity by changing metering rates at entrance ramps</p> <p>Shifting of trips to alternate modes during the course of the trip</p>	<p>Improved Safety:</p> <p>Reduction in the number and severity of crashes</p> <p>Enhanced Mobility:</p> <p>Improved movement of people and freight</p> <p>Improved Travel Time Reliability:</p> <p>Accuracy and predictability of the public's travel times</p> <p>Reduction in emissions and fuel consumption:</p> <p>Reduction in fuel use and emissions</p>	<p>Dallas, TX</p> <p>San Diego, CA</p>	<p>http://ops.fhwa.dot.gov/program_areas/corridor_traffic_mgmt.htm</p> <p>http://www.its.dot.gov/research_archives/icms/index.htm</p> <p>https://www.transit.dot.gov/research-innovation/integrated-corridor-management-icm</p> <p>http://www.ops.fhwa.dot.gov/publications/fhwahop16035/index.htm</p> <p>http://www.ops.fhwa.dot.gov/publications/fhwahop16036/fhwahop16036.pdf</p>

3. Managed Lanes – Highway facilities or a set of lanes where operational strategies are proactively implemented and managed in response to changing conditions.¹¹

Operational Strategies	Demonstrated Benefits	Examples	References
<p>Pricing — Includes both traditional toll lanes and toll lanes using congestion pricing that is varied during certain time periods in order to manage demand (e.g., peak-period surcharge or off-peak discount):</p> <ul style="list-style-type: none"> • Value Priced Lanes • Toll Lanes <p>Vehicle eligibility — Lanes are managed by allowing certain vehicles or restricting others; minimum occupancy is an example of an eligibility restriction.</p> <ul style="list-style-type: none"> • High Occupancy Vehicle (HOV) Lanes • Truck Lane Restrictions • HOV lane use by other groups of vehicles <p>Access control — Access is limited for long stretches of the facility, minimizing turbulence in the flow of vehicles:</p> <ul style="list-style-type: none"> • Express Lanes • Reversible Lanes 	<p>Provision of more mobility options</p> <p>Promotion and sustainment of transit service</p> <p>Reduced dependence on single occupant travel by promoting ridesharing</p> <p>Enhanced travel-time reliability</p> <p>Enhanced air quality</p> <p>Improved safety</p> <p>Enhanced commercial vehicle operations</p> <p>Augmented transportation funding</p> <p>Enhanced throughput</p> <p>Reduction in travel delay</p> <p>Revenue generation</p>	<p>SR 91 Express Lanes, Orange County, CA</p> <p>QuickRide, Houston, TX</p> <p>Interstate 15 Express Lanes, San Diego, CA</p> <p>New Jersey Turnpike: Dual-Dual Section, NJ</p>	<p>http://ops.fhwa.dot.gov/publications/managelanes_primer/</p> <p>http://ops.fhwa.dot.gov/freewaymgmt/managed_lanes.htm</p> <p>http://ops.fhwa.dot.gov/freewaymgmt/mngd_ins_hov.htm</p> <p>http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/index.htm</p>

¹¹ http://ops.fhwa.dot.gov/publications/managelanes_primer/

4. Active Demand Management – Reduces or redistributes travel demand to alternate modes or routes. It also incentivizes drivers by providing rewards for travelling during off peak hours with less traffic congestion.

Operational Strategies	Demonstrated Benefits	Examples	References
Dynamic Pricing Dynamic Fare Reduction Dynamic High-Occupancy Vehicle (HOV) / Managed Lanes Dynamic Ridesharing Dynamic Routing Dynamic Transit Capacity Assignment On-Demand Transit Predictive Traveler Information Transfer Connection Protection	Reduced demand on congested facilities More balanced demand across modes Spread demand across times of day	I-10 Katy Expressway Dynamic Pricing Predict-a-TripSM predictive traveler information	http://ops.fhwa.dot.gov/atdm/approaches/adm.htm http://www.ops.fhwa.dot.gov/congestionpricing/index.htm http://www.ops.fhwa.dot.gov/congestionpricing/strategies/without_involving_tolls/dynamic_sharing.htm

5. Active Parking Management – A suite of strategies designed to affect the demand on parking capacity.

Operational Strategies	Demonstrated Benefits	Examples	References
Dynamic Overflow Transit Parking Dynamic Parking Reservation Dynamic Wayfinding Dynamically Priced Parking	Reduced travel demand Reduced congestion caused by search for parking spaces	SFPark – dynamically priced parking and dynamic wayfinding in San Francisco PARK Smart - dynamically priced parking in New York City QuickPark - Dynamically priced parking and dynamic parking reservations in San Diego	http://ops.fhwa.dot.gov/atdm/approaches/apm.htm Pedestrian and Bicycle Strategies http://www.ops.fhwa.dot.gov/congestionpricing/strategies/notes_involving_tolls/parking_pricing.htm

6. Pedestrian and Bicycle Strategies – Technologies and strategies to provide enhanced pedestrian and bicycle mobility and safety.

Demonstrated Benefits	Examples	References
Reduced vehicle demand Better balanced demand across modes Enhanced safety of pedestrians and bicyclists Enhanced travel options	Pedestrian Countdown Signals – Western Michigan University, Kalamazoo, MI Pedestrian gates at highway-rail crossings – Chicago, IL BIKETOWN - Portland Bike Share – Portland, OR Denver “B-cycle” bike sharing program – Denver, CO	https://www.fhwa.dot.gov/environment/bicycle_pedestrian/ https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/resurfacing/ https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/page00.cfm https://www.fhwa.dot.gov/environment/bicycle_pedestrian/resources/equity_paper/ https://www.fhwa.dot.gov/environment/bicycle_pedestrian/funding/funding_opportunities.pdf

C. CHAPTER 10 - EMERGING TACTICS

Start with an introduction to this topic. Include purpose of the chapter, objectives, and desired outcomes as a minimum.

1. Connected and Automated Vehicles

- a) Autonomous Vehicle definition and potential impacts
- b) Connected and automated vehicle definition and potential impacts
- c) Synergies of adding connected to autonomous
- d) Policy implications
- e) Operational readiness

2. Mobility On Demand and Transportation Network Companies (TNC)

- a) Services like Uber and Lyft
- b) Potential for first/last mile, enhanced mobility
- c) Potential impacts and opportunities
- d) Policy implications

3. Mobility as a Service

- a) Public sector integration with private providers
- b) Potential impacts and opportunities
- c) Policy implications

4. Smart City and Data Analytics

- a) Integration of many technologies across many sectors
- b) Data availability and need for robust analytics
- c) Potential impacts and opportunities
- d) Policy implications

5. Emerging Technology Impacts on Infrastructure

- a) Evolution of organizations and structure
- b) Increased emphasis on technology
- c) Increased need for data/performance management and reporting
- d) Increased need for workforce development

e) Increased need for integration

- Technology
- Organizational
- Partnerships