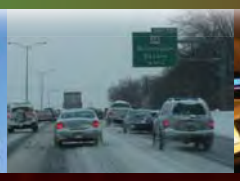
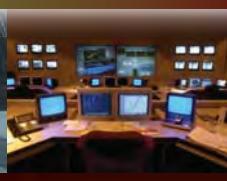
Creating an Effective Program to Advance Transportation System Management and Operations





Primer

U.S. Department of Transportation
Federal Highway Administration

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Foreword

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INTRODUCTION

PURPOSE OF THE PRIMER

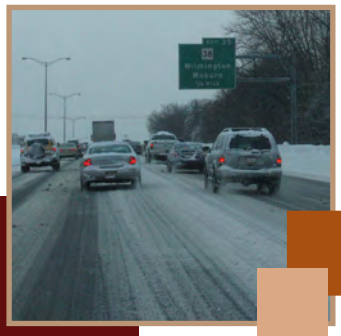
The purpose of this Primer is to raise awareness of the opportunities for improving the effectiveness of State and local Transportation System Management and Operations (TSM&O) activities. The Primer provides high-level guidance focused on key program, process, and organizational capabilities that are 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.

Research shows that moving beyond a collection of ad hoc strategy applications to an effective TSM&O program is dependent on deliberate change management to improve agency capabilities in six-specific dimensions. The "capability maturity" approach presented here identifies the key areas that impact program effectiveness: business processes, systems and technology, performance measurement, culture, organization and workforce, and collaboration.

Creating an effective program to advance TSM&O guidance is structured for agency self evaluation – so that agencies can identify their current areas of strength and weakness. The Primer provides the following information.

- Descriptions of the six key dimensions of agency capability that support improved system operations and management effectiveness;
- Definitions of capability improvement levels that support increasing effectiveness in each of the six dimension; and
- Descriptions of the actions an agency can take to reach the next level of capability in each dimension, and illustrate its implementation through several examples.

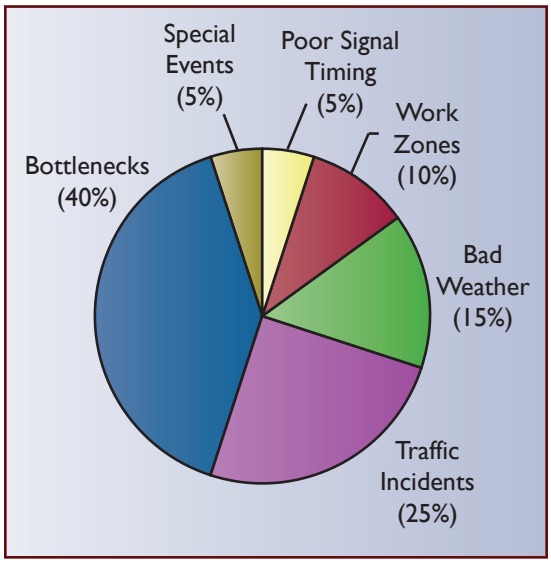
For more detailed information, a link is provided to the web-based American Association of State Highway and Transportation Officials (AASHTO) Guide to Systems Operations and Management Improvement. In addition, the FHWA is sponsoring State and regional workshops for agency management personnel to facilitate their use of the guidance on an as-requested basis.



BACKGROUND

BASIC TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS STRATEGIES

Figure 1. Sources of Congestion



The Need for TSM&O

As congestion spreads and intensifies and the level of incidents, delays, and disruptions increase, the level of service and reliability of the roadway systems in many areas continues to deteriorate. Given the constraints on the provision of significant new capacity, it is increasingly important to operate the existing network to its fullest service potential, especially "taking back" the capacity lost to congestion, incidents, construction, weather, poor signalization etc. The contribution of these problems to congestion is shown in Figure 1.

TSM&O offers the potential to provide an integrated program to optimize the performance of existing infrastructure through the implementation of specific systems and services that preserve capacity and improve reliability and safety. The TSM&O activities focus on a set of well-know strategies such as incident management, traffic signal timing, ramp metering, road weather management, and others.

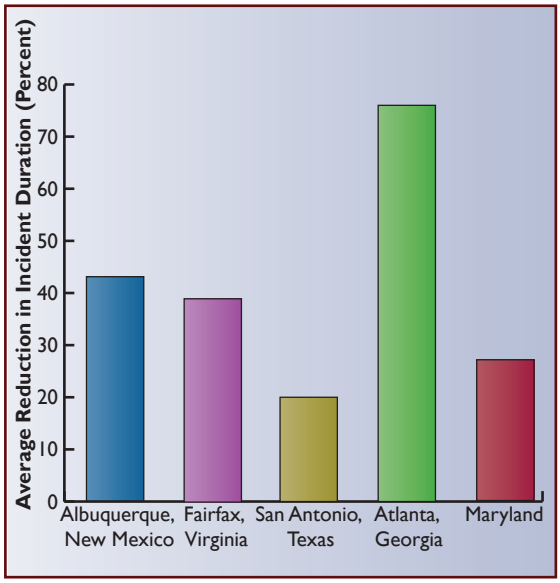
Improving TSM&O Program Effectiveness

The logic for aggressive pursuit of TSM&O is compelling. The TSM&O strategies are extremely cost effective (and low cost) with relatively short-lead times. As shown in Figure 2, there is a wide variation among agencies regarding the effectiveness of their TSM&O – reflecting differences in the degree of commitment in terms of organization, resources, program innovation.

A major challenge for transportation agencies is the identification of ways in which they might improve their programs – especially what changes in existing practices or new arrangements are needed to support expanded and aggressive TSM&O activities.

Recent research conducted by both the Transportation Research Board (TRB) and AASHTO has focused on ways in which the effectiveness of existing TSM&O activities in State and local agencies might be improved. Surprisingly, the wide variations in the effectiveness of TSM&O (defined by impacts on delay and reliability) found that they were not the result of differences in technology, level of investment, or knowledge of basic strategies. Rather, the effectiveness of departments of transportation (DOT) appears to be closely related to the development of the specific processes and institutional arrangements needed to support TSM&O strategies.

Figure 2. Best Practice Incident Management Reduction



Source: FHWA, ITS Benefits and Costs Database.

Figure 3 provides some examples of successful innovations and changes made by State DOTs in pursuit of improved TSM&O programs.

The research indicates the importance of focusing on critical dimensions, including:

- Processes that support effective applications such as integration of TSM&O into planning, consistent use of systems engineering, standardization and documentation, and performance management; and
- Institutional characteristics that support the processes such as leadership commitment, organizational consolidation, staff development, and external collaboration.

Figure 3. Examples of Agencies Moving Towards Comprehensive TSM&O Programs

New collaboration arrangements can make a difference:

Both the Florida Department of Transportation (FDOT) Rapid Incident Scene Clearance (RISC) program and Georgia DOT Towing and Recovery Incentive Program (TRIP) are public-private partnerships that utilize both incentive payments and disincentive liquidated damages to ensure shortened clearance times for heavy vehicle wrecks. These programs are the implementation of TSM&O strategies and have reduced the average clearance times by 100 percent.

Staff training in program development is important:

The 16-State I-95 Corridor Coalition has supported an "operations academy," which is a two-week residential program designed to provide middle and upper managers in State DOTs with a thorough grounding in various aspects of systems operations and management state of the practice.

A formal program and budget can be important:

The Maryland State Highway Administration (SHA) Coordinated Highways Action Response Team (CHART) program is a formal, multiyear budgeted ITS and operations program with an advisory board that provides oversight and strategic direction.

High-level reorganization can make a difference:

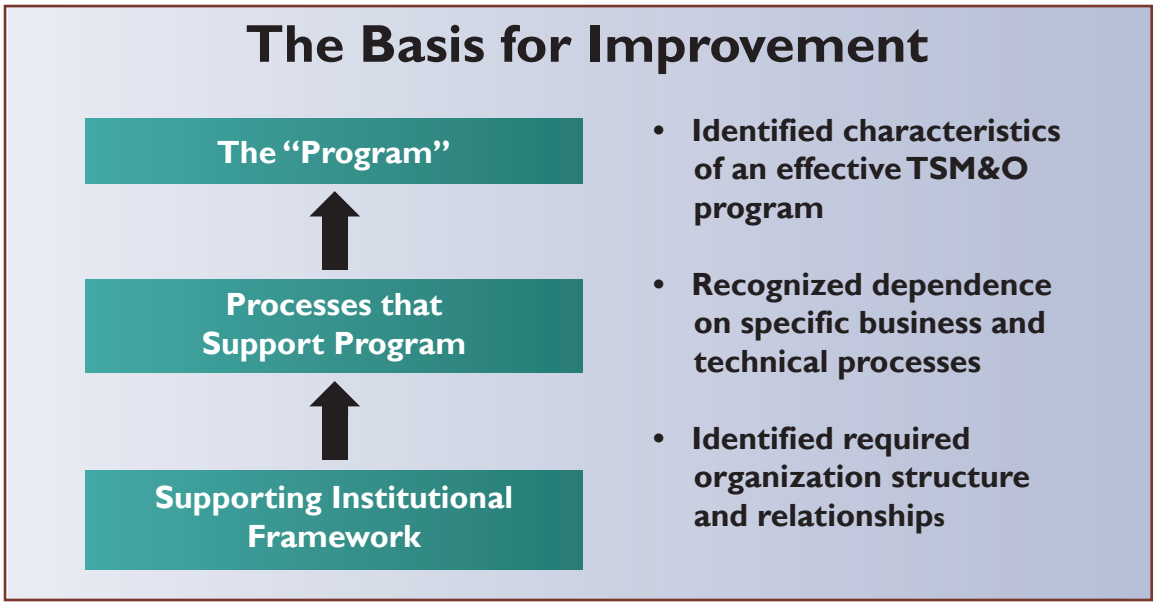
Virginia DOT has reorganized its senior management to include a Deputy Director for Operations and Maintenance responsible for all systems operations and management activities as well as maintenance resources.

Measuring performance is essential:

The Wisconsin DOT has made a strong and transparent commitment to performance measurement as evidenced by the quarterly Gray Notebook, which tracks performance based on five legislative goals for the Wisconsin DOT, including mobility/congestion, and includes regular updates on progress in the application of operations strategies such as incident management and High-Occupancy Toll (HOT) lanes.

As suggested in Figure 4, it is apparent that reaching full TSM&O program potential requires certain specific business and technical process dimensions and supporting institutional arrangements be put in place and managed – just like the other formal core program of the DOTs.

Figure 4. Relationships Among Program, Processes in Institutional Framework



Capability Maturity Concept to Improve TSM&O

A specific guidance framework has been developed to help transportation agencies improve the effectiveness of their TSM&O activities. The framework is based on self-evaluation regarding the key process and institutional capabilities required from a transportation agency (or group of agencies) to achieve effective TSM&O. This framework is adapted from a concept developed in the IT industry called the Capability Maturity Model which has been tailored to the transportation community.

The Capability Maturity Model identifies the key dimensions of process and institutional capability that directly relate to improving program effectiveness. It converts what were previously fuzzy concepts into specific manageable actions to improve capability.

Self-Evaluation

The Operations Capability Improvement Process starts with a self evaluation of the agency's current level of capability in the key dimensions and – based on the evaluation – provides the strategies and related actions needed to reach the next level of capability.

Key Dimensions of Capability

Six-critical dimensions (and their corresponding sub-dimensions) are closely associated with the more effective TSM&O activities, including:

1. Business processes – including formal scoping planning, programming, and budgeting;
2. Systems and technology – including systems architecture, standards, interoperability, and standardization and documentation;
3. Performance measurement – including measures definition, data acquisition, analysis, and utilization;
4. Culture – including technical understanding, leadership, policy commitment, outreach, and program authority;
5. Organization and workforce – including organizational structure, staff capacity, development and retention; and
6. Collaboration – including relationships with public safety agencies, local governments, MPOs, and the private sector.

Levels of Agency Capability

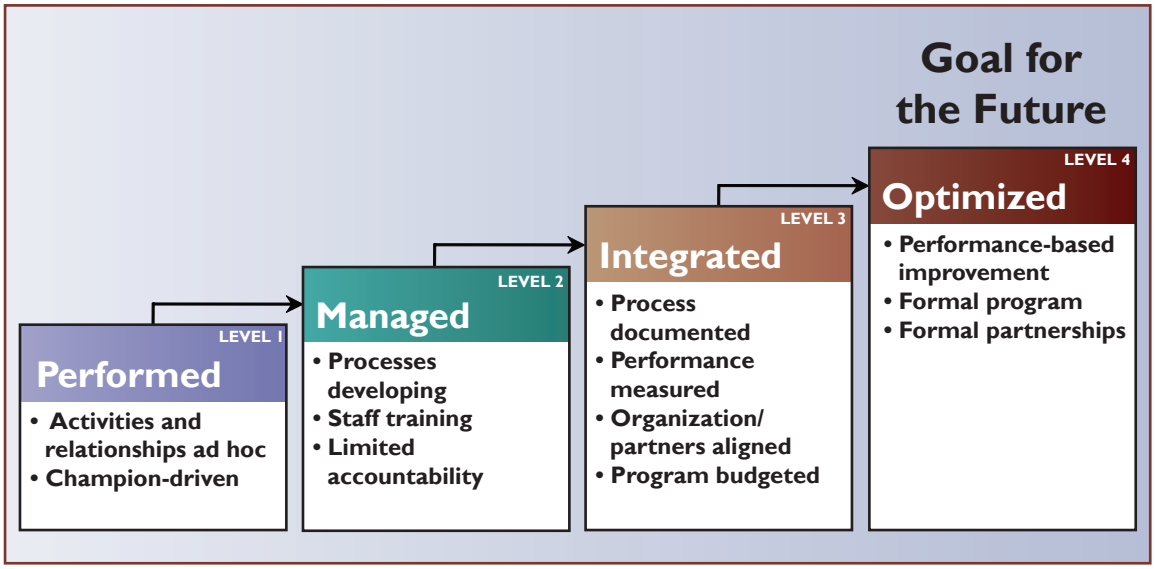
For each of the six dimensions there are discrete levels of agency capability – observed in actual agency practice. These levels range from "ad hoc" activities to more "integrated" program levels.

Four incremental levels of capability are used to assess current State of play and improvement targets for each dimension. They are defined as "doable" steps, each building on the one before:

- **Level 1: Performed –** Activities and relationships largely ad hoc, informal, and champion-driven – substantially outside the mainstream of other transportation activities.
- **Level 2: Managed –** Basic strategy applications in place with key process and needed staff capacities under development – but limited accountability and collaboration and sustainable resources
- **Level 3: Integrated –** Standardized strategy applications implemented in priority contexts and managed for performance; the TSM&O technical and processes developed, documented, and integrated into the regional transportation agencies, partnerships aligned.
- **Level 4: Optimized –** The TSM&O as full, sustainable, regionwide program, established on the basis of continuous improvement with all partners.

The relationships among the levels are illustrated in the Figure 5 graphic (found on page 8).

Figure 5. Levels of Agency Capability Maturity



TSM&O Capability Improvement Guidance Available

The concepts of key dimension of capability, levels of achievement, and self evaluation have been combined into a guidance framework to assist agencies in improving their capability for effective TSM&O. The guidance is available at several levels.

- This Primer includes a high-level summary of concepts to provide agencies with the generalized strategies needed to move on an incremental basis from their current State of practice to the next level of capability for effective TSM&O.
- Workshops supported by the FHWA – in which State DOT and other regional partners are led through a facilitated use of the guidance structure, discussion with outside peers, and develop their own custom-tailored action plans.
- The web-based *AASHTO Guide to Systems Operations and Management Capability Improvement* is available at http://www.aashtosomguidance.org. This guide has separate versions for top management, program managers, or senior staff and can be tailored to current agency activities and capabilities in the TSM&O arena.

Using the Primer

This Primer presents a simplified high-level version of the guidance via use of the two tables below – Table 1 (in Figure 6) is used for agency self-evaluation, and Table 2 (in Figure 6) identifies the related strategies for agency capability improvement. Together, these provide a quick assessment of the key challenges facing the agency in improving the effectiveness of the TSM&O program.

Review Table 1. The table presents the six critical capability maturity dimensions – as defined in the first column – needed to develop and maintain an effective TSM&O program. For evaluation purposes, four distinct levels of agency capability have been defined for each of the six dimensions.

Select the cell that most closely reflects your agency's current capability level for each of the dimensions. Then go to Table 2.

Review Table 2. The table presents the general strategies needed to move up to the next level of capability for each dimension. For each of the six dimensions (rows), go to the cell representing your agency's current level of capability that you identified in Table 1. This cell presents general management strategy to get from your current level of capability (Table 1) to the next highest level.

Using the TSM&O Capability Improvement Framework

Figure 6 illustrates an example of how to use the tables. Start by identifying your current agency level in each dimension (row) in Table 1.

Figure 6. Using the Tables – Example

Table 1. Current Level of Agency Capability

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

Then, go to corresponding cell in Table 2.

Table 2. General Strategies to Advance to the Next Level of Capability

Capability Dimension	Level 1 to Level 2	Level 2 to Level 3	Level 3 to Level 4
Business Processes *(Planning, programming, implementation)*	Establish framework for suitable TSM&O-related planning and programming activities	Develop multiyear statewide TSM&O plan and related process improvements	Integrate new operations objectives and processes into department activities as formalized standard operating procedures
Systems and Technology *(Systems engineering and technology interoperability)*	Introduce systems engineering into project development processes	**Develop tools, procedures and training to support standardized systems engineering process**	Coordinate and update architectural activities with performance measurement on a continuing basis
Performance Measurement *(Measures, data and analytics, and utilization)*	Identify output and outcome performance measures for the selected operations activities	Develop data collection and management plan to support utilization of outcome performance measures	Develop routine performance management process for continuing improvements in operating policies, procedures, systems and deployments
Culture *(Technical understanding, leadership, outreach, and program authority)*	Develop business case for TSM&O and continuous improvement of operations performance	Establish TSM&O with a formal core business program status equivalent to other major programs	Rationalize TSM&O program development with other programs on basis of service-related cost-effectiveness
Organization/Workforce *(Organizational structure and workforce capability development)*	Identify needed adjustments in organizational structure, staffing roles and responsibilities supportive of system management and operations	Integrate TSM&O organization and staff into overall agency structure and clarify reporting relationships	Create a management and organizational structure for TSM&O equivalent to that of other major agency programs
Collaboration *(Partnerships among levels of government and with public safety agencies and private sector)*	Establish mechanisms for regular coordination and cooperation	Execute formal interagency agreement for cooperative approach	Negotiate effective roles and responsibilities in light of agency priorities, resources and objectives

The Guidance provided in the corresponding cell is a high-level description of the actions needed to get to the next level of capability.

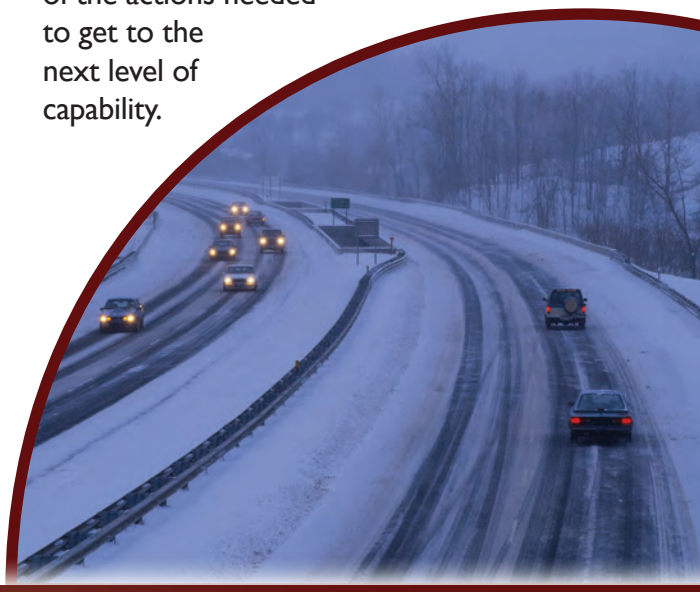


Table 1. Current Level of Agency Capability				
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Organization/ Workforce *(Organizational structure and workforce capability development)*	Fragmented roles based on legacy organization and available skills	Relationship among roles and units rationalized and core staff capacities identified	Top-level management position and core staff for TSM&O established in central office and districts	Professionalization and certification of operations core capacity positions including performance incentives
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Collaboration *(Partnerships among levels of government and with public safety agencies and private sector)*	Establish mechanisms for regular coordination and cooperation	Execute formal interagency agreement for cooperative approach	Negotiate effective roles and responsibilities in light of agency priorities, resources and objectives

TSM&O in Practice

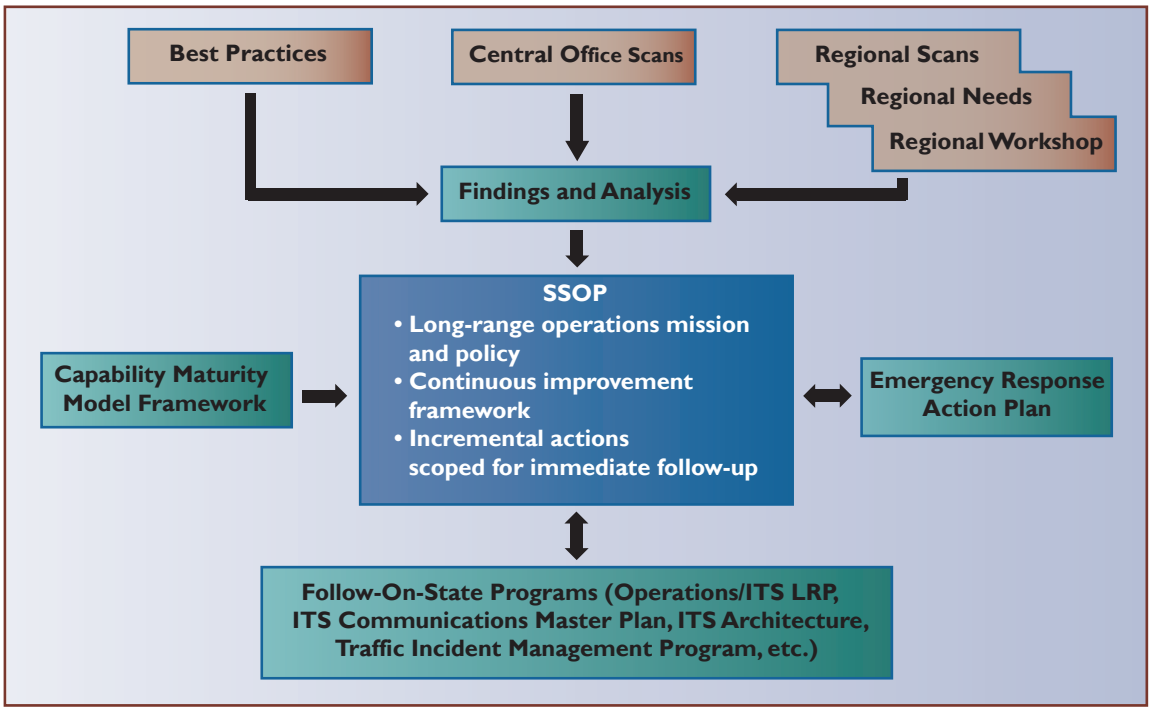
The strategies of Table 2 are the "themes" for the management actions essential to improvement of capability in each of the six dimensions. No dimension can be ignored. They are all essential and mutually supportive components of improving agency capability for effective TSM&O.

The dimension at the lowest level is usually the principal constraint to improving program effectiveness – and often most difficult to address! Nevertheless, it should be the highest priority. This is because improved performance levels result from the synergism among the processes and the institutional arrangements that are needed to support them. The agency's overall level of program effectiveness is, determined by the dimension with the lowest level.

For any element, levels cannot be skipped. Actions taken for given dimension need to be in place for a period (e.g., one year) to become embedded as the basis of the next level of improvement.

This simple process provides a mechanism for agencies to assess their strengths and weaknesses. It also provides the basis for an action plan, by which agencies can identify specific areas that can be improved with the overall payoff of enhanced TSM&O performance.

Figure 7. Virginia Department of Transportation (VDOT) SOPP Structure



Example Applications

The Virginia Department of Transportation (VDOT) developed a new Statewide Operations Program Plan using the TSM&O Capability Improvement approach of dimensions and levels. This framework provided the framework for both VDOTs Central Office and regional evaluations – and the development of specific actions that are being embodies in both ongoing technical and policy development Figure 7 illustrates their approach.

Florida DOT uses a "business planning" process – created in organizational "tiers" from program focus to district level to statewide – as shown in Figure 8 below. The TSM&O capability improvement framework was used to identify additional levels of detail for consideration in the program-level analysis.

Several State DOTs and regions have been using the TSM&O capability improvement framework in workshops designed to help DOT and partner agency managers and staff self-identify the dimensions where improvement would have the greatest payoff in improved TSM&O program effectiveness. In these workshops, the participants evaluate their current level of capability (as highlighted in Figure 9) and then identify key strategies needed to improve up to the next level.

Figure 8. Florida DOT Business Plan

Florida DOT Business Plan						
Criteria Area	**Objectives**	**Activities**	**Performance Indicators**	**Targets**	**Progress**	**Person(s) Responsible**
Mission						
Vision						
1. Leadership						
2. Strategic Planning						
3. Customer and Market Focus						
4. Measurement, Analysis, Knowledge Management						
5. Human Resource Focus						
6. Process Management						
7. Organizational Results						

Figure 9. Participant Worksheet

DIMENSION: Systems and Technology				
	LEVEL 1 PERFORMED	**LEVEL 2 MANAGED**	**LEVEL 3 INTEGRATED**	**LEVEL 4 INTEGRATED**
	Ad hoc approaches to system implementation without consideration of systems engineering and appropriate procurement processes	**Regional conops and architectures developed and documented with costs included, appropriate procurement process employed**	Integrate new operations objectives and processes into department activities as formalized standard operating procedures	Integrate new operations objectives and processes into department activities as formalized standard operating procedures
Staff evaluation of program capability maturity	Systems Architecture/concepts of operations in place Lack of standardization of systems/technology = interoperability relationships among jurisdictions Inconsistent technology, operations along interjurisdictional corridors Legacy systems upgrade cost burden (DOT) Regional procurement contracts in place – set up through DOT Variation in staff technical capabilities among jurisdictions			
Staff identification of Strategies to get to the next level	Develop systems engineering checklist in conjunction with FHWA Document systems for future development Improve interoperability among systems (signals, Integrated corridor management) across jurisdictions Develop approaches to increase level of shared operational control (after hours) Communicate lessons learned in systems engineering, technology to all participants			

Additional resources in the form of TSM&O Capability Improvement Workshops

While this Primer is limited to a high-level approach to evaluate capability and identify improvement strategies, there are two opportunities to utilize the framework to develop a more custom-tailored approach and to access detailed guidance.

The FHWA supports State DOT and regional workshops to tailor guidance more specifically to the State and regional context. The workshop begins with a self-evaluation process based on the guidance structure. The evaluation is conducted by the participating transportation agency staff members, based on their detailed knowledge of the current status of their organization. A facilitator assists the participants in the evaluation. The focus of this first part of the Workshop is to achieve consensus on the current level for each dimension of their organization.

The second half of the workshop takes the current levels of capability as the point-of-departure for each of the six dimensions, and by reviewing the criteria for the next level; participants identify the actions that are needed to reach the target level on a consensus basis. The actions identified constitute a starting point for a more detailed cooperative action plan that can be used by the agencies to get the agency on the path to improved TSM&O capability.

Additional resources: The AASTHO Guide to Systems Operations and Management Improvement

The web-based tool can be used by agency managers who desire more detailed guidance. The AASHTO Guide (http://www.aashtosomguidance.org) can be tailored to both current agency context and program activity – and to the level of management responsibility of the user of the Guide. The AASHTO Guide uses a self-evaluation questionnaire – more detailed than the Primer – to determine the agency's current levels of capability. It then presents detailed guidance in the six dimensions – with related sub-dimensions – that constitute and action plan to improve agency capability to the next level.

For more information:

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Other Resources in the toolbox

AASHTO System Management and Operations Guidance – http://www.aashtosomguidance.org/

SHRP 2 – Institutional Architectures to Advance Systems Operations and Management Webinar http://onlinepubs.trb.org/onlinepubs/webinars/InstitutionalArchitecturesPresentations.pdf

SHRP2 STRATEGIC HIGHWAY RESEARCH PROGRAM

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