Regional Operations Forum
Performance Measurement
Four Guiding Questions

1. What are conditions like out there?
2. How does this compare to my peers?
3. Are things better or worse (trends)?
4. Did my program have anything to do with it (investments)?

*We can’t answer these fundamental questions without performance measurement*
Features of Performance Management

• Ongoing collection, analysis, and reporting of data related to a firm’s (agency’s) mission

• Based on indicators (measures) at different levels:
  – Inputs: resources put into an activity (e.g., staff-hrs)
  – Activities or Outputs (e.g., service patrol assists)
  – Outcomes (e.g., travel time, congestion level)
  – Efficiencies (e.g., $ spent per reduction in incident duration)
Why Operations Performance Measures?

- Operations Objectives in the Transportation Plan Can Drive Better Investments in Management and Operations,
- Increases Accountability and Measurement of System Performance,
- Engages the Operations Community in a Substantive Manner.

“What Gets Measured Gets Managed”
Why Do Performance Measurement? (Internal Story)

- How will we get better? How do we compare?
- Who gets paid to reduce congestion and crashes?
  - Um, uh, er, …… anyone??
- Allows operations to compete in idea marketplace
- Similar to other data intensive programs
- Tell a good story for budget justification
  - % of pavements in Good or better
  - # of structurally deficient bridges
  - # of operating dynamic message signs…really care???
NATIONAL PERFORMANCE MEASUREMENT ACTIVITIES
Performance Measurement Today
(What the heck is going on out there?)

- Lots of data to support performance measurement
  - Quality, completeness, and coverage
  - Many data sources for the same measurement (Ex: travel time)
  - Collection/acquisition/preparation cost
- Measures
  - Are we measuring the right things?
  - Targets and benchmarks
- Interpretation
  - Understanding “outside of our control” factors
  - Allocation of funding based on performance
## MAP-21 Staged Rulemaking

<table>
<thead>
<tr>
<th>NPRM DATE</th>
<th>MEASURE CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STATUS I</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Feb ’14 | ✓ Serious Injuries per VMT  
|   | ✓ Fatalities per VMT  
|   | ✓ Number of Serious Injuries  
|   | ✓ Number of Fatalities |
| **STATUS II**  |
| May ’14 | • Pavement Condition on the Interstates  
|   | • Pavement Condition on the Non-Interstate NHS  
|   | • Bridge Condition on NHS |
| **STATUS III**  |
| Fall ’14 | • Traffic Congestion  
|   | • On-road mobile source emissions  
|   | • Freight Movement  
|   | • Performance of Interstate System  
|   | • Performance of Non-Interstate NHS |
Setting Performance Targets: Options

• Look at peer performance
• Avoid “level” targets at first – use “change” instead
  – “Are things better or worse?”
  – Easiest, least controversial way to get started
• Set “hard” targets or “% change” targets that are considered to be achievable in the short term
  – Examine & extend recent trends in the performance measure
• Normalize targets to allow desirable outcomes
  – Congestion change tied to jobs or population
Congestion Management Process Example
Texas DOT & Texas Legislature
http://apps.dot.state.tx.us/apps/top_100/

• Appropriations rider: 100 most congested sections (post on website every year)
• Travel delay per mile - find the biggest & slowest
• What are the projects that will attack congestion for each section?
• Projects that will “get the most bang for the buck”
• Targeted funding (Not the typical “creamy peanut butter” process)
• What are economic benefits of projects?
• http://mobility.tamu.edu/mip/
Developing a Plan for Operations
Performance Measures & Management
Strategic Planning: Foundation for Performance Based Management

- “What do we want to achieve with operations”
  - Improved congestion/mobility and reliability
  - Many safety and environmental benefits flow from improved congestion

- Performance measures are a vital part of the strategic planning process
  - Can be specific to operations or part of agencywide strategic planning
  - Used to track progress toward meeting goals and objectives
Lessons for Plan Development:
Getting Started

• Get the key people involved from the start and keep them “in the loop”
  – Includes senior-level people involved in transportation planning and programming
• Choose measures that are understandable to intended audience
  – Internal staff and bosses
  – General public & decision makers
• Get started now, use current data and IT capabilities
• Focus on known problems & estimate the rest
Lessons for Plan Development: Getting Started

- Maintain continuity with already adopted measures that have a strong cultural buy-in
- Develop consensus about what transportation outcomes are of interest before developing goals and measures
- Agree at the start – the end product is a small set of measures that get used, not a single “best” measure
- Plan to evolve rather than attempting to be perfect at the start
Performance Measures: Key Considerations

- Clear link to agency goals
- Relevant to policy-makers and the public
- Intuitive or easy to understand
- Outcome influenced by agency program and policy decisions
- Communicate the core mission of the organization
- Reliable data must be available
- Manageable number of measures
- Must be capable of showing a trend
Performance Measures: Key Considerations

• **When?** Peak, Off-peak, Weekend
• **Where?** Corridors, sub-regions, metro areas, state
• **What?** Need both vehicle and person-based performance measures
• **Why?** … did it happen? Requires long period of inter-agency & intra-agency cooperation
• **How?** Examine 3 dimensions of congestion:
  – How bad? Where bad? When bad?
• **Another How?** Linking - Have a few measures that connect across applications and time frames
The Approach

Regional goals and motivation

Operations objectives

Systematic process to develop and select M&O strategies to meet objectives

M&O strategies

Metropolitan transportation plan

Transportation improvement program and other funding programs

Implementation

Define performance measures
Determine operations needs
Identify M&O strategies
Evaluate M&O strategies
Select M&O strategies for the plan
Selecting Operations Performance Measures (Metrics)
Definitions of Terms: Types of Measures

• **Input**
  – Amount of resources devoted to a process or activity
    • E.g., staff-hours, number of service patrol vehicles

• **Output (a.k.a., activity-based)**
  – Physical quantities of items; levels of effort expended, scale or scope of activities; important to the system operator
    • E.g., number of service patrol vehicle assists

• **Outcome**
  – Measures typically experienced by the user
    • E.g., average travel speeds, on-time transit performance
## Examples of Transportation System Performance Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel time</td>
<td>Average travel times; Average travel speeds</td>
</tr>
<tr>
<td>Congestion extent</td>
<td>Lane miles of congested conditions; Average hours of congestion per day</td>
</tr>
<tr>
<td>Delay</td>
<td>Vehicle-hours of recurring delay; Non-recurring delay</td>
</tr>
<tr>
<td>Incident occurrence/delay</td>
<td>Median minutes from time of incident to clearance</td>
</tr>
<tr>
<td>Travel time reliability</td>
<td>Buffer time; Buffer time index</td>
</tr>
<tr>
<td>Transit performance</td>
<td>On-time performance; Transit travel times in comparison to personal vehicle travel times</td>
</tr>
<tr>
<td>Customer satisfaction</td>
<td>Percent reporting being satisfied</td>
</tr>
<tr>
<td>Person throughput</td>
<td>Peak hour persons moved per lane</td>
</tr>
</tbody>
</table>
Why Is Reliability Important?

- Less tolerance for unexpected delay
- Planning for unreliable travel has costs for users – late & early arrivals!
- Economic competitiveness
- Valued service in other utilities & industries
- This is how we can “solve the problem”
- Can be treated effectively by addressing roadway “events”
Averages don’t tell the full story

How traffic conditions have been communicated

Travel time

Annual average


What travelers experience

Travel time

Travel times vary greatly day-to-day


When Mn/DOT’s ramp meters were turned off in 2000:

• Average travel time was 22 percent worse
• Reliability was 91 percent worse
WHAT THEY TELL YOU

Level 1
- Travel conditions are unreliable (Variable over time)

Level 2
- What’s causing unreliable travel (e.g., incidents, weather, work zones)

Level 3
- What aspects of operations, management, and construction need to be improved

MEASURES

Overall Reliability
- e.g., buffer index

Delay by Source
- e.g., vehicle-hours

USED BY
- Upper Management
- Public Relations
- Planners
- Mid-Management
- Operators
- Planners

INCIDENT TIMELINE

- Incident Occurs 6:35 A.M.
- Incident Recorded into CAD (Detection) 6:42 A.M.
- Incident Verified 6:47 A.M.
- Personnel Dispatched and Actions Initiated 6:49 A.M.
- Responders Arrive to Scene 6:50-7:00 A.M.
- Incident Cleared and Actions Canceled 7:15 A.M.
- Return to Normal Conditions 8:26 A.M.

Detection Time 1
Verification Time 2
Dispatch Time 3
Response Time 4
Clearance Time 5
Time to Normal Conditions 6

SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM
OF THE NATIONAL ACADEMIES
USING OPERATIONS PERFORMANCE MEASURES IN DECISION-MAKING AND COMMUNICATION
Reporting, Accountability, Decision Making

• You have goals, you have data, you have measures – what is next?
• Hint – You’re already behind; have a story first!
• Develop measures and meanings
• Report the results!!
  – To the public & decision makers
  – To system operators and planners
• Use them!! -- Funding decisions, operational strategies, new designs, before/after, new data
Real-Time Applications

• Tailored to local issues, tastes, public understanding and terms – Whatever works!!
  – Developing “generic” guidelines -- difficult
  – Lots of examples are available
• Use the historical real-time information
  – Relatively new, but detailed data sets
• Peak period usually; off-peak important for just-in-time manufacturing
• Color coding very useful
Real-Time vs. Historical

SPEED CHART
I-10 Katy Eastbound (Sam Houston Tlwy to Blalock)

- Today's Speed
- Year 2003 Average Speed
- Year 2002 Average Speed
- Year 2001 Average Speed
- Year 2000 Average Speed

Time
5:00: 6:00: 7:00: 8:00: 9:00: 10:00: 11:00: 12:00: 13:00: 14:00: 15:00: 16:00: 17:00: 18:00: 19:00: 20:00
Speed (mph)
Example: Incident Management

• Most common describe the services performed
  – Detection time; Response time; Clear time
  – Location and timing of incidents (by type)
  – Service patrol vehicles per mile or hours of service provided

• How justify the program?
Program Logic Model Adapted for Incident Management

Program Objectives
- Accessibility
- Travel Cost

Final Outcomes
- Delay
- Travel Time Index

Intermediate Outcomes
- Incident Duration

Initial Outcomes
- Response Time
- Clearance Time
- On-Scene Time

Outputs
- Number Assists
- Number Messages
- Service Patrols/Mile
- On-Scene Policies

Program Activities

Resources (Inputs)
- Number IM Staff
- Hours of Operation
- Number DMS
- Number Service Patrol Vehicles

Accessibility
Travel Cost
Delay
Travel Time Index
Incident Duration
Response Time
Clearance Time
On-Scene Time
Number Assists
Number Messages
Service Patrols/Mile
On-Scene Policies
Number IM Staff
Hours of Operation
Number DMS
Number Service Patrol Vehicles

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES
Other System and Program Evaluations

• Reporting on work zones
  – Number of work zones by type
  – Ratio of active days to inactive days
  – Delay & unreliability associated w/ work zones

• Weather
  – How often is bad weather a factor?
  – What type of bad weather?
  – How effective are agency responses to that weather?
Short-Term Reporting– Frequency of Congestion Info

- Depends upon purpose
- Likely outlined in strategic or business plan
- Possibilities include (not exclusively):
  - Real-time
  - Monthly
  - Seasonally
  - Annually
GDOT HERO Incident Response: Explaining Agency Performance

http://www.dot.state.ga.us/statistics/performance/Pages/HEROResponseTime.aspx
Houston SAFEClear
Rapid Towing Response

• Response time requirement held towing companies responsible (90% within 6 minutes)
• Clearance time & crash reduction used to justify City expenditures
• Reduction in secondary crashes an important component on public support
• $5M program => $30+M crash reduction
Reporting

• The big difference between audiences is not what you SAY, but HOW you say it and WHAT measures you highlight

• Use examples and summaries to illustrate the key points

• Use chart title to tell story

• Use captions to note key points

• What is the “ask”? (“what they do after they hear you”)
Communicating Results: DVRPC (Philadelphia MPO)

- Periodic reports (e.g., regional congestion reports, “State of the Commute” reports, performance dashboards)
- Brochures and newsletters
- Websites
WSDOT’s Gray Notebook

- WSDOT’s Strategic Approach
  - Accountability and Transparency
  - Comprehensive Performance Analysis and Reporting
  - Adaptive and Dynamic Performance Measurement

- Communicating Two Simple Themes:
  - Accountability
  - Project Delivery
# Performance Dashboard

<table>
<thead>
<tr>
<th>Policy goal/Performance measure</th>
<th>Previous reporting period</th>
<th>Current reporting period</th>
<th>Goal</th>
<th>Goal met</th>
<th>Progress</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of traffic fatalities per 100 million vehicle miles traveled (VMT) in Washington State (annual measure, calendar years 2006 &amp; 2007)</td>
<td>1.12</td>
<td>1.0</td>
<td>1.0</td>
<td>✓</td>
<td>✓</td>
<td>Working toward additional reductions through Target Zero</td>
</tr>
<tr>
<td>Yearly OSHA-recordable injury and illness rate per 100 WSDOT maintenance &amp; engineering workers (annualized: FY03 Q4, FY04 Q1)</td>
<td>5.3</td>
<td>4.2</td>
<td>6.0</td>
<td>✓</td>
<td>✓</td>
<td>Continuing to aggressively improve worker safety</td>
</tr>
<tr>
<td><strong>Preservation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of state highway pavements in fair or better condition (annual measure, calendar years 2006 &amp; 2007)</td>
<td>93.5%</td>
<td>93.3%</td>
<td>90.0%</td>
<td>✓</td>
<td></td>
<td>Performance level exceeds goal - challenges ahead</td>
</tr>
<tr>
<td>Percentage of state bridges in fair or better condition (annual measure, calendar years 2006 &amp; 2007)</td>
<td>97.4%</td>
<td>97.0%</td>
<td>97.0%</td>
<td>✓</td>
<td></td>
<td>Performance level meets goal - trending downward</td>
</tr>
<tr>
<td><strong>Mobility (Congestion Relief)</strong></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Average clearance times for major (90+ minute) incidents on key Puget Sound corridors (quarterly: FY08 Q4, FY09 Q1)</td>
<td>153 minutes</td>
<td>147 minutes</td>
<td>5% reduction</td>
<td>✓</td>
<td></td>
<td>Met 5% goal, included in &quot;Moving Washington&quot; initiative</td>
</tr>
<tr>
<td>Percentage of Washington State Ferries trips departing on-time (quarterly: FY08 Q4, FY09 Q1)</td>
<td>92%</td>
<td>87%</td>
<td>90%</td>
<td></td>
<td></td>
<td>Quarterly performance declined with busy summer season</td>
</tr>
<tr>
<td>Percentage of Amtrak Cascades trips arriving on-time (quarterly: FY08 Q4, FY09 Q1)</td>
<td>62%</td>
<td>61%</td>
<td>80%</td>
<td></td>
<td></td>
<td>Performance is holding steady after improving last quarter</td>
</tr>
<tr>
<td>Annual weekday hours of delay statewide on highways compared to maximum throughput (51 MPH) in thousands of hours (annual measure, calendar years 2006 &amp; 2007)</td>
<td>23,330</td>
<td>25,490</td>
<td>N/A</td>
<td></td>
<td></td>
<td>The rate of growth in delay declined from 35% to 8% between 2007 and 2005</td>
</tr>
</tbody>
</table>
KC SCOUT Clearance Times

Average Time to Clear Traffic Incident
Kansas City

Calendar Month
Leveraging ITS Data - Travel Time Analysis

The Annual Congestion Report highlights the performance of 52 Puget Sound region commute corridors (GP and HOV lanes): Average Travel Time (@posted speed); (worst 5 min) Peak Travel Time; Maximum Throughput Travel Time (@51 mph); 95th percent Reliable Travel Time.
Detroit Average Annual Speeds
National Capital Region Congestion Report (Beta) 4th Quarter 2011

**Congestion on Freeways**

**Delay in Q4/2011**

- All time in Q4/2011
- 12.3 Hours → $237* per traveler per month during Q4/2011 vs. Q4/2010

*Cost of time = $19.24/ hour (Derived from TPB model & Travel Survey)

(see p. 3)

**Reliability on Freeways**

**Extra Time for On-Time Arrival** in Q4/2011

- AM Peak (6 – 10 AM)
  - 202% of free flow travel time vs. Q4/2010
  - +6 pp*

- PM Peak (3 – 7 PM)
  - 236% of free flow travel time vs. Q4/2010
  - +11 pp*

*pp: percentage points.

**This is compared to free flow travel time. For example, a 20-minute free flow travel with 200% extra time for on-time arrival indicates one has to budget a total of 20 * 200% = 40 minutes to arrive on time (this measure essentially is Planning Time Index). (see p. 4)

**Percentages of Freeway Lane-Miles by Congestion Level in Q4/2011**

- AM Peak (6 – 10 AM)
  - Uncongested 72%
  - Moderate 15%
  - Severe 4%
  - Light 9%
  - +1 %

- PM Peak (3 – 7 PM)
  - Uncongested 59%
  - Moderate 19%
  - Severe 8%
  - Light 14%
  - +3 %

**Spotlight**

Traffic on “Black Friday”

The region’s overall freeway traffic was examined for the day after Thanksgiving in the past 4 years and the results revealed significant changes in 2011.

(see p.15)

Powered by the I-95 Corridor Coalition Vehicle Probe Project and expansions made available by MDOT and VDOT, and the Transportation Technology Innovation and Demonstration (TTID) Program of FHWA.
Maryland Reliability Map
Planning Time Index (PTI)
PM Peak Hour (5PM-6PM)

Legend
- Green: Reliable
- Yellow: Moderately Reliable
- Red: Unreliable

Notes:
1) Planning Time Index (PTI) refers to the ratio of the extreme (95 percentile) travel time to the (minimum) free flow travel time of the segment.
2) Unreliable condition is assumed when PTI is larger than 2.5, i.e., when 5 percentile speed is less than 40 percent of the free flow speed.
3) Unreliable mileage (PTI>2.5) totals 188 (11%) directional miles.
4) Total roadway system considered is 1,698 directional miles long.
5) Unreliable Vehicle Miles Traveled (VMT where PTI>2.5) constitutes 26% of the total VMT is the same period.
Performance Measure
System Design

• How do the performance measures get reported?
• How are performance measures used by:
  – Those who have required them?
  – Staff level?
• What have been the costs of:
  – Data collection?
  – Analysis and reporting?
• Where are the overlaps? How can they be better coordinated? More efficient?
Operations Performance Measures: Resources

• FHWA Operations Performance Measures Website
  – Example Programs
    • http://www.ops.fhwa.dot.gov/perf_measurement/example_programs.htm

• Other Sources
  – AASHTO Standing Committee on Performance Measures
  – TRB Performance Measurement Committee
  – I-95 Corridor Coalition Probe Vehicle Data Project/Performance Measures Project