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

<table>
<thead>
<tr>
<th>From</th>
<th>Outcome measures identified and consistently used for TSM&amp;O strategies improvement (L3)</th>
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<tr>
<td>To</td>
<td>Mission-related outputs/outcomes data routinely utilized for management, reported internally and externally, and archived (L4)</td>
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<tr>
<td>By</td>
<td>Developing routine performance management process for continuing improvements in operating policies, procedures, systems, and deployments</td>
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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 CO₂ 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:**

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:**

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

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<td>B</td>
<td>Improve external reporting to include the public and decision-makers</td>
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**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:

- The Washington State Department of Transportation Accountability & Performance Program provides good examples: http://www.wsdot.wa.gov/accountability/