Business Process Guidance

✔ LEVEL 1 TO LEVEL 2

Why Business Processes are Important

Use of the appropriate processes for design and implementation of systems will ensure that the needs of the region are appropriately addressed, that systems are implemented in an efficient manner, and interoperability with other systems is achieved.

Improvement Target

From	Processes related to TSM&O activities ad hoc and un-integrated (L1)
To	Multiyear statewide TSM&O plan and program exists (L2)
By	Establishing framework for suitable TSM&O related planning and programming activities

Key Sub-dimensions

- Planning Process
- Programming/Budgeting
- Project Development/Procurement

Planning Process Action Plan (L1 to L2)

Strategy Summary

Based on existing state of play, identify key priorities and develop initial state DOT district/regional plan(s) for TSM&O infrastructure and real-time operations

Key Actions

A	Review current agency mission, vision and goals with respect to TSM&O, including implied strategies and outcomes related to specific stakeholders
B	Review current state of play within the agency regarding TSM&O deployment and relationships with key players regarding the planning and development processes – district, regional and statewide
C	Identify agency operations objectives and related priorities for immediate action/next step implementation of standard TSM&O strategies in key urban and rural regions/districts and develop/update state DOT district/regional plans(s)
D	Develop operational concepts and systems architecture for start-up strategies or next steps
E	Encourage and participate in incorporation of TSM&O within the ongoing cooperative regional planning process within MPO/RTPA planning to coordinate state proposed actions with local government and related regional activities
F	Identify internal and external processes or process changes needed to implement operational concepts

ACTIONS

Action A: Review current agency mission, vision and goals with respect to TSM&O, including implied strategies and outcomes related to specific stakeholders

Rationale: Agency program should reflect stated mission, vision and goals (MVG) in terms of strategies and level of emphasis and appropriate investment.

A.1 Review MVG for focus on customer level of service both in terms of mobility and safety (passenger and freight) programs included in formal agency documents, including management of congestion, reduction of delay and improvement of reliability—especially in relationship to non-recurring congestion.

A.2 Identify the degree to which current agency programs incorporating conventional strategies and performance targets associated with reducing delay include non-recurring congestion, and identify missing opportunities or the need to revise policy.

A.3 Develop discussion among key agency leadership, planning and TSM&O-related staff regarding appropriate range of strategies and program implications to meet or modify current MVG.

A.4 Conduct parallel discussions with regional planning entities and local governments.

Responsibility and Relationships: Working group combining central office operations and planning staff and key district/regional staff together with public safety, MPO and local government staff as appropriate.

Action B: Review current state of play within the agency regarding TSM&O deployment and relationships with key players regarding the planning and development processes – district, regional and statewide

Rationale: The next steps in improved TSM&O strategy implementation/improvement should build on existing processes and project activity as point of departure.

B.1 Identify staff at central office and relevant districts/regions to work together to evaluate the existing state of play regarding TSM&O strategies deployed and ongoing formal planning and development processes, including whether and how TSM&O is involved in current regional planning, congestion management planning and corridor planning. Include a status review covering DOT statewide planning, rural (RTPA) and urban (MPO) planning.

B.2 Identify any ongoing TSM&O activities that may serve as persuasive points of departure or models for next steps, including utilization of traffic management center data as may be available. Develop discussion of impact of cost and capacity constraints, mobility, safety and livability cost-effectiveness.

B.3 Working in collaboration with regional partners in service delivery, determine current/needed responsibilities for planning among agency operations and planning staff and establish working relationships with MPOs and emergency managers – including establishment of regional group (committee, task force) for TSM&O planning, agency representation, and identification of decision-making regarding projects and resource allocation. Develop a work program for plan development.

Responsibility and Relationships: Working group combining central office operations and planning staff and key district/regional staff together with MPO and local government staff as appropriate.

Action C: Identify agency operations objectives and related priorities for immediate action/next step implementation of standard TSM&O strategies in key urban and rural regions/districts and develop/update state DOT district/regional plans(s)

Rationale: Recognizing the timeline that may be required for development of a formal district/regional TSM&O planning process, consider state DOT initiative to implement high priority strategies where need/justification is apparent and independent agency actions are feasible.

C.1 Identify objectives as apparent in agency policy documents and/or widely accepted (see Performance Measurement Guidance: Measures Utilization Plan L1 to L2).

C.2 Identify the most visible and urgent priorities and objectives for short-term and unique potential of TSM&O strategies based on agency policy initiative, recent or ongoing emergency response, weather, major incidents or special event challenges – focused on upgrading existing technology and expanding coverage.

C.3 Identify the relationships between agency policy objectives and the current improvement activities with respect to the potential of improved TSM&O to meet objectives, with special focus on congestion-reduction, reliability improvement, and safety.

C.4 Gain policy and managerial support for development of agency approach to improved TSM&O including senior activity sponsor, both for immediate event-related response and for longer term strategic development.

C.5 Review existing state of play regarding relationships between known operations-related problems and current TSM&O activities at the level of agency districts/regions and statewide (urban and rural) in areas where the agency may proceed independently.

C.6 Identify districts/regions and locations with most compelling problems suitable for start-up or improved TSM&O actions. This may result from obvious problems (where study is not needed), upgrades of existing strategy applications, or improvements in technology. Consideration may also be given to a critical corridor approach, interregional or statewide.

C.7 Review peer experience regarding the relevance of TSM&O strategies and their logical staging and key implementation issues.

C.8 Identify highest payoff TSM&O strategies (recognizing resource constraints) to respond to obvious major recurring and non-recurring congestion (urban and rural) on an immediate action basis where they can be implemented without the need for formal planning among jurisdictions (i.e. incorporation into planned construction or maintenance projects or standalone TSM&O strategies with minimal interjurisdictional dependency or in rural areas where multijurisdictional coordination is less essential). Initiate consultation and integration into the formal planning process (as per C.10 below).

C.9 Develop high level statewide ITS/TSM&O policy framework for immediate action related to DOT priorities in each region or all regions, reflecting statewide policy standards on responding to key recurring and non-recurring congestion as addressed by TSM&O conventions and considering capabilities and resources, including DOT regional/district plan. Develop consistent district/regional level plans as appropriate and consider approach to replicating successful approaches from one district/region to others.

C.10 Take the lead in assembling a working group of relevant implementation partners (including public safety agencies) at the regional level for key strategy applications related to state responsibility areas to coordinate immediate action strategy implementation at the district/regional level as appropriate to the agency's immediate actions (such as incident management) and coordinate early action planning with related ongoing activities and requirements such as Department of Homeland Security National Incident Management System planning.

C.11 Develop implementation plan for selected immediate next step(s) and phases related to annual budgeting and state transportation improvement program (STIP) development including upgrades to existing ITS infrastructure or expansion of coverage and continued maintenance (focused on surveillance, detection, and interagency communications), initial consensus goals and objectives, operations concepts and protocols, as well as appropriate performance measures and related data (see the Performance Measurement Dimension).

Responsibility and Relationships: Working group combining central office operations and planning staff and key district/regional staff together with public safety, MPO and local government staff as appropriate.

Action D: Develop operational concepts and systems architecture for start-up strategies or next steps

Rationale: Effective strategies must link planning with actual operations through clear understanding regarding operations objectives, roles and responsibilities of participants, data and communication requirements, and real-time protocols.

D.1 Develop Regional Concept of Operations involving all key participants in planning and service delivery and include consideration of performance measures, ITS infrastructure, relationships and procedural agreements, and resource arrangements.

D.2 Develop and document regional architectures as appropriate supporting existing and proposed TSM&O strategy implementation including conventional systems operations and management strategies, emergency management and emerging Connected Vehicle services.

D.3 Review implications for ITS infrastructure deployment on a strategic basis to support multiple strategies and to extend network coverage over time.

Responsibility and Relationships: Working group combining central office operations and planning staff and key district/regional operations, traffic management center and maintenance staff together with public safety and local government staff as appropriate.

Action E: Encourage and participate in incorporation of TSM&O within the ongoing cooperative MPO/RTPA regional planning process to coordinate state proposed actions with local government and related regional activities

Rationale: To become most effective at the regional level, TSM&O must be incorporated into the formal regional planning and programming process.

E.1 Establish agency policy about participation in regional agencies' ongoing planning and programming process in terms of representation on policy and technical committees, and activities to represent TSM&O interests of agency.

E.2 Establish policy regarding agency involvement in regional planning and ways to support further inclusion of TSM&O improvements within MPO/RTPA regional multimodal transportation planning and programming processes including designation of agency representation and objectives. An existing Congestion Management Plan may provide a useful point of departure.

E.3 Working with MPO/RTPA, identify the relationships between regional policy objectives and the current improvement activities in relationship to the potential of improved TSM&O to meet objectives with special focus on congestion-reduction, reliability improvement and safety. Where appropriate, develop persuasive presentation, based on national and peer experience regarding the relevance of TSM&O strategies for use with partners in the regional planning context.

E.4 Working with regional partners, establish and discuss among key service delivery partner technical staff the current best practice of peers regarding TSM&O strategies as relevant to context (urban and rural), including implications of operational concepts, infrastructure, roles, and procedures. Include consideration of federal planning and architecture requirements and performance reporting.

E.5 Working with regional partners and MPO/RTPA staff, determine type of regional planning needed, compared to available resources and data and consistent with federal requirements and best practices (planning, forecasting, analysis, and evaluation). Identify start-up/next steps with methods suitable to TSM&O strategies' short-term, network-wide characteristics, and assign responsibility. Identify collaboration mechanisms and assemble resources.

E.6 Working with regional partners, identify the key recurring and non-recurring relevant regional problems to be addressed by regional TSM&O programs as related to key transportation objective, including mobility, safety, and livability, and relevant performance measures (both output and outcome).

E.7 Work with regional partners to identify scope and structure to develop standalone plan or comprehensive metropolitan or rural regional plan element. Include consideration of appropriate level of detail in policy statement, deficiency analysis, future problem forecast, alternatives evaluation, and improvement programming. Develop plan product with appropriate staging and relationships to responsibilities of jurisdictions and resource availability.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework.

Action F: Identify internal and external processes or process changes needed to implement operational concepts

Rationale: Existing communications, information transfer and field roles and procedures may require adjustments to bring into conformance with operational concepts.

F.1 Develop working group to review operational concepts for both existing and proposed TSM&O strategy applications with objective outcome of improved efficiency and effectiveness.

F.2 Compare operations concepts at best practice level with current roles, relationships and field procedures regarding communications and actions, and identify inconsistencies and barriers to improving effective performance and achieving the operations objective.

F.3 Develop and execute changes appropriate for consistency with operational concept and improved efficiency and effectiveness.

Responsibility and Relationships: Working group combining central office operations and planning staff and key district/regional operations, traffic management center and maintenance staff—bringing in public safety and local government staff as appropriate. Senior district/regional executive support may be essential to establish framework.

Examples/References:

- Primer: Statewide Opportunities For Linking Planning and Operations (FHWA): http://www.ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf
  Primer designed to raise awareness of the benefits and opportunities for coordinating planning and operations.
- Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference (FHWA, April 2010): http://www.ops.fhwa.dot.gov/publications/fhwahop10027/fhwahop10027.pdf

Resource designed to enable transportation planners and their planning partners to build a systematic transportation plan.

- Congestion Management Process Guidebook (FHWA): http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/
- Florida Department of Transportation ITS Plan: http://www.dot.state.fl.us/trafficoperations/its/Projects_Deploy/Strategic_Plan/050512-FinlRprt_V1-2.pdf
- Nevada Department of Transportation Best Practices Reference Guide: http://www.kimley-horn.com/projects/NevadaITRP/images/pdfs/TechMem_three.pdf
- Guide to Integrating Business Processes to Improve Travel Time Reliability (SHRP 2 L01): http://www.trb.org/Publications/Blurbs/165284.aspx
- Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes (SHRP 2 L05): http://www.trb.org/Main/Blurbs/168854.aspx
- Evaluating Alternative Operations Strategies to Improve Travel Time Reliability (SHRP 2 L11): http://www.trb.org/Main/Blurbs/168142.aspx
- Maricopa County Association of Governments ITS Concept of Operations: http://www.azmag.gov/Documents/pdf/cms.resource/RCTO-Final_Report79101.pdf
- Maricopa County Association of Governments ITS Strategic Plan: http://www.azmag.gov/Projects/Project.asp?CMSID=1050&CMSID2=4231

Programming/Budgeting Action Plan (L1 to L2)

Strategy Summary

Identify initial resource needs for logical TSM&O strategies "next steps" for key districts

Key Actions

A	Develop order of magnitude cost estimates – capital, operating and maintenance
B	Develop agency district/regional-level program and budget based on initial district plans
C	Determine short term district/regional-level funding strategy (capital, maintenance and staffing) by budget categories and timeframes
D	Develop cooperative approach to MPO/RTPA programming and budgeting

ACTIONS

Action A: **Develop order of magnitude cost estimates – capital, operating and maintenance**

Rationale: For budgeting and programming purposes, a set of preliminary cost estimates for proposed improvements is essential, including all key resource categories projected forward.

A.1 Develop unit cost estimates for key plan elements broken down into discrete elements and stages. Elements to be included are communications, field devices, equipment, software and systems integration, systems upgrades, structures, staffing (in terms of fulltime equivalents), and maintenance.

A.2 Determine costs for at least a budget cycle (5-6 years). Logical increments of program should be developed that deliver discrete benefits and which are logical increments to proceeding phases (or existing systems).

A.3 Consideration should be given to acquisition strategies such as turnkey, leasing, and outsourcing, as these may impact costs.

Responsibility and Relationships: Working group combining central office operations, planning and project development staff and key district/regional operations, traffic management center and maintenance staff.

Action B: Develop agency district/regional-level program and budget based on initial district plans

Rationale: Moving beyond one-time opportunistic funding of a given stage for TSM&O strategy deployment requires an understanding of the resource implications.

B.1 Building on initial district plan, develop implementation approach for selected immediate next step(s) and subsequent phases related to ITS infrastructure deployment needs (focused on surveillance, detection, and interagency communications), initial consensus goals and objectives, and operations concepts and protocols, as well as appropriate performance measures and related data (see Performance Measurement Dimension).

B.2 Determine order of magnitude multi-year capital investment for infrastructure and staged upgrades, as well as staffing requirements and annual maintenance costs.

Responsibility and Relationships: Working group combining central office operations, planning and budgeting staff and key district/regional operations, traffic management center and maintenance staff.

Action C: Determine short term district/regional-level funding strategy (capital, maintenance and staffing) by budget categories and timeframes

Rationale: TSM&O improvements will be constrained both by overall budgets at the district/regional and statewide level, but also by the budget categories and conventional uses

C.1 Identify the current and/or most likely sources for funding capital, staffing, and maintenance requirements, both in the short-run (based on current budgeting and programming processes) and as may be appropriate in the long-run – given the potential of TSM&O.

C.2 Prepare program proposal and match program components to likely available sources.

Responsibility and Relationships: Working group combining central office operations, planning and budgeting staff.

Action D: Develop cooperative approach to MPO/RTPA programming and budgeting

Rationale: Funding for metropolitan and rural regions utilizing both federal and individual jurisdiction funds requires the development of a collaborative approach to budgeting.

D.1 Based on plan development identify consensus regional priorities with realistic funding potential.

D.2 Work with MPO/RTPA to develop joint funding schedule and program commitments.

D.3 Initiate dialogue with participants in planning process regarding relative costs and benefits of TSM&O program and use of performance measures.

Responsibility and Relationships: Develop cooperative joint working group with MPO/RTPA led by central office statewide operations leader.

Examples/References

- Transportation Management Center Business Planning and Plans Handbook: http://tmcpfs.ops.fhwa.dot.gov/cfprojects/uploaded_files/TMC_BPG_Final.pdf
- Strategic Planning and Decision Making in State Departments of Transportation: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_326.pdf
- Maryland State Highway Administration Coordinated Highways Action Response Team (CHART) Non-constrained Deployment Plan (2005): http://www.chart.state.md.us/downloads/readingroom/CHART-NCDP-2005-Final-Plan.pdf

Project Development/Procurement Action Plan (L1 to L2)

Strategy Summary

Analyze special needs and requirements for efficient TSM&O project development

Key Actions

A	Coordinate implementation of TSM&O-related infrastructure into other ongoing highway development activities
B	Develop appropriate TSM&O project development process by project type and components
C	Consider "make or buy" options for development of infrastructure and services
D	Develop appropriate TSM&O project procurement strategies
E	Review agency procurement process options for appropriate modifications to accommodate ITS infrastructure

ACTIONS

Action A: Coordinate implementation of TSM&O-related infrastructure into other ongoing highway development activities

Rationale: Even where TSM&O-related projects and their ITS infrastructure and other project components are not part of the formal project development process they can be added into on-going highway improvement projects.

A.1 Compare type and location of proposed TSM&O-related infrastructure improvements (communication, surveillance and detection, dynamic message signs, ramp metering, etc.) with ongoing highway improvement projects (such as major reconstruction or new lanes) and identify opportunities for "piggybacking" ITS infrastructure into the project design and development process, including provision of conduit, device structures, and geometric modifications.

A.2 Work with highway project development manager to integrate TSM&O-related features into ongoing project development process.

Responsibility and Relationships: Central office statewide and district operations staff working with highway development project managers.

Action B: Develop appropriate TSM&O project development process by project type and components

Rationale: Various ITS/TSM&O projects have different characteristics that impact steps in the standard project development process.

B.1 Identify project characteristics that may suggest variations in the agency standard project development processes including project type, staffing and management, data acquisition, scope, systems engineering, software, systems integration, mix of capital and operations costs, investments in procedures development and training, acceptance testing, acquisition of private services, etc.

B.2 Identify other special requirements of TSM&O (legal and technical) that differentiate them from current formal processes for capital projects (systems engineering, integration). Identify conventional steps in the project development process that may be inappropriate given project characteristics (e.g. absence of environmental impact or small project size).

B.3 Identify lead time issues (if any) such as right-of-way acquisition, permitting, and environmental clearance.

B.4 Identify the applicability of agency standard project development processes (including any special "minimal "project development processes for low cost, low impact projects) and develop modifications as appropriate.

B.5 Apply appropriate process for initial projects.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff.

Action C: Consider "make or buy" options for development of infrastructure and services

Rationale: It may be cost effective in terms of capital, staffing and maintenance costs, as well as technology risk, to outsource the development of certain capabilities.

C.1 Review existing projects and their probable continuing evolution and consider pros and cons of outsourcing vs. agency staff provision, taking into account time to implement, staffing requirements, technology flexibility, agency control and risk factors.

C.2 Review range of experience with peer agencies, with special attention to performance management of outsourcing contracts.

C.3 Develop strategy for technology and services acquisition with appropriate balance of in-house vs. outsourced elements.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff.

Action D: Develop appropriate TSM&O project procurement strategies

Rationale: Various ITS/TSM&O projects have different characteristics for which certain procurement approaches are appropriate to support minimal costs and limit risk.

D.1 Review existing literature and peer state experience for project development and procurement experience and guidelines. Match project type with optimum procurement including consideration of type of work, mix of hardware and software, complexity, method of award to contractor, contract form and type.

D.2 Review range of procurement options including commodity supply, low bid, design/construct, systems manager, consultant, and outsourcing and their impact of quality and costs assurance and risks.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff.

Action E: Review agency procurement process options for appropriate modifications to accommodate ITS infrastructure

Rationale: Standard procurement options may or may not be appropriate for optimum control of quality and costs, and therefore modifications to existing procurement may be necessary.

E.1 Address issue with agency procurement staff to develop approach appropriate to procurement strategies as a function of system size, complexity, and type.

E.2 Develop appropriate approach and instruments for initial projects.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff.

Examples/References:

- Guide to Contracting ITS: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_560.pdf
- Managing High Technology Projects in Transportation (offered by the Consortium for ITS Training and Education. To Access This Resource: http://www.citeconsortium.org/courses/2mod11.html
- Best Practices In Project Delivery Management: http://onlinepubs.trb.org/onlinepubs/nchrp/docs/nchrp20-68A_07-01.pdf
- Project Management - Delivering the Capital Construction Programs at the Project Level: http://www.wsdot.wa.gov/projects/projectmgmt/

Business Process Guidance

LEVEL 2 TO LEVEL 3

Why Business Processes are Important

Technical and business processes are an essential capability for establishing a stable and replicable basis for continuous improvement by identifying incremental improvements, determining the needed resources (capital, staffing, etc.), and establishing a standardized approach to implementation.

Improvement Target

From	Multiyear statewide TSM&O plan and program with deficiencies, evaluation, and strategies (L2)
To	Programming, budgeting, and project development processes for TSM&O standardized and documented (L3)
By	Developing multiyear statewide TSM&O plan and related process improvements

Key Sub-dimensions

- Planning Process
- Programming/Budgeting
- Project Development/Procurement

Planning Process Action Plan (L2 to L3)

Strategy Summary

Develop multiyear statewide TSM&O plan and program and integrate into statewide and metropolitan planning processes

Key Actions

A	Identify opportunities for TSM&O infrastructure integration into planned/ongoing construction projects, both by state DOT and local governments
B	Formalize state DOT consultation in plan development with other state DOT offices (statewide planning, emergency operations, state policy) as well as local government and regional planning entities (MPO/RTPA) and local public safety agencies
C	Expand stakeholder basis to interests for whom systems reliability is important and seek their involvement in the planning process
D	Review opportunities for special grants and other forms of federal support for key innovative projects and approaches
E	Develop statewide TSM&O plan
F	Integrate statewide TSM&O plan into statewide multimodal Long Range Plan
G	Assess and develop formal multiagency approach to collaborative strategy applications and their continuous improvement

ACTIONS

Action A: **Identify opportunities for TSM&O infrastructure integration into planned/ongoing construction projects, both by state DOT and local governments**

Rationale: Both reconstruction and new construction offer opportunities to equip the network with the ITS infrastructure necessary to support future TSM&O at substantial reduced cost compared to retrofit.

A.1 Utilize available statewide and regional concepts as per L1 to identify ITS needs by facility type, network, and region regarding communications and roadside device infrastructure.

A.2 Establish a standard procedure in overall agency project development process to incorporate ITS components into new projects as appropriate at the point of project initiation, as well as a procedure for including components in projects already in development.

Responsibility and Relationships: Working group combining operations and project development (design and construction) staffs from both central office operations district/regions. Senior district/regional executive support may be essential to establish framework.

Action B: Formalize state DOT consultation in plan development with other state DOT offices (statewide planning, emergency operations, state policy) as well as local government and regional planning entities (MPO/RTPA) and local public safety agencies

Rationale: It is important to incorporate TSM&O strategies and investments as a core element in the MPO/RTPA planning and programming process and in statewide planning as a matter of policy to ensure it receives appropriate technical support and weight in the regional decision-making process.

B.1 Work with planning partners to identify conditions that formalize TSM&O within the regional planning process focusing on deficiency analyses (including those related to non-recurring congestion), short and long range planning, and evaluation criteria, recognizing reliability and safety benefits. As appropriate this may be part of the congestion management process.

B.2 Give explicit consideration to joint state-local projects on a corridor or network basis such as integrated corridor management and improved arterial signalization and coordination.

B.3 Conduct a short-term regional travel performance-related deficiency analysis related to major recurring and non-recurring congestion problems (recurring congestion/non-recurring congestion, bottlenecks, peaking, incidents, weather, safety, construction, special events, etc.) and match problem to functional (work, recreation, freight), regional (urban and rural), corridor (through, interstate), and network (freeways, arterials, transit) seriousness and significance.

B.4 Extend deficiency analysis into the long-term based on rules of thumb and other methods related to expected sources of recurring congestion and non-recurring congestion to identify strategies that may be implemented for response to future problems and appropriate staging.

B.5 Analyze and evaluate responsive TSM&O strategy applications using performance measures and cost-effective tools, as available, related to mobility, safety, economic development, livability and sustainability, and identify staged TSM&O strategies approach consistent with potential resources.

B.6 Develop approach to commitment of needed service delivery partners (state, local, public safety agency) to staffing and cooperative protocols essential for effective TSM&O strategy implementation.

B.7 Incorporate TSM&O investments and related commitments into the regional transportation improvement program and long-range plan.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework. Special technical expertise will be needed.

Action C: Expand stakeholder basis to interests for whom systems reliability is important and seek their involvement in the planning process

Rationale: TSM&O strategies address new service issues that may be of interest to a range of interest groups with stakes in system reliability who have not been involved in the participatory aspects of the planning process.

C.1 Identify groups with potential interest in TSM&O improvements (such as commercial vehicle operators) and specific TSM&O functionality (such as the construction industry and work zone traffic control.

C.2 Establish forum for interaction as part of the planning process when considering objectives, measures and specific improvements.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force.

Action D: Review opportunities for special grants and other forms of federal support for key innovative projects and approaches

Rationale: Federal financial and technical support may be available for innovative projects.

D.1 Track federal aid program in ITS, TSM&O and Connected Vehicle areas via regular contact at FHWA Division and headquarters program offices to identify emerging areas where federal programs may be seeking “test bed” , pilot program or other developmental opportunities at the state and local level.

D.2 Consider match of federal and state/local interest and capacity to conduct project, as well as advantages and disadvantages of special supplementary federal aid.

D.3 Pursue grant opportunities through appropriate liaison and applications processes.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force.

Action E: Develop statewide TSM&O plan

Rationale: In order to follow a cost-effective path to making TSM&O investments, strategy applications should be developed and deployed in relationship to a consistent statewide policy on priority customer needs.

E.1 Establish appropriate objectives and policy framework for the statewide TSM&O plan and program in terms of relationship to state policy, performance, and resource commitments and limitations, including highlighting the potential of TSM&O to meet agency goals in resource-constrained contexts (see Performance Measurement Dimension).

E.2 Conduct a statewide data-based deficiency analysis related to major recurring and non-recurring congestion problems (recurring congestion/non-recurring congestion, bottlenecks, peaking, incidents, weather, safety, construction, special events, etc.) and match problem to functional (work, recreation, freight), regional (urban and rural), corridor (through, interstate), and network (freeways, arterials, transit) seriousness and significance.

E.3 Analyze and evaluate responsive TSM&O strategy applications using performance measures and cost-effective tools, as available, related to mobility, safety, emergency operations, economic development, livability and sustainability, and identify staged TSM&O strategies approach consistent with potential resources for infrastructure and staffing.

E.4 Establish and document a standardized statewide policy regarding achieving objectives, priority problems, priority contexts (regions, facilities, corridors), network level (freeway, arterials), and priority strategy deployment, as well as an approach to strategies staging and extent – including both infrastructure and operations concepts evolution.

E.5 Establish statewide standard approach to TSM&O strategy applications including operational concepts, systems architecture, partner roles and relationships, technology, and procedures.

E.6 Develop a statewide TSM&O plan at the level of detail appropriate to identify operations objectives, priorities and their context and to serve as the basis for staging and budgeting. Include persuasive analysis focused on the unique role of TSM&O regarding implementation timeframes and cost effectiveness.

Responsibility and Relationships: Working group combining central office statewide and district/regional operations staff.

Action F: Integrate statewide TSM&O plan into statewide multimodal Long Range Plan

Rationale: The statewide Long Range Plan represents the official policy/program document that sets the framework for the STIP and the planning and programming that supports STIP projects.

F.1 Relate statewide TSM&O planning to ongoing statewide long range multimodal planning by integrating criteria related to recurring congestion and non-recurring congestion management and improved reliability into plan framework objectives, priorities, and strategies as well as related performance measures.

F.2 Provide examples and cost-effectiveness measures within the plan as appropriate.

Responsibility and Relationships: Working group combining central office statewide and district/regional operations staff with statewide planning staff.

Action G: Assess and develop formal multiagency approach to collaborative strategy applications and their continuous improvement

Rationale: The real-time procedures for strategy applications—based on operational concepts and systems architecture—require formal attention on a cooperative basis, involving all partners who participate in delivering the service.

G.1 Convene working group of key participants in each strategy application and review mutual roles and objectives and related procedures and protocols, such as incident command, evacuation plans, diversion plans, ramp operation, work zone traffic management, and equipment and material prepositioning.

G.2 Identify the roles and responsibilities associated with the operational concepts for each strategy and the roles in development of infrastructure and in field procedures for each service delivery partner (state DOT, public safety agencies, local government, MPO, private service suppliers).

G.3 Establish a continuing cooperative approach (such as working group) for monitoring, evaluating, and improving procedures (see Collaboration Dimension).

Responsibility and Relationships: Working group of key participants. Senior executive sponsorship by transportation agency and partners may be necessary.

Examples/References:

- Primer: Statewide Opportunities For Linking Planning and Operations (FHWA): http://www.ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf
  Primer designed to raise awareness of the benefits and opportunities for coordinating planning and operations.
- Advancing Metropolitan Planning for Operations: The Building Blocks of a Model Transportation Plan Incorporating Operations – A Desk Reference (FHWA, April 2010): http://www.ops.fhwa.dot.gov/publications/fhwahop10027/fhwahop10027.pdf
  Resource designed to enable transportation planners and their planning partners to build a systematic transportation plan.
- Advancing Metropolitan Planning for Operations: An Objectives-Driven, Performance-Based Approach – A Guidebook: http://ops.fhwa.dot.gov/publications/fhwahop10026/fhwa_hop_10_026.pdf
- Guide to Integrating Business Processes to Improve Travel Time Reliability (SHRP 2 L01): http://www.trb.org/Publications/Blurbs/165284.aspx
- Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes (SHRP 2 L05): http://www.trb.org/Main/Blurbs/168854.aspx
- Evaluating Alternative Operations Strategies to Improve Travel Time Reliability (SHRP 2 L11): http://www.trb.org/Main/Blurbs/168142.aspx
- Maricopa County Association of Governments ITS Strategic Plan: http://www.azmag.gov/Projects/Project.asp?CMSID=1050&CMSID2=4231
- Nevada Department of Transportation Statewide Integrated Transportation Reliability Program: http://www.kimley-horn.com/projects/NevadaITRP/images/pdfs/TechMem_Dec.pdf
- Congestion Management Process North Central Texas Council of Governments: http://www.nctcog.org/trans/outreach/rmi/CMPrmi0308.pdf
- Management and Operations in the Metropolitan Transportation Plan: http://ops.fhwa.dot.gov/publications/moguidebook/index.htm

Programming/Budgeting Action Plan (L2 to L3)

Strategy Summary

Develop plan-based multiyear statewide TSM&O program and budget

Key Actions

A	Develop a staged multiyear program and budget for statewide TSM&O, including consideration of commitments by service delivery partners
B	Consider consolidation of TSM&O-related costs as a separate line item category in state DOT annual and multiyear budget on a multi-year lifecycle basis
C	Determine administrative or legal adjustments necessary regarding eligible use of funds and appropriate budget categories for TSM&O program components on a sustainable basis
D	Develop modifications to existing statewide and district/regional-level programming and budgeting process that integrates TSM&O
E	Develop methodology to consider TSM&O with other investments through a rational process of performance-based trade-offs and resource allocation

ACTIONS

Action A: Develop a staged multiyear program and budget for statewide TSM&O including consideration of commitments by service delivery partners

Rationale: A key step in formalizing TSM&O as a program and integrating it as a statewide consolidated resource allocation is the establishment of a multiyear, costed program.

A.1 Building on statewide plan, develop a staged statewide implementation program recognizing priorities as well as the capital, staffing, maintenance, and ITS technology upgrade needs, with identification of costs and benefits on a life-cycle basis, as well as relationships for incorporation into other proposed capacity and preservation-related improvements.

A.2 Develop a collaborative approach to identify and incorporate into respective service delivery partners' (local government, public safety agencies) planning and budgeting processes, commitments of the needed staffing and cooperative protocols essential for effective TSM&O strategy implementation.

Responsibility and Relationships: Working group combining central office and statewide budgeting and programming staff sponsored by senior program managers.

Action B: Consider consolidation of TSM&O-related costs as a separate line item category in state DOT annual and multiyear budget on a multi-year lifecycle basis

Rationale: For rational and transparent policy-related resource allocation, it is important to formalize TSM&O as a core program of the state DOT as an explicit consolidated line item in the statewide budget (including a time stream of resource commitments) consistent with the other core programs.

B.1 Secure agreement from top management and develop consolidated short and long-term TSM&O program capital and operating budgets (see Culture Dimension).

B.2 Modify current agency budgeting process at district/regional and statewide levels to incorporate systematic consideration of TSM&O project and program needs.

B.3 Consider reformatting agency annual budget and STIP as appropriate with consolidated categories reflecting TSM&O to include capital, maintenance and operating costs as distinct visible line items and incorporating short and long term commitments on a life-cycle basis. Account for short-term issues regarding budget restructuring.

B.4 Develop approach for briefing and buy-in from key legislative and/or commission/board stakeholders as appropriate to secure authorization to provide a separate budget for TSM&O.

Responsibility and Relationships: Authorized by top management and implemented by central office budgeting staff.

Action C: Determine administrative or legal adjustments necessary regarding eligible use of funds and appropriate budget categories for TSM&O program components on a sustainable basis

Rationale: The agency's existing sources of program resources (federal and state) may or may not have restrictions and subcategories (capital, maintenance, regions, use horizon) that need to be accommodated or adjusted to support TSM&O related budget items.

C.1 Identify current and past sources of state and federal funds used to fund TSM&O- and emergency operations-related capital, operating and maintenance costs.

C.2 Review state constitutional or statutory constraints regarding use of state capital and/or maintenance funds for TSM&O improvements (if any) both for infrastructure and maintenance.

C.3 Identify most logical sources of funds to program and budget for TSM&O capital, operating and maintenance costs.

Responsibility and Relationships: Central office operations program and budgeting/finance leadership in consultation with DOT legal counsel and legislative committee staff as appropriate

Action D: Develop modifications to existing statewide and district/regional-level programming and budgeting process that integrates TSM&O

Rationale: The existing set of activities that constitutes the budgeting and programming processes must be adjusted if it is to incorporate TSM&O on a transparent and rational basis.

D.1 Obtain policy support to adjust formal budgeting and programming process to integrate TSM&O on an appropriate level of consideration with other major investment categories.

D.2 Establish TSM&O-specific components of the agency budgeting and programming process to integrate TSM&O including specific activities, processes, formats, data, etc.

Responsibility and Relationships: Authorized by top management and implemented by central office budgeting staff.

Examples/References:

- Use of regional architecture in budgeting and programming (FHWA): http://ops.fhwa.dot.gov/publications/regitsarchguide/72use.htm
- FHWA Asset management paper: http://www.fhwa.dot.gov/infrastructure/asstmgmt/amppplan.cfm
- Project Management – Delivering the Capital Construction Programs at the Project Level: http://www.wsdot.wa.gov/projects/projectmgmt/
- Congestion Mitigation and Air Quality Program (CMAQ) funding application example: http://www.azmag.gov/Documents-Ext/ModalApps/ITS/APJ-ITS-1.pdf
- Guidelines for Transportation Management Systems Maintenance: http://tmcpfs.ops.fhwa.dot.gov/cfprojects/uploaded_files/Guidelines%20for%20TMS%20Maintenance.pdf

Project Development/Procurement Action Plan (L2 to L3)

Strategy Summary

Develop and document standardized project development/procurement procedures for TSM&O projects

Key Actions

A	Modify and document existing agency standard project development process (as needed) to suit TSM&O, in coordination with systems and technology development
B	Identify and adapt available (legal) procurement procedures as suitable for various TSM&O strategy deployments

ACTIONS

Action A: Modify and document existing agency standard project development process (as needed) to suit TSM&O, in coordination with systems and technology development

Rationale: It is important to standardize the project development process for ITS/TSM&O projects to reduce the "soft costs" and timeframes for project development.

A.1 Review experience with ITS/TSM&O management of project development for both expansion and enhancement of existing systems, as well as new systems, and determine if optimal process is being followed; evaluate experience.

A.2 Consider range of ITS and TSM&O-related infrastructure requirements and identify those that benefit from integration into other highway improvements and the implication for formalizing the appropriate project development process.

A.3 Document the project development process appropriate to ITS/TSM&O and integrate into agency project development manuals.

A.4 Consider the need for additional training and senior management support where guidelines are not being followed.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff.

Action B: Identify and adapt available (legal) procurement procedures as suitable for various TSM&O strategy deployments

Rationale: It is important to standardize the project development process for ITS/TSM&O projects around agency or statewide Information Technology (IT) procedures to reduce the "soft costs" and timeframes for project development.

B.1 Working with agency and/or statewide IT staff, convene working group for the development of appropriate procurement strategies.

B.2 Develop/adapt current state/agency procurement strategies for both expansion and enhancement of existing ITS and TSM&O systems, as well and new systems, and consider modifications if appropriate for compatibility with ITS and TSM&O best practice.

B.3 Publish guidelines as an agency procurement regulation for use with all future high-tech procurements, and provide training and other suitable outreach to ensure that future procurements follow these regulations.

B.4 Consider the need for additional training and senior management support where guidelines are not being followed.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff – and legal counsel as necessary.

Examples/References:

- Georgia Department of Transportation – Use of a Systems Integrator to Manage ITS Implementation: http://ntl.bts.gov/lib/jpodocs/repts_te/13459.pdf
- Michigan Department of Transportation – Use of a Design/Build/Warranty Contract: http://ntl.bts.gov/lib/jpodocs/repts_te/13460.pdf
- Nevada Department of Transportation – Use of a Systems Manager Contractor to Procure ITS http://ntl.bts.gov/lib/jpodocs/repts_te/13461.pdf
- Maryland State Highway Administration Coordinated Highways Response Action Team (CHART) – Using a Design Competition to Procure ITS Software: http://ntl.bts.gov/lib/jpodocs/repts_te/13462.pdf

Business Process Guidance

LEVEL 3 TO LEVEL 4

Why Business Processes are Important

Technical and business processes are an essential capability for establishing a stable and replicable basis for continuous improvement by identifying incremental improvements, determining the needed resources (capital, staffing, etc.), and establishing a standardized approach to implementation.

Improvement Target

From	Programming, budgeting, and project development processes for TSM&O standardized and documented (L3)
To	Processes streamlined and subject to continuous improvement (L4)
By	Integrating new operations objectives and processes into department activities as formalized standard operating procedures

Key Sub-dimensions

- Planning Process
- Programming/Budgeting
- Project Development/Procurement

Planning Process Action Plan (L3 to L4)

Strategy Summary

Evolve planning process to support continuous improvement in program effectiveness

Key Actions

A	Track emerging state-of-practice TSM&O strategies as appropriate to understand how well operational objectives are being achieved
B	Develop approach to introducing upgraded and state of the practice concepts and systems
C	Continue to improve and expand TSM&O scope to all network elements (urban and rural) and modes on a continuous basis based on performance evaluation
D	Introduce and utilize improved methods of combined consideration for operations and capacity improvements into the statewide and regional planning process
E	Standardize and document process for continuous improvement of TSM&O and emergency management strategies effectiveness

ACTIONS

Action A: Track emerging state-of-practice TSM&O strategies as appropriate to understand how well operational objectives are being achieved

Rationale: TSM&O strategies are evolving towards approaches that combine actions to better anticipate, avoid and respond to potential problems, and should be considered in evolving agency program.

A.1 Maintain contact with the state of the practice in relevant TSM&O areas through interaction with USDOT resources, technical conferences, associations, and the private sector, including international developments, and participate in pilot programs as appropriate.

A.2 Review and evaluate strategy evolutionary paths towards combined synergistic approaches, combining management and information tools such as more intensive freeway management (ATM – Advanced Traffic Management) and/or multi-jurisdictional implications (integrated corridor management [ICM], ramp metering), and the integration of probe vehicles, remote sensing, image assessment and other technologies.

A.3 Develop strategic approach to balancing ITS expansion/improvement with state of practice procedures, including service delivery partner role alignments related to performance improvement.

Responsibility and Relationships: Designated senior operations staff with ability to establish and maintain national professional contacts with peers.

Action B: Develop approach to introducing upgraded and state of the practice concepts and systems

Rationale: It is important to consider ongoing developments in new technology, management and operations concepts as they evolve since they may substantially improve TSM&O effectiveness.

B.1 Track state-of-the-art research and developments in advancing technology and applications, such as vehicle-to-infrastructure wireless communications and probe data and related operational concepts, such as active traffic management, corridor integration, traveler information and Connected Vehicle.

B.2 Seek opportunities to remain current on new approaches through peer interaction and awareness of federal and other research and development activities.

B.3 Consider costs and benefits to both customers and agency operations of capitalizing on commercial service providers for information, and consider incremental approaches to substituting/integrating new technology while balancing service and cost advantages with other risks.

B.4 Provide test-bed opportunities for new systems development where practical (pilot programs, pooled peer activities) to enhance agency understanding and potential for effective integration.

Responsibility and Relationships: Designated senior operations staff with working group to design piloting approaches.

Action C: Continue to improve and expand TSM&O scope to all network elements (urban and rural) and modes on a continuous basis based on performance evaluation

Rationale: Maximum mobility improvements require extending strategies to all elements of a regional transportation system that are part of a multimodal network with significant interdependence, including arterials and transit.

C.1 Review opportunities for interjurisdictional cooperation on an integrated corridor basis—including both freeways and arterials—and review options for ITS networking and for coordinated or consolidated operations, including data collection burden sharing, data sharing, devolved operational responsibility, cost-sharing, etc.

C.2 Review transit and freight operations for appropriate intermodal interaction and integration, including preferences and specialized traveler information.

C.3 Consider new forms of collaboration and partnership to capitalize on inter-network and multimodal opportunities including both joint planning/programming and joint operations (including establishment of new joint regional operating entities).

Responsibility and Relationships: Designated senior operations staff with working group to design piloting approaches.

Action D: Introduce and utilize improved methods of combined consideration for operations and capacity improvements into the statewide and regional planning process

Rationale: The planning state-of-the-practice is focused on capacity investments. It does not currently accommodate deficiency analysis, travel forecasting, or alternatives evaluation for TSM&O investments—or comparisons between TSM&O and capacity investments.

D.1 Encourage and support a review of state-of-the-practice for available methods to integrate TSM&O into the planning processes, as based on performance and B/C related to mobility, safety, and livability, including sketch planning, forecasting, simulation, use of archived data, etc.

D.2 Custom tailor approach to strategies under consideration, data, staff capabilities, and decision focus.

Responsibility and Relationships: Senior statewide operations staff working with DOT statewide and MPO/RTPA staff. May require special technical support.

Action E: Standardize and document process for continuous improvement of TSM&O and emergency management strategies effectiveness

Rationale: A key underpinning to continuous improvement is a continuous planning process that relates evaluated outcomes to a process of improving operational concepts and their applications.

E.1 Establish a performance evaluation framework (see Performance Measurement Dimension) that is linked to operations concepts and field protocols that can be modified for improvement with the resource implications introduced into the planning process.

E.2 Optimize ITS infrastructure for maximum synergy among TSM&O strategies and ease of improvement with technology and operations concept advancements.

E.3 Develop process to systematically relate existing and potential strategies to problem type, area, facility, network, and mode, including "tuning up" for changing conditions.

E.4 Benchmark agency strategy applications against peer state-of-the-practice to ensure best practice implementation.

E.5 Establish continuing scanning process to identify benefits and costs of TSM&O strategies in conjunction with other project types.

Responsibility and Relationships: Working group of statewide operations and planning staff with district/regional operations staff support.

Examples/References:

- Primer: Statewide Opportunities For Linking Planning and Operations (FHWA): http://www.ops.fhwa.dot.gov/publications/fhwahop08028/state_plnops.pdf
  Primer designed to raise awareness of the benefits and opportunities for coordinating planning and operations.
- District level program example: Virginia Department of Transportation (VDOT) Northern Virginia District (NOVA) Program Regional ITS Architecture 1.0: http://www.vdot-itsarch.com/docs/NVITSArchMaintenancePlanV1%200(2009-09-18).pdf
- VDOT NOVA Program Plan summary: http://virginiadot.org/travel/resources/ProgramPlanSummaryFinal.pdf
- VDOT NOVA Program Plan update: http://www.virginiadot.org/travel/resources/3-27-06_Final_NOVA_Program_Plan.pdf
- Maryland State Highway Administration Coordinated Highways Response Action Team (CHART) Non-constrained Deployment Plan (2005): http://www.chart.state.md.us/downloads/readingroom/CHART-NCDP-2005-Final-Plan.pdf
- Maricopa Association of Governments ITS Concept of Operations: http://www.azmag.gov/Documents/pdf/cms.resource/RCTO-Final_Report79101.pdf
- Maricopa County Association of Governments ITS Strategic Plan: http://www.azmag.gov/Projects/Project.asp?CMSID=1050&CMSID2=4231
- *Institutional Architectures to Improve Systems Operations and Management* (SHRP 2 L06), Appendix D: Regional Operations Collaboration Examples: http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2_S2-L06-RR-1.pdf

Programming/Budgeting Action Plan (L3 to L4)

Strategy Summary

Integrate TSM&O into the MPO/RTPA programming and budgeting process

Key Actions

A	Develop unified joint programming process with MPO/RTPA and other operators in continuing programming and budgeting activities
B	Seek innovative financing opportunities
C	Develop integrated collaborative approach to budgeting and funding regional/interjurisdictional TSM&O investments and activities
D	Incorporate process for investment trade-offs among capacity vs. operations vs. maintenance investments as part of regular budgeting cycle

ACTIONS

Action A: **Develop unified joint programming process with MPO/RTPA and other operators in continuing programming and budgeting activities**

Rationale: TSM&O improvements in regional plan should be included in the regional programming and budgeting process.

A.1 Develop a staged multiyear program and budget for regional TSM&O, based on the MPO/RTPA TSM&O plan component, including consideration of commitments by service delivery partners.

A.2 Consider consolidation of TSM&O-related costs as a separate line item category in the TIP and long-range plan.

A.3 Determine administrative or legal adjustments necessary regarding eligible use of funds and appropriate budget categories for TSM&O program components on a sustainable basis.

A.4 Develop modifications to the existing MPO/RTPA programming and budgeting process that integrates TSM&O.

Responsibility and Relationships: Senior statewide operations and program/budgeting staff working with counterpart MPO/RTPA staff.

Action B: Seek innovative financing opportunities

Rationale: There may be opportunities to reduce or share agency costs through relationships with other public entities or private sector service providers.

B.1 Review methods to share or offload direct costs such as: cost-sharing (capital and operating) with other jurisdictions; public-private partnerships allowing private entities to capitalize on state infrastructure or right-of-way; and joint use of roadside devices, communications, etc.

B.2 Compare costs of agency provision of services supported by agency infrastructure with costs of acquisition of such services, and where beneficial, build into financial plan.

Responsibility and Relationships: Senior statewide operations and program/budgeting staff working with possible specialist consultant support.

Action C: Develop integrated collaborative approach to budgeting and funding regional/interjurisdictional TSM&O investments and activities

Rationale: In the cases where there are several jurisdictions within a single region, special funding arrangements may be appropriate for proposed TSM&O investments and activities that are most effective on a multijurisdictional basis.

C.1 Review multijurisdictional projects (such as corridors) where coordinated implementation is important.

C.2 Identify resource capacities and constraints of involved jurisdictions.

C.3 Review opportunities for sharing, contracting out of responsibilities, consolidation, cross-subsidies, staged investments, etc.

Responsibility and Relationships: Senior statewide operations and program/budgeting staff working with counterpart MPO/RTPA staff.

Action D: Incorporate process for investment trade-offs among capacity vs. operations vs. maintenance investments as part of regular budgeting cycle

Rationale: TSM&O investments provide unique short-run and cost-effective benefits to key congestion and safety-related issues that may postpone or modify the need for new capacity and therefore must be incorporated into consideration of the annual budget and transportation improvement program as they relate to regional mobility policy and programs.

D.1 Identify capacity project contexts where TSM&O may provide a contributing service improvement and consider the impacts on configuration and timing of related capacity improvements (and potential cost savings).

D.2 Develop a performance-based, cost-benefit analytic approach to identify and optimize the benefits and trade-offs where TSM&O provides a substitute, postponement, or augmentation impact regarding capacity investments.

Responsibility and Relationships: Senior statewide operations, statewide planning and program/budgeting staff. Senior executive support will be essential.

Examples/References:

- *Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes*, (SHRP 2 L05): http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2prepubL05Guide.pdf
- Analytical Tools for Asset Management: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_545.pdf
- Public-Private Partnerships for Highway Infrastructure: Capitalizing on International Experience: http://international.fhwa.dot.gov/pubs/pl09010/index.cfm

Project Development/Procurement Action Plan (L3 to L4)

Strategy Summary

Integrate standardized TSM&O project development/procurement process with overall DOT procedures

Key Actions

A Document and standardize statewide process for both project development and procurement, with options available by project type, into the agency standard processes and manuals

ACTIONS

Action A: Document and standardize statewide process for both project development and procurement, with options available by project type, into the agency standard processes and manuals

Rationale: Standardization of the processes is essential for efficient and effective management of TSM&O program development.

A.1 Review existing project development and procurement process and identify appropriate modifications to facilitate TSM&O projects, recognizing their special characteristics.

A.2 Develop standard project development and procurement instruments including sample plans, specifications, and estimates documentation, as well as standard set of general provisions to be incorporated into these documents.

Responsibility and Relationships: Central office statewide operations staff working with project development and procurement staff and legal counsel as necessary.

Examples/References:

- Georgia Department of Transportation – Use of a Systems Integrator to Manage ITS Implementation: http://ntl.bts.gov/lib/jpodocs/repts_te/13459.pdf
- Michigan Department of Transportation – Use of a Design/Build/Warranty Contract: http://ntl.bts.gov/lib/jpodocs/repts_te/13460.pdf
- Nevada Department of Transportation – Use of a Systems Manager Contractor to Procure ITS http://ntl.bts.gov/lib/jpodocs/repts_te/13461.pdf

- Maryland State Highway Administration Coordinated Highways Response Action Team (CHART) – Using a Design Competition to Procure ITS Software: http://ntl.bts.gov/lib/jpodocs/repts_te/13462.pdf

Collaboration Guidance

✔ LEVEL 1 TO LEVEL 2

Why Collaboration is Important

The development and implementation of TSM&O requires a collaborative approach. The effectiveness of most strategies is dependent on improving the coordinated performance of each partner.

Improvement Target

From	Relationships on informal, infrequent and personal basis (L1)
To	Regular collaboration at regional level (L2)
By	Establishing mechanisms for regular coordination and cooperation

Key Sub-dimensions

- Public Safety Agency Collaboration
- MPO/RTPA/Local Government Cooperation
- Outsourcing/Public-private Partnerships

Public Safety Agency Collaboration Action Plan (L1 to L2)

Strategy Summary

Establish working relationships

Key Actions

A	Establish relationships at agency and district/regional level (metro and rural) with fire, police, emergency management and other responders and agree to regular interaction aimed at improving processes—with initial focus on emergency response and incident management
B	Identify mutual objectives (shared vision) and key challenges to joint/cooperation in TSM&O and establish initial approach to performance management
C	Review voice and data communications interoperability and information transfer for potential resolution
D	Review, discuss and clarify key incident and emergency management data items needed for communication among key players in real time to support effective management
E	Review, discuss, clarify and train for roles and responsibilities both in the field and centers for all key participants

ACTIONS

Action A: Establish relationships at agency and district/regional level (metro and rural) with fire, police, emergency management and other responders and agree to regular interaction aimed at improving processes—with initial focus on emergency response and incident management

Rationale: A close working relationship is essential to identify and carry out the key roles set forth in the operational concepts at more than a "nominal" level.

A.1 Identify and establish relationships among key personnel at the transportation agency, regional and local government level and among public safety counterparts (state patrol and local law enforcement, fire, and emergency entities) and agree to meet to discuss traffic-related activities focused on mutual cooperation to achieve respective agency objectives. Utilize as appropriate existing regional general purpose government planning and program mechanisms as conveners.

A.2 Identify and establish relationships among key personnel at the transportation agency central office (statewide) level and among public safety counterparts, including other state agencies and with appropriate state-level associations. Utilize as appropriate existing state and regional general purpose government program mechanism and administration level conveners as appropriate to establish and maintain the relationships.

Responsibility and Relationships: A working relationship needs to be both at the district/region level and at the agency level (CEO-to-CEO). DOT Executive sponsorship will be necessary, supplemented by district/regional leadership, to establish a framework for and interagency activity at the district/regional staff level. In some cases an MPO/RTPA or Council of Governments can provide the convening function.

Action B: Identify mutual objectives (shared vision) and key challenges to joint/cooperation in TSM&O and establish initial approach to performance management

Rationale: An understanding of respective (and differing) agency objectives, priorities, and constraints regarding safety, mobility, and law enforcement is essential to the development of an understanding of key issues as the basis for developing an effective cooperative approach. This understanding is essential both in the field and at the executive management level.

B.1 At the regional/district level, review the material from National Traffic Incident Management Responder Training Program (SHRP 2 L12/L32) and the National Transportation Incident Management Coalition (NTIMC) including shared objectives related to responder safety, quick clearance, and interoperable communications, as they relate to basic operational issues from each agency perspective in conduct of both routine and special procedures; do this in a formal manner for use as an agenda for follow-up joint consideration. (See references below for available material.)

B.2 At the central office level, review the material from the NTIMC and the relationship between field activities and overall agency-level policy, program, and resource considerations on the part of each agency.

Responsibility and Relationships: Utilize working group(s) as established in Action A.

Action C: Review voice and data communications interoperability and information transfer for potential resolution

Rationale: Effective operating relationships depend on good data and voice interchange among key players in real-time to establish situational awareness and to coordinate information and actions that must be based on compatible technologies.

C.1 Review status of existing and planned communications improvements (voice and data) regarding interoperability on an interagency basis—both center to center and field.

C.2 Review mutual availability of public safety agency computer-aided dispatch (CAD) information and DOT camera and sensor data in support of improved incident and emergency management, focusing on real-time availability of critical information.

C.3 Identify a potential staged plan to reach an acceptable level of interoperability and the commitment implications for each agency.

Responsibility and Relationships: Central Office staff working with district/regional traffic management centers and partners.

Action D: Review, discuss and clarify key incident and emergency management data items needed for communication among key players in real time to support effective management

Rationale: Effective incident and emergency and management depend on center and field personnel receiving key information items regarding incident characteristics and status in real time.

D.1 Review best practice regarding incident management procedures and protocols in light of current local practice to identify key information needed by public safety agencies, DOT, and towing and recovery participants to provide most effective response.

D.2 Identify specific information items, formats and sequences for communication (voice and data) needed by key participants at each key stage of incident and emergency management.

D.3 Develop appropriate communications protocols.

Responsibility and Relationships: Central Office staff working with district/regional traffic management centers and key partners (public safety agencies and private sector).

Action E: Review, discuss, clarify, and train for roles and responsibilities both in the field and centers for all key participants

Rationale: Effective incident and emergency response requires both joint preplanning and close real-time cooperation on the part of key players.

E.1 Identify key procedures and protocols among all key players with reference to incident and emergency management best practice and the National Incident Management Systems (NIMS), including incident command and support roles.

E.2 Review and discuss lines of authority within DOT and partner public safety agencies and clarify where necessary.

E.3 Conduct appropriate training, drills and tabletop exercises to test and improve concepts and familiarize personnel with roles and procedures, and to test communication protocols. (See the

National Traffic Incident Management Responder Training Program [SHRP 2 L12/L32] in the references.)

Responsibility and Relationships: Central office staff working with district/regional traffic management centers and partners.

Examples/References:

- Simplified Guide to the Incident Command System: http://ops.fhwa.dot.gov/publications/ics_guide/ics_guide.pdf
- Intelligent Transportation System (ITS) Operational Support Contracts Implementation Plan: http://utrc2.org/~old_site/research/assets/76/itsoperations1.pdf
- For state of the practice material: http://ntimc.transportation.org/Pages/default.aspx and http://ops.fhwa.dot.gov/eto_tim_pse/index.htm
- National Traffic Incident Management Responder Training Program: http://www.fhwa.dot.gov/goshrp2/Solutions/Reliability/L12_L32/National_Traffic_Incident_Management_Responder_Training_Program

MPO/RTPA/Local Government Cooperation Action Plan (L1 to L2)

Strategy Summary

Develop and formalize basis for cooperative needs/opportunity analysis

Key Actions

A	Establish mechanism for interagency dialogue regarding TSM&O at district/regional level between DOT and other transportation planning and operating agencies
B	Participate in regional planning regarding agency priorities and funding opportunities

ACTIONS

Action A: Establish mechanism for interagency dialogue regarding TSM&O at district/regional level between DOT and other transportation planning and operating agencies

Rationale: There may be several road and transit operators in a regional service network including state facilities where TSM&O strategy development and operational coordination opportunities exist and are currently not considered by relevant jurisdictions.

A.1 Identify key participants in regional planning, systems development, routine systems operation, and emergency response—both highway and transit—and conduct mutual briefings regarding TSM&O policy, objectives, and program activities.

A.2 Establish (if it doesn't exist) or participate in interagency group to focus on ITS and TSM&O in regional transportation systems development or operations, including appropriate existing MPO/RTPA committees.

A.3 Coordinate local government TSM&O discussions with state and local public safety community as described above.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework.

Action B: Participate in regional planning regarding agency priorities and funding opportunities

Rationale: A metropolitan and rural regional or local government transportation planning activity (if it exists) needs to consider TSM&O development and state DOT representation, and is essential as part of its planning and programming process in order to accomplish desired objectives and outcomes.

B.1 Participate in regional planning regarding agency priorities and funding opportunities representing agency interests at the regional level.

B.2 Identify cross-jurisdictional boundary issues and cooperative mechanisms to overcome cooperative barriers.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework.

Examples/References:

- "The Benefits of Regional Collaboration in Managing Network Transportation Operations": http://www.piarc.org/ressources/documents/actes-seminaires06/c14-malaisie06/8619,TS15-Berman.pdf
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx
- Regional Concept for Transportation Operations: http://www.plan4operations.dot.gov/reg_concept.htm
- Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security (FHWA): http://ntl.bts.gov/lib/jpodocs/repts_te/13686/13686.pdf
  This primer was written for transportation professionals and public safety officials from cities, counties, and states that are responsible for day-to-day management and operations within a metropolitan region. It is intended to help agencies and organizations, and the operations people within them, understand the importance of regional collaboration and coordination, how it happens, and how to get started.

Outsourcing/Public-Private Partnerships Action Plan (L1 to L2)

Strategy Summary

Analyze opportunities for beneficial outsourcing and/or other public-private partnership opportunities

Key Actions

A	Identify TSM&O activities that may lend themselves to outsourcing and/or hybrid staffing
B	Review pros and cons of leveraging private sector resources and outsourcing functions

ACTIONS

Action A: Identify TSM&O activities that may lend themselves to outsourcing and/or hybrid staffing

Rationale: While there is wide variation in applicability, certain TSM&O functions and needed resource development may be candidates for outsourcing or purchase from private service providers where dictated by staffing, cost or technology considerations. These may include: traffic management center staffing, service patrol, systems maintenance and systems engineering, and planning and design responsibilities. In addition there may be revenue-raising and cost saving potential regarding right-of-way resource sharing, or purchase of private traffic or asset conditions data.

A.1 Identify functions where constraints indicate that outsourcing may be a beneficial approach to achieve agency objectives including: access to flexible or low cost staffing, capitalizing on special outside expertise, acquiring private data, or overcoming staffing constraints.

A.2 Identify peer state settings for outsourcing and contact client agency for lessons learned including range of approaches to procurement and contract management for outsourcing functions with a focus on relationships between functions to be supplied and type and length of contract and procurement strategy.

Responsibility and Relationships: Central office working with key district/regional staff.

Action B: Review pros and cons of leveraging private sector resources and outsourcing functions

Rationale: There is always a range of trade-offs to be made when considering staffing vs. outsourcing.

B.1 Analyze the relative merits of agency staffing vs. outsourcing, carefully considering the cost components of functions (capital, labor, management, maintenance), staffing/hiring flexibility, maintenance of internal capabilities, and sustainability.

B.2 Consider benefits of applying a performance contracting approach to outsourcing, including capabilities needed to shift from managing people to managing performance by external contractor, and the ability to impose performance measurement as a basis for contracting.

B.3 Review comparative potential costs (direct and indirect) of outsourcing vs. internal provision and assess the level of competition for cost comparability and other factors as itemized in Action A above. Consider the need to maintain core capacities in-house—technical and management—(rather than outsource) to maintain policy and to ensure sustainability of basic agency capability to advance program in both the short and long run. Where the agency has multiple service delivery units (districts, regions, traffic management centers) a mixed approach may be feasible.

Responsibility and Relationships: Central office working with key district/regional staff.

Examples/References:

- State DOT Outsourcing and Private-Sector Utilization: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_313.pdf
- Outsourcing of Kansas Department of Transportation functions: http://www.e-archives.ky.gov/Pubs/transportation/tc_rpt/ktc_05_12_spr282_04_1f.pdf
- Congestion Mitigation and Air Quality Improvement (CMAQ) and public-private partnerships: http://www.fhwa.dot.gov/environment/air_quality/cmaq/reference/public-private_partnerships/
- "Procuring, Managing, and Evaluating the Performance of Contracted TMC Services": http://tmcpfs.ops.fhwa.dot.gov/projects/perf_cont_tmc.htm

Collaboration Guidance

✔ LEVEL 2 TO LEVEL 3

Why Collaboration is Important

The development and implementation of TSM&O requires a collaborative approach. The effectiveness of most strategies is dependent on improving the coordinated performance of each partner.

Improvement Target

From	Regular collaboration at regional level (L2)
To	Collaborative interagency adjustment of roles/responsibilities by formal interagency agreements (L3)
By	Executing formal interagency agreement for cooperative approach

Key Sub-dimensions

- Public Safety Agency Collaboration
- MPO/RTPA/Local Government Cooperation
- Outsourcing/Public-private Partnerships

Public Safety Agency Collaboration Action Plan (L2 to L3)

Strategy Summary

Develop and formalize basis for cooperation at interagency level

Key Actions

A	Execute formal interagency agreement to develop cooperative approach to TSM&O including formal interagency working group—both emergency and incident management
B	Conduct transportation incident and emergency executive forums for senior management
C	Develop and implement protocols for communication of key incident and emergency management data items among key players in real time to support effective management, including establishment of voice and data communications interoperability and information transfer
D	Develop and administer interagency and cross-functional guidance for traffic and emergency incident response and scene management functions and procedures, including associated training and credentialing programs
E	Establish a major incident and emergency debriefing process for review and rationalization of responsibilities and procedures as developed in previous actions
F	Develop joint agreement to performance measurement and process improvement approach

ACTIONS

Action A: Execute formal interagency agreement to develop cooperative approach to TSM&O including formal interagency working group—both emergency and incident management

Rationale: The interagency commitments, relationships and procedures regarding traffic incidents and transportation emergency response activities must be established on a stable, sustainable basis (surviving staff/organizational changes) to support continuous improvement.

A.1 Establish a Traffic Incident Management/Systems Operations Working Group including an executive committee and technical committees as appropriate. Include both field and management personnel and identify leadership.

A.2 Develop an agenda building on traffic incident and emergency operations debriefings including operation concepts, drawing on peer and national best practice materials as appropriate.

Responsibility and Relationships: DOT executive sponsorship will be necessary (both agencies), supported by central office staff development of agreement in conjunction with public safety agency staff.

Action B: Conduct transportation incident and emergency executive forums for senior management

Rationale: Effective TSM&O requires cooperation at the overall agency level to cope with varying priorities and resources and support mutual objectives, and will require adjustments in policies, programs, technology, and staff development that must be addressed by leadership across agency boundaries.

B.1 Identify key leadership that is essential to improved TSM&O on an interagency basis and develop briefing material. The working group established in Action A above may be used for this purpose.

B.2 Conduct executive briefings on key topics with policy implications including the benefits associated with improved management, and as related to national and state requirements, professional standards and conventions; identify key issues for executive consideration.

Responsibility and Relationships: DOT executive sponsorship will be necessary with materials developed by central office staff.

Action C: Develop and implement protocols for communication of key incident and emergency management data items among key players in real time to support effective management including establishment of voice and data communications interoperability and information transfer

Rationale: Effective incident and emergency management requires real time communication of key information needed by all participants.

C.1 Building on the identified information transfer needs (see L1-L2), obtain agreement on data items, formats and sequences for their communication at each stage in incident and emergency management.

C.2 Test and implement protocols.

Responsibility and Relationships: Central office staff working with district/regional traffic management centers and partners.

Action D: Develop and administer interagency and cross-functional guidance for traffic and emergency incident response and scene management functions and procedures, including associated training and credentialing programs

Rationale: Guidance, training, and drills are important to develop and institutionalize common procedures and protocols.

D.1 Update or develop/adapt incident and emergency management guidance regarding roles and relationships and protocols and procedures consistent with agreed-upon performance levels—and adapted to the specifics of both statewide and regional contexts.

D.2 Consider the use of self-assessment as the basis for identifying training, drilling and other program development needs (as available from FHWA) as identified in Action B above.

D.3 Access training and drilling resources as appropriate. (See the National Traffic Incident Management Responder Training Program [SHRP 2 L12/L32] in the references.)

Responsibility and Relationships: Senior TSM&O staff working with public safety counterparts and in consultation with agency training unit.

Action E: Establish a major incident and emergency debriefing process for review and rationalization of responsibilities and procedures as developed in previous actions

Rationale: To establish the basis for continuous improvement on a cooperative basis, it is important to start with mutual reviews of major incidents to identify the relationships between safety and mobility.

E.1 Define “major” incident as mutually satisfactory to merit debriefing and identify a procedure for convening and conducting debriefings and managing follow-up.

E.2 Exercise debriefing procedures.

Responsibility and Relationships: Conceptual agreement may require senior executive sponsorship with central office developing criteria in cooperation with districts/regions and their public safety agency partners. A lead staff manager/convener/coordinator will be necessary.

Action F: Develop joint agreement to performance measurement and process improvement approach

Rationale: Reduction in disruption from traffic incidents and other events can only take place in the context of measuring procedural outputs and service outcomes.

F.1 Develop mutual agreement on performance metrics (see Performance Measurement Dimension) for the purposes of establishing a basis to measure the relationship between changes in procedures and improved performance.

F.2 Collect and analyze performance data for incidents, emergencies, and events of different types and utilize as part of debriefing process.

Responsibility and Relationships: Executive sponsorship at both the DOT and relevant public safety agencies will be necessary—supported by staff development units—to develop policy to collaborate an appropriate joint administrative and technical approach.

Examples/References:

- Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security (FHWA): http://ntl.bts.gov/lib/jpodocs/repts_te/13686/13686.pdf
  This primer was written for transportation professionals and public safety officials from cities, counties, and states that are responsible for day-to-day management and operations within a metropolitan region. It is intended to help agencies and organizations, and the operations people within them, understand the importance of regional collaboration and coordination, how it happens, and how to get started.
- Sharing information between public safety and transportation agencies: http://plan4operations.dot.gov/docs/sharing_nchrp2004.pdf
- For state of the practice material: http://ntimc.transportation.org/Pages/default.aspx and http://ops.fhwa.dot.gov/eto_tim_pse/index.htm
- National Traffic Incident Management Responder Training Program: http://www.fhwa.dot.gov/goshrp2/Solutions/Reliability/L12_L32/National_Traffic_Incident_Management_Responder_Training_Program

MPO/RTPA/Local Government Cooperation Action Plan (L2 to L3)

Strategy Summary

Undertake collaborative planning and budgeting for priority improvements

Key Actions

A	Support integration of TSM&O considerations into regional plans and cooperative approach to planning and budgeting
B	Develop joint agreement to performance measurement and process improvement approach to be applied to regional operations in real time
C	Execute formal interagency-level agreement for cooperative TSM&O real time operational activities, respecting the objectives of all parties and committing to performance-based continuous improvement
D	Identify and initialize cross-discipline training activities utilizing both local and national resources

ACTIONS

Action A: Support integration of TSM&O considerations into regional plans and cooperative approach to planning and budgeting

Rationale: Regional transportation development programs may be focused on jurisdiction-specific legacy capital improvements and overlook cost-effective opportunities for cooperative regional service improvement.

A.1 Provide persuasive materials for the regional planning and programming process regarding TSM&O role in short-term mobility, safety, livability, and sustainability, and support regional planning staff in appropriate briefings.

A.2 Review opportunities to modify regional (metro and rural) planning processes to incorporate TSM&O improvements and identify potential cooperative projects, including traffic operations, integrated corridors, ramp metering, HOV, bus operations, etc.

A.3 Incorporate traffic signal systems management and transportation public safety communications interoperability elements into statewide and regional long range transportation plans, transportation improvement programs, and transportation programming processes.

A.4 Review respective (state and local) resource allocation process to identify opportunities for cost-effective synergism, cost sharing, and staging.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework.

Action B: Develop joint agreement to performance measurement and process improvement approach to be applied to regional operations in real time

Rationale: Developing improved TSM&O effectiveness requires alignment of operational objectives, operational concepts, plans and activities—driven by performance objectives aligned among all key collaborators. A good measurement program can improve program credibility and support program expansion.

B.1 Identify mutually acceptable start-up performance measures with agreed upon measures and an approach to measurement and analysis. The measures may be continuous or event-related.

B.2 Develop an interjurisdictional performance review process with debriefings as appropriate, focused on operations adjustments to improve performance and an approach to reporting performance to decision-makers and the public.

Responsibility and Relationships: Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force. Senior district/regional executive support may be essential to establish framework.

Action C: Execute formal interagency-level agreement for cooperative TSM&O real time operational activities, respecting the objectives of all parties and committing to performance-based continuous improvement

Rationale: Beyond planning, there may be opportunities for improved interjurisdictional operational coordination to improve service in real time.

C.1 Review opportunities for improved network operations across jurisdictional boundaries and facility types such as improved roadway network and corridor operations and related improvements supporting transit operations.

C.2 Establish the performance management process as per Action B above.

Responsibility and Relationships: Senior executive sponsorship may be essential to establish framework. Central office and district planning and operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force.

Action D: Identify and initialize cross-discipline training activities utilizing both local and national resources

Rationale: Training is important to develop and institutionalize common procedures and protocols that may be involved in regional traffic operations and intermodal operations.

D.1 Consider the use of self-assessment as the basis for identifying training and other program development needs (as available from FHWA), identified in Action B above.

D.2 Access training resources as appropriate.

Responsibility and Relationships: Central office and district/regional operations staff taking initiative with MPO/RTPA staff through appropriate regional planning task force.

Examples/References:

- Enhance collaboration by sharing office space among operations stakeholders: http://www.itslessons.its.dot.gov/its/benecost.nsf/ID/7CAC2DE1EC1D0A8E8525707E0061C4E8
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx

Outsourcing/Public-Private Partnerships Action Plan (L2 to L3)

Strategy Summary

Develop policy on outsourcing if relevant

Key Actions

A	Where outsourcing or new forms of public-private partnership are relevant, develop business model regarding role, costs and benefits of outsourcing on a "make or buy" basis
B	Develop performance procurement/contract management approach for any outsourced service
C	Coordinate outsourcing among agency client units

ACTIONS

Action A: Where outsourcing or new forms of public-private partnership are relevant, develop business model regarding role, costs and benefits of outsourcing on a "make or buy" basis

Rationale: The decision regarding outsourcing may imply a change in agency business model regarding the provision of service delivery and organizational and managerial responsibilities.

A.1 Where outsourcing is under consideration, develop an annualized operations program resourcing and staffing plan that integrates public and private sector resources. Consider the shift in basic staff management focus, size, type, and skill needs associated with outsource.

A.2 Where an agency has limited outsourcing experience, consider a pilot test of certain function(s) or in specific districts/regions, including opportunities to run comparisons of staff vs. private provision in parallel contexts (different regions) for comparative purposes.

Responsibility and Relationships: Central office working with key district/regional staff. Outside technical support may be helpful in analyzing options based on peer experience.

Action B: Develop performance procurement/contract management approach for any outsourced service

Rationale: A key advantage of outsourcing is the ability to impose performance management through contract performance levels.

B.1 Review industry experience with performance contracting, including review of contract documents from peer agencies and develop or access needed expertise.

B.2 Consider multi-stage test of outsourcing contract framework allowing for periodic adjustment of performance targets and other scope matters.

Responsibility and Relationships: Central office operations and procurement staff, working with key district/regional staff for specific projects. Outside technical support may be helpful in analyzing options based on peer experience.

Action C: Coordinate outsourcing among agency client units

Rationale: In states with multiple, ongoing outsourced and interacting TSM&O functions, standardization and coordination at the management level is important.

C.1 Develop organized, consistent approach to outsourcing contract management, performance requirements, reporting, and other features to ensure uniformity, comparability, and coordination where contractors and managers intersect.

Responsibility and Relationships: Central office staff with involvement of all relevant units outsourcing TSM&O activities. Senior sponsorship may be essential for appropriate span of control.

Examples/References:

- "Innovations in Public-Public Partnering and Relationship Building in State DOTs": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-7.pdf
- Analysis of ATIS (Advanced Traveler Information System) Partnering: http://tti.tamu.edu/documents/3950-2.pdf
- Public-private partnerships and managed lanes: http://www.itsbenefits.its.dot.gov/its/benecost.nsf/ID/D48C18FE714FD32A852572BF00544D8F
- Transportation Joint Management Centers: http://www.campo-nc.us/2009-conference-slides/Presentations/PDFs/A.1-Joint_TMCs-Edelstein_11-5-09.pdf

Collaboration Guidance

LEVEL 3 TO LEVEL 4

Why Collaboration is Important

The development and implementation of TSM&O requires a collaborative approach. The effectiveness of most strategies is dependent on improving the coordinated performance of each partner.

Improvement Target

From	Collaborative interagency adjustment of roles/responsibilities by formal interagency agreements (L3)
To	High level of operations coordination institutionalized among key players—public and private (L4)
By	Negotiate effective roles and responsibilities in light of agency priorities, resources and objectives

Key Sub-dimensions

- Public Safety Agency Collaboration
- MPO/RTPA/Local Government Cooperation
- Outsourcing/Public-private Partnerships

Public Safety Agency Collaboration Action Plan (L3 to L4)

Strategy Summary

Rationalize roles via new forms of sharing and consolidation

Key Actions

A	Rationalize roles, responsibilities, and resources in light of agency priorities, resources, and agreement on performance
B	Review opportunities for statutory and administrative adjustments to institutionalize changes that improve efficiency and effectiveness
C	Standardize and document joint operational procedures and related performance measures as interagency policy

ACTIONS

Action A: Rationalize roles, responsibilities, and resources in light of agency priorities, resources, and agreement on performance

Rationale: While general responsibilities of transportation agencies and public safety agencies are established in law, specific actions, prerogatives, customary procedures, and regulations have evolved without regard to optimizing public safety together with mobility and may benefit from adjustment and reallocation with regard to both effectiveness and costs.

A.1 Conduct a joint review of specific roles and actions as typically exist and consider potential for adjustments (such as transfer or reallocation of functions, collocation, and adjustments in operating roles) that may improve the effectiveness of TSM&O (such as improved incident clearance time, reduced accidents, and reduced costs through such benefits as more effective use of personnel, consolidation of like functions, collocation, and outsourcing).

A.2 Compare current practices with appropriate optimum business model. Make such changes as per A.1 that are possible on an administrative basis.

A.3 Implement an annualized traffic incident management program process that encompasses updating of programmatic strategic plans and performance reporting that is consistent with national best practice.

A.4 Consider advantages of pooled and mutual support approach to meeting planning and TSM&O resource needs and develop cooperative approach to budgeting related resources and activities.

A.5 Plan and incrementally develop physical collocation of communications, command, and control centers and other facilities as appropriate for maximum cooperation, coordination and collaboration, and efficient use of resources.

Responsibility and Relationships: Central office staff. Outside technical support may provide neutral perspective and knowledge of peer experience.

Action B: Review opportunities for statutory and administrative adjustments to institutionalize changes that improve efficiency and effectiveness

Rationale: Some important "rationalizations" of roles and responsibilities between transportation and public safety entities may require legislative action.

B.1 Identify and agree on needed changes in law ranging from minor (quick clearance) to more significant (transportation personnel role in towing, first responder prerogatives, relationships with safety service providers).

B.2 Seek legislative support and action.

Responsibility and Relationships: Central office staff in consultation with legal unit. Senior executive oversight needed to provide policy and political input.

Action C: Standardize and document joint operational procedures and related performance measures as interagency policy

Rationale: Continuous improvement of operational concepts, procedures, and protocols requires documentation to ensure improvements are mainstreamed—and to serve as a clear point of departure for the next increment of improvement.

C.1 Agree on an interjurisdictional basis on the form of documentation and assemble appropriate capability.

C.2 Document current procedures and develop schedule and format for periodic updates.

Responsibility and Relationships: Joint interagency staff group can develop documentation. consensus agreements may require senior staff involvement.

Examples/References:

- Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security (FHWA): http://ntl.bts.gov/lib/jpodocs/repts_te/13686/13686.pdf
  This primer was written for transportation professionals and public safety officials from cities, counties, and states that are responsible for day-to-day management and operations within a metropolitan region. It is intended to help agencies and organizations, and the operations people within them, understand the importance of regional collaboration and coordination, how it happens, and how to get started.
- Sharing information between public safety and transportation agencies: http://plan4operations.dot.gov/docs/sharing_nchrp2004.pdf

MPO/RTPA/Local Government Cooperation Action Plan (L3 to L4)

Strategy Summary

Rationalize roles and relationships to optimize partners' resources

Key Actions

A	Consider reconfigured institution options for operating systems based on new approaches to cost-sharing, incentives, transfer, or consolidation of authority
B	Develop new forms of cooperation for meeting resource needs

ACTIONS

Action A: Consider reconfigured institution options for operating systems based on new approaches to cost-sharing, incentives, transfer, or consolidation of authority

Rationale: Jurisdictional fragmentation and uneven capabilities among owner-operators of components of the regional transportation system may represent a substantial barrier to improved regional TSM&O that can be addressed by new levels of coordination, consolidation or other new forms of regional operations collaborative entities.

A.1 Identify key impediments to improved relational operational collaboration in one or more service area (TMC, HOV, signalization, HOT, etc.) and the ways in which they may be overcome through new cooperative relationships, including a review of relevant existing institutional models in other metropolitan areas.

A.2 Review spectrum of options ranging from improved real time coordination, to collocation, shared control and staffing, contracting out responsibilities, joint funding, and control of activity. Include consideration of shared data, images and off-hours control consolidation.

Responsibility and Relationships: Joint interagency working group (existing operations group may suffice).

Action B: Develop new forms of cooperation for meeting resource needs

Rationale: New forms of regional cooperation and consolidation may suggest ways of rationalizing operational costs.

B.1 Explore range of options for improved cost-effectiveness and savings including pooled funding, intergovernmental contracting, outsourcing, facility sharing, etc.

B.2 Develop and administer coordinated regional and statewide traffic operations infrastructure and ITS plans for deployment, operations, maintenance and lifecycle replacement.

B.2 Develop appropriate intergovernmental agreements as necessary.

Responsibility and Relationships: Joint interagency working group (existing operations group may suffice) with DOT and MPO/RTPA and local government involvement to establish options. Senior executive oversight needed.

Examples/References:

- Regional Transportation Operations Collaboration and Coordination: A Primer for Working Together to Improve Transportation Safety, Reliability, and Security (FHWA): http://ntl.bts.gov/lib/jpodocs/repts_te/13686/13686.pdf
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx

Outsourcing/Public-Private Partnerships Action Plan (L3 to L4)

Strategy Summary

Develop consistent approach to outsourcing regarding contracting procedures, performance management, and timeframe of contracts

Key Actions

A	Evolve improved performance management approach to services that are outsourced
B	Continuously update understanding of relative costs of capabilities, technology, and function provision, comparing in-house with evolving private sector capabilities

ACTIONS

Action A: Evolve improved performance management approach to services that are outsourced

Rationale: There is the potential for "learning" regarding more effective outsourcing, both on the client and contractor side as experience is gained and as competition develops.

A.1 Regularly review outsourcing activities among all unit and contract managers to capitalize on experience and develop the most competitive and cost-effective approaches.

A.2 Where feasible, consider controlled comparisons across comparable contexts to maximize learning regarding effective procurement, contracting, and contract management.

Responsibility and Relationships: Central office operations and procurement staff, working with key district/regional staff for specific projects. Outside technical support may be helpful in analyzing options based on peer experience.

Action B: Continuously update understanding of relative costs of capabilities, technology, and function provision, comparing in-house with evolving private sector capabilities

Rationale: As the TSM&O program develops, the nature and relative importance may change, impacting the trade-offs between in-house and outsourced provision of specific functions.

B.1 Review the changes in operational concepts, ITS technology, comparative costs, etc., for each key function, and their impact on the pros and cons of outsourcing and the importance of

maintaining functions in-house or related core technical capacities that may be important for informed function management.

B.2 Explore opportunities to combine TSM&O outsourcing with ongoing or projected outsourcing of other non-TSM&O functions such as HOV lane operations, private toll road development, and total asset management.

Responsibility and Relationships: Central office staff working with administrative and budgeting units to determine real costs for comparison.

Examples/References:

- FHWA Office of Innovative Program Delivery P3 Toolkit: http://www.fhwa.dot.gov/ipd/p3/toolkit/index.htm

Culture Guidance

✔ LEVEL 1 TO LEVEL 2

Why Culture is Important

Culture is the combination of values, assumptions, knowledge and expectations of the agency in the context of its institutional and operating context, and expressed in its accepted mission and related activities.

Improvement Target

From	Value of TSM&O not widely understood beyond champions (L1)
To	Agency-wide appreciation of the value and role of TSM&O (L2)
By	Developing business case for TSM&O and continuous improvement of operations performance

Key Sub-dimensions

- Business Case
- Leadership/Championship
- Outreach
- Program Status/Authorities

Business Case Action Plan (L1 to L2)

Strategy Summary

Provide technical justification of TSM&O regarding customer service-related performance

Key Actions

A	Develop the business case for TSM&O relative to the jurisdiction
B	Identify relevant TSM&O state-of-practice in peer states with examples
C	Develop strategy to familiarize leadership and staff with TSM&O

ACTIONS

Action A: Develop the business case for TSM&O relative to the jurisdiction

Rationale: TSM&O can play a unique role in agency mission and program but its characteristics and potential are not widely understood without explicit recognition and discussion.

A.1 Identify staff champion, representative cross-disciplinary group, and process to develop the business case for TSM&O.

A.2 Prepare written material for circulation that defines the business case for TSM&O (including relationships to ITS) and identifies the unique role of TSM&O within the overall agency program in achievement of mobility/safety/ livability/sustainability and other customer service attributes and performance measures, including recognition of impact and fiscal limits and potential of competing strategies, such as new capacity. Consider its unique potential regarding the management of both recurring (peak) and non-recurring congestion, as well as the provision of system status information for customers. Include both urban and rural considerations. Identify the role of TSM&O to supplement/postpone capacity requirements. Review the relationship between routine incident management and agency support functions for major emergency management. Include the relationship to current formal agency goals and objectives as expressed in policy and plans and discussion of implications for agency policy, program, staffing, organization, and relationships. Identify the key stakeholders in improved TSM&O.

A.3 Develop benefit-cost analysis for typical TSM&O projects drawing on both national peer examples and state-specific examples using available data. Organize in a format for both internal use in comparing investments and external use in making the business case.

A.4 Identify importance of working with DOT partners (public safety, local government and private sector) to develop common understanding of the business case in developing/improving major incident and emergency response capability (including National Incident Management System [NIMS]) and the relationship—organizational, procedural and technological—between day-to-day incident management and major emergency response.

Responsibility and Relationships: Business case development needs to be sponsored by top management, including directing the appropriate involvement and handling of dialogue and products. A staff champion/task leader is needed with a supporting working group.

Action B: Identify relevant TSM&O state-of-practice in peer states with examples

Rationale: Consideration should be given to the approach taken by peer states and their experience.

B.1 Review material on state-of-the-practice within the state and regions on the complete range of TSM&O strategies. Compare the deployment and activities with appropriate peer states to consider program completeness, direction, and the comparable performance/service contributions, including potential benefits and costs, as available from federal and association sources. In particular, highlight successes as the points of departure for future improvements.

B.2 Conduct interchange with peer states and prepare analysis of their rationale, program, and program development history in terms of its relevance to the agency; review relevant success stories in peer states; and prepare material for internal circulation.

Responsibility and Relationships: Business case development needs to be sponsored by top management, including directing the appropriate involvement and handling of dialogue and products. A staff champion/task leader is needed with a supporting working group.

Action C: Develop strategy to familiarize leadership and staff with TSM&O

Rationale: Advancing the scope and effectiveness of TSM&O requires a strong understanding of strategies, requirements, and potential on the part of policy, management, and technical leaderships, both at the central office and district/regional levels.

C.1 Prepare brief business case document for purposes of informing decision makers, including need for TSM&O, principal strategies and related costs and benefits. Utilize the business case material to conduct familiarization activities at senior, middle, and technical levels across the agency, building on the existing agency TSM&O activities, next steps, and relevant peer examples.

C.2 Consider utilization of national resources (conferences, courses and training) to improve technical backgrounds of key staff.

Responsibility and Relationships: Business case development needs to be sponsored by top management, including directing the appropriate involvement and handling of dialogue and products. A staff champion/task leader is needed with a supporting working group.

Examples/References:

- The 21st Century Operations Oriented State DOT: http://ssom.transportation.org/Documents/21stCenturyStateDOT.pdf
- Optimizing the System: http://downloads.transportation.org/OptimizingTheSystem.pdf
- "Systems Management and Operations: A Culture Shock," *ITE Journal*, Vol. 75, No. 5
- Twenty-First Century Leadership and Management Techniques for State DOTs: ftp://ftp.mdt.mt.gov/research/LIBRARY/TFCL-1-21ST_LEADERSHIP-MANAGEMENT_TECHNIQUES-AASHTO.PDF
- Puget Sound Regional Council Benefit cost: http://secure.psrc.org/assets/3158/Benefit_Cost_White_Paper_2009_final.pdf
- AASHTO Primer on performance management: ftp://ftp.mdt.mt.gov/research/LIBRARY/PBHP-1-PERFORMANCE-BASED_PROGRAM_MGMT-AASHTO.PDF

Leadership/Championship Action Plan (L1 to L2)

Strategy Summary

Provide technical justification of TSM&O regarding customer service-related performance

Key Actions

A	Develop articulation of senior management talking points to support mandate for familiarization with business case and support of program for TSM&O within agency
B	Identify and support potential TSM&O champions in central office and districts/regions with technical and management responsibility to develop business case/plan
C	Capitalize on external events (emergencies/events or policy initiatives) to highlight TSM&O and adjust ongoing program development in response

ACTIONS

Action A: Develop articulation of senior management talking points to support mandate for familiarization with business case and support of program for TSM&O within agency

Rationale: A top manager who is going to champion the development of TSM&O needs to "take ownership" and become familiar with the issues.

A.1 Identify staff leader to develop senior executive briefing (see the Business Case Action Plan for L1-L2).

A.2 Establish senior management working group to review business case (see the Business Case Action Plan for L1-L2).

A.3 Develop senior management talking points to address agency staff and external stakeholders regarding the business case.

A.4 Encourage and support analysis and discussion of relationships between agency mission, performance trends, and programs/investments, as related to current and future programs.

Responsibility and Relationships: Senior staff working groups to develop strategies, sponsored by top management—including identification of triggering events.

Action B: Identify and support potential TSM&O champions in central office and districts/regions with technical and management responsibility to develop business case/plan

Rationale: The development of the necessary strategy to improve agency TSM&O capabilities (see the six dimensions of TSM&O capability) requires staff consideration and lead.

B.1 Identify leads and support group in both central office division and districts/regions with visible mandates/recognition and technical and management responsibility.

B.2 Support case/plan development group with resources as necessary.

Responsibility and Relationships: Senior staff working groups to develop strategies, sponsored by top management, including identification of triggering events.

Action C: Capitalize on external events (emergencies/events or policy initiatives) to highlight TSM&O and adjust ongoing program development in response

Rationale: Major events provide the opportunity to demonstrate and/or justify the importance of improved TSM&O capabilities.

C.1 Identify event vulnerability (major weather or emergencies, special events) and prepare TSM&O contingency plans, as well as "what we could do if we were properly equipped/organized" concepts.

C.2 Where event occurrence makes it possible and appropriate, use the opportunity to make the case to decision-makers regarding the components of response that would benefit from more formal day-to-day TSM&O infrastructure and capabilities.

Responsibility and Relationships: Senior staff working groups to develop strategies, sponsored by top management, including identification of triggering events.

Examples/References:

- Developing Transportation Agency leaders: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_349.pdf
- Mission, vision and values statements: http://managementhelp.org/plan_dec/str_plan/stmnts.htm

Outreach Action Plan (L1 to L2)

Strategy Summary

Introduce value and concepts regarding TSM&O to external stakeholders and general public

Key Actions

A	Capitalize on external events to highlight TSM&O importance in external communications
B	Identify and clarify in routine and special communications the current role of ITS and its value in providing traveler information and system performance information to customers
C	Present business case to partner agencies for TSM&O, based on customer service attributes and performance measures, for consensus strategy development regarding roles and activities

ACTIONS

Action A: Capitalize on external events to highlight TSM&O importance in external communications

Rationale: A major event (disruption, emergency, incident, etc.) offers the opportunity to demonstrate the value of responsive TSM&O to external audiences who may not be aware of the current or potential value.

A.1 Prior to events, prepare general background template for educational material (press release, memo to decision-makers, other key stakeholders) for use in conjunction with specific incident/emergency report.

A.2 At time of event, prepare description of agency (and partner) response with emphasis on value of agency pre-preparations. In some cases, a discussion of what additional investments/measures might improve response may be appropriate.

A.3 Utilize incident response briefing as opportunity to make the case for the relationship between major incident responsiveness and routine preparedness, and the relevance of additional resources, procedures, relationships, etc., as appropriate.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action B: Identify and clarify in routine and special communications the current role of ITS and its value in providing traveler information and system performance information to customers

Rationale: The provision of traveler information (by a range of media) provides an opportunity to highlight real-time customer service being provided by the agency and the importance of ITS and TSM&O activities to the public.

B.1 As per the Performance Measurement Dimension, develop information in a form of direct use to travelers with emphasis on travel time and delay, congestion, major incident and weather notification, alternative routings, etc.

B.2 Provide the information in a "branded" format—with catchy name and agency logo—that associates the information with the agency.

B.3 Work with agency leadership and public affairs to fully represent TSM&O in all agency communications, including visibility on agency website and social media activities.

B.4 Utilize the full range of media: conventional roadside, web-based and 511 options, as well as social media (Twitter, Facebook, and other mobile applications).

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action C: Present business case to partner agencies for TSM&O, based on customer service attributes and performance measures, for consensus strategy development regarding roles and activities

Rationale: Key partners of transportation agencies in the delivery of TSM&O (public safety agencies, local governments, MPOs, contractors) have other priorities at the management level, and their level of collaboration will depend on an understanding of TSM&O as it relates to those priorities.

C.1 Identify key decision makers and managers in partner entities with influence over agency priorities and the disposition of partner resources as targets for dialogue regarding the mutual value of operations. Include both senior and middle managers.

C.2 Secure support from decision-maker level (state, local and regional) for discussion regarding TSM&O collaboration on the part of key managers.

C.3 Convene meetings of key managers from stakeholder entities with mandate for an ongoing dialogue on key issues of both mutual and individual interests with appropriate agenda and working groups to explore issues. Review existing agency programs and the degree to which they are

providing quantifiable improvements (or maintenance of) customer level of service. Present and discuss the business case for TSM&O.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Examples/References:

- Summary of outreach techniques: http://www.dot.state.mn.us/planning/railplan/files/PACHandout20090320.pdf
- Florida Department of Transportation Public Involvement handbook: http://www.dot.state.fl.us/emo/pubs/public_involvement/pubinvolve1.shtm
- Mainstreaming ITS (California context): http://www.uctc.net/papers/790.pdf
- Uses of Social Media in Public Transportation: http://www.trb.org/main/blurbs/167067.aspx

Program Status/Authorities Action Plan (L1 to L2)

Strategy Summary

Review authorizations needed for effective agency role in TSM&O strategies

Key Actions

A	Identify existing constraints (legal, administrative, interagency, institutional) to effective TSM&O strategies application and approach to resolving them
B	Review constraints/opportunities related to improved cooperative planning and programming with local government, MPO/RTPAs, and public safety agencies and approaches to resolving them

ACTIONS

Action A: Identify existing constraints (legal, administrative, interagency, institutional) to effective TSM&O strategies application and approach to resolving them

Rationale: Some key constraints to effective accomplishment of basic operational concepts may be embedded in law or custom.

A.1 Review basis for customary roles and procedures of TSM&O involving interagency collaboration that impact strategy effectiveness to determine those with informal vs. formal status; work with partners to identify range of adjustments and likely leverage to improve performance. Consider areas where existing laws and authorities of customary practices may constrain the most effect execution of TSM&O strategies.

A.2 Review key political and legal constraints including: relative authority of transportation agency in relationship to that of public safety entities regarding incident clearance; use of speed and lane use controls and other safety-related authorities; liabilities regarding diversion; and other advisories.

A.3 Develop cooperative legal strategy to achieve modifications as appropriate.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Action B: Review constraints/opportunities related to planning and programming with local government, MPO/RTPAs, and public safety agencies and approaches to resolving them

Rationale: A fully effective statewide or regional TSM&O program is dependent on aligning the approaches of jurisdictions to planning, implementing, and maintaining operational collaboration.

B.1 Review basis of customary roles and procedures in TSM&O involving interagency collaboration that impact cooperative planning, programming, and implementation to determine those with informal vs. formal status; work with partners to identify range of adjustments and likely leverage to improve performance.

B.2 Review key political and legal constraints including relative authority of local government and regional transportation entities to engage in more aggressive support of TSM&O.

B.3 Review legal and/or customary constraints on the sources and uses of federal, state, and local funds in conjunction with ITS capital projects and related maintenance.

B.4 Develop collaborative strategies to achieve modifications as appropriate.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Examples/References:

- None

Culture Guidance

✔ LEVEL 2 TO LEVEL 3

Why Culture is Important

Culture is the combination of values, assumptions, knowledge and expectations of the agency in the context of its institutional and operating context, and expressed in its accepted mission and related activities.

Improvement Target

From	Agency-wide appreciation of the value and role of TSM&O (L2)
To	TSM&O accepted as a formal core program (L3)
By	Establishing TSM&O with a formal core business program status equivalent to other major programs

Key Sub-dimensions

- Business Case
- Leadership/Championship
- Outreach
- Program Status/Authorities

Business Case Action Plan (L2 to L3)

Strategy Summary

Promote understanding agency-wide regarding the implications of TSM&O on overall agency mission, strategies, and program

Key Actions

A	Develop vision of TSM&O at maximum implementation based on both current and potential state-of-the-practice
B	Circulate and discuss TSM&O business case (see L1-L2), vision, and example program development and present material for discussion at both executive and unit management level
C	Develop a business plan for TSM&O that identifies and specifies the general capabilities needed to support continuous improvement of TSM&O

ACTIONS

Action A: Develop vision of TSM&O at maximum implementation based on both current and potential state-of-the-practice

Rationale: Important justifications for the development/improvement of TSM&O related to the evolution of functionalities and related technologies, both within and external to the highway system, requiring a response or role related to the agency.

A.1 Using the Business Case Action Plan of Level 1 to Level 2, identify the case for expanding operations beyond freeways to include arterials and other modes for integrated corridors and subarea service improvements.

A.2 Identify the range of long range systems developments including connected vehicles, automated traffic management, probe-based traveler information, location-based technology and services, vehicle miles of travel fees, road pricing, and other future developments.

A.3 Relate long range developments to potentially needed infrastructure and capacities related to ITS and TSM&O and implications for TSM&O development.

Responsibility and Relationships: Business plan development needs sponsored/authorized by top management, with the implication of formal policy, program action in response.

Action B: Circulate and discuss TSM&O business case (see L1-L2), vision, and example program development and present material for discussion at both executive and unit management level

Rationale: An effective program requires gaining wide understanding across the agency of the importance of TSM&O to agency mission and relationships between TSM&O and activities of other agency units and external partners.

B.1 Develop strategy for agency-wide familiarization with TSM&O, including material to be circulated and forms of discussion, as appropriate to managers and units within the agency.

B.2 Develop process for identification of implications/responsibilities for all relevant agency units.

Responsibility and Relationships: Business plan development needs sponsored/authorized by top management, with the implication of formal policy, program action in response.

Action C: Develop a business plan for TSM&O that identifies and specifies the general capabilities needed to support continuous improvement of TSM&O

Rationale: A plan is needed as an overall framework to address the development of key agency capabilities and their staging, covering all six dimensions of capability covered in this Guide.

C.1 Develop business plan outline for each dimension as appropriate to the self-evaluated level of capability and discuss with affected management and units.

C.2 Develop business plan for TSM&O, including appropriate action plans for next stage of development in key dimensions with emphasis on priority capability areas (as per this Guide), including systems and technology, performance measurement, organization and workforce, and collaboration—as related to program development.

C.3 Consider carefully the relationship between organization, plans, procedures, systems and external relationships already organized for emergency management as related to routine incident management. Review the requirements of the National Incident Management System (NIMS) for relevant points of consistency.

C.4 Incorporate recognition of the full range of process and institutional adjustments needed to support improved capability (as per this Guide) and incorporate considerations for expanding network and modal coverage.

C.5 Review plan with top management and secure support for next stage as appropriate, including organizational adjustments and resources as appropriate.

Responsibility and Relationships: Business plan development needs sponsored/authorized by top management, with the implication of formal policy, program action in response.

Examples/References:

- Travel Time Reliability: Making It There On Time, All The Time (FHWA 2006): http://ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm
- Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation: http://ops.fhwa.dot.gov/congestion_report/congestion_report_05.pdf
- Urban Mobility Report, Texas Transportation Institute: http://mobility.tamu.edu/ums/
- National Traffic Scorecard: http://scorecard.inrix.com/scorecard/
- Maryland State Highway Administration CHART Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf

Leadership/Championship Action Plan (L2 to L3)

Strategy Summary

Establish visible top management commitment to TSM&O

Key Actions

A	Obtain top management support for adjustments to formal agency mission/vision/objectives as embedded in agency documents
B	Identify senior manager with full-time responsibility for TSM&O agency-wide and establish status vis-à-vis senior managers in central office and districts/regions
C	Develop internal campaign to develop staff commitment to real-time customer-related performance as major professional agency and staff commitment

ACTIONS

Action A: Obtain top management support for adjustments to formal agency mission/vision/objectives as embedded in agency documents

Rationale: The business case and plan will indicate the need for adjustments in the formal agency policy and program, appropriate position, and commitment to TSM&O, which must be led by top management.

A.1 Review and identify modifications to revise formal agency documents regarding agency mission, vision, strategy, and performance objectives to accommodate a commitment to TSM&O.

A.2 Provide support to agency top management regarding actions that provide visible leadership in supporting agency-wide buy-in to a business model with operations service performance mission in terms of a commitment to drive strategies by measuring performance.

Responsibility and Relationships: Senior staff working groups sponsored by top management commitment to making essential changes. A staff leader/manager for the effort will be required.

Action B: Identify senior manager with full-time responsibility for TSM&O agency-wide and establish status vis-à-vis senior managers in central office and districts/regions

Rationale: Significant improvements in TSM&O capabilities require top level program level status regarding level of reporting equivalent to other major mission-related program.

B.1 Revise organization as appropriate to develop formal program status for TSM&O. Formal status as a program is indicated by level in agency of senior fulltime operations manager compared to other programs such as construction project development and maintenance. As a new program with a distinct mission and activities and resource requirements, TSM&O should not be subordinate to other parallel functions with competing resource requirements, such as construction or maintenance simply as a matter of scale or convenience. As a distinct core program, the senior TSM&O manager should report directly to the chief operating officer.

B.2 Identify senior manager for agency-level TSM&O program leadership. This position should evolve to a direct report to chief operating officer as part of formal program status.

B.3 Take the lead in facilitating the establishment of career paths for operations personnel equivalent to other disciplines, clarifying opportunities for training and advancement.

Responsibility and Relationships: Senior staff working groups sponsored by top management commitment to making essential changes. A staff leader/manager for the effort will be required.

Action C: Develop internal campaign to develop staff commitment to real-time customer-related performance as major professional agency and staff commitment

Rationale: Significant TSM&O improvements visible to customers require a wide range of adjustments—both large and small—that cut across all units that impact real-time service—both in the office and field.

C.1 Assemble staff-wide working group across all units (development, construction, maintenance, operations) to consider range of impacts of their activities on real-time customer service and the degree to which operational considerations can be built into other activities such as construction and maintenance.

C.2 Prepare list of actions that impact or support systems operations (on the part of other units) and how they relate to conventional TSM&O strategies, such as opportunities to embed ITS infrastructure in construction projects, role of TSM&O in maintenance, etc.

C.3 Input action and/or role changes into strategy development and into standard operating procedures of other units.

Responsibility and Relationships: Senior staff working groups sponsored by top management commitment to making essential changes. A staff leader/manager for the effort will be required.

Examples/References:

- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx
- Using Customer Needs to Drive Transportation Decisions: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_487.pdf

Outreach Action Plan (L2 to L3)

Strategy Summary

Develop publically visible linkages of performance with TSM&O

Key Actions

A	Develop outreach program to familiarize key stakeholder constituencies (freight, safety) with relevance of TSM&O
B	Develop brand message and delivery strategy
C	Maximize exposure of TSM&O program and benefits utilizing full range of social media
D	Establish mechanism for two-way communication and feedback with public and key system users regarding TSM&O

ACTIONS

Action A: Develop outreach program to familiarize key stakeholder constituencies (freight, safety) with relevance of TSM&O

Rationale: Any significant changes in agency policy need to be "sold" to decision-makers and external stakeholders.

A.1 Present to decision-makers (commissioners, legislators, etc., as appropriate) justification for needed changes utilizing business case and business plan, as well as draft mission/vision/objectives material prepared.

A.2 Present to key external stakeholders (public safety leadership, MPO and local government leadership, key commercial interests, as appropriate) a depiction of their stakes in reduced delays, improved system reliability, traveler information and security as justification for needed changes utilizing business case and business plan, as well as draft mission/vision/objectives material prepared. Focus on stakeholders with interest in reliable travel, including shippers, trucking and distribution, businesses with time sensitive operations and land/facility developers for whom reliable travel may have market value. Explain the role of TSM&O in an agency program and the relationship to stakeholder objectives.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action B: Develop brand message and delivery strategy

Rationale: Because many TSM&O strategies are drawn from traditional DOT functions, it is important to communicate that TSM&O is "something different" that needs to be recognized as a separate function and respond directly to customer needs.

B.1 Identify and articulate the "brand promise" in terms of core messages regarding the relationships of TSM&O to customers/audiences (travelers, shippers), services (traffic/incident management information, etc) and desired outcomes (minimizing delay, improving reliability, safety).

B.2 Identify opportunities to deliver the messages, including both formally scheduled opportunities and event-related opportunities (post weather, crash, special events).

B.3 Develop procedures to deliver messages, working with public relations and communications staff.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action C: Maximize exposure of TSM&O program and benefits utilizing full range of social media

Rationale: The range of stakeholder audiences utilizes a broad range of media for initial exposure to programs as well as to obtain information and maintain contact.

C.1 Identify the most effective social media tool by target audience including links to agency websites, topical websites, Twitter, Facebook, LinkedIn, RSS feeds and other mobile applications.

C.2 Tailor messages to the structure and style of specific media.

C.3 Test media effectiveness with appropriate audiences via feedback mechanisms.

C.4 Develop outreach program approach and coordinate with agency public relations and communications staff.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action D: Establish mechanism for two-way communication and feedback with public and key system users regarding TSM&O

Rationale: Customer input can play an important role in ensuring TSM&O is related to customers own perceptions of their needs and in creating a dialogue with the public, and can build credibility/support for agency program in general.

D.1 Identify range of mechanisms for customer feedback and input including: user survey, safety service patrol hand-out/mail back cards, websites, Facebook, Twitter, dialogue through newspaper and TV, and call-in "hot lines."

D.2 Implement selected operational modifications as reasonable and notify public of changes, response, and/or clarification of approach via media, recognizing that selected approaches must demonstrate responsiveness and be sustainable.

D.3 Develop mechanism to demonstrated responsiveness to customer input, such as public versions of TSM&O analyses and statistics, quarterly and annual reports, and regular media updates.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Examples/References:

- Innovations in DOT communications and outreach: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-4.pdf
- Public involvement: http://www.fhwa.dot.gov/environment/pubinv2.htm
- FHWA Public involvement resource guide: http://www.fhwa.dot.gov/planning/public_involvement/publications/resource_guide/
- Outreach materials on NTIMC website: http://ntimc.transportation.org/Pages/MaterialsandResources.aspx
- Uses of Social Media in Public Transportation: http://www.trb.org/main/blurbs/167067.aspx

Program Status/Authorities Action Plan (L2 to L3)

Strategy Summary

Establish formal program status for full effectiveness

Key Actions

A	Review existing TSM&O activities in terms of status and formal agency program
B	Identify existing constraints (legal, administrative, interagency) to full formal program status for TSM&O

ACTIONS

Action A: Review existing TSM&O activities in terms of status and formal agency program

Rationale: The critical relationship of TSM&O to a transportation agency's mobility and safety mission indicates the need for its inclusion as a formal and distinct element in the features that distinguish top level programs such as explicit inclusion in policy, strategies, programming, budgeting and organization.

B.1 Identify the key features that characterize the status and expressions of the agency's legacy formal programs such as new capacity construction, maintenance and safety – and compare with TSM&O regarding its comparable representation.

B.2 Develop strategy for incorporating TSM&O as top level program in terms of explicit inclusion in mission, vision, goals, policy, strategies, performance measures, planning process, budgeting and programming, organizational structure and staffing.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Action B: Identify existing constraints (legal, administrative, interagency) to full formal program status for TSM&O

Rationale: Some key constraints to establishing TSM&O with formal program status may require legislative action or clarification.

B.1 Review key legal constraints including: statutory authority regarding mission and purpose; network ownership and/or responsibilities; use of state funds for TSM&O purposes and budget categories (capital, staffing, maintenance); relative authority of transportation agency; law enforcement and emergency response; and other features that impact establishing TSM&O as a formal, budgeted top level program.

B.2 Develop legal strategy to achieve modifications as appropriate to achieve formal program status, including support from top level of jurisdiction administration.

B.3 Implement strategy.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Examples/References:

- State DOT legal authority (quick clearance example): http://ops.fhwa.dot.gov/publications/fhwahop09005/role_relevance.htm
- Best Practices for Linking Strategic Goals To Resource Allocation and Implementation Decisions (asset management examples): http://minds.wisconsin.edu/handle/1793/6883

Culture Guidance

✔ LEVEL 3 TO LEVEL 4

Why Culture is Important

Culture is the combination of values, assumptions, knowledge and expectations of the agency in the context of its institutional and operating context, and expressed in its accepted mission and related activities.

Improvement Target

From	TSM&O accepted as a formal core program (L3)
To	Explicit agency commitment to TSM&O as key strategy to achieve full range of mobility, safety and livability/sustainability objectives (L4)
By	Rationalizing TSM&O program development with other programs on basis of service-related cost-effectiveness

Key Sub-dimensions

- Business Case
- Leadership/Championship
- Outreach
- Program Status/Authorities

Business Case Action Plan (L3 to L4)

Strategy Summary

Develop new performance-driven business model with real time service component

Key Actions

A	Incorporate TSM&O business case implications into formal agency mission, goals, objectives, and strategies
B	Integrate concept of "continuous improvement" into agency management as a crosscutting process, including process of TSM&O capability improvement based on performance

ACTIONS

Action A: Incorporate TSM&O business case implications into formal agency transportation mission, goals, objectives, and strategies

Rationale: In order to become a formal program, priority must be embedded in key agency policy program, budgeting, and planning as well as organizational structures.

A.1 Articulate goals and objectives as appropriate to intended role of TSM&O in agency activities. Position TSM&O strategies in relationship to overall agency objectives and in relation to other agency strategies (such as capacity additions). This may involve modifications to existing agency policy materials as embodied in policy plans, website, etc.

A.2 Adjust formal mechanisms and procedures to introduce TSM&O as a program into resource allocation and other top management decision making. This may involve adjusting current agency program structure to introduce a new top level category for planning and programming, and adjusting the related processes and participants accordingly.

A.3 Identify needed adjustments in level of senior TSM&O authority and reporting relationships to provide the appropriate level of consideration consistent with a new degree of formality of an TSM&O program.

Responsibility and Relationships: Senior staff working groups sponsored by top management including internal senior staff dialogue across agency leadership.

Action B: Integrate concept of "continuous improvement" into agency management as a crosscutting process, including process of TSM&O capability improvement

Rationale: Improving the capabilities of the agency to maximize the effectiveness of the existing highway system requires a management process to incrementally develop the necessary capabilities for TSM&O regarding processes, resources, and relationships.

B.1 Define the concept of continuous improvement within agency mission context as related to establishing a performance-driven framework of processes, resources, and institutional relations focused on improved customer service and increased agency efficiency on a continuous incremental basis.

B.2 Identify the dimensions of needed capabilities that support continuous improvement from agency evaluations (as per this Guidance) and relate incremental changes in each dimension of capability to relevant performance measures—both outputs and outcomes—including consideration of specific customer relevance.

B.3 Obtain top management commitment and relevant staff buy-in for the use of performance accountability as the basis of determining process and institutional adjustments according to a related action plan.

B.4 Integrate concept of "continuous improvement" into agency management as a crosscutting process, including process documentation requirements, performance measurement, accountability, incentives, etc.

Responsibility and Relationships: Senior staff working groups sponsored by top management including internal senior staff dialogue across agency leadership.

Examples/References

- Travel Time Reliability: Making It There On Time, All The Time (FHWA 2006): http://ops.fhwa.dot.gov/publications/tt_reliability/TTR_Report.htm
- Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation: http://ops.fhwa.dot.gov/congestion_report/congestion_report_05.pdf
- Urban Mobility Report, Texas Transportation Institute: http://mobility.tamu.edu/ums/
- National Traffic Scorecard: http://scorecard.inrix.com/scorecard/

Leadership/Championship Action Plan (L3 to L4)

Strategy Summary

Institutionalize agency commitment to and accountability for systems performance

Key Actions

A	Elevate/support TSM&O senior manager to top management level
B	Articulate and accept public responsibility for TSM&O in performance reporting and commitment to continuous improvement in agency program

ACTIONS

Action A: Elevate/support TSM&O senior manager to top management level

Rationale: Agency-level commitment to TSM&O requires that it have top level status for appropriate visibility, leadership, accountability, seniority, and access to resources appropriate to program on an equal level with construction and maintenance.

A.1 Make appropriate organizational changes with related personnel appointments and reporting relationships.

A.2 Identify senior manager of TSM&O appropriate as direct report to chief operating officer.

A.3 Encourage top management buy-in to TSM&O business case in terms of a commitment to drive strategies by measuring performance.

Responsibility and Relationships: Top management with senior staff support.

Action B: Articulate and accept public responsibility for TSM&O in performance reporting and commitment to continuous improvement in agency program

Rationale: Building on the business case, it is necessary to lead the development of policy and a responsive program that visibly accepts responsibility for a maximum reasonable effort to maintain and improve systems performance via TSM&O.

B.1 Establish effort for performance reporting (see Performance Measurement Dimension).

B.2 Develop visible policy outreach to explain nature of agency responsibility for systems performance, including limitations over external context factors.

B.3 Articulate the logic of continuous capability improvement to overall TSM&O mission and strategy as the basis for performance-driven program development and evaluation to maintain and improve service levels, including installation of a formal capability maturity process to periodically evaluate agency regarding capabilities essential to program objectives.

B.4 Establish agency approach to unit accountability related to execution of TSM&O activities as appropriate (recognizing span of control).

Responsibility and Relationships: Top management with senior staff support.

Examples/References:

- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx

Outreach Action Plan (L3 to L4)

Strategy Summary

Articulate legitimacy of agency responsibility for improving TSM&O as public commitment

Key Actions

A	Articulate in agency documents and outreach contacts an acceptance of shared responsibility (risks and rewards) for improvements in operational performance (short- and long-term)
B	Establish forum for key external stakeholders/users to interact with agency service provider/collaborators on policy, plan and performance matters

ACTIONS

Action A: Articulate in agency documents and outreach contacts an acceptance of shared responsibility (risks and rewards) for improvements in operational performance (short- and long-term)

Rationale: Establishing TSM&O as agency mission and goal must be understood regarding its potential in the context of agency span of control and limitations imposed by congestion context.

A.1 Analyze and recognize the potential and limitations of conventional TSM&O given trends in travel demand and supply limitations to support realistic articulation of potential. Analyze and recognize the potential and limitations of the evolution of more advanced and intense TSM&O strategies (integrated corridors, advanced active freeway management, real-time in-vehicle information, automated controls/enforcement, etc.) and the relevance of staging TSM&O toward such strategies

A.2 Analyze and recognize the potential and limitations of conventional TSM&O given varying levels of collaboration among key partners in the provision of TSM&O strategies. Consider limitations imposed by current traditional arrangements and consider options in terms of sharing or reconfiguration of the traditional allocation of roles and responsibilities.

A.3 Develop articulation of "the case for improved TSM&O" and its dependencies, both for internal and external use.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Action B: Establish forum for key external stakeholders/users to interact with agency service provider/collaborators on policy, plan and performance matters

Rationale: Both program improvement and stakeholder support can be facilitated through establishment of an official TSM&O advisory group to provide advice and supportive involvement of key stakeholder groups in areas of policy, priorities, planning, and interagency support and coordination.

B.1 Identify key stakeholders—both implementation partners and key user/stakeholder interests—as possible participants on an advisory basis; consider existing examples from peer agencies. These may include the complete range of public agency service providers as well as representatives from business, community, and interest groups.

B.2 Consider advisory group format: role, composition, status, convener, staff support, agenda, setting, and stakeholder view of the value of participation, as well as risk and reward of this activity to the agencies.

B.3 Consider start-up strategies for advisory group—such as quarterly meetings—with potential for more regular function, and utilize for key milestone functions, such as plan update.

Responsibility and Relationships: Senior staff working groups sponsored by top management. A staff leader/manager for the effort will be required.

Examples/References:

- Innovations in DOT communications and outreach: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-4.pdf
- Public involvement: http://www.fhwa.dot.gov/environment/pubinv2.htm
- FHWA Public Involvement Resource Guide: http://www.fhwa.dot.gov/planning/ppasgpi.htm
- Uses of Social Media in Public Transportation: http://www.trb.org/main/blurbs/167067.aspx

Program Status/Authorities Action Plan (L3 to L4)

Strategy Summary

Initiate changes to rationalize interagency and public/private sector roles

Key Actions

A	Establish TSM&O as formal core program in policy and statute as appropriate
B	Review implications of TSM&O business model for long-term change in agency program, role, partnerships, and other institutional arrangements

ACTIONS

Action A: Establish TSM&O as formal core program in policy and statute as appropriate

Rationale: To achieve full effectiveness at the program level (and to compete for resources as appropriate) TSM&O must become a top-line formal program with all the features of such a program within the agency context.

A.1 Adjust formal mission, vision, objectives, and strategies in line with overall agency program in accordance with statutory and administrative provisions made.

A.2 Reorganize as necessary to achieve TSM&O program equivalence with existing legacy programs (construction, maintenance) in terms of reporting relationships at the central office and district/regional level.

A.3 Establish a sustainable, rational, and transparent approach to budgeting and resource allocation.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Action B: Review implications of TSM&O business model for long-term change in agency program, role, partnerships, and other institutional arrangements

Rationale: To achieve full effectiveness at the strategy level, legacy conventions regarding the roles of transportation and non-transportation entities may require modifications in agency operational roles and responsibilities.

B.1 Identify potential modifications to the legacy configuration of agency operational roles and responsibilities as they might improve the mobility and safety-related effectiveness of TSM&O activities.

B.2 Review opportunities to realign responsibilities with PSAs including realignment of traffic-related responsibilities to improve operational control and field efficiencies.

B.3 Review opportunities to realign responsibilities with MPOs and local governments including partial consolidation, common management, and other forms of resource sharing.

Responsibility and Relationships: Senior staff working groups sponsored by top management including representation from agency legal staff. A staff leader/manager for the effort will be required.

Examples/References:

- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx

Organization and Workforce Guidance

✔ LEVEL 1 TO LEVEL 2

Why Organization and Workforce is Important

Efficient execution of processes supporting effective programs requires appropriate combination of coordinated organizational functions and technical qualified staff with clear management authority and accountability.

Improvement Target

From	Fragmented roles based on legacy organization and available skills (L1)
To	Relationship among roles and units rationalized and core staff capacities identified (L2)
By	Identifying needed adjustments in organizational structure, staffing roles and responsibilities supportive of TSM&O

Key Sub-dimensions

- Program Status
- Organizational Structure
- Staff Development
- Staff Recruitment and Retention

Program Status Action Plan (L1 to L2)

Strategy Summary

Identify responsibility for agency TSM&O program—statewide and districts

Key Actions

A	Identify TSM&O leadership responsibilities and authorities at the central office and regional levels
B	Clarify TSM&O chain of command to senior TSM&O manager in central office (statewide) and districts/regions and between districts/regions and central office
C	Clarify relative hierarchy with other program activities regarding key authorities

ACTIONS

Action A: Identify TSM&O leadership responsibilities and authorities at the central office and regional levels

Rationale: To advance TSM&O activities from an ad hoc status towards a formal managed multi-activity program, key technical and management responsibilities must be established—both in the central office (statewide level) and at the district/regional level.

A.1 Establish agreement among top managers at central office and districts/regions that organizational development is essential to improving TSM&O effectiveness and identify characteristics of formal program as management target.

A.2 Scope out existing and/or new activities at conceptual level to identify functions and resources to be involved both at district/regional level and statewide (central office) level that supplies support.

A.3 Identify top management "sponsor" for ensuring progress in development of program concepts.

A.4 Identify personnel to lead/champion program development with knowledge, skills and abilities (KSAs) appropriate to new function (requiring some technology knowledge and understanding of current organization). Individuals may be in central office or key district for start-up purposes.

A.5 Clarify internal and external roles and provide authority and resources for next steps, including roles and relationships, both among TSM&O-related units and between them and other related units (including project development and maintenance).

Responsibility and Relationships: Top management and program level managers as identified.

Action B: Clarify TSM&O chain of command to senior TSM&O manager in central office (statewide) and districts/regions and between districts/regions and central office

Rationale: Increasing the effectiveness of TSM&O requires clarification of relationships between senior (division level) management at central office and districts, and individuals responsible for management of TSM&O program development.

B.1 Review existing relationships among central office and relevant district/regional units with responsibilities for TSM&O-related activities for issues regarding access management coordination and access to decision makers with resource control and performance accountability.

B.2 Modify organization and/or reporting as appropriate to provide program level status parallel with top manager with TSM&O responsibility.

Responsibility and Relationships: Chief operating officer and senior management (statewide division level) and top district/regional managers.

Action C: Clarify relative hierarchy with other program activities regarding key authorities

Rationale: Development of an TSM&O organization and workforce—both technical and management—is hampered by an often subsidiary status of the activities and related units to other legacy programs within the agency with regard to authority, management and resources.

C.1 Identify the features needed for full program status within the agency regarding features of organizational structure and staffing, including reporting relationships, staffing decisions, and span of control of senior and middle managers, characteristic of other key mission-related legacy programs such as capacity development and maintenance.

C.2 Identify the needed characteristics of the relationships between district/regional level providers of operations and maintenance services and central office (statewide) support functions regarding responsibilities, authority and reporting, including relationships with external partners such as PSAs and private service providers.

C.3 Develop staged strategy to move TSM&O activities and related units (ITS systems, TMCs, ITS maintenance, programs with external collaboration [incident management, construction work zone management, etc.]) from functional status to program status.

Responsibility and Relationships: Senior TSM&O staff in central office and district/regions working with top management chief operating officer.

Examples/References

- Maryland State Highway Administration CHART Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf

Organizational Structure Action Plan (L1 to L2)

Strategy Summary

Identify basis for efficient consolidation of relevant organizational units

Key Actions

A	Develop organizational structure for TSM&O responding to implications of the concepts of operations of the key strategic activities to be undertaken
B	Identify appropriate relationships, span of control, and nature of accountability among all TSM&O-related units
C	Conduct briefings for non-TSM&O staff in key related units (project development, maintenance, safety) regarding need for cooperation/collaboration
D	Consider development of TSM&O policy group of key internal and external stakeholders to identify and adopt policies for improved TSM&O

ACTIONS

Action A: Develop organizational structure for TSM&O responding to implications of the concepts of operations of the key strategic activities to be undertaken

Rationale: TSM&O has special organizational structure requirements based on its unique features, especially in comparison with the civil engineering and maintenance functions.

A.1 Identify the features of TSM&O activities and services in terms of concepts of operations that, to be effective, need to be reflected in the organizational structure including its real-time activity orientation, its dependence on eternal collaborators, and its systems and technology intensiveness.

A.2 Compare the features of the concepts of operations and their organizational implications with the current structure of the units that are involved in some aspect of TSM&O, including ITS, systems operations, incident management, maintenance, etc.

A.3 Develop an "organizational concept of operations" rationalizing roles and relationships for the key functions. Interpret the organizational ConOps in terms of desirable horizontal span of control and vertical reporting relationships.

Responsibility and Relationships: Task force of appropriate TSM&O managers at both the central office (statewide) and district/regional level with agency champions and/or top management.

Action B: Identify appropriate relationships, span of control, and nature of accountability among all TSM&O-related units

Rationale: Characteristics of TSM&O dictate real-time cooperation/coordination needs among functions (and related units) and key technical support needs.

B.1 Define key functions associated with moving TSM&O from concept to execution. This includes: (1) direct field operational responsibilities that may be at the district/regional level (planning; protocol development with partners; TMC management, operations and field support; infrastructure and systems deployment; and maintenance) and (2) direct support activities that may be centralized (including planning, systems engineering, procurement, standards development, data archiving, etc.) and functions where coordination is essential (traffic engineering, safety, maintenance, IT, etc.).

B.2 Identify current configuration of these functions and adjustments that may be required or desired to achieve improved effectiveness and the ability to improve continuously.

Responsibility and Relationships: Senior managers at central office (statewide) and district/regional managers, including TMC management (field and district/regional staff and related central office units).

Action C: Conduct briefings for non-TSM&O staff in key related units (project development, maintenance, safety) regarding need for cooperation/collaboration

Rationale: It is important to brief managers and key professionals in key positions in the agency (both central office and district/regional divisions) regarding TSM&O and its key collaboration and support needs from other units as the basis for ongoing cooperation.

C.1 Hold briefing sections for key agency units and clarify the mission, strategies, performance objectives, and current and developing TSM&O strategies. Indicate the areas of needed cooperation and support from other units. These briefings should be both at division and subunit levels.

C.2 Identify key liaison contacts in key units as mechanism to support continuing communication.

Responsibility and Relationships: TSM&O leadership in central office and districts/regions. Establish key relationships between TSM&O units and other support units.

Action D: Consider development of TSM&O policy group of key internal and external stakeholders to identify and adopt policies for improved TSM&O

Rationale: The multidisciplinary nature of TSM&O at the policy, planning, budgeting, design, implementation, and maintenance levels involves a wide range of collaborators/partners and indicates the need to develop the basis for broad discussion and input in the development and execution of TSM&O strategies.

D.1 Review potential participants from key agency units including district/regional representation, senior managers, service delivery partners (public safety agencies) and key private service providers.

D.2 Develop working group with continuing and regular meetings to consider evolving issues.

D.3 Establish "secretariat" function within TSM&O central office unit to develop agendas, minutes and provide meeting support.

Responsibility and Relationships: Central office TSM&O staff (under lead manager). Include participation from key units involved in development and delivery of TSM&O functions, and key public safety entities and private service providers (support contractors, towing and recovery, etc.).

Examples/References:

- Maryland State Highway Administration CHART Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf
- "Impacts of Technology Advancements on Transportation Management Center Operations" (FHWA, 2013) includes discussion on KSAs for TMC staff: http://www.ops.fhwa.dot.gov/publications/fhwahop13008/
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx
- "Managing Change in State DOTs: Innovations in Strategic Leadership and Measurement for State DOTs": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-1.pdf

Staff Development Action Plan (L1 to L2)

Strategy Summary

Identify staffing needs

Key Actions

A	Identify needed operations-related core capabilities needed to support the development TSM&O activities—both technical and management
B	Develop position description for each position including required knowledge, skills and abilities (KSAs)
C	Evaluate existing staff in terms of KSAs for their positions and identify gaps
D	Identify training opportunities for key staff including lead manager, funding and training program, covering systems engineering, process, project management and other key skills
E	Participate in technical interchanges with peer agencies and professionals

ACTIONS

Action A: Identify needed operations-related core capabilities needed to support the development TSM&O activities—both technical and management

Rationale: Effective development, execution and improvement of TSM&O activities require a combination of specific core TSM&O-technical and management capabilities related to the scope of the developing program. Agencies must identify and acquire the needed core competencies through staff development or outsourcing.

A.1 Identify the range of needed capabilities in specific areas of systems and technology development, acquisition, and implementation, as well as strategy-specific procedures and protocols, including collaboration, planning and programming, administration, and general management.

A.2 Identify "core capacities" that are essential to building and managing TSM&O activities and that require special knowledge, skills, abilities and experience compared with those that can be filled by existing staff.

Responsibility and Relationships: Central office staff. May require consultant assistance where new strategies are to be developed.

Action B: Develop position description for each position including required knowledge, skills and abilities (KSAs)

Rationale: Position descriptions including specific KSAs and prerequisites are necessary to accommodate agency requirements.

B.1 Develop position description for each position (core and non-core) including required KSAs and include position title, civil service classification, function and purpose of position, reporting relationships, general tasks, and decisions related to duties.

B.2 Compare position descriptions with comparables in other program areas to ensure recognition of special backgrounds, education, skills for position, and related compensation.

B.3 Include review of positions with partial responsibilities for TSM&O (such as district engineer) to determine potential training needs.

Responsibility and Relationships: Senior TSM&O staff. May obtain material from peer states to use as model.

Action C: Evaluate existing staff in terms of KSAs for their positions and identify gaps

Rationale: KSAs for key TSM&O positions should be matched with those of existing staff. Where possible, consideration should be given to the training and development of existing agency staff with interest and appropriate backgrounds, especially given staff increase limitations.

C.1 Solicit interest on the part of existing staff through briefings and formal position vacancy procedures and review qualifications of interested staff for unfilled positions.

C.2 Identify both core and support competencies that can be filled from existing staff, accounting for training impacts.

Responsibility and Relationships: Senior TSM&O staff in both central office and districts/regions working with agency human resources and training staff.

Action D: Identify training opportunities for key staff including lead manager, funding and training program, covering systems engineering, process, project management and other key skills

Rationale: Certain staff responsibilities can be filled via appropriate training.

D.1 Identify immediate opportunities for training for key staff including lead training coordinator/manager, funding and training program, covering both core and non-core skills.

D.2 Working with FHWA and the RITA ITS Joint Program Office, Review the complete range of training opportunities offered by FHWA, SHRP2, and National Highway Institute.

D.3 Review training opportunities available from The Operations Academy Senior Managers Program, the Institute of Transportation Engineers and from educational entities related to the DOT as well as other universities and organizations.

D.4 Establish training schedule for key staff.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources.

Action E: Participate in technical interchanges with peer agencies and professionals

Rationale: Peer states at similar levels of capability and program development can offer useful examples of strategy applications, logical staging of improvements, business and technical processes, etc. that can serve as valuable sources of learning as part of staff development.

E.1 Identify peer states based on: (1) state size and organizational configuration of urban vs. rural areas, and (2) experience with issues related to TSM&O challenges faced and strategies being deployed. Develop ongoing relationships of management and technical staff visits, workshops and document review.

E.2 Seek out opportunities and support staff participation in national conferences and workshops (TRB, AASHTO, AMPO, ITE, ITS-A, etc.) to maintain agency involvement in state of the practice and contributions to it.

E.3 Utilize key web-based resources such as the AASHTO TSM&O Guidance website, the SHRP 2 Knowledge Transfer System website, and other key online resources.

Responsibility and Relationships: Work with relevant peer state TSM&O management and staff.

Examples/References

- "Help Wanted: Meeting the Needs for Tomorrow's Transportation Workforce": http://www.fhwa.dot.gov/publications/publicroads/01julaug/helpwanted.cfm
- "Managing Change in State DOTs: Innovations in Work Force Strategies": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-5.pdf

Staff Recruitment and Retention Action Plan (L1 to L2)

Strategy Summary

Develop position descriptions for key staff recruitment and promotion

Key Actions

A	Survey existing staff for qualification and interest in staff, using position descriptions knowledge, skills and abilities (KSAs), and identify gaps
B	Develop staffing and succession strategy
C	Identify recruitment priorities
D	Review recruitment experience of peer agencies

ACTIONS

Action A: Survey existing staff for qualification and interest in staff, using position descriptions knowledge, skills and abilities (KSAs), and identify gaps

Rationale: Many key positions may be filled by existing staff with traffic engineering, ITS and other related backgrounds—strengthened by their knowledge of the agency. However some positions may have to be filled from outside the agency.

A.1 Using the position descriptions and staff match and interest, identify core positions that remain to be filled.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Action B: Develop staffing and succession strategy

Rationale: Required staff capabilities will depend on current staffing vs. staffing needs for program improvements. There is a range of strategies to be considered to augment staff, including internal development, outside hires and outsourcing.

B.1 Evaluate the availability of in-house staff relevant to core and support capabilities and the potential of training to fill gaps within an appropriate timeframe.

B.2 Review the options for outside staff augmentation including external hires from educational institutions (recent graduates), other transportation agencies, or relevant non-transportation entities in terms of cost and timeframe for hiring. Compare this with the costs and benefits of outsourcing related functions.

Responsibility and Relationships: Senior TSM&O working with agency human resources with appointed staff responsibility.

Action C: Identify recruitment priorities

Rationale: The staff development plan (described in the Staff Development Action Plan) should indicate "core capacities" that are a priority for recruitment, are needed in house, and cannot be outsourced without endangering the agency's ability to manage improvement.

C.1 Review the identified core positions.

C.2 Compare core positions with available in-house staff, including presumed KSA enhancements from short-term training, and identify the gaps that represent recruitment priorities.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Action D: Review recruitment experience of peer agencies

Rationale: Peer states have faced many of the same recruiting problems and have developed some experience relating specific expertise sought and potential sources, as well as recruitment methods.

D.1 Contact peer states to obtain background on relevant recruiting efforts focused on various target groups, including effective recruitment methods.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Examples/References:

- Baldrige criteria: http://www.nist.gov/baldrige/publications/business_nonprofit_criteria.cfm
- "Recruiting and Retaining Individuals in State Transportation Agencies": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_323.pdf
- "The Transportation Workforce Challenge: Recruiting, Training, and Retaining Qualified Workers for Transportation and Transit Agencies" contains a discussion of core competencies: http://www.trb.org/Publications/Blurbs/152777.aspx
- "Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management" (NCHRP Report 693): http://www.trb.org/Main/Blurbs/166342.aspx

Organization and Workforce Guidance

✔ LEVEL 2 TO LEVEL 3

Why Organization and Workforce is Important

Efficient execution of processes supporting effective programs requires appropriate combination of coordinated organizational functions, and technical qualified staff with clear management authority and accountability

Improvement Target

From	Relationship among roles and units rationalized and core staff capacities identified (L2)
To	Top level management position and core staff for TSM&O established in central office and districts (L3)
By	Integrating TSM&O organization and staff into overall agency structure and clarifying reporting relationships

Key Sub-dimensions

- Program Status
- Organizational Structure
- Staff Development
- Staff Recruitment and Retention

Program Status Action Plan (L2 to L3)

Strategy Summary

Establish senior executive manager in central office and districts with program responsibility

Key Actions

A	Develop case for top level organizational unit status appropriate to formal program of equal importance to mission
B	Develop systems for accountability appropriate to unit responsibilities for TSM&O-related outputs or outcomes

ACTIONS

Action A: Develop case for top level organizational unit status appropriate to formal program of equal importance to mission

Rationale: Advancing TSM&O as a key agency strategy on the path to continuous improvement of effectiveness requires program-level status with explicit recognition as a program that can be managed.

A.1 Identify key features of responsibility and authority, including span of control and reporting/accountability, that are essential to a formal agency program that is expected to make explicit and accountable contributions to agency mission.

A.2 Position responsible senior TSM&O managers at the overall statewide level, one that provides the necessary span of control and access to senior management without a detour through competing program managers.

A.3 Establish position in districts/regions which establishes/incorporates program-wide focus/management for all TSM&O-related activities.

Responsibility and Relationships: Consideration of establishing formal program status should be widely discussed among senior managers involved in policy, planning and operations.

Action B: Develop systems for accountability appropriate to unit responsibilities for TSM&O-related outputs or outcomes

Rationale: Program status requires reporting and accountability to determine if progress is being made in fulfilling the mission of increasingly effective use of the existing system.

B.1 Identify performance measures for both activity effectiveness (outputs and outcomes) and unit effectiveness, with appropriate level of accountability at the unit level.

B.2 Establish reporting and accountability framework for TSM&O managers based on reasonable fulfillment potential.

Responsibility and Relationships: Central office (statewide) and district/region managers develop proposed approach. Accountability relationships are needed and developed between TSM&O managers and agency top management.

Examples/References

- "Managing Change in State DOTs: Innovations in Institutionalization of Operations": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-3.pdf
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx

Organizational Structure Action Plan (L2 to L3)

Strategy Summary

Consolidate central office units with appropriate span of control and accountability and central office-district relationships

Key Actions

A	Clarify and/or establish central office vs. regional/district roles and establish regular process for internal accountability
B	Review functions that may merit consideration for outsourcing
C	Consolidate TSM&O-related central office (statewide) functions as necessary to minimize overlap and clarify responsibility
D	Establish senior manager with fulltime responsibility for TSM&O and appropriate span of control
E	Clarify unit objectives and relate to program objectives, including accountability
F	Utilize TSM&O policy group of key internal and external stakeholders to review program and relationships

ACTIONS

Action A: Clarify and/or establish central office vs. regional/district roles and establish regular process for internal accountability

Rationale: Field activities involving TSM&O strategy implementations require (often in common) a range of specialized technical support that can be supplied by central office units.

A.1 Determine the allocation of functions that can be efficiently centralized vs. dispersed to districts/regions, based on the existing "organizational concept of operations" (see L1-L2, Action A). In most cases responsibility for real-time TSM&O activities and the related local partnerships will be at the regional or corridor level. The organization structure and reporting relationships may be consolidated or decentralized depending on the scope of regional programs and the value of consolidation for shared functions.

A.2 Consider staged evolution towards new organizational structure recognizing the current fit of positions and individuals and convenient opportunities for minimally disruptive organizational change.

Responsibility and Relationships: Lead by senior central office TSM&O managers with all key unit managers involved.

Action B: Review functions that may merit consideration for outsourcing

Rationale: Given staffing resource constraints and recruitment limitations, certain functions and key capabilities may be considered for outsourcing to capitalize on access to technical capabilities and staffing flexibility.

B.1 Review key functions regarding ability to effectively staff or recruit and consider outsourcing opportunities and related costs and benefits. (See the Outsourcing/Public-Private Partnerships Action Plan (L1 to L2) within the Collaboration Dimension for further considerations.)

Responsibility and Relationships: Senior central office TSM&O managers with all key unit managers involved.

Action C: Consolidate TSM&O-related central office (statewide) functions as necessary to minimize overlap and clarify responsibility

Rationale: While there is no ideal organizational structure for TSM&O appropriate to all agencies, systematic consideration must be given to making changes necessary to improve organizational efficiency.

C.1 Consider functional relationships in terms of lead and support capabilities, frequency and type of interaction, and degree of interdependency. Identify those that can be efficiently centralized vs. those that are service delivery and field related. In this regard, key trade-offs will be necessary.

C.2 Consolidate TSM&O-related functions as necessary to minimize overlap and clarify responsibility through alternative organizational structure orientations (hierarchy vs. matrix) to account for program/project delivery consolidation vs. shared oversight with technical support.

C.3 Review both ideal (as per above) structure and short-run practical limitations accounting for existing staff capabilities and positions. While compromises will be essential, keep improving organization as target to be achieved with staff turnover and reorganization over time.

Responsibility and Relationships: Senior TSM&O-related management at the central office and district/regional level including traffic engineering and maintenance.

Action D: Establish senior manager with fulltime responsibility for TSM&O and appropriate span of control

Rationale: To ensure coordination and accountability across all TSM&O activities, it is essential to have a fulltime program manager with agency-wide span of control over TSM&O.

D.1 Create position as necessary and staff with appropriate capability in relationship to organizational structure developed in Action A.

Responsibility and Relationships: Senior management. Note: Units may have new reporting relationships.

Action E: Clarify unit objectives and relate to program objectives, including accountability

Rationale: Effective TSM&O requires clarifying the program objectives and related performance objectives of each unit in delivering the program of activities.

E.1 Identify work program-related objectives within the overall program objectives as set forth in the agency TSM&O mission and defined by the unit roles.

E.2 Identify specific measures of internal performance for which the unit can be held accountable during efficient execution of its role.

Responsibility and Relationships: Senior central office manager working with all unit managers collectively and individually.

Action F: Utilize TSM&O policy group of key internal and external stakeholders to review program and relationships

Rationale: Utilize the established TSM&O policy group (see L1-L2, Action D) representing policy, planning, budgeting, design, implementation and maintenance on a continuing basis.

F.1 Convene TSM&O policy group on a regular basis to review unit functions and organizational structure, as they relate to program effectiveness, and identify any needed changes.

Responsibility and Relationships: Central office unit responsible for convening policy group.

Examples/References

- "A Transportation Executive's Guide to Organizational Improvement" (NCHRP 20-24(42)): http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/20-24(42)_FR.pdf

Staff Development Action Plan (L2 to L3)

Strategy Summary

Develop training opportunities and access to national knowledge base

Key Actions

A	Identify and resolve issues regarding position descriptions, related KSAs and existing agency and state position descriptions
B	Expand training program to include technical as well as management personnel at all levels and units in agency (including internal "operations academy")
C	Establish co-training opportunities with partners (public service agencies, local government, coalitions, colleges and universities)
D	Eliminate legacy limitations on non-civil engineering staff advancement
E	Participate in national forums and associations such as AASHTO, TRB, ITE, and others

ACTIONS

Action A: Identify and resolve issues regarding position descriptions, related KSAs and existing agency and state position descriptions

Rationale: TSM&O positions may introduce new KSAs related to technical knowledge, work hours and responsibilities across traditional job classifications requiring special adjustments to accommodate efficient staffing.

A.1 Compare TSM&O-related position requirements (see L1-L2) and current agency and state job classifications for compatibility and identify inconsistencies or issues, if any.

A.2 Work with agency and state HR and union officials where relevant to resolve barriers to efficient staffing and recruiting.

Responsibility and Relationships: Senior TSM&O staff working with agency training/human resources staff, as well as through potential cooperation with peer states.

Action B: Expand training program to include technical as well as management personnel at all levels and units in agency (including internal "operations academy")

Rationale: A continuing training "process" is required to facilitate TSM&O program development to higher levels of effectiveness and scale, as well as to develop efficient, non-disruptive staff succession.

B.1 Identify key position and activity-related training needs that may warrant a continuing availability, and develop or access training materials. These materials would include both technical and management materials and would focus both on training for entry-level positions in TSM&O for current activities and to obtain KSAs to support program advancement.

B.2 Establish training requirements and training schedule for key positions.

B.3 Develop or acquire training materials for in-house training program especially where such training can be offered as a component of an existing agency program supported by in-house training program manager. Consideration may also be given to contracting with outside entity to develop and offer training (that may be supported by multiple agencies).

B.4 Establish a formal mentoring program for junior staff to support professional development and clarify paths of career advancement.

Responsibility and Relationships: Senior TSM&O staff working with agency training/human resources staff, as well as through potential cooperation with peer states.

Action C: Establish co-training opportunities with partners (public service agencies, local government, coalitions, colleges and universities)

Rationale: Given the specialized nature of TSM&O systems, strategy protocols, and management objectives, a cooperative, consolidated approach to providing training may efficient.

C.1 Review opportunities to develop joint training with appropriate peer states, including custom-tailored offerings.

C.2 Consider opportunities to cooperate with key collaborators in TSM&O service delivery (public service agencies, local government, coalitions, colleges and universities).

C.3 Review offerings and availability of existing training programs such as National Highway Institute and the I-95 Corridor Coalition Operations Academy™ and utilize or adapt as appropriate.

Responsibility and Relationships: Senior TSM&O staff working with agency training/human resources staff, as well as through potential cooperation with peer states.

Action D: Eliminate legacy limitations on non-civil engineering staff advancement

Rationale: In some cases, agencies are unable to hire and retain staff with the needed key technical specialties (that may be "core" capabilities needed to ensure program improvement) owing to external competition for such skills.

D.1 Review relevance/appropriateness of current agency position specifications, qualifications, classifications, and compensation and incentive packages compared to the market for key capabilities.

D.2 Develop case (if needed) for modifications in civil service categories and propose approach to meet agency needs.

Responsibility and Relationships: Senior TSM&O staff working with agency training/human resources staff, as well as through potential cooperation with peer states.

Action E: Participate in national forums and associations such as AASHTO, TRB, ITE, and others

Rationale: It is essential that TSM&O staff participate in forums related to state of the practice in order to learn from the experience of other agencies; share experience and stay current with the development of federal programs and technology development; and gain the perspective from other entities such as public service agencies and private technology and service providers.

E.1 Identify key staff to participate in national forums such as AASHTO, TRB, ITE, ITS-America, IEEE, etc.

E.2 Encourage senior agency executives to participate in TSM&O-related events to provide agency-level perspective.

E.3 Establish membership on appropriate committees considering issues of importance to the agency.

E.4 Support establishment of, and participation in, state-level chapters of national organizations focused on TSM&O.

Responsibility and Relationships: Senior TSM&O managers working with professional staff.

Examples/References

- University of Maryland Center for Advanced Transportation Technology Laboratory training and capability study reports: http://www.catt.umd.edu/research/transportation-operations-framework
- "Tools to Aid State DOTs in Responding to Workforce Challenges": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_636.pdf
- Incident management core competencies: http://www.cattlab.umd.edu/?portfolio=incident-management-core-competencies

Staff Recruitment and Retention Action Plan (L2 to L3)

Strategy Summary

Develop strategies to access and retain key staff

Key Actions

A	Identify issues regarding position descriptions, related KSAs and existing agency and state position descriptions limiting attractive conditions of employment
B	Conduct a survey of peer agencies, private sector and other government agencies to establish competitive conditions of employment for key staff positions
C	Investigate alternatives to align agency benefits/skills/job functions with positions offered by other organizations
D	Develop incentives for staff retention including enhanced training, working conditions and professional development

ACTIONS

Action A: Identify issues regarding position descriptions, related KSAs and existing agency and state position descriptions limiting attractive conditions of employment

Rationale: Agencies frequently experience difficulties retaining and/or recruiting qualified staff due to limitations imposed by agency and state level position-filling procedures related to position descriptions, preferences and specific KSAs.

A.1 Review position requirements as per current procedures and consider limitations imposed regarding acquiring qualified staff (see L1-L2).

A.2 Identify potential sources of recruits for specific positions (recent graduates, inside agency, other state departments, private sector) regarding their known employment interests and likely conditions of employment criteria, and compare with existing position descriptions and conditions of employment.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Action B: Conduct a survey of peer agencies, private sector and other government agencies to establish competitive conditions of employment for key staff positions

Rationale: Agencies frequently experience difficulties attracting qualified staff due to competition with the private sector and peer agencies. However, before concluding that this is a problem, it is important to survey these other organizations to establish a benchmark regarding conditions of employment that is likely to be effective.

B.1 Conduct a survey of peer agencies, transportation consultants and other comparable government agencies to establish the relative competitiveness in terms of salaries, fringe benefits and other conditions of employment.

B.2 Review other considerations of interest to potential hires including length of hiring process and attractiveness of training and advancement.

B.3 Incorporate findings into recruitment strategy.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility. Consulting support is recommended to ensure development of an unbiased set of results.

Action C: Investigate alternatives to align agency benefits/skills/job functions with positions offered by other organizations

Rationale: Salaries within public agencies are often legislatively constrained, a condition that prevents adjustments to ensure that such salaries are competitive with the private sector and/or other public agencies. It is important to recognize the unique aspects of a TSM&O within the overall agency and the public sector.

C.1 Identify full range of benefits (some of which may be attractive to recruits from other agencies and the private sector) including regular working hours, ability to establish policy and direction and provide leadership, and working with advanced systems and technology.

C.2 Work with human resources and government civil service managers to identify unique features of positions.

C.3 Adjust job descriptions where possible to provide improved parity with private sector salaries.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Action D: Develop incentives for staff retention including enhanced training, working conditions and professional development

Rationale: Employee retention is as important as effective hiring. Given the shortage of qualified TSM&O personnel, and the cost of hiring and training new personnel, it is incumbent upon all public sector agencies to utilize every tool at their disposal to maximize employee satisfaction.

D.1 Develop a retention strategy for TSM&O staff recognizing the importance of effective management, choice of job assignments, public contact, job satisfaction, agency and professional recognition, working conditions, salary, incentive performance bonuses and other factors.

D.2 Develop incentives for staff retention including enhanced training, working conditions, professional development, rotational assignments and opportunities to participate in external professional activities.

Responsibility and Relationships: Senior TSM&O staff working with agency human resources with appointed staff responsibility.

Examples/References

- "Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management" (NCHRP Report 693): http://www.trb.org/Main/Blurbs/166342.aspx
- "Recruiting and Retaining State IT Employees" (National Association of Chief Information Officers): http://www.nascio.org/publications/documents/NASCIO-WorkforceEvolution.pdf
- Maryland State Highway Administration CHART (Coordinated Highway Action Response Team) Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf

Organization and Workforce Guidance

✔ LEVEL 3 TO LEVEL 4

Why Organization and Workforce is Important

Efficient execution of processes supporting effective programs requires appropriate combination of coordinated organizational functions, and technical qualified staff with clear management authority and accountability

Improvement Target

From	Top level management position and core staff for TSM&O established in central office and districts (L3)
To	Professionalization and certification of operations core capacity positions including performance incentives (L4)
By	Creating a management and organizational structure for TSM&O equivalent to that of other major agency programs

Key Sub-dimensions

- Program Status
- Organizational Structure
- Staff Development
- Staff Recruitment and Retention

Program Status Action Plan (L3 to L4)

Strategy Summary

Establish first-tier executive for TSM&O in central office (statewide) and at district/regional level

Key Actions

A Establish top level executive for TSM&O with fulltime program responsibility and direct reporting to Director/CEO with equivalent positions in districts as appropriate to the agency

ACTIONS

Action A: Establish top level executive for TSM&O with fulltime program responsibility and direct reporting to Director/CEO with equivalent positions in districts as appropriate to the agency

Rationale: TSM&O as a first level strategy in the agency's mission to maintain and improve mobility and safety requires full top level program status.

A.1 Develop position with fulltime TSM&O and statewide span of control in central office that reports directly to the chief operating officer on an equal level with other first-tier programs, such as maintenance and project development, and does not report to a manager preoccupied with a different and competing program (e.g., maintenance).

Responsibility and Relationships: Must be established by agency Director/CEO. New division head for TSM&O will be at equal level with corresponding managers for project development and maintenance.

Examples/References:

- "Managing Change in State DOTs: Innovations in Institutionalization of Operations": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w39-3.pdf
- "Institutional Architectures to Improve Systems Operations and Management" (SHRP 2 L06): http://www.trb.org/Main/Blurbs/165285.aspx
- Maryland State Highway Administration CHART (Coordinated Highway Action Response Team) Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf

Organizational Structure Action Plan (L3 to L4)

Strategy Summary

Continue to refine organizational structure with operational experience

Key Actions

A	Refine organizational structure as necessary to retain authority/responsibility/ accountability structure (custom-tailored) for TSM&O
B	Utilize accountability systems (at both regional and statewide program levels) as an incentive for continuous improvement of program

ACTIONS

Action A: Refine organizational structure as necessary to retain authority/responsibility/ accountability structure (custom-tailored) for TSM&O

Rationale: As the agency gains experience regarding the requirements of continuous improvement of TSM&O activities towards greater effectiveness, relevant organizational structure modifications should be considered.

A.1 Periodically review existing organizational structure with respect to program growth and changes, including relative importance of key functions and related organizational units, level of outsourcing, and partner relationships.

A.2 Identify opportunities for increasing efficiency through consolidation and adjustment of reporting relationships. In some cases, promotions or retirements or other staffing changes offer promising opportunities to make key changes. Peer states may suggest some relevant models.

Responsibility and Relationships: Senior managers in central office and regions/districts, working with unit managers.

Action B: Utilize accountability systems (at both regional and statewide program levels) as an incentive for continuous improvement of program

Rationale: Building in continuous improvement requires establishment of a system of accountability regarding both the internal efficiency and external effectiveness of the functions of agency TSM&O units, both of which are involved in direct service delivery and support functions.

B.1 Establish clear measures for management accountability based on the concept of continuous improvement related to both output and outcome performance measures being used by the agency in overall program management.

B.2 Set up reporting and review system between responsible senior manager(s) and the reporting units. Special attention must be given to evaluation of the centralized support provided to district/regional operations.

Responsibility and Relationships: Senior manager with overall TSM&O responsibility and direct reports.

Examples/References:

- "A Transportation Executive's Guide to Organizational Improvement" (NCHRP 20-24(42)): http://onlinepubs.trb.org/onlinepubs/archive/NotesDocs/20-24(42)_FR.pdf

Staff Development Action Plan (L3 to L4)

Strategy Summary

Professionalize/certify staff positions and career path

Key Actions

A Establish complete professionalization of TSM&O positions, including certification and establishment of clear, attractive career paths

ACTIONS

Action A: Establish complete professionalization of TSM&O positions, including certification and establishment of clear, attractive career paths

Rationale: Mainstreaming TSM&O into the agency program, culture and organization requires professionalization of TSM&O, its legitimization on the same basis as civil engineering, and the development of a credible certification program.

A.1 Review existing certification programs relevant to TSM&O, such as the Institute of Transportation Engineers (ITE) and the Institute of Electrical and Electronics Engineers (IEEE), and consider their use or adaptation to agency needs in hiring and promotion.

A.2 Consider establishment of certification program appropriate to agency which may accept or modify external professional certification requirements. Ensure that plan is implementable, cost effective, and achievable in reasonable time cycles.

A.3 Establish professionalization of TSM&O positions at a level parallel to other agency technical specialties, including certification and integration of position specifications into agency job classifications.

Responsibility and Relationships: TSM&O management working with agency human resources.

Examples/References:

- University of Maryland Center for Advanced Transportation Technology Laboratory training and capability study reports: http://www.catt.umd.edu/research/transportation-operations-framework
- "Tools to Aid State DOTs in Responding to Workforce Challenges": http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_636.pdf

Staff Recruitment and Retention Action Plan (L3 to L4)

Strategy Summary

Develop attractive career path for operations personnel

Key Actions

A	Develop and publicize career advancement opportunities for operations personnel
B	Provide opportunities for advancement including support of training/certification, professional involvement and related incentives
C	Identify (and where possible eliminate) obstacles to attraction of qualified personnel, and develop career enhancements to attract qualified personnel

ACTIONS

Action A: Develop and publicize career advancement opportunities for operations personnel

Rationale: Public agencies are experiencing a need for qualified management and operations personnel in a number of junior, midrange and senior positions. It is important to develop unconventional aggressive approaches to fill these positions.

A.1 Clearly identify and define career opportunities and criteria for advancement within the agency.

A.2 Review the competitive opportunities, compensation and related conditions of employment in competing agencies and the private sector. Develop appropriate "package."

A.3 Reach out both within the agency and externally to pools of potentially qualified candidates. Outreach should be made through universities, professional societies and trade magazines.

A.4 Consider finder's fee rewards for references and recruiting.

Responsibility and Relationships: Upper management and executed by managers of units requiring management and operations personnel.

Action B: Provide opportunities for advancement including support of training/certification, professional involvement and related incentives

Rationale: Mainstreaming TSM&O as a core program requires integration of TSM&O-oriented professional staff into the full range of frameworks that define a professional career in the agency.

B.1 Provide opportunities for advancement including support of training/certification, professional involvement and related incentives. Consider staff exchanges with other agencies to increase career awareness and opportunities.

B.2 Consider development of a formal succession plan to support career development, recruitment, and retention.

B.3 Seek opportunities to indicate that TSM&O professionals have an equitable opportunity to rise to top management positions in both central office and district/regional executive positions.

Responsibility and Relationships: Top management of the agency (Director/CEO) and senior TSM&O managers.

Action C: Identify (and where possible eliminate) obstacles to attraction of qualified personnel, and develop career enhancements to attract qualified personnel

Rationale: A number of obstacles to advancement exist within many public sector organizations. These obstacles include low employee turnover (positions for advancement may be infrequent), small or non-existent salary increases for higher level positions, limited training budgets, and in some cases, union rules that dictate advancement policies.

C.1 Increase the number of grades associated with a given career track.

C.2 Provide rewards other than advancement including employee recognition, choice work assignments, attendance at professional meetings, etc.

C.3 Develop management training to prepare employees for increased responsibility.

C.4 Conduct brainstorming regarding incentives on a continuing basis to assist in the attraction and retention of key management and operations staff.

Responsibility and Relationships: Senior management and relevant unit managers.

Examples/References:

- "Attracting, Recruiting, and Retaining Skilled Staff for Transportation System Operations and Management" (NCHRP Report 693): http://www.trb.org/Main/Blurbs/166342.aspx
- "Recruiting and Retaining State IT Employees" (National Association of Chief Information Officers): http://www.nascio.org/publications/documents/NASCIO-WorkforceEvolution.pdf
- Maryland State Highway Administration CHART (Coordinated Highway Action Response Team) Business Area Architecture: http://www.chart.state.md.us/downloads/readingroom/CHARTNCDP2008FinalPlan.pdf

Performance Measurement Guidance

✔ LEVEL 1 TO LEVEL 2

Why Performance Measurement is Important

Performance measurement is essential as the means of determining program effectiveness, determining how changes are affecting performance, and guiding decision-making. In addition, operations performance measures demonstrate the extent of transportation problems and can be used to "make the case" for operations within an agency and to decision-makers and the traveling public, as well as to demonstrate to them what is being accomplished with public funds on the transportation system.

Improvement Target

From	No regular performance measurement related to TSM&O (L1)
To	TSM&O strategies measurement largely via outputs, with limited after-action analyses (L2)
By	Identifying output and outcome performance measures for the selected operations activities

Key Sub-dimensions

- Measures Definition Action Plan
- Data Acquisition Action Plan
- Measures Utilization Action Plan

Measures Definition Action Plan (L1 to L2)

Strategy Summary

Identify output performance measures to support development and evaluation of TSM&O activities in place and under consideration

Key Actions

A	Identify operational activities to be monitored
B	Review Federal Highway Administration rule (FHWA) implementing MAP-21 performance measure requirements; coordinate the development of operations-specific performance measures with those developed at the agency level for the MAP-21 requirement
C	Review FHWA Office of Operations activities related to performance measures for incident management, work zone management, weather management, and signal systems
D	Create taskforce to develop stepwise strategy to produce useful TSM&O measures working with existing agency program-wide performance measurement unit
E	Develop initial strategy for performance measures using available output data

ACTIONS

Action A: Identify operational activities to be monitored

Rationale: The selection of measures depends on the functions to be measured. Both output and outcome measures are important. While outcome measures most directly evaluate the impact of TSM&O strategies and their contribution to meeting agency mobility and safety mission, they require significant data collection and analytics. Output measures—more readily available—can be used to determine how efficiently resources are utilized to implement a given scale and level of specific TSM&O function and constitute an important starting point to a performance measurement program.

A.1 Identify which aspects of operations should be included in an operations performance measurement program. Examples include: incidents, weather, work zones, special events, traveler information, freight, and signal control.

A.2 Identify output measures useful for determining agency efficiency in strategy applications (for example in reducing incident clearance time). Consider the relationship between operational activities underway or under consideration and their implications for easily obtainable output

measures, and estimate the cost and level of effort associated with the amount and sophistication of activities involved. Output measures must relate to activities that are "actionable", those that can be changed by the agency. Example measures include number of events responded to, time to complete a given function, coverage of detection, miles of safety service patrol, costs and level of effort, etc.

Responsibility and Relationships: Staffing should come from the central office with district/regional traffic management center (TMC) support as appropriate. If an agency-wide performance measurement strategic plan has been prepared, then it should be used as guidance in developing performance measures.

Action B: Review Federal Highway Administration (FHWA) rule implementing MAP-21 performance measure requirements; coordinate the development of operations-specific performance measures with those developed at the agency level for the MAP-21 requirement

Rationale: FHWA is developing a formal rule to implement the performance management requirements imposed by MAP-21 legislation. The rule will deal with performance measures for congestion, reliability, and freight movement, among other functional areas such as pavements, bridges, and safety. FHWA will propose specific measures be used for each functional area; these will be outcome in nature. However, output measures must also be constructed so that operations activities can be geared to making improvements in the outcome measures.

B.1 Consider the relationship between the agency's TSM&O program focus and the federal rule with regard to the potential targets for measurement. Target setting will be a feature of the FHWA rule implementing MAP-21 requirements, and the agency should develop an understanding of how operations strategies affect progress toward the targets. This can be done in the short-term through modeling exercises. In the longer term, evaluations of operations projects will provide estimates of how the targets are affected.

Responsibility and Relationships: Staffing should come from the central office TSM&O program leadership in consultation with FHWA Division Office.

Action C: Review FHWA Office of Operations activities related to performance measures for incident management, work zone management, weather management, and signal systems

Rationale: FHWA and peer agencies have conducted studies of appropriate performance measures, data, analytics and other relevant considerations to support a performance measurement program that can supply useful background and input to the agency's efforts regarding TSM&O.

C.1 Review FHWA background memos and studies regarding measure for specific TSM&O activities

C.2 Review TSM&O measures strategy in relation to current statewide performance measurement program

Responsibility and Relationships: Staffing should come from the central office TSM&O program leadership in consultation with FHWA Division Office.

Action D: Create taskforce to develop stepwise strategy to produce useful TSM&O measures working with existing agency program-wide performance measurement unit

Rationale: All states are preparing strategies to comply with the MAP-21 performance measurement requirements, of which TSM&O congestion-related measures are a part and must be related to an agency's overall approach.

D.1 Review overall state performance measurement strategy including that for complying with federal requirements.

D.2 Consider issues associated with appropriate integration with agency program-wide activities and approaches, including performance measurement for both MAP-21 compliance and for internal uses in TSM&O improvement.

Responsibility and Relationships: Staffing should come from the central office TSM&O program leadership in consultation with FHWA Division Office.

Action E: Develop initial strategy for performance measures using available output data

Rationale: A performance measurement program must identify measures that: (1) are actionable in terms of where/how/how much the TSM&O function is deployed/implemented (i.e., will changes in a performance measure directly lead to actions by the agency); (2) have the capability to influence changes in deployment, configuration, technology, or procedures that may influence outcome measures of interest that support the agency's objective; and (3) can cost-effectively evolve from agency outputs to user-performance related outcomes (e.g. how reductions in lane-hours lost due to work zones can be expected to reduce overall congestion levels). While the strategy starts with output measures, it must be capable of evolving towards outcomes.

E.1 Identify the output performance measures that are consistent with the goals and objectives of the process in which they are being employed. Even though outcome measures are not expected to be developed at this stage, it is still important to consider the linkage for future evolution of the program, in terms of direct linkages between outputs that can be directly managed (e.g. lane hours lost to work zones linked to congestion levels). Determine a cost effective path for the data collection.

E.2 Determine the potential targets of the output performance measurement process and related analysis in light of the audiences and their interests. This includes the scope of the analysis, location of the improvement, travel modes that will use the system, time-of-day that might be affected, the year or years that are the subject of the analysis, and the level of detail and the subjects included in the analysis (e.g. planning, operations, etc.).

E.3 Relate the targets and related measures to key audiences, including technical and nontechnical groups, and groups defined by information needs, time, and locations. Measures must be able to be composed into statistics that are useful for the variety of potential audiences. Screen measures for those that are understandable and easily communicated regarding key use context (deficiency analysis and development, including selecting alternatives, congestion management, growth management, or optimizing the operation of the freeway systems). The set of measures must be technically capable of illustrating the problems and the effects of the potential improvements to the audiences involved.

E.4 Recognize multiple contexts for use of each measure, including problem identification and assessment, evaluation and comparison of alternative strategies, demonstration of effectiveness of various programs and projects, and ongoing real-time system monitoring and reporting. However, while it is desirable to maintain performance measures that are used for specific applications, a core set of measures should be used across all applications. This is particularly useful for congestion/mobility metrics. Increasing the flexibility of the measures also may improve the ability to use the information beyond the particular analysis.

E.5 Compare potential projects, programs, and policies to the measures in terms of their ability to illustrate the effect of the improvements, including all activities of interest to the agency and the audiences, as well as the ability of the measures and related analytics to yield reliable information.

Responsibility and Relationships: The performance measurement taskforce created in Action D above should lead the development of the performance measures strategy with inputs from relevant participants, both internal and external. In addition, state and regional planning staff should be involved to provide relationships to state and regional policy.

Examples/References:

- The FHWA website on general performance measurement for operations provides useful background: http://ops.fhwa.dot.gov/perf_measurement/index.htm
- A reasonable starting point for an appropriate short list of performance measures is found at: http://www.ite.org/M&O/ntoc_final_report.pdf

- Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes (SHRP 2 L05): http://www.trb.org/Main/Blurbs/168854.aspx
- Performance Measures for Freight Transportation: http://www.trb.org/Publications/Blurbs/165398.aspx
- The FHWA rulemaking process for MAP-21 performance management requirements is underway as of early 2014. Its status can be found at: https://www.fhwa.dot.gov/tpm/about/schedule.cfm

Data Acquisition Action Plan (L1 to L2)

Strategy Summary

Collect readily available data

Key Actions

A	Collect output measures from data that are already being collected
B	Identify output performance measure data gaps that will require new data collection
C	Develop rudimentary data management system

ACTIONS

Action A: Collect output measures from data that are already being collected

Rationale: Because most of the available performance data are collected for purposes other than reporting performance, obtaining data from existing traffic management and traveler information systems is often far more difficult than logic would dictate. Output measures are those that relate to specific activities undertaken by agencies (e.g., characteristics of incidents and work zones, incident response time, messages displayed on DMSs, traveler website "hits"). These are contrasted with outcome measures, which relate directly to the system conditions that travelers experience, such as delay and other travel time-based measures, as well as safety.

A.1 Review current output data collection activity and how data are collected and stored. In many cases, target data for utilization already exist, such as incident clearance times and safety service patrol responses.

A.2 Review current archiving function and ease of retrieving data, including software needed to efficiently store and retrieve data already "collected," and identify initial steps to produce useful archived data on a continuing basis.

Responsibility and Relationships: Relevant data may not all be exclusively collected by operations personnel. Other units within the agency may also collect useful data (e.g. work zone safety) as well as external organizations (e.g. weather). The first step is to identify if the data are being archived at all, and if so, what is its accessibility. Once accessibility is determined, a data processing system must be developed to produce the performance measures and associated reports. Central office should perform the scan and determine what the features of the data processing system should be.

Action B: Identify output performance measure data gaps that will require new data collection

Rationale: Once a clear understanding of the available data exists, it is possible to define the supplemental data collection that is needed to complete the data sets needed for the desired output performance monitoring system.

B.1 Identify output measures for which existing data are not available. Define supplemental data needed to fill in gaps in available data.

B.2 Develop phased program for collection.

B.3 Provide information that helps eliminate biases in previously collected data.

B.4 Recognize that the data used to support operations performance measures will have value for many other agency functions, such as planning and safety. It will be useful to involve other potential stakeholders in the data gap analysis at an early stage so that multiple uses of the data can be satisfied. This will help to build support for any new data collection activities.

Responsibility and Relationships: An existing performance measurement taskforce (as per Measures Definition Action D) may be used to include relevant participants, both internal and external. In addition, state and regional planning staff should be involved to provide relationships to state and regional policy.

Action C: Develop rudimentary data management system

Rationale: A start-up data management system is needed. There are several resources that can be used in the development of data archives for performance monitoring or other applications. At this stage, it may be possible to develop the system in-house.

C.1 Develop simple start up system, designed so that future expansion is facilitated. At this stage, the level of system sophistication need not be great, but expansion or migration plans to a more formal information management system should be considered.

C.2 See reference below for technical approach.

Responsibility and Relationships: An existing performance measurement taskforce (as per Measures Definition Action D) may be used to include relevant participants, both internal and external. IT staff should also be involved.

Examples/References:

- "Guide to Effective Freeway Performance Measurement: Final Report and Guidebook" is available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w97.pdf
- "Establishing Monitoring Programs for Mobility and Travel Time Reliability" (SHRP 2 L02): http://www.trb.org/Main/Blurbs/168765.aspx
- "Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Technical Reference" (SHRP 2 L05) provides a "how-to" guide for technical staff to select and calculate the appropriate performance measures to support the development of key planning products, including operations planning: http://www.trb.org/Main/Blurbs/168856.aspx
- A reasonable starting point for an appropriate short list of performance measures is found at: http://www.ite.org/M&O/ntoc_final_report.pdf
- Guidelines for Developing ITS Data Archiving Systems is available at: http://tti.tamu.edu/documents/2127-3.pdf

Measures Utilization Action Plan (L1 to L2)

Strategy Summary

Create standard performance reports for use in immediate improvement of the strategies for TSM&O

Key Actions

A	Create standard performance report for internal use that will identify trends in performance so that specific problems can be targeted
B	Prepare first "rough cut" benefit-cost estimates for key applications

ACTIONS

Action A: Create standard performance report for internal use that will identify trends in performance so that specific problems can be targeted

Rationale: Routine, periodic reports regarding output performance are needed both for strategy improvement and activity reporting.

A.1 Review examples of reporting from peer states and inquire regarding level of effort, cost and audience response.

A.2 Develop TSM&O reports for both internal use and for potential inclusion in external reporting such as agency dashboards. Include both current and trend data.

A.3 Develop reporting frequency for reports: weekly, monthly, quarterly, annually, or some combination.

A.4 Determine initial subjects of performance reports. Depending on data availability and staff resources, the reporting of events/disruptions (e.g., incidents, work zones, weather, special events) may be the initial subjects of performance reports. This is because the data are usually readily available within operating agencies, is simple in content, is not too voluminous, and is amenable to simple summaries and graphics. Recognize that outcome measures eventually will need to be included.

A.5 Determine how trends will be identified and tracked. Trends should be reported for both the characteristics and frequencies of events/disruptions as well as management activities to address them (e.g., incident and work zone duration). When reporting trends, it is very important to consider

sample sizes and seasonal changes in traffic. For example, incidents are fairly infrequent events and reporting weekly changes in incident occurrence is not very stable.

A.6 Perform trend analysis. Trend analysis should be the goal of performance reports, i.e., how are conditions changing on the system? Trends can be produced on a monthly basis, but same items may exhibit unstable patterns at such a short time interval (e.g., incidents), so in some cases, quarterly reports may be more appropriate. In addition, an Annual Report should also be produced that tracks changes from year-to-year. Trends should be developed for the entire region as well as individual corridors. Comparisons can be made between corridors to identify those that exhibit poor performance. Comparison to national benchmarks or to other regions (either within the state or for similar locations in other states) is another method for identifying where problems may exist.

Action B: Prepare first "rough cut" benefit-cost estimates for key applications

Rationale: Prior to full development of performance measures and supporting data, it may be useful to produce rough order of magnitude benefit-cost estimates to support program justification.

B.1 Review availability of useful cost and benefit data based on available data and/or estimates made of comparable TSM&O improvements from peer states.

B.2 Prepare estimated benefit cost estimates as part of business case of planning activities.

Responsibility and Relationships: Staffing should come from the central office, but in coordination with key strategy staff to ensure measure relevance. Performance reports generated for operations use may also be relevant for other parts of the agency, especially if agency-wide performance reporting is mandated.

Examples/References:

- "Guide to Effective Freeway Performance Measurement: Final Report and Guidebook" is available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w97.pdf
- "ITS Benefits, Costs, Deployment, and Lessons Learned Desk Reference" includes information on ITS benefits, costs, and lessons learned that have been compiled since the late 1990s. The benefit, cost, and lessons learned sections of the database all include links to supporting documentation in the form of reports, papers, or other related work: http://www.itskr.its.dot.gov/its/benecost.nsf/files/BCLLDepl2011Update/$File/Ben_Cost_Less_Depl_2011%20Update.pdf
- "Evaluating Alternative Operations Strategies to Improve Travel Time Reliability" (SHRP 2 L11) identifies and evaluates strategies and tactics intended to satisfy users' travel-time reliability requirements of roadways, including performance measures and targets: http://www.trb.org/Main/Blurbs/168142.aspx

- A Guidebook for Standard Reporting and Evaluation Procedures for TSM&O Strategies: http://tsmoinfo.org/documents/files/67/GuidebookforStandardReporting_FINAL.pdf

Performance Measurement Guidance

✔ LEVEL 2 TO LEVEL 3

Why Performance Measurement is Important

The inclusion of outcome measures, linked to output measures, is a major advancement in operations performance measurement. At this stage, it is possible to track the "bottom line", the effect that operations strategies have on users' experiences. However, outcome measures are subject to a variety of influences outside the influence of agency TSM&O.

Improvement Target

From	TSM&O strategies measurement largely via outputs, with limited after-action analysis (L2)
To	Outcome measures identified and consistently used for TSM&O strategies improvement (L3)
By	Developing data collection and management plan to support utilization of outcome performance measures

Key Sub-dimensions

- Measures Definition Action Plan
- Data Acquisition Action Plan
- Measures Utilization Action Plan

Measures Definition Action Plan (L2 to L3)

Strategy Summary

Identify limited number of outcome measures, in addition to the output measures defined in Level 2, for use statewide and for national reporting

Key Actions

A	Review state, local and regional (MPO/RTPA) policy and plans to identify relevant performance measures to determine appropriate range of mission- and customer-related performance measures for operations
B	Consider both agency and system measures related to a full range of measures for mobility/safety/livability/sustainability
C	Identify and establish policy accountability and reporting (internal and external) for systems operational performance
D	Develop outreach program to report measured performance

ACTIONS

Action A: Review state, local and regional (MPO/RTPA) policy and plans to identify relevant performance measures to determine appropriate range of mission- and customer-related performance measures for operations

Rationale: Outcome measures that may be important will span different functions within the agency, and among collaborating agencies, because many different groups are concerned with congestion, mobility, safety, and environmental performance. Customer satisfaction measures are also important and can be used in conjunction with outcome measures.

A.1 Review agency's existing formal mission commitments and relate them to potentially appropriate performance measures. Special attention should be paid to objectives relating to travel time, delay and reliability.

A.2 Review congestion-based performance measures in use in other areas and the data or models that are used to develop them.

A.3 Review measures used in related programs (safety, air quality, economic development) for potential issues and measures overlap. For example, safety personnel will have developed crash-related measures that are relevant for incident and work zone management. Air quality personnel will have developed measures whose development can be improved through the use of operations data.

A.4 Compare local performance issues with national approaches to capitalize on peer experience. Areas to consider include measures' short list, data collection, and analysis issues, with special attention on travel time and reliability, as well as related computational approaches (see National Transportation Operations Coalition [NTOC] measures as representative of a broad national consensus and focus on how users experience travel time). Review federal guidelines in the area of performance measurement to ensure consistency and for additional guidance.

A.5 Consider measures for different purposes such as planning, strategy improvements, internal accountability and public reporting regarding both temporal and spatial extent of congestion, reliability, and the duration and location of incidents and work zones.

A.6 Consider customer satisfaction measures (in addition to outcome measures) related to quality of service (e.g. how congestion is perceived by users) as opposed to "hard" measures (e.g. average speed in a corridor).

A.7 Congestion measures need to be developed based on three dimensions: temporal, spatial, and source of congestion.

- Temporal – decide on the time slices for which congestion will be reported. For example: peak hour, peak period, off-peak, weekend/holiday.
- Spatial – decide over what geographic areas the data will be summarized: segment, corridor, subarea, area-wide.
- Source of congestion – to the extent possible, "tag" what the contributors to total congestion are: recurring vs. nonrecurring is the easiest break-down. If data and methods permit, decompose nonrecurring congestion into the type of disruption: incidents, work zones, inclement weather, etc.

A.8 Integrate output and outcome measures into a comprehensive performance management program for operations. To the extent possible, determine what effect changes in output measures have on outcome measures. For example, how does a reduction in crash frequency or incident response time change travel times/speeds in a corridor and a region? These linkages can be developed over time if the agency has established a routine evaluation program of operations strategies (discussed in Action D below).

Responsibility and Relationships: Staffing should come from the central office. These Actions require strong communication with other units in the agency to coordinate the measures (e.g., statewide and regional planning); other units may possess the data required for certain types of operations performance measures (e.g. work zone crashes).

Action B: Consider both agency and system measures related to a full range of measures for mobility/safety/livability/sustainability

Rationale: At this stage of development, the focus is on developing output performance measures for operations. However, it must be kept in mind for future development that operational strategies affect not only congestion but a range of other impact areas.

B.1 Consider objectives beyond mobility and safety that—based on agency mission and goals, as well as current external policy context (land use, livability, climate change)—may influence the performance measures strategy. For example, consider the following chain of events: A change in policy reduces incident duration, which reduces overall congestion. It also reduces secondary crashes because incident exposure is reduced. Reduced congestion in turn has a positive effect on emissions, and generally influences economic development. Operations performance must be viewed within a larger context that influences an agency's customers. Operations performance is only part of an overall mobility picture, which includes other modes as well. Mobility, in turn, is part of a larger system of economic activity, which ultimately factors into the quality of life for the public.

Responsibility and Relationships: An existing Architecture Task Force may be used to include relevant participants, both internal and external. In addition, state and regional planning staff should be involved to provide relationships to state and regional policy.

Action C: Identify and establish policy accountability and reporting (internal and external) for systems operational performance

Rationale: While some measures may be dictated by legislative or regulatory mandates, it is also useful to select measures that provide internal or detailed operational and planning data beyond that normally required for reporting purposes.

C.1 Review internal performance accountability structure, including both program and unit performance for management purposes. Identify existing or proposed reporting, review processes, and identify the information, format, frequency and media used for reporting.

C.2 Review the value of performance outcome information with planning units (state, local MPO/RTPA) and establish arrangements for transfer of information as appropriate for use in upgrading deficiency analysis and travel forecasting. At the MPO level, this involves close coordination with the Congestion Management Process, since a key component is the ongoing monitoring of system conditions.

C.3 Review external performance accountability structure and key audiences, including reporting regulations, requirements of policy/decision makers, and potential voluntary reporting (as per agency dashboards, briefings and other reports). Consider key audiences including: other transportation agencies (coordination, support, reporting), elected officials (funding and leadership), business community (coordination with development), private sector service providers (data and services provision), academia (research), and the general public.

C.4 Evaluate existing accountability scheme on a regular basis to identify improvements that can be identified in the measures, data, actions, and communication devices.

Responsibility and Relationships: The policy on accountability must be sponsored by top management and can be developed by operations staff in the central office. Note that operations accountability has parallels in other types of program and project accountability and must be coordinated on a multi-program basis.

Action D: Develop outreach program to report measured performance

Rationale: Agency TSM&O program understanding and support can be affected by demonstration of its relevance to policy makers and user-customers. It is useful to revisit the selected measures and compare them to possible improvements that may be evaluated for uses and audiences.

D.1 Relate performance measures to known customer interests (and vice versa) and determine if measures illustrate the effect of the improvements that communicates in an understandable and reliable way to the customers. A wide variety of customers must be considered:

- Accountability – elected officials and the public are a major customer base
- Agency management must be informed of the effectiveness of operations programs to build internal support
- Agency personnel responsible for programming annual budgets need to have concise information on how operations affects system conditions – this is needed in order to build the case for operations budgets
- Agency and non-agency personnel responsible for performance management of their own will benefit from coordination with operations performance activities – this includes those in the agency responsible for meeting MAP-21 performance requirements, MPOs responsible for their own MAP-21 performance requirements as well as the Congestion Management Process, and non-transportation agencies such as emergency responders with their own performance management needs

D.2 Review aspects of the projects, programs, or policies that will not be identified by the measures and consider options for adding measures or other means of communicating performance.

Responsibility and Relationships: Staffing should come from the central office and coordinate with central office staff responsible for other performance reporting (such as dashboards).

Examples/References:

- Discussion of general context in "Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation": http://ops.fhwa.dot.gov/congestion_report
- See reporting examples in: http://ops.fhwa.dot.gov/perf_measurement/index.htm
- Performance Measures for Freight Transportation: http://www.trb.org/Publications/Blurbs/165398.aspx
- "Guide to Effective Freeway Performance Measurement: Final Report and Guidebook" is available at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w97.pdf

Data Acquisition Action Plan (L2 to L3)

Strategy Summary

Develop a data collection and management business plan for collection, integration, management, reporting and application of measures

Key Actions

A	Establish data acquisition plan and system for acquiring outcome data using indirect measurements and analytic methods
B	Identify opportunities for multipurpose data acquisition to service operations, safety, planning, and freight, including external data sources and private provision opportunities
C	Identify opportunities for acquisition of private data

ACTIONS

Action A: Establish data acquisition plan and system for acquiring outcome data using indirect measurements and analytic methods

Rationale: The collection, analysis, storage and retrieval of data must be carefully considered to accommodate efficiency and also use relevance. Travel time is a key measure, so acquiring travel time data is at the center of this activity owing to its direct relevance to customer-related performance interests. It is assumed that direct and continuous measurement of travel times is not feasible at this level, so the use of indirect methods is indicated. This can include: (1) models based on surrogate measures such as volume-to-capacity ratio or (2) use of ITS detectors on freeways where adequate coverage exists (see below).

A.1 Review with staff and management the importance of travel time data—travel times are the basis for all congestion/mobility performance metrics, especially reliability metrics.

A.2 Develop plan to acquire data for travel time measures to support congestion/mobility evaluation. A variety of methods can be used to collect or develop travel times. Travel times can be estimated directly by measuring the passage of individual vehicles over time, synthesized from point detection of spot speeds, or computed with models. Because there is no universal coverage of a single method in urban areas, it is likely that multiple methods will be used in the foreseeable future. The best way is to measure travel times directly via probe vehicles or other instrumented vehicles; these measure the passage of the vehicle over time and space. Indirect methods also exist to develop travel times. Speed data from ITS roadway equipment is commonly transformed to travel times; such estimates have been found to be accurate when detector spacing is reasonably short (<= 1 mile spacing). Models can also be used to transform volumes and capacities to travel times, but such methods usually only consider recurring congestion.

A.3 Review available options for direct measurement of travel time, including probe vehicles or the "floating car" method. Recognize the limitations of both approaches—the availability of probe data and the small sample size uncertainty of floating car approach.

A.4 Incorporate activities to continue and/or augment travel time data with direct volume measures necessary for a full suite of performance measures. Without corresponding volume measurements, data from a sample of probe vehicles (for example) can only be used to compute *unit* statistics, such as delay per vehicle.

A.5 Consider indirect measures of measurement/modeling as an interim stage such as ITS-detected spot speed conversion, volume-based approaches, and forecasting models.

A.6 Develop a staged approach based on the data that are currently available and consider approaches to filling the gaps indicated.

Responsibility and Relationships: Relevant data may not all be collected by operations personnel. Other units within the agency may also collect useful data (e.g. work zone safety) as well as external organizations (e.g., weather). Staffing should come from the central office.

Action B: Identify opportunities for multipurpose data acquisition to service operations, safety, planning, and freight, including external data sources and private provision opportunities

Rationale: Data collected for operation (real time and archived) can serve not only the needs of operations personnel but a variety of other agency functions.

B.1 Identify other potential users of performance-related data or measures developed for TSM&O. For example, data from roadway detectors can be used to develop a wide array of planning data such as AADT, K- and D-factors, and temporal distributions. The information can also be used to support modeling efforts. Incident data can be used as a supplement to traditional crash data, especially for estimating unreported crashes.

B.2 Consult with other agency units to determine needs and potential overlaps. Consider cost-sharing approaches to satisfy broadest range of needs. For example, the traditional traffic monitoring group may want to use ITS detectors in lieu of temporary counts on congested urban freeways.

B.3 If data purchases from private vendors are being considered, it is imperative that multiple data uses within the agency be identified as a way to justify the expense.

Responsibility and Relationships: Staffing should come from the central office working with stakeholders for the data from non-operations units.

Action C: Identify opportunities for acquisition of private data

Rationale: Private vendors are increasingly developing probe-based databases on a real time basis over increasingly large components of the highway network and are making information available to transportation agencies on a commercial basis.

C.1 Investigate vendor activities within the agency's jurisdiction to determine current coverage and their ability to expand coverage and the types of data under contract. These vendors assemble travel times collected from vehicle probes for resale in the traveler information market, both public and private.

C.2 Review desired coverage, especially off-freeway (where ITS detection may not exist), for purposes such as 511, diversion and integrated corridor management.

C.3 Develop an integration plan for merging probe data with volume data. For the immediate future, private vendor probe data is only a sample of vehicles in the traffic stream, so some important measures (e.g., delay, VMT) cannot be produced from private vendor data alone.

C.4 Evaluate how existing agency congestion measurement data can be used in conjunction with probe data. For example, if agency detector data is to be used on one part of the network, agencies should understand how such measurements compare to congestion estimates derived from probe data. This will require that an agency perform a test on facilities where both detector and private vendor data are available, and compare the results. If one method produces consistently different results, it is important to understand why this is occurring. At a minimum, reports should include caveats for comparing the performance of facilities with different base data. Note: this problem should not affect trend analysis on individual facilities.

C.5 Compare the performance of private vendor data with agency data specifications and compare pros and cons of outsourcing data collection. Factors to consider include cost, coverage, reliability, data quality, timeframe of availability, and risk of external dependence (with related contingency plan needed).

C.6 Consider a pilot program using private vendor travel time data on a limited basis (e.g., a small set of highways). The pilot should include all aspects of a full-grown performance measurement system: data processing, measure development, and reporting.

Responsibility and Relationships: Central office staff should contact peer agencies regarding experience with private sector data and work with agency procurement staff.

Examples/References:

- "Establishing Monitoring Programs for Mobility and Travel Time Reliability" (SHRP 2 L02): http://www.trb.org/Main/Blurbs/168765.aspx

- "Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Technical Reference" (SHRP 2 L05) provides a "how-to" guide for technical staff to select and calculate the appropriate performance measures to support the development of key planning products, including operations planning: http://www.trb.org/Main/Blurbs/168856.aspx
- See FHWA Archived Data User Service: http://www.fhwa.dot.gov/policy/ohpi/travel/adus.cfm
- A discussion of measures and overlap is at: http://www.ite.org/M&O/ntoc_final_report.pdf
- The I-95 Corridor Coalition has a vehicle probe project for performance data. See: http://www.i95coalition.net/i95/Projects/ProjectDatabase/tabid/120/agentType/View/PropertyID/107/Default.aspx#COVERAGE

Measures Utilization Action Plan (L2 to L3)

Strategy Summary

Develop formal management process that utilizes performance reports to measure the effectiveness of TSM&O strategies

Key Actions

A	Develop consistent internal performance data analysis process including targets and benchmarks
B	Develop process to incorporate operations performance measures into the development of highway projects
C	Coordinate congestion reporting with planning personnel; coordinate incident reporting with safety personnel
D	Improve reporting of performance to include both internal (TSM&O) and external (e.g. planning) personnel and public/decision-maker outreach

ACTIONS

Action A: Develop consistent internal performance data analysis process including targets and benchmarks

Rationale: Consistency in how operations performance measures are developed must be maintained especially if different data and methods are used for different parts of the system, and if corridor performance can be compared and area wide statistics can be developed by combining them.

A.1 Establish a start-up approach for outcome performance measurement. Given the complexity of a new process, consideration should be given to a "no target" approach, i.e. using the changes from time period to time period (for ongoing monitoring and evaluations) and among alternatives to indicate performance: "are things better or worse?"

A.2 Establish a process for setting "hard targets." Initial hard targets should be those that are considered to be achievable in the short term, based on percentage changes in the baseline over a given time period. This is chiefly a consensus building process with input provided from a number of sources, including professionals and elected officials, and in some cases the public. In doing so, agencies will want to follow a multi-step process. Because performance targets will be arrived at by consensus, several passes through the process will be necessary.

A.3 Examine recent trends in the performance measures being considered for a target. Look at the rate of change and any unusual circumstances that might have influenced the change. This analysis

alone will go a long way toward telling an agency what is achievable, and more importantly, what might be acceptable to the public and elected officials. Extrapolate recent trends to the future. Using models or expert judgment, forecast what the performance measures would be under several scenarios: "do nothing," "business as usual," "maintain current conditions," and "aggressive action" are four such scenarios that can bound the possible outcomes. Along with examining the recent past, this provides additional information to be used in the consensus building process.

A.4 Look at the performance of peers. If information is available nationally or from other agencies individually, it can be used to help determine targets. Even within an area with varying conditions, this is a useful approach. If congestion is light on one freeway, and it is agreed that this condition is desirable, then its performance standard could be used on other freeways in the area. Include non-peers with bigger problems. Consider the case of a small city undergoing rapid growth and the resulting growth in congestion. Examination of the current condition of a larger city in the state or region whose conditions are familiar could reveal an upper bound for a target.

A.5 Drill down into the output (activity-based) measures and estimate what the effect of changes in these low-level performance measures will have on the outcome-based targets. For example, consider a congestion target that states that congestion levels will be held constant over the next 10 years in the face of 2 percent annual traffic growth. Models and examining past performance can be used to make estimates of the overall congestion effect of improving certain activities such as reducing average incident duration by 10 percent over the period, utilizing dynamic message signs within work zones, etc. Develop packages of improvements that in total will produce a desired change in outcomes.

A.6 Consider stretch goals to provide vision, direction, and motivation for agencies. An example of a stretch goal is eliminating all roadway fatalities, as proposed by some European nations. Stretch goals require a level of commitment and funding not widely available for most U.S. public agencies and must be instituted with caution.

A.7 Targets for operations programs should coordinate closely with agency-wide performance targets that are set to meet MAP-21 requirements for the congestion, reliability, safety, and freight performance categories.

Responsibility and Relationships: Staffing should come from the central office. Goals and trends must be established in cooperation with responsible units, including external partners. Performance reports generated for operations use may also be relevant for other parts of the agency, especially if agency-wide performance reporting is mandated.

Action B: Develop process to incorporate operations performance measures into the development of highway projects

Rationale: Due to an increasingly competitive fiscal environment, DOTs are increasingly asked to rank their TSM&O projects against traditional expansion projects as well as conduct other "value" related exercises. This requirement can put operations and ITS projects at a disadvantage since many

specialists in this arena have limited experience in performing benefit-cost analysis, and many of the established tools available for conducting benefit-cost analysis for traditional infrastructure projects are poorly suited to analyzing the specific performance measures, benefits, and costs associated with operational improvements.

B.1 Identify staff team to review available options for incorporating operations performance measures into the highway development process. Options include both technical aspects (models, data) and institutional (at what point in the development process should they be considered). This should include systems engineers, travel forecasting and transport economists, and data analysts.

B.2 "Operations performance measures" should include congestion and safety measures beyond recurring congestion and geometrically-influenced crashes. These include:

- Estimates of nonrecurring delay (all sources) or at a minimum, incident delay
- Estimates of travel time reliability
- Estimates of secondary crashes: those that occur in the presence of an initial crash

B.3 Review the analytical background used in benefit-cost and other evaluations for competing projects in terms of measures, timeframes, and reliability/validity of data sources to establish the benchmark for comparable analysis. Also consider emerging federal requirements for conducting project evaluations.

B.4 Review available tools regarding their evaluation focus, data requirements, and complexity of analytics compared to available resources. These include:

- ITS Deployment Analysis System (IDAS)
- Screening Analysis for ITS (SCRITS)
- Surface Transportation Efficiency Analysis Module (STEAM)
- Sketch Planning Analysis Spreadsheet Model (SPASM)
- IMPACTS
- Highway Economic Requirements System (HERS) Operations Preprocessor
- Cal-B/C (Caltrans)
- Traffic Operations Corridor Sketch Planning Methodology (Wisconsin DOT)
- Metropolitan Transportation Commission (MTC – San Francisco Bay Area) Regional Transportation Plan Benefit-Cost spreadsheet (postprocessor)
- MTC Cost to Sustain Traffic Operations Systems spreadsheet tool

B.5 Select "best fit" option(s) for incorporating operations performance measures into the highway development process, and pilot test for level of effort and comparative credibility of results.

Responsibility and Relationships: Top management sponsorship may be necessary to standardize new procedures. Staffing should come from the central office with a Team including systems engineers, travel forecasting and transport economists, and data analysts.

Action C: Coordinate congestion reporting with planning personnel; coordinate incident reporting with safety personnel

Rationale: The information developed in the performance measurement process represents a good opportunity for cooperation between planning and operations personnel and to improve the credibility of TSM&O investments.

C.1 Develop liaison with MPO staff regarding ongoing Congestion Management Process (CMP) based on MPO requirements to develop and report output-related congestion/mobility performance measures. There should be a core set of performance measures, especially outcome measures that are common to both operations needs and the CMP.

C.2 Identify and reconcile areas of overlap of performance reporting, such as different performance measures and data acquisition approaches being simultaneously utilized, and develop mutual approach to maximize reporting of measures.

C.3 Review the data and reporting done by agency safety units to ensure consistency. Of special interest are the so-called high hazard locations identified by safety personnel. These may be useful for incident management activities, such as concentrating or pre-positioning resources.

C.4 Adjust TSM&O performance measurement process as appropriate. This may require the addition or deletion of measures and changes in the way the measures are reported.

Responsibility and Relationships: Staffing should come from central office. A combined work effort with safety office and MPO staff will be necessary.

Action D: Improve reporting of performance to include both internal (TSM&O) and external (e.g. planning) personnel and public/decision-maker outreach

Rationale: The impact of reporting depends substantially on the clarity and regularity of reporting so as to present data in a form that provides a "story" of changes in performance.

D.1 Develop reports such as web dashboards, briefings and quarterly performance reports to cover a range of audiences and differing levels of detail as appropriate.

D.2 Incorporate measures explanation in easily understood terms accompanied by a short, nontechnical explanation and example of the meaning.

D.3 Select reporting frequency related to cycle of demand changes and/or TSM&O program improvements, rather than frequencies driven by the cycle of major capital improvements (annual). Consider monthly, seasonal or quarterly reporting to establish a memorable sequence.

D.4 Develop a written and graphic approach to displays, publications and presentations that establishes a recognizable and continuous look and feel and that can easily be used by various audiences to identify problems. Successful outreach efforts for establishing best practice include:

- Stories – narrative reporting to describe projects and programs in plain language that nontechnical audiences understand
- Data – must be credible and form the basis for stories and measures; data sources should be cited and data quality control should be a part of every step of the process
- Graphics – design of the document and charts and diagrams should not distract from the content; should both answer and ask questions; use maps to connect what readers are familiar with to the data; colors can be used, but the charts should work in black and white as well; clearly label the axes and use pointers rather than legends where possible
- Timing – timely and frequent information
- Software – capable of good formats and graphics
- Targets for measures where they have been determined
- Using continuously-collected data as often as possible
- Measuring the causes of the problems. Congestion, safety and other factors have causal factors – many of them are related. Problems with different causes may have different solutions

D.5 Highlight the use of performance measures in project evaluations: what actually happened after project completion? Begin the development of an ongoing project evaluation program (i.e., before/after studies of completed projects). This can be done only for a small number of projects per year until the process is established. Develop a process for examining the results: why a project worked or why it didn't. This may require a field audit of the implemented project.

Responsibility and Relationships: This effort must be developed in cooperation with central office program and public affairs units as information is likely to be part of existing activity. Staffing should come from the central office.

Examples/References:

- FHWA Planning Resource Center: http://www.fhwa.dot.gov/resourcecenter/teams/planning/index.cfm
- USDOT Congestion Management site: http://plan4operations.dot.gov/congestion.htm
- Washington Council of Governments CMP website: http://www.mwcog.org/clrp/elements/cmp/
- FHWA Operations Performance measurement website: http://ops.fhwa.dot.gov/perf_measurement/index.htm
- A Guidebook for Standard Reporting and Evaluation Procedures for TSM&O Strategies: http://tsmoinfo.org/documents/files/67/GuidebookforStandardReporting_FINAL.pdf

Performance Measurement Guidance

✔ LEVEL 3 TO LEVEL 4

Why Performance Measurement is Important

The final stage of development in operations performance measurement is to move beyond reporting of statistics and to use performance measures to influence investment decisions and policy changes.

Improvement Target

From	Outcome measures identified and consistently used for TSM&O strategies improvement (L3)
To	Mission-related outputs/outcomes data routinely utilized for management, reported internally and externally, and archived (L4)
By	Developing routine performance management process for continuing improvements in operating policies, procedures, systems, and deployments

Key Sub-dimensions

- Measures Definition Action Plan
- Data Acquisition Action Plan
- Measures Utilization Action Plan

Measures Definition Action Plan (L3 to L4)

Strategy Summary

Incorporate outcome and customer satisfaction performance measures with both national and local application

Key Actions

A Extend measures to include full range of output measures and customer satisfaction measures related to mobility/safety/livability/sustainability

ACTIONS

Action A: Extend measures to include full range of output measures and customer satisfaction measures related to mobility/safety/livability/sustainability

Rationale: Fully mainstreaming TSM&O on the basis of continuous improvement requires a comprehensive set of measures that reflects the agency's objectives for the program.

A.1 Develop a full range of outcome measures. National professional dialogue suggests a broad range for consideration:

- Customer satisfaction
- Extent of congestion – spatial and temporal
- Incident duration
- Recurring delay
- Speed
- Throughput – person and vehicle
- Travel time – facility and trip
- Travel time reliability

A.2 Consider additional output and outcome measures to meet the needs of "fine tuning" real-time procedures and protocols. Examples can be developed that assess various components that are part of conventional strategy applications. For example, within incident management, this might include components of the incident timeline, rather than just total duration (e.g., response time, roadway clearance time, incident clearance time, and secondary crashes). Measures that identify the severity of disruptions, such as lane-hours lost due to incidents and work zones, should also be considered.

A.3 Extend outcome measurement program to support broader (non-mobility, non-safety) agency measures which may emerge, including CO_2 generation (average speed and variations) and livability (generic origin-destination travel times).

Responsibility and Relationships: These Actions require strong communication with other units in the agency to coordinate the measures; other units may possess the data required for certain types of operations performance measures (e.g. work zone crashes). Staffing should come from the central office.

Examples/References:

- See FHWA Traffic Incident Management (TIM) Performance Measurement Knowledgebase: http://ops.fhwa.dot.gov/eto_tim_pse/preparedness/tim/knowledgebase/index.htm
- See FHWA archived data user service descriptions at: http://www.fhwa.dot.gov/policy/ohpi/travel/adus.cfm

Data Acquisition Action Plan (L3 to L4)

Strategy Summary

Implement data business plan with formal data archive to house all the required data and implement system to manage data internal to operations units

Key Actions

A	Establish Operations Data Business Plan and System for producing outcome measures using direct measurements
B	Design and implement an Archived Data Management System
C	Develop data quality assurance program

ACTIONS

Action A: Establish Operations Data Business Plan and System for producing outcome measures using direct measurements

Rationale: A formal Operations Data Business Plan will identify the roles and responsibilities of the various groups that must participate in the development of an ongoing performance monitoring system.

A.1 Develop an Operations Data Business Plan and System. In the plan, consider the following items:

1. Introduction
   - Purpose of this document
   - Uses and benefits of operations performance measures [OPM] (why OPM are needed)
   - Current state of the practice (examples from other states)
   - Agency activities to date (timeline/history of events)
2. User Requirements for Operations Performance Measures
   - Who needs operations performance measurement, how often, and in what form; may have been conducted as part of a larger strategic plan (interviews)
   - Ongoing monitoring
   - Project evaluations
   - Multiple uses for the data
3. Recommended Operations Performance Measures (include description, calculation)
   - Operations measures for statewide reporting (mainly high level outcome measures; integration with long-range planning or agency-wide annual performance reports)
   - Operations measures for program management (both outcome and output measures; used by TMCs and regions to manage daily activities)

- Reporting levels
- Reporting formats

4. Data Inventory and Needs
   - Data required to support measure development (map data to measures; note analytics required)
   - Inventory of current data (include source, latency, quality, accessibility, data structure, temporal/spatial resolution)
   - Data gap analysis (to identify new data that needs to be collected)
   - Uses of the data beyond operations performance measurement (traditional traffic monitoring, air quality analysis, travel demand modeling, etc.)
5. Data Management to Support Operations Performance Measures
   - Operations data management system (the starting point is to decide on the degree of automation required—can reporting requirements be handled by staff or does new software have to be developed?)
   - Design (needs to be detailed; include integration with legacy systems, hardware/software requirements, architecture, quality control)
   - Construction (plan for how the software gets written internally or procured)
   - Operation and maintenance
   - Coordination with other stakeholders for the data

A.2 Develop implementation plan for Operations Data Business Plan and System, including assignment of responsibilities (who's in charge of the system; who has to report data, etc.) and scheme for distributing reports.

Responsibility and Relationships: Linkages to legacy systems are extremely important as these can provide valuable data (e.g., VMT and crashes). Staffing should come from the central office. Outside technical assistance may be required.

Action B: Design and implement an Archived Data Management System

Rationale: An Archived Data Management System (ADMS) is needed to facilitate the production of operations performance measures and to provide data for other applications.

B.1 Combine data collected for TSM&O with data collected from special studies and with data collected from external sources, including data collected by other agencies (e.g. weather data from the National Weather Service), or data from systems that are not part of the agency TSM&O activities (e.g. staff deployment and levels). The ADMS may be statewide or employed separately by region.

B.2 Develop ADMS utilizing standard information technology (IT) principles. These principles include:

- formal user requirements process

- functional requirements specs
- state-of-the-practice software tools
- software development cycle
- documentation and metadata
- active database administration

B.3 Include complete range of core functions essential to quality and utility including:

- data quality control and reporting
- data imputation (optional, depending on users' wishes)
- data aggregation and fusion
- data repackaging for other software
- standard output reports
- custom analysis

Responsibility and Relationships: Staffing should come from the central office, working closely with IT unit. Outside technical assistance may be required. Separate ADMSs may be warranted for some regions, rather than a single, central ADMS. The decision to decentralize ADMS is a local option, but provisions must be made for "roll-up" of regional results to the state level.

Action C: Develop data quality assurance program

Rationale: Data quality is a key concern given that minimal error detection is performed as the data are being collected in real time and that the resulting large data sets are new to many data users who have varying quality criteria (e.g. operations vs analysts).

C.1 Identify key attributes essential for quality control including:

- Suspect or erroneous data – identifying and "treating" illogical or improbable data values that do not fall within expected ranges or meet established principles or rules
- Missing data – identifying and "treating" expected data values that are missing because of hardware/software malfunction or quality control edits
- Inaccurate data – identifying and "treating" data values that are systematically inaccurate (but within the range of plausible values) because of equipment measurement error (e.g. equipment improperly calibrated)

C.2 Employ standard quality assurance strategies including:

- Improving data quality at the source (if possible) and avoiding "scrap and rework"
- Applying business rules (quality checks) to automate the identification of invalid data
- Making data quality results available to data and information consumers

C.3 Utilize an established construction inspection and acceptance testing process for field devices to improve data quality, focusing on sensors prone to long-term maintenance issues such as inductance loop detectors. Consideration may be given to use of performance-based data collection

contracts with the private sector. That is, the data from private vendors would be required to meet pre-set data quality standards, most importantly, accuracy.

Responsibility and Relationships: Staffing should come from the central office, working closely with IT unit. Outside technical assistance may be required.

Examples/References:

- See FHWA archived data user service descriptions at: http://www.fhwa.dot.gov/policy/ohpi/travel/adus.cfm
- Guidelines for Developing ITS Data Archiving Systems is available at: http://tti.tamu.edu/documents/2127-3.pdf
- See ASTM Standards E2259-03a http://www.astm.org/Standards/E2259.htm; E2468-05 http://www.astm.org/Standards/E2468.htm; and E2665-08 http://www.astm.org/Standards/E2665.htm
- See FHWA Traffic Data Quality Measurement Final Report: http://ntl.bts.gov/lib/jpodocs/repts_te/14058.htm

Measures Utilization Action Plan (L3 to L4)

Strategy Summary

Undertake nationally-defined self-assessments and benchmarking annually; consider developing state-specific self-assessments to cover aspects of performance monitoring missed by national level material

Key Actions

A	Routinely evaluate newly deployed projects and changes in policies using performance measurement system and make adjustments to existing deployments and policies
B	Improve external reporting to include the public and decision-makers
C	Include assessment of benefits of operations in annual reporting

ACTIONS

Action A: Routinely evaluate newly deployed projects and changes in policies using performance measurement system and make adjustments to existing deployments and policies

Rationale: Evaluation efforts typically judge the effect of new programs or changes in existing programs. Monitoring programs provide regular and periodic reporting on any performance attributes including both the current situation as well as trends over time. (Note: project evaluations are separate from the ongoing performance reporting function, e.g., the Annual Performance Report. They focus on the effect of specific improvements which will have different time and spatial scales than ongoing reporting. The measures used, however, will be the same.)

A.1 Broaden measures to respond to TSM&O extensions and/or deployment of new strategies. For example, multimodal and single mode measures may be needed.

A.2 Continuously review performance and measurement methods to improve ability to respond to policy makers and public regarding system justification related to specific issues of interest (mobility and others)

A.3 Include individual project evaluations in routine performance reports. Highlight what was learned from the evaluation and how the knowledge will be used in future investment decisions.

A.4 Compare estimates of impacts from project planning to evaluation of completed projects; make adjustments in project planning process and models as appropriate.

A.5 Evaluate proposed projects to assess their likely effect on system performance. This evaluation should include projects of all kinds, not just operations projects. This will involve application of models and other forecasting methods that are capable of assessing operations, capacity expansion, and demand management projects. During the evaluation phase, compare the forecasted impacts (model-based) with the actual impacts (empirical data-based).

A.6 Routinely review performance trends to identify potential problems. Examples include high crash locations, components of the incident timeline (verification, response, on-scene time, etc.), ramp meter timing, work zone duration, and small-scale geometric problems creating bottlenecks. Compare to other parts of the system as well as to national benchmarks or the performance of peer agencies in other states. Drill down to identify specific problems, either via special data analysis, after action reports, or interviews with field personnel. Determine changes in policy or new investments required to address specific problems.

Responsibility and Relationships: Staffing should come from the central office (this may be a continuous function requiring the formation of a task force). Performance reports generated for operations use may also be relevant for other parts of the agency, especially if agency-wide performance reporting is mandated.

Action B: Improve external reporting to include the public and decision-makers

Rationale: A principal value of performance measurement is to provide accountability and justification for the program, i.e. to gain support essential to mainstreaming TSM&O as a continuing formal program. Therefore, performance information needs to be produced specifically for these purposes.

B.1 Identify how performance measurement information is used to support specific program decisions. When produced in light of the policies being implemented, control systems being applied, and management actions being used, outcome measurements can become statistics that describe whether operational and policy goals are being reached. They also describe whether management decisions are having the effects desired, and these combine, in turn, lead to more informed decision-making regarding more vs. less effective actions.

B.2 Clarify the degree of influence that TSM&O activities have on outcomes as a way to establish realistic accountability for TSM&O programs. That is, to what extent can improvements in TSM&O programs produce changes in outcome measures at the project, regional, and statewide levels? It is essential to be clear—in both internal and external reporting—of the degree to which external factors influence performance statistics and trends (e.g. the impact of growth in VMT and weather). Analysis frameworks and reporting should be designed to distinguish among these factors. When performing evaluations of specific projects, the use of control groups may be useful in controlling for certain background factors, such as VMT growth or a spate of inclement weather.

B.3 Develop performance reports with the understanding that while documenting trends in system condition is valuable, ultimately the purpose of performance monitoring is to effect changes in policies, investments, and program structure. By including both outcome and output measures—and comparing them to state, peer, or national benchmarks—it will be possible to identify locations or policies that are in need of improvement,

B.4 Tailor reporting to range of audiences/stakeholders in improved operations in terms relevant to their interests. These interests may include:

- Transit agencies that provide service which use the freeway
- Transportation and land use policy-making bodies
- State, regional, and local planning groups that help identify, design, prioritize, and fund transportation improvement projects
- Regulatory bodies that oversee distribution of national and state funds
- Agencies that perform emergency response
- Police agencies that are responsible for law enforcement and major accident investigations
- Local news media that wish to report on the condition and operation of the local highway system
- Private businesses such as trucking companies that routinely use the highway system and whose business practices are therefore affected by operational performance
- Individual taxpayers that either wish to use performance information directly, or desire that the operating agency use that information to develop and publicize travel information that improves the quality of their lives

Responsibility and Relationships: This effort must be developed in cooperation with central office performance monitoring program and public affairs units. Usually, central office and public affairs activities include the performance of many functional areas (e.g., pavements, bridges, safety) and their reporting requirements are more of a summary nature. Staffing for this coordination should come from the central office.

Action C: Include assessment of benefits of operations in annual reporting

Rationale: It is important to develop the ability to "tell a story" about system performance trends that distinguish the positive role of operations within the broader influences impacting congestion and delay (e.g., development patterns, general level of economic activity).

C.1 In reporting, identify the complete array of factors affecting performance including both "manageable" and "unmanageable" factors. This will enable the agency to isolate contributions, recognizing that congestion may continue to increase at the regional or statewide level even with the implementation of TSM&O strategies. This is the reason that project evaluations are so important: they isolate the positive impacts which will be diluted at higher levels of spatial aggregation. Include a distinction between recurring and non-recurring congestion and discuss unique potential impacts of TSM&O strategies.

C.2 Use modeling to show what would have happened in the current year with improved operations assuming that demand was constant or that operations measures were not employed. This can be done selectively rather than comprehensively; it is undertaken to make a point about the complexity of dealing with congestion and influences that are beyond the control of state transportation agencies. Microsimulation is the most appropriate tool at the project level while sketch planning tools would be appropriate at the state level.

C.3 Report subordinate outcome measures such as incident delay, work zone delay, lane-hours lost, incident duration, etc., as indicators of performance in the face of changing demand. By decomposing congestion into its components, there is a better chance that TSM&O activities will exhibit an effect. This will require that travel time data be fused with geometric and disruption (incidents, weather, work zones) data.

Responsibility and Relationships: This effort should be conducted in cooperation with the planning and programming staff units—both within DOT and regional planning entities—as well as units responsible for internal and external reporting. Operations input and staffing should come from the central office.

Examples/References:

- See FHWA archived data user service descriptions at: http://www.fhwa.dot.gov/policy/ohpi/travel/adus.cfm
- The Washington State Department of Transportation Accountability & Performance Program provides good examples: http://www.wsdot.wa.gov/accountability/
- See FHWA Planning Resource Center: http://www.fhwa.dot.gov/resourcecenter/teams/planning/index.cfm

Systems and Technology Guidance

✔ LEVEL 1 TO LEVEL 2

Why Systems and Technology are Important

Use of the appropriate processes for design and implementation of TSM&O systems will ensure that the needs of the region are appropriately addressed, that systems are implemented in an efficient manner, and interoperability with other systems is achieved.

Improvement Target

From	Ad hoc approaches outside systematic systems engineering (L1)
To	Systems engineering employed and consistently used for ConOps, architecture and systems development (L2)
By	Introducing systems engineering into project development processes

Key Sub-dimensions

- Regional Architecture
- Systems Engineering/Testing/Validation
- Standards/Interoperability

Regional Architecture Action Plan (L1 to L2)

Strategy Summary

Ensure that agency is an active participant in the development, maintenance and use of the regional architecture for planning and project development

Key Actions

A	Assign responsibility for leading architecture developments/improvement/maintenance to a qualified individual within the agency
B	Convene Architecture Review Committee
C	Monitor system developments and other agency activities to ensure that architectural relevancy is maintained

ACTIONS

Action A: Assign responsibility for leading architecture developments/improvement/maintenance to a qualified individual within the agency

Rationale: The systems architecture provides the framework for institutional agreement and technical integration for the implementation of ITS projects or groups of projects. It is required to obtain federal funding for the implementation of an Intelligent Transportation System and must be continuously updated as the TSM&O program develops.

A.1 Identify an individual (designated here as the Architecture Lead) with a knowledge of TSM&O concepts of operations (ConOps).

A.2 Provide the individual with the opportunity to attend training in the development of ITS architecture. Alternatively, employ a consultant to provide needed architectural leadership and identify appropriate individual to provide agency oversight.

Responsibility and Relationships: Implemented by senior management with appointment of responsible individual with appropriate background as "Architecture Lead" within central office (or district/region as appropriate).

Action B: Convene Architecture Review Committee

Rationale: The architectures involve concepts, systems and roles for a range of service providers who must be involved in reaching a consensus approach.

B.1 Assign Architecture Lead responsibility for assembling and convening an Architecture Review Committee of individuals representing stakeholder organizations related to the regional architecture. Stakeholders include organizations representing all surface transportation modes within the region.

B.2 Brief Architecture Review Committee on the principles of the regional architecture (new or existing) and then introduce the draft architecture being considered for the region.

B.3 Review systems and functions of all stakeholders to ensure that they are adequately represented by the architecture.

B.4 Prepare and present the "business case" for maintaining current architecture in terms of expected program, system or technology improvements.

Responsibility and Relationships: The creation and operation of the architecture review committee is the responsibility of the Architecture Lead. All organizations within the region that are stakeholders in the architecture development and implementation must be participants in the Architecture Review Committee.

Action C: Monitor system developments and other agency activities to ensure that architectural relevancy is maintained

Rationale: As systems are developed and as needs for improvements emerge, the impact on the existing architecture must be reviewed for needed updates if it is to remain current.

C.1 Monitor system developments and other agency activities to ensure that architectural relevancy is maintained. This is performed through periodic stakeholder meetings, during which the architecture is reviewed in terms of the technological developments and needs of the participating agencies.

Responsibility and Relationships: Periodic reviews are the responsibility of the Architecture Review Committee which is convened by the Architecture Lead. All organizations within the region that are stakeholders in the architecture development and implementation must be participants in the Architecture Review Committee.

Examples/References:

- The requirements for a regional architecture are defined by Part 940 of the Code of Federal Regulations: http://law.justia.com/us/cfr/title23/23-1.0.1.11.47.html
- Information about the committee to be formed for the development of a regional architecture "National ITS Architecture": http://www.iteris.com/itsarch/
- "Turbo Architecture: A Tool for Leveraging the National ITS Architecture" http://www.tfhrc.gov/pubrds/mayjun00/turbo.htm
- An online course that provides an introduction to the National ITS Architecture is available at http://www.citeconsortium.org. The course name is "Introduction to the National ITS Architecture".

Systems Engineering/Testing/Validation Action Plan (L1 to L2)

Strategy Summary

Require that all projects of above a certain size adhere rigorously to the systems engineering process

Key Actions

A	Adopt the systems engineering process as a requirement for the procurement and development of new systems
B	Provide training to agency personnel involved at all levels in high-tech system developments

ACTIONS

Action A: Adopt the systems engineering process as a requirement for the procurement and development of new systems

Rationale: Systems engineering is the methodology by which complex systems should be designed, updated and managed. Systems engineering is an interdisciplinary process that from concept, to design, to operations focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation.

A.1 Develop an agency-wide policy that requires the use of systems engineering for the procurement of new systems and the enhancement of existing systems utilizing advanced technology.

A.2 Specify the process to define the systems engineering steps to be executed, including risk management, configuration management, incremental development, concept of operations, requirements, design and testing.

A.3 Incorporate reporting procedures and acceptable procurement processes.

Responsibility and Relationships: The policy on using systems engineering must be established by senior management and developed by qualified staff. Outside technical assistance may be required.

Action B: Provide training to agency personnel involved at all levels in high-tech system developments

Rationale: The continuing evolution of the TSM&O and related architecture, systems, and technology requires a sustainable technical competency to manage and execute architecture and system maintenance and development.

B.1 Require all agency personnel involved with the management of projects involving the development, enhancement and/or utilization of advanced technology to attend at least 16 hours of training that describes the systems engineering process as it is applied to advanced transportation projects.

B.2 Attend available training as indicated in the examples/references. Training should be associated with both the regional architecture and the use of the Turbo Architecture (see References below).

Responsibility and Relationships: Senior management to require the development of an agency-wide training program for appropriate personnel.

Examples/References:

- Requirements definition (USDOT) in its Code of Federal Regulations Part 940, ITS Architecture and Standards: http://law.justia.com/us/cfr/title23/23-1.0.1.11.47.html
- Available online training is recommended for the architecture. See Consortium for ITS Training and Education course "Introduction to the National ITS Architecture" at: http://citeconsortium.org
- Information about the Turbo Architecture can be found at: http://www.tfhrc.gov/pubrds/mayjun00/turbo.htm
- Turbo Architecture Support Page: http://www.iteris.com/itsarch/html/turbo/turbomain.htm

Standards/Interoperability Action Plan (L1 to L2)

Strategy Summary

Identify applicable standards for all new system implementations

Key Actions

A	Identify and require relevant standards as an integral step of the system design process
B	Require training for all systems development personnel who might be involved in the specification and usage of standards

ACTIONS

Action A: Identify and require relevant standards as an integral step of the system design process

Rationale: Working together in a region requires standards that support the interoperability of various systems and facilitation of the interchange of field and central system hardware and software operations. Standards developed for the ITS industry are used for harmonizing data communications, database exchanges, and information displays among diverse systems. It is essential that standards be integrated into the system development and acquisition program.

A.1 Review system acquisitions that have occurred during the previous five years and upcoming procurements to identify features and functions for which existing standards are applicable.

A.2 Compile a list of relevant standards, and develop a guidebook for their application to all future developments.

Responsibility and Relationships: The policy on standards must be established by senior management and developed by qualified staff with the involvement of all agencies that are part of a region's TSM&O. Outside technical assistance may be required.

Action B: Require training for all systems development personnel who might be involved in the specification and usage of standards

Rationale: A basic background in the full range of ITS standards is important for staff that is going to be involved.

B.1 Identify available training courses for the application of standards identified in Action A.

B.2 Prepare training budget and require that project management personnel or other appropriate staff members with responsibility for the implementation of systems incorporating the standards attend relevant programs.

Responsibility and Relationships: Senior management to require the development of an agency-wide training program for appropriate personnel involved in the development of high technology systems.

Examples/References:

- Standards are available for a broad range of ITS applications, communication, information exchange, databases etc. Standards are used for communication between a central computer and field equipment (traffic signals, dynamic message signs, highway advisory radio, etc.). Database standards are available to ensure that data is archived in a manner that will enhance the agency's ability to share the information with other agencies and jurisdictions. It is essential that standards be integrated into the system development and acquisition program. Overview and detailed information on the entire range of ITS standards can be found at: http://www.standards.its.dot.gov/
- Managers need training that provides an overview of the standards framework and an appreciation of their benefits, while technical professionals involved with the specification, acquisition and testing of standards require more detailed instruction. A listing of available ITS standards training can be found at: http://www.standards.its.dot.gov/DeploymentResources/Training

Systems and Technology Guidance

✔ LEVEL 2 TO LEVEL 3

Why Systems and Technology are Important

Use of the appropriate processes for design and implementation of TSM&O systems will ensure that the needs of the region are appropriately addressed, that systems are implemented in an efficient manner, and interoperability with other systems is achieved.

Improvement Target

From	Systems engineering employed and consistently used for ConOps, architecture and systems development (L2)
To	Systems and technology standardized, documented and trained statewide, and new technology incorporated (L3)
By	Developing tools, procedures and training to support standardized systems engineering process

Key Sub-dimensions

- Regional Architecture
- Systems Engineering/Testing/Validation
- Standards/Interoperability

Regional Architecture Action Plan (L2 to L3)

Strategy Summary

Monitor ongoing system developments as well as changing needs to ensure that the architecture is both followed and updated as needed

Key Actions

A	Develop procedure to identify changes in plans for TSM&O system development including new systems, maintenance, upgrade and replacement of existing systems, and/or other changes
B	Develop an advisory procedure to review submitted changes and recommend modifications to ensure conformance with the Regional Architecture
C	Develop and execute memoranda of understanding among all participating agencies

ACTIONS

Action A: Develop procedure to identify changes in plans for system development including new systems, maintenance, upgrade and replacement of existing systems, and/or other changes

Rationale: The TSM&O Regional Architecture is a living plan that must be continuously updated as individual systems in the region are planned, designed, implemented and upgraded. It is necessary to continuously monitor these activities to assess their impact on the regional architecture.

A.1 Review needs for updating existing architecture in terms of systems, technology, procedures and role changes since the original architecture.

A.2 Using the Architecture Review Committee, develop procedures in the form of required reports and presentations that provide the information it needs to ensure that the Regional Architecture is up-to-date and relevant.

A.3 Focus on use of systems architecture regarding the complete range of ongoing systems additions, modifications, and maintenance to ensure concepts of operations, new systems procedures, roles and interoperability are maintained for full effectiveness.

Responsibility and Relationships: Periodic reviews are the responsibility of the Architecture Review Committee which is convened by the Architecture Lead. Both project personnel and managers of organizations within the region that are stakeholders in the architecture development and implementation are involved.

Action B: Develop an advisory procedure to review submitted changes and recommend modifications to ensure conformance with the Regional Architecture

Rationale: During its periodic meetings, the Architecture Review Committee must review changes submitted by the individual agencies submitting their updated plans.

B.1 Assess the impact of these changes on the Regional Architecture as it affects interconnections, interoperability and standards.

B.2 Provide (when necessary) feedback to the developers of the individual agencies, requesting conformance with regional standards and other regional needs.

B.3 Update the Regional Architecture to reflect these changes.

Responsibility and Relationships: Periodic reviews are the responsibility of the Architecture Review Committee which is convened by the Architecture Lead. Both project personnel and managers of organizations within the region that are stakeholders in the architecture development and implementation are involved.

Action C: Develop and execute memoranda of understanding among all participating agencies

Rationale: Part 940 of the Code of Federal Regulations—Intelligent Transportation System (ITS) Architecture and Standards—specifies that projects entering the design phase must follow a systems engineering approach commensurate with the project scope and requires the identification of participating agencies' roles and responsibilities including the execution of memoranda of understanding among the participants.

C.1 Using the Architecture Review Committee, define operational and funding responsibilities and agreement to follow applicable regional standards.

C.2 Conduct a review of systems and technology interoperability regarding voice and data across all participants.

C.3 Create and execute memoranda of understanding among all agencies participating in the regional integration of their systems.

Responsibility and Relationships: The Architecture Review Committee, which is convened by the Architecture Lead, representing organizations within the region that are stakeholders in the architecture development and implementation.

Examples/References:

- Part 940 of the Code of Federal Regulations (CFR) requires the development of a regional architecture. It requires all projects receiving federal funding to conform to the approved architecture. It indicates that: "If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated as provided in the process defined in §940.9(f) to reflect the changes." Many agencies have determined that periodic updates of the architecture will minimize the likelihood that projects will not conform to the architecture. See: http://law.justia.com/us/cfr/title23/23-1.0.1.11.47.html
- "National ITS Architecture": http://www.iteris.com/itsarch/
- "Turbo Architecture: A Tool for Leveraging the National ITS Architecture": http://www.tfhrc.gov/pubrds/mayjun00/turbo.htm
- Turbo Architecture Support Page: http://www.iteris.com/itsarch/html/turbo/turbomain.htm
- An online course that provides an introduction to the National ITS Architecture is available at http://www.citeconsortium.org ("Introduction to the National ITS Architecture")
- A good example of a memorandum of understanding can be found at: http://lawrenceks.org/web_based_agendas/2009/06-02-09/06-02-09h/pl_tac_approved_ldcmpo_cooperative_agreement.pdf
- The requirements for a memorandum of understanding are defined by USDOT in its Code of Federal Regulations Part 940, ITS Architecture and Standards: http://law.justia.com/us/cfr/title23/23-1.0.1.11.47.html

Systems Engineering/Testing/Validation Action Plan (L2 to L3)

Strategy Summary

Develop tools and procedures to support the systems engineering process including testing and validation

Key Actions

A	Invest in tools and training for maintaining configuration management during system development
B	Invest in required tools and equipment for testing and validating system operability
C	Create a Configuration Control Board (CCB) to monitor TSM&O system development, testing and validation process on a continuing basis
D	Develop procurement standards to ensure that all contractors selected for system design, implementation, operation and maintenance are fully qualified to execute the systems engineering process
E	Develop process for maintaining and improving staff capabilities including maintenance of contact with best available IT, systems, communications and device technology

ACTIONS

Action A: Invest in tools and training for maintaining configuration management during system development

Rationale: As ITS and Emergency Management systems develop and are augmented or changed, it is essential to document and manage the configuration of the functional and physical attributes of software in order to perform systematic control of changes for the purpose of maintaining software integrity and traceability throughout software development life cycles.

A.1 Identify required tools (primarily configuration management software) and training required to facilitate configuration management during the system development process.

A.2 Acquire the required tools, including needed training, to ensure their effective use.

A.3 Ensure that all individuals participating in the system development process have appropriate training and access to the required tools. This includes provision of appropriate training for maintenance personnel. The appropriate level of familiarity and training should also be provided to program management personnel.

A.4 Ensure continued use of the tools as the system transitions from implementation to maintenance as a standard operating procedure.

Responsibility and Relationships: Senior management personnel overseeing system implementation are responsible for budgeting for the acquisition of the tools, and ensuring their use and involving program managers and agency technical staff.

Action B: Invest in required tools and equipment for testing and validating system operability

Rationale: Testing and validation are processes for verifying that a product or system meets specifications and that it fulfills its intended purpose.

B.1 Identify required hardware and software tools, and training required to facilitate validation and testing of system capabilities and operation during the system development process.

B.2 Acquire the required tools, including needed training, to ensure their effective use.

B.3 Ensure that all individuals participating in the system development have appropriate training and access to the required tools.

B.4 Ensure continued use of the tools as the system transitions from implementation to maintenance. This includes provision of appropriate training for maintenance personnel.

B.5 Consider the use of an independent verification and validation service.

Responsibility and Relationships: Senior management personnel overseeing system implementation are responsible for budgeting for the acquisition of the tools, and ensuring their use and involving program managers and agency technical staff.

Action C: Create a Configuration Control Board (CCB) to monitor TSM&O system development, testing and validation process on a continuing basis

Rationale: A Configuration Control Board is composed of technical and administrative representatives who are empowered to approve all engineering and architectural changes being made to a system during its implementation, operations and maintenance.

C.1 Identify Configuration Control Board membership.

C.2 Schedule monthly meetings for CCB.

C.3 Develop change form with description of the change, justification, and estimate of time and cost impacts.

C.4 Develop procedure to precede CCB meetings with an agenda and submissions of change forms.

C.5 CCB meets to approve or disapprove requested changes.

Responsibility and Relationships: Members of the CCB are at a level within the participating organizations to authorize the use of additional funds if required to implement the recommended changes. Project managers from both the Contractor and the Agency must be included.

Action D: Develop procurement standards to ensure that all contractors selected for system design, implementation, operation and maintenance are fully qualified to execute the systems engineering process

Rationale: Qualifications of contractors providing hardware, software and systems integration services must be reviewed to determine the quality of the products to be provided. The Capability Maturity Model (CMM) is a five-step rating that is used to evaluate the effectiveness of an organization's software development process.

D.1 Meet with appropriate procurement personnel to ensure that the requirements for a specific CMM rating can be included in the agency's evaluation of proposers.

D.2 Working with appropriate experts, select a CMM level on which to base contractor selection.

D.3 Develop model procurement specifications to be included in all procurements related to contractor qualifications.

D.4 Working with procurement personnel, identify alternative types of procurement (low-bid, consultant, system manager, and design-bid) to be used in connection with various types of high-tech projects.

Responsibility and Relationships: This effort should be led by agency's project manager. Participants include procurement personnel and may require participation by senior management.

Action E: Develop process for maintaining and improving staff capabilities including maintenance of contact with best available IT, systems, communications and device technology

Rationale: ITS technology and systems for TSM&O are developing rapidly, often independently in other jurisdictions. It is important to stay abreast of best practice.

E.1 Identify key staff members responsible for implementation, operations and maintenance of technology associated with operations.

E.2 Establish budget allowing staff members to participate in appropriate conferences and meetings.

E.3 Encourage participation on appropriate technical committees of national associations and subscribe to appropriate technical journals for review by relevant personnel.

E.4 Develop approach to support training and capability improvement for IT staff.

E.5 When possible request presentations from manufacturers and consultants regarding technical advances in their areas of specialization.

Responsibility and Relationships: Senior management must provide needed budget for tracking of new technology, and encouraging participation by key staff members in professional and technical activities.

Examples/References:

- Configuration management tools were used extensively during the development of the Maryland Coordinated Highways Action Response Team (CHART) ATMS (Advanced Traffic Management) system. These tools were used to provide the traceability needed to ensure that all requirements were included in the specifications, and subsequently tested. The tools were invaluable when applied to a system such as CHART, which had several hundred requirements that must be tracked. This can be found at: http://www.chart.state.md.us/
- A variety of tools may be required to support the validation in addition to the configuration management tools. For example, a traffic management system is often required to process data received from conventional traffic detectors (radar, inductive loop, etc.). Validation testing must ensure that data is being correctly received and processed from these detectors. One tool that has been developed to support these tests is a detector simulator, which uses a simulation program to model traffic flow, and then translates the traffic flow into detector actuations, which in turn are transmitted to the traffic management system under test. A good summary of the configuration management tools that are used to identify the tests to be performed based on the system requirements, can be found at: http://www.daveeaton.com/scm/CMTools.html
- A Configuration Control Board (as described by the reference) was established during the development of the Maryland CHART System. This $30 million development project avoided

schedule slippage and major cost overruns through the efforts of the CCB, which required that all changes (no matter how small) had to be documented and submitted to the Board for approval prior to their implementation. The CCB is described in the following reference: "System Engineering for Intelligent Transportation Systems": http://ops.fhwa.dot.gov/publications/seitsguide/index.htm

- The use of a CMM level as a criterion for contractor selection (this was not the only criterion) was successfully implemented by the Louisiana Department of Transportation and Development (DOTD) in its procurement of a statewide traffic management system by limiting offerers to a few highly qualified systems integration firms. It is described in the online course offered by the Consortium for ITS Training and Education (CITE), titled "Introduction to Systems Engineering": http://www.citeconsortium.org
- Organizations that serve as sources of information regarding advances in the field of management and operations include:
  - ✓ Institute of Transportation Engineers (ITE): http://www.ite.org/
  - ✓ ITS America: http://www.itsa.org/
  - ✓ American Association of State Highway and Transportation Officials (AASHTO), subcommittee on Systems Operations and Management (SSOM): http://ssom.transportation.org/Pages/default.aspx
  - ✓ Transportation Research Board (TRB): http://www.trb.org/Main/Home.aspx
- Publications that track new technology include:
  - ✓ ITE and TRB reports
  - ✓ Thinking Highways: http://www.thinkinghighways.com/
  - ✓ Traffic Technology International: http://www.ukipme.com/mag_traffic.htm
  - ✓ ITS International: http://www.itsinternational.com/

Standards/Interoperability Action Plan (L2 to L3)

Strategy Summary

Coordinate application of TSM&O standards and interoperability statewide/regionally and for planning

Key Actions

A	Develop a five-year plan for the implementation of systems and standards needed to facilitate statewide/regional interoperability
B	Analyze database standards to ensure their uniform application in a manner that permits seamless exchange of information among agencies
C	Develop protocols and systems (if needed) to permit regional visibility of the status of transportation systems managed by individual participating jurisdictions

ACTIONS

Action A: **Develop a five-year plan for the implementation of systems and standards needed to facilitate statewide/regional interoperability**

Rationale: Standards developed for the ITS industry are used for harmonizing data communications, database exchanges, and information displays among diverse systems. The appropriate use of these standards will ensure the ability for interoperability of various systems, as well as simplifying interchange of field and central system hardware and software.

A.1 Develop a five-year plan for the standardization of systems (both existing and planned) within the region in order to achieve desired levels of interoperability.

A.2 Identify the systems included in the plan, and provide a precise definition of the desired level of interoperability for the region. Identify needed standards, and provide a phased implementation plan and budget for the modification of the systems included in the plan to achieve these standards.

A.3 Estimate anticipated regional benefit of the regional standardization.

A.4 Ensure input of plan into programming, budgeting and project planning processes.

Responsibility and Relationships: The development of the plan is the responsibility of the Architecture Review Committee and should involve all agencies within the region involved in the development of high technology systems. Outside technical assistance may be used as necessary.

Action B: Analyze database standards to ensure their uniform application in a manner that permits seamless exchange of information among agencies

Rationale: While database standards currently exist for transportation applications, they include many alternative ways of representing the same data.

B.1 Analyze the available database standards to arrive at a single representation for each data item required for regional interoperability.

Responsibility and Relationships: The development of the standards is the responsibility of the Architecture Review Committee and should involve all agencies within the region involved in the development of high technology systems. Outside technical assistance may be used as necessary.

Action C: Develop protocols and systems (if needed) to permit regional visibility of the status of transportation systems managed by individual participating jurisdictions

Rationale: A protocol is a convention or standard that controls or enables the connection, communication, and data transfer across a network between computing endpoints, including the operational rules that dictate the information that can be shared among agencies and released to the media and general public.

C.1 Determine standards needed to support seamless interchange of transportation system status including incidents, traffic flow and mass transit operations.

C.2 Develop protocols required for information sharing.

C.3 Allocate resources for long-term support of the operation and maintenance of the regional system.

C.4 Implement systems and/or software as needed to provide integrated seamless displays of transportation status regionally.

Responsibility and Relationships: The development of the protocols is the responsibility of the Architecture Review Committee and should involve all agencies within the region involved in the development of high technology systems. Outside technical assistance may be used as necessary.

Examples/References:

- The Minnesota DOT sponsored a regional workshop to initiate the process of regionally planning for the use of standards. The workshop brought together the potential users of standards within the state of Minnesota with the objective of increasing awareness of their benefits and opportunities for application. This workshop provides a mechanism for initiating the development of a standards review activity: http://ntl.bts.gov/lib/jpodocs/brochure/9r701!.pdf
- "ITS Standards Development Plan": http://www.iteris.com/itsarch/documents/sdp/sdp.pdf
- The standard dealing specifically with the subject of message sets and data dictionaries is AASHTO-ITE TM 3.0, Standards for Traffic Management Center-to-Center Communications: http://www.standards.its.dot.gov/Factsheets/Factsheet/17
- An overview of the ITS standards program can be found at: http://www.standards.its.dot.gov/Factsheets/All
- An example of one such regional development is the Regional Integrated Traffic Information System (RITIS) developed for the Washington DC region. RITIS provides seamless displays of transportation system status within the DC region and disseminates this information to local transportation agencies and the media. RITIS is described at: http://www.cattlab.umd.edu/?portfolio=ritis

Systems and Technology Guidance

✔ LEVEL 3 TO LEVEL 4

Why Systems and Technology are Important

Use of the appropriate processes for design and implementation of TSM&O systems will ensure that the needs of the region are appropriately addressed, that systems are implemented in an efficient manner, and interoperability with other systems is achieved.

Improvement Target

From	Systems and technology standardized, documented and trained statewide, and new technology incorporated (L3)
To	Systems and technology routinely upgraded and utilized to improve efficiency and performance (L4)
By	Coordinating and updating architectural activities with performance measurement on a continuous basis

Key Sub-dimensions

- Regional Architecture
- Systems Engineering/Testing/Validation
- Standards/Interoperability

Regional Architecture Action Plan (L3 to L4)

Strategy Summary

Monitor ongoing system developments as well as changing needs to ensure that the architecture is both followed and updated as needed

Key Actions

A	Supplement the activities of the Architecture Review Committee to include proactive review of the regional architecture to ensure performance measurement is an integral function
B	Develop concepts of operation for regional operations activities such as major incidents, weather emergencies, etc.; evaluate the ability of the regional architecture to support the requirements as defined by the ConOps

ACTIONS

Action A: Supplement the activities of the Architecture Review Committee to include proactive review of the regional architecture to ensure performance measurement is an integral function

Rationale: The functionalities supported and data developed by the systems may require modification to produce the outcome and output measures needed for performance management and reporting.

A.1 Review performance measures in use by participating agencies to identify those measures with regional applicability.

A.2 Identify additional measures (or locations for performance measurement) that reflect the quality of regional operations.

A.3 Review all systems developed as part of the architecture to ensure that needed regional performance measures can be evaluated.

A.4 Recommend changes to systems to appropriate participating agencies.

Responsibility and Relationships: Periodic reviews are the responsibility of the Architecture Review Committee which is convened by the Architecture Lead. Both project personnel and managers of organizations within the region that are stakeholders in the architecture development and implementation are involved.

Action B: Develop concepts of operation for regional operations activities such as major incidents, weather emergencies, etc.; evaluate the ability of the regional architecture to support the requirements as defined by the ConOps

Rationale: The Architecture Review Committee should evolve into an organization with the ability to assist in the coordination of regional transportation management and operations especially for events requiring multijurisdictional cooperation, such as weather, major emergencies and special events.

B.1 Develop concepts of operations to define the roles of all participants, the channels of communication, command hierarchies etc.

B.2 Evaluate the ability of existing and planned systems to support the regional event.

B.3 Review the Regional Architecture to identify enhancements required for alignment with the ConOps.

Responsibility and Relationships: Periodic reviews are the responsibility of the Architecture Review Committee which is convened by the Architecture Lead. Both project personnel and managers of organizations within the region that are stakeholders in the architecture development and implementation are involved.

Examples/References:

- It is imperative that performance measurement be an integral functionality of any newly developed or enhanced system. In the Maryland Coordinated Highways Action Response Team (CHART) traffic management system, performance measurement was included at the earliest stages of the system design, including the concept of operations. The CHART system documentation including reference to performance measurement can be found at: http://www.chart.state.md.us/downloads/readingroom/chart_ii_documents/BAA-Report-BodyFinal.pdf
- The importance of performance measurement is emphasized at: http://ops.fhwa.dot.gov/publications/regitsarchguide/7use.htm
- An excellent example of a concept of operations for a broad range of traffic management applications can be found within the Maryland CHART Advanced Traffic Management System design documentation at: http://www.chart.state.md.us/downloads/readingroom/chart_ii_documents/BAA-Report-BodyFinal.pdf
- Information that deals specifically with the regional concept of operations can be found at: http://ops.fhwa.dot.gov/publications/rctoprimer/index.htm

Systems Engineering/Testing/Validation Action Plan (L3 to L4)

Strategy Summary

Implement continuous training program emphasizing philosophy, procedures and benefits

Key Actions

A	Implement/adapt a training program to ensure that all personnel associated with system development, operation and maintenance are fully conversant with the principles of systems engineering
B	Develop a certification process for individuals involved with system development, operation and maintenance to ensure that they are qualified to participate in the process
C	Develop a personnel advancement program to reward personnel who have become certified in the systems engineering process

ACTIONS

Action A: Implement/adapt a training program to ensure that all personnel associated with system development, operation and maintenance are fully conversant with the principles of systems engineering

Rationale: Placing the agency on a continuous improvement basis requires developing internal capability to upgrade and augment existing systems to provide wider and more effective TSM&O.

A.1 Identify personnel involved at the project management and assistant project management levels with responsibility for leading the acquisition, development or enhancement of high technology assets.

A.2 Develop a systems engineering training curriculum for these personnel using available resources from FHWA, universities and online. The curriculum development should be the responsibility of either agency personnel or other resources with knowledge of the systems engineering process.

A.3 Develop a systems engineering training curriculum for those personnel that includes the identification of specific individuals to be trained, the training schedule, and the training resources to be used. The curriculum should also include a budget and funding sources to be used to support the program.

Responsibility and Relationships: Senior management personnel overseeing system implementation are responsible for budgeting for the acquisition of the tools, and ensuring their use and involving program managers and agency technical staff.

Action B: Develop a certification process for individuals involved with system development, operation and maintenance to ensure that they are qualified to participate in the process

Rationale: Institutionalizing systems engineering within the agency requires establishing a systematic basis for determining the qualifications for recruitment and promotion that meet the agencies technical requirements for management and upgrades the existing systems.

B.1 Define the knowledge, skills and abilities (KSAs) that must be possessed by individuals involved with the planning, design, development, operations, maintenance, and project management of high technology systems.

B.2 Use the KSAs as a resource for a certification program to identify the skill levels that must be attained by either existing or new agency employees for assignment to various positions within the agency involving high technology systems.

B.3 Using outside support, develop a certification testing process to be used to ensure that candidates for these positions have achieved the required skill levels.

Responsibility and Relationships: The program to be developed by middle management for technical staff and approved by senior management. Outside technical support may be necessary.

Action C: Develop a personnel advancement program to reward personnel who have become certified in the systems engineering process

Rationale: Developing the basis for continuous improvement of the agency's TSM&O program requires establishing the basis for career advancement that is closely related to the appropriate technical expertise, both for technical and management staff.

C.1 Develop an incentive program for agency personnel successfully completing the training curriculum. Depending on agency policy, incentives might include promotion, salary increases, bonus programs, and/or employee awards.

Responsibility and Relationships: The program to be developed by middle management for technical staff and approved by senior management. Outside technical support may be necessary.

Examples/References:

- Numerous systems engineering curricula are available at local colleges and universities for individuals and agencies willing to invest in intensive training on this subject. An effective approach to systems engineering training that has been used by several agencies is to schedule a blended training program (combination of online and instructor participation) through the Consortium for ITS Training and Education (CITE). Information on systems engineering curricula can be found at: http://www.citeconsortium.org
- Certifications currently exist in a number of fields including project management and traffic signal operations. University graduate level certificate programs also exist for systems engineering. Some agencies have developed certification processes to meet their specific job requirements, such as the Maryland State Highway Administration's certification program for CHART traffic management system operations personnel.
- CITE also offers certificates for ITS system engineering and ITS traffic management. These programs require completion of a suite of relevant courses within a predefined time period. Information related to these programs can be found at: http://www.citeconsortium.org

Standards/Interoperability Action Plan (L3 to L4)

Strategy Summary

Implement training program for project-level personnel, emphasizing utilization of standards and resulting benefits

Key Actions

A	Implement a standards training program for project-level personnel to familiarize them with the available standards and acquaint them with their potential benefits
B	Implement an executive level program for senior leadership of the region to acquaint them with the costs and benefits of regional interoperability

ACTIONS

Action A: Implement a standards training program for project-level personnel to familiarize them with the available standards and acquaint them with their potential benefits

Rationale: Placing the agency on a continuous improvement basis requires developing internal capability to upgrade and augment existing systems through an understanding of available standards and knowledge of the standards development process.

A.1 Establish a program for continuous skill development through both initial and follow-up training related to applicable standards.

A.2 Support professional activities for involvement in industry standards development and tracking recent standards development.

A.3 Provide direct support and incentives to ensure that this training and self-education is pursued on a continuing basis.

Responsibility and Relationships: Senior management sponsors the program and should involve all agencies within the region involved in the development of high technology systems. Outside technical assistance may be used as necessary.

Action B: Implement an executive level program for senior leadership of the region to acquaint them with the costs and benefits of regional interoperability

Rationale: Given the civil engineering culture of many transportation agencies, it is important to develop an understanding of the significance of systems engineering and standards development to continuous improvement in effective TSM&O.

B.1 Develop materials for senior managers and other non-technical decision makers to explain the benefits of standards and the importance of systems engineering.

Responsibility and Relationships: Senior management sponsors the program and should involve all agencies within the region involved in the development of high technology systems. Outside technical assistance may be used as necessary.

Examples/References:

- Many agencies have recognized the importance of standards. The importance of standards is emphasized in various systems engineering courses found at: http://www.standards.its.dot.gov/DeploymentResources/Training
- To be effective, executive training must be brief and focused. Some have found it more effective to sponsor regional workshops that present the concept of standards with emphasis on their benefits and costs. The Minnesota DOT sponsored a regional workshop to initiate the process of regionally planning for the use of standards for the potential users of standards within the state: http://ntl.bts.gov/lib/jpodocs/brochure/9r701!.pdf