



Regional Operations Forum

Performance Measurement

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Howdy!

- What is the most important use for performance measures?
- Which is more important?
 - What you say?

Or

- What they hear?

Or

- What they do after they hear you?

What We're Talking About

- What gets measured gets done....
- ...but also, You get what you measure.
- Why is performance measurement important?
(funding, program management, improve practices and operations, manage staff)
- Performance measure process
 - Identify key elements – connect vision and goals to the measures and data.
- Congestion, mobility and safety
- Examples of successful applications

Where We're Going Today

- Your state DOT will construct a set of operations performance measures for the multi-state corridor. You are the team to develop a set of performance measures, the supporting analytical and data tools, and a reporting scheme.
- Create a mock-up of a two-page summary report that could be published every quarter and an additional page that summarizes the other important information – sources, data needs, partners, etc.

Credits

- Agencies – DOTs in Washington State, Missouri, California, Georgia, Texas
- FHWA
- Rich Taylor (FHWA), Rich Margiotta (CamSys), Mark Hallenbeck (UWash), Daniela Bremmer (WSDOT), Mara Campbell (MODOT), Valentin Vulov (GRTA)

BACKGROUND ON PERFORMANCE MEASURES

Why Do Performance Measurement?

- We were forced to by...
 - Legislative mandate or agency initiative
 - Funding increase proposal

But it might be just a darned good idea!

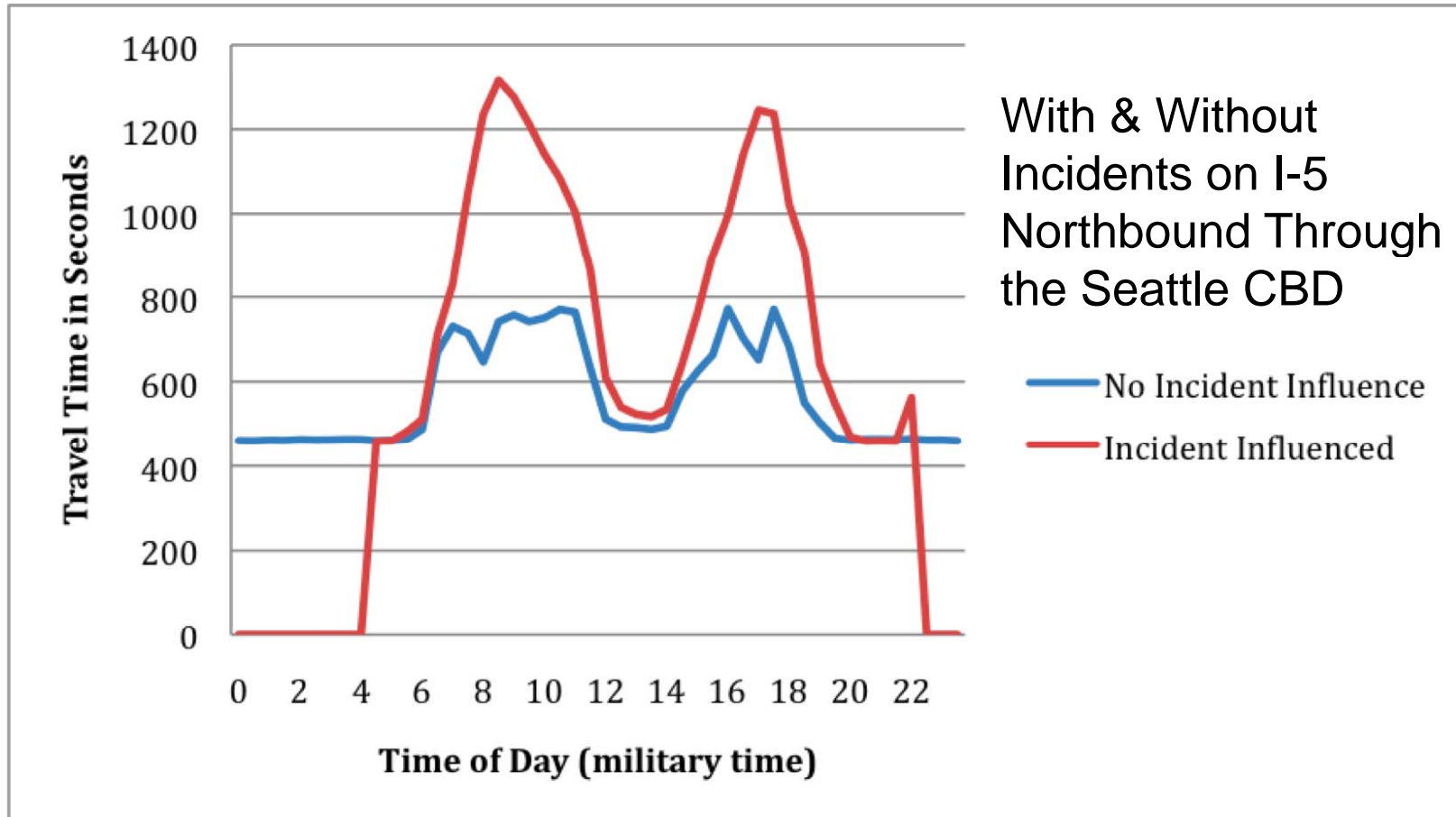
- Accountability and transparency
 - Decision makers, the public, our bosses
 - What did we produce with their money?
- Proactive public relations for the agency
 - Maintain visibility of transportation
 - Data + Analysis + Communication = Credibility

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???*

The Operations Goal:

Can I Make Every Day Averagely Bad?



SHRP 2 Project C02

A Systems-Based Performance Measurement Framework for Highway Capacity Decision Making

- Framework for selecting performance measures to evaluate major transportation projects. Performance measures can be used in long-range planning, programming, environmental review, and permitting.

Transportation	Environment	Economics	Community	Cost
<ul style="list-style-type: none"> • Mobility • Reliability • Accessibility • Safety 	<ul style="list-style-type: none"> • Ecosystems, Habitat, & Biodiversity • Water Quality • Wetlands • Air Quality • Climate Change • Environmental Health 	<ul style="list-style-type: none"> • Economic Impact • Economic Development 	<ul style="list-style-type: none"> • Land Use • Archeological Resources • Cultural Resources • Social • Environmental Justice 	<ul style="list-style-type: none"> • Cost • Cost-Effectiveness

BASIC PRINCIPLES FOR OPERATIONS PERFORMANCE MEASUREMENT

Key Principles for Performance Monitoring

Principle 1	Mobility performance measures – focus on travel time Safety measures - severity, time and location Operations Measures must include activity and event data
Principle 3	Many measures should be used
Principle 5	Vehicle volume & person volume should be used
Principle 6	Need quality of service (outcome) and activity-based (output) performance measures; efficiency and input measures play a role also.

Key Principles for Performance Monitoring

Principle 10	Four dimensions of mobility/congestion should be tracked: <ul style="list-style-type: none">• Source of congestion• Time of congestion• Location of congestion• Change in any of these – Reliability
Principle 11	Performance measurement should be communicated with graphics that resonate with a variety of technical and nontechnical audiences.
Principle 12	Continuity should be maintained in performance measures across applications and time horizons; Use the same performance measures for trend monitoring, project design, forecasting, and evaluations.

Principle 13

Data & institutional issues can't be allowed to get in the way

- Agencies will only pay for data collection if there is a clear return on investment
- Data collected for purposes other than performance measures is almost always better
- Data integration is key; models for data you don't have
 - Gather data from several sources
 - Perform quality control & assurance
 - Spatial integration with other GIS datasets
 - Human interpretation
- ***Even though a lot of data may be collected, integration is NOT a trivial exercise!!!***

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

NPRM DATE	MEASURE CATEGORY
STATUS I 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 July '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/>

Washington State DOT Project Delivery Statement

As of September 30, 2008, WSDOT delivered 167 of 391 projects funded by the 2003 and 2005 gas tax, valued at \$1.8 billion. Another 61 valued at \$2.7 billion are under construction and 43 valued at \$1.3 billion will be advertised in the next six months.

Before/After analysis of 21 sampled projects

- Savings of more than 6,400 hours of travel a day – 10% improvement.
- ~\$60 million a year in economic benefits to Washington commuters and businesses.
- 49 safety projects on high risk corridors reduced all types of collisions by 6%, and injury/fatal collisions by 14%

SHRP2 L05

Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes

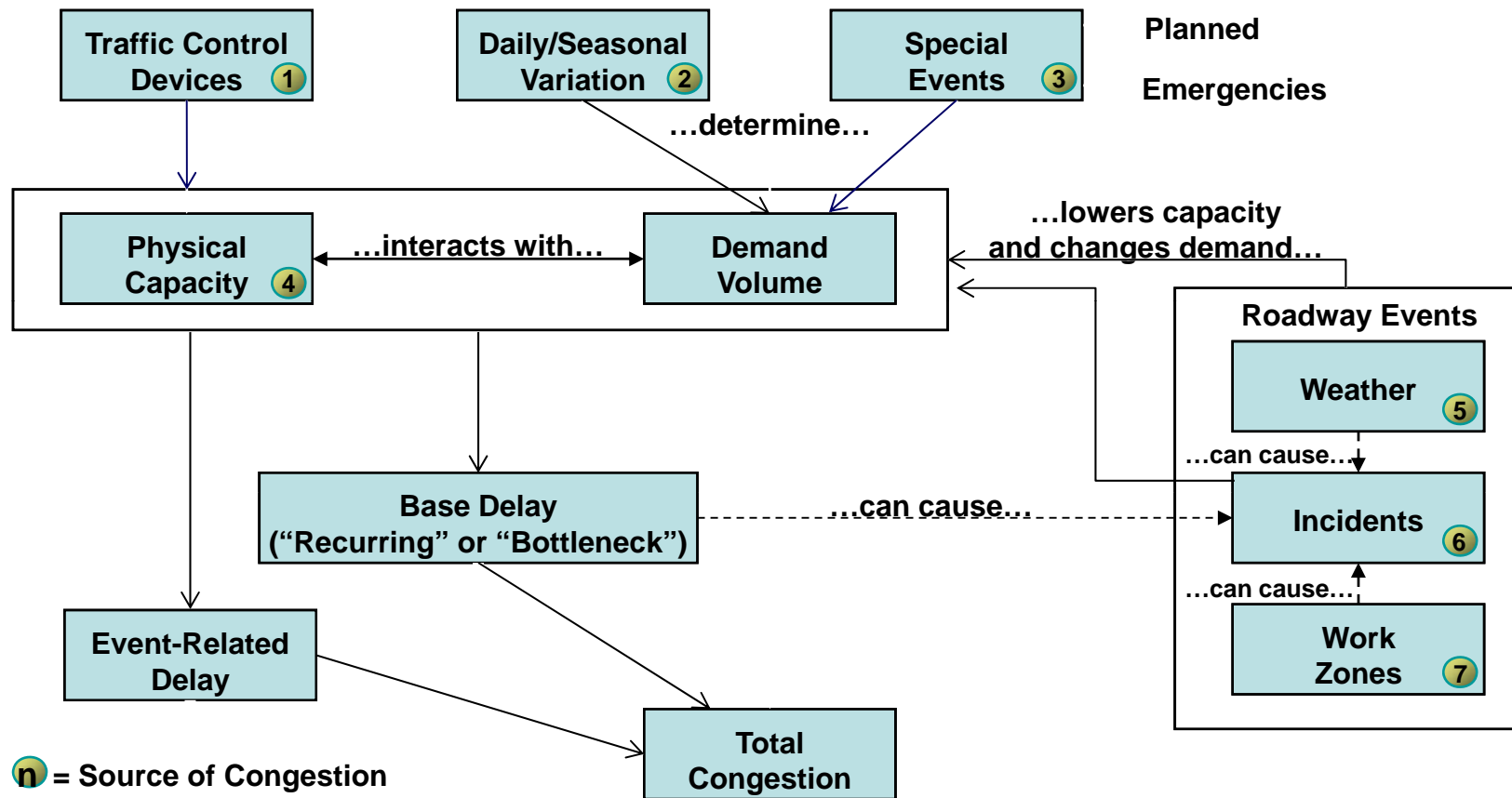
- High-level reference document
- Will help planning, programming, and operations managers apply the concept of travel-time reliability to balance investment in programs and projects.
- Four key areas to incorporate reliability including:
 - Developing and Tracking a Reliability Performance Measure
 - Incorporating Reliability in Policy Statements
 - Evaluating Reliability Needs and Deficiencies
 - Incorporating Reliability into Investment Decision Making
- The suite of products was pilot tested through project L38 in Washington, Minnesota, California, and Florida. Reports in editing -- results are expected soon.

Incorporating Travel Time Reliability Into Tools and Models

- SHRP2 L04 - Operations and Planning Modeling Tools
 - Scenario generation is the core -- Identify events, probabilities, dependencies (e.g., inclement weather conditions tend to increase crash rates).
- SHRP2 L08 - Highway Capacity Manual
 - Discussing adoption in the HCM of freeway and urban street methodologies for including reliability
- Final reports and pilot project results available

THE PATH TO A SET OF OPERATIONS PERFORMANCE MEASURES

A Model of Congestion and Its Sources



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

SHRP 2 L07

Evaluation of Cost-Effectiveness of Highway Design Features

- Three separate analyses of the design treatments: operational, safety, and benefit/cost. (Traffic operation analysis work completed in SHRP 2 Project L03)
- Relationship between congestion and safety--specifically the relationship between Level of Service and crash frequency
- L07 added data on significant snowfall in peak hours in large metropolitan areas
- Benefit/cost evaluation; Delay savings, reliability improvement, and safety improvement
- L07 Products (tested and improved by pilot test)
 - Design Guide and User guide
 - Dissemination Plan
 - Spreadsheet-based analysis tool

OVERVIEW: MEASURES, DATA & PROCESSING STEPS

Travel Time (*Quality*)

- Basis for mobility measures
- The average time required to traverse a section of roadway in a single direction
 - Urban Freeways: 2-5 miles or between interchanges
 - Signalized Roads: 0.5-2 miles or between intersections with major roads
- Measurement
 - Direct: probe vehicle-based
 - Indirect: detector-based

<http://www.wsdot.wa.gov/accountability/>

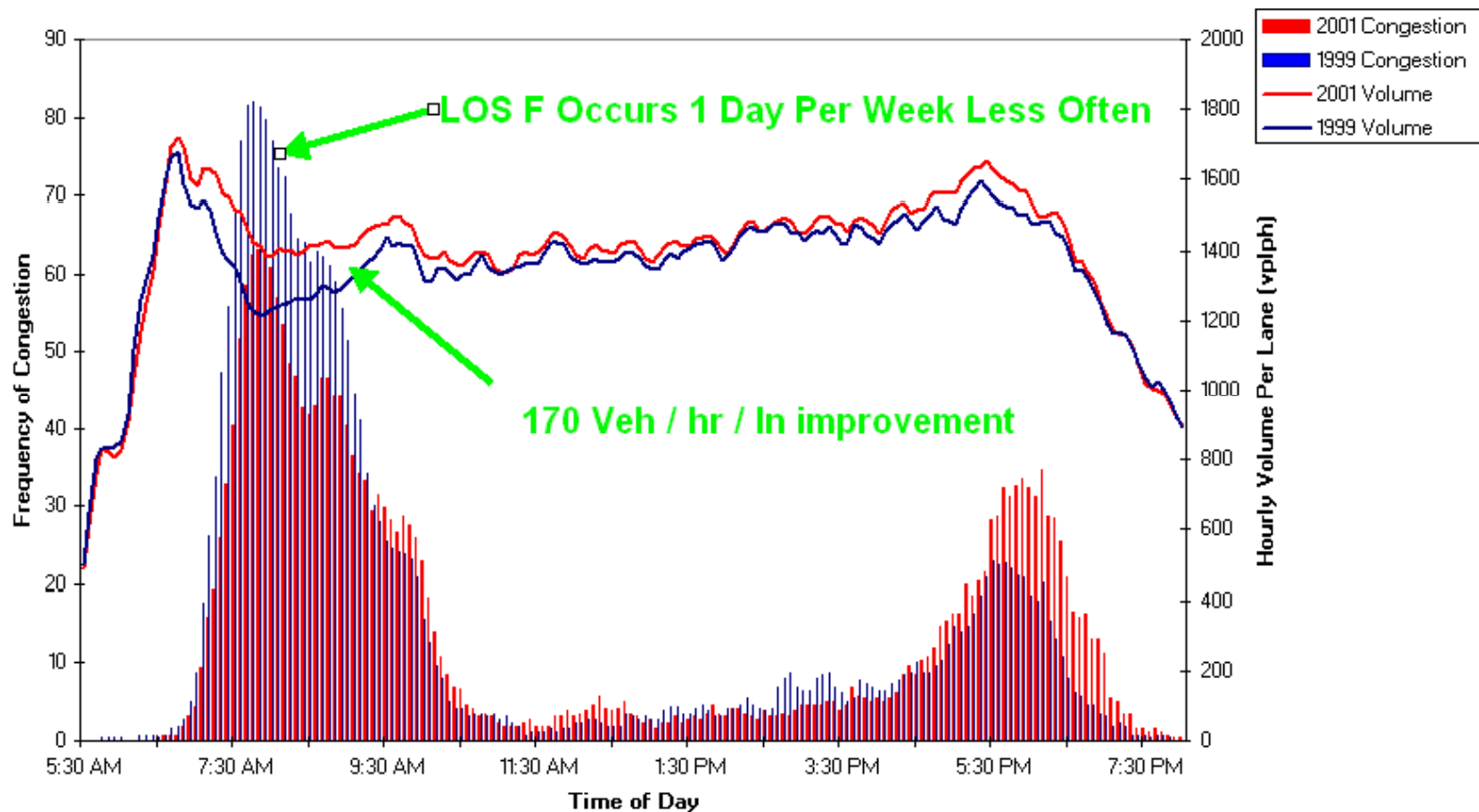
Total Delay (*Quality*)

- Total delay (measured across entire year)
 - Recurring - Vehicle delays that are repeatable for the current time-of-day and day-of-week
 - Non-recurring or Event – Unusual delays
- Defined as the difference between the travel time required to traverse a roadway segment and the unconstrained travel time
 - Vehicle-hours and person-hours
 - For multiple corridors – delay per mile

Throughput (*Quality*)

- Person: People flow on all roadway types under both recurring and nonrecurring traffic conditions (persons/hour)
- Vehicle: Traffic flow on all roadway types under both recurring and nonrecurring traffic conditions (vehicles/hour)
- VMT often used as a throughput measure as well; also used as weighting factor for all measures

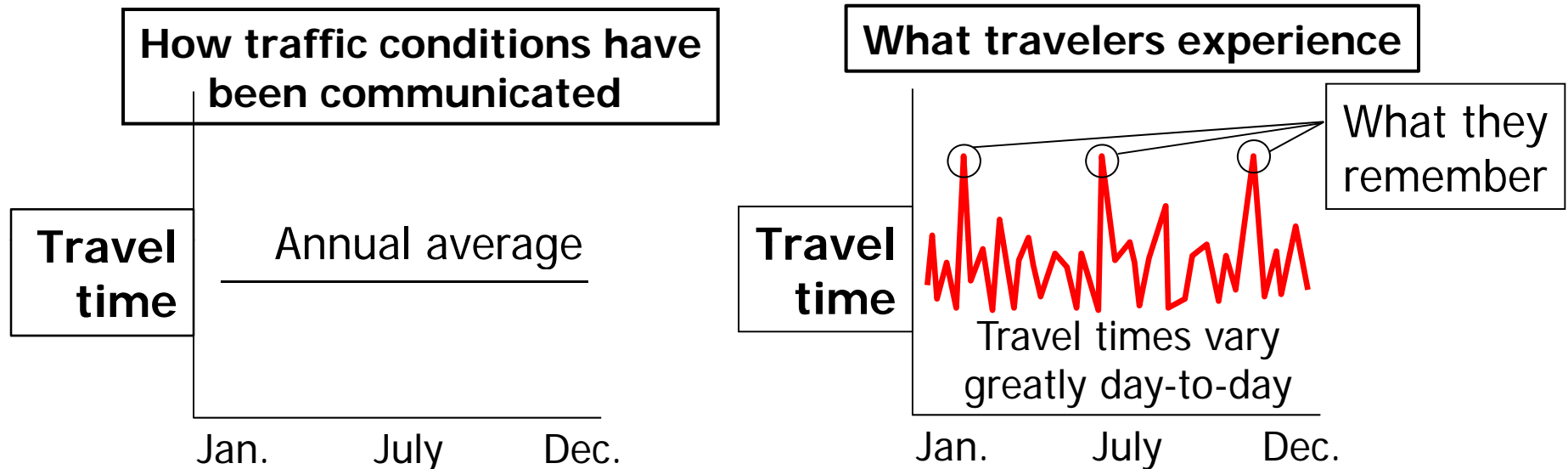
Combining Speed and Throughput to Make the Case for Ramp Metering



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”

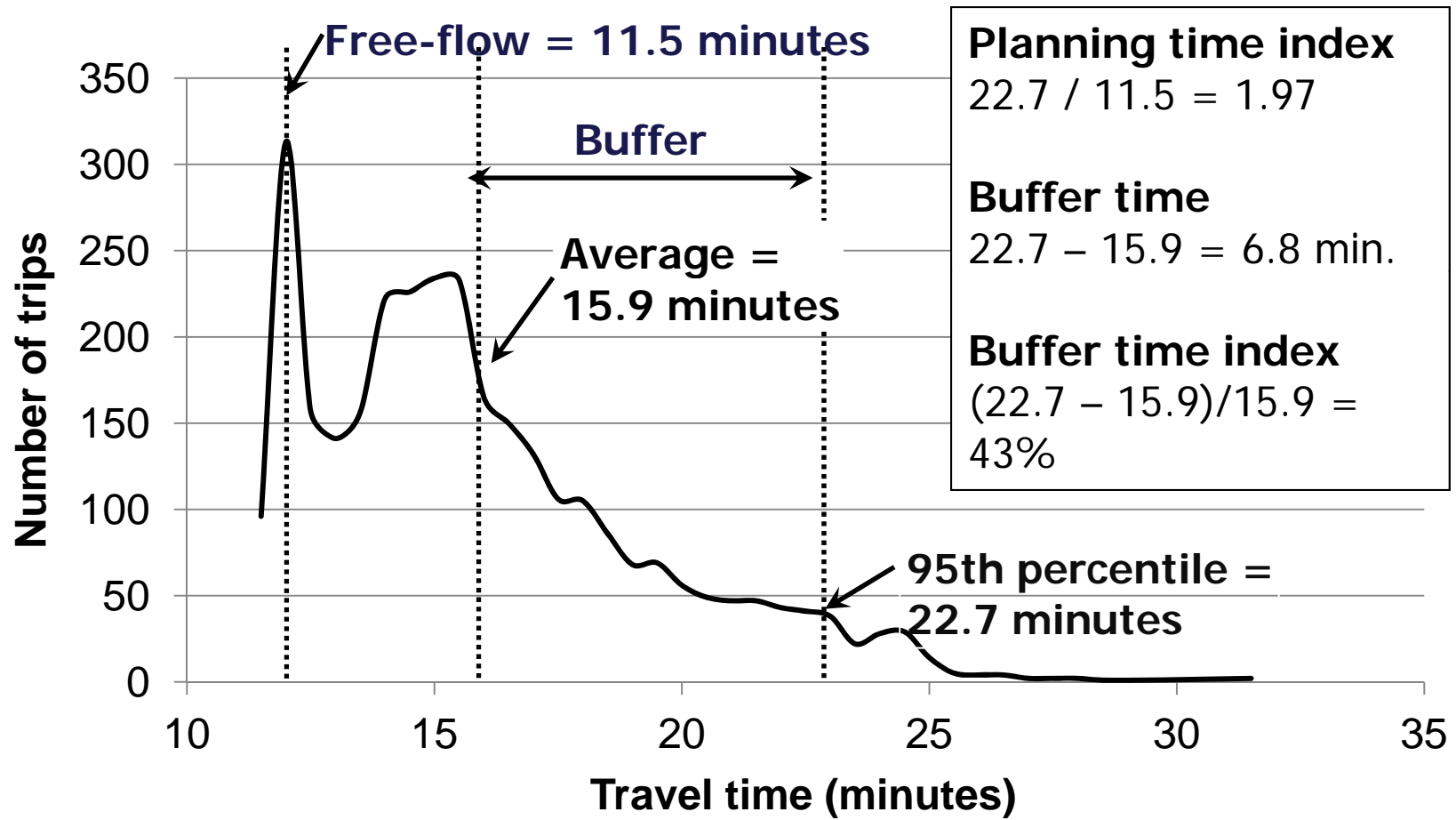
Averages don't tell the full story



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

- Average travel time was 22 percent worse
- Reliability was 91 percent worse

Reliability Measures Illustrated (On the Barnes & Noble Magazine Rack)



Reliability Effects

Logic Check - Performance Measures May Flat Out Lie To You

Period	Travel Time Index	Buffer Index	Planning Time Index
Before	2.60	31%	3.40
After	1.50	44%	2.20
%Change	-70%	+40%	-50%

Seattle, I-405 Lane Addition, Evening Peak Period

Travel Time Reliability (*Quality*)

- Planning Time Index: The additional time that must be planned for in excess of the free-flow travel time to ensure that travelers arrive on-time
- 95% of the time for travelers
- 80% of the time for agency actions
- Continuously-collected travel times
- Need to capture all the events that make travel times variable

<http://www.wsdot.com/traffic/seattle/default.aspx>

Safety Measures (*Quality*)

- Total and fatal crashes
 - Yearly consistency is important
 - Expect values to increase if monitoring is increased
- Crash rate and fatal rate
 - Per VMT
 - Time periods may be important
- Secondary crashes
 - Tie to the “incident timeline”
- Map the congestion and safety problems together
- Florida Hwy Safety Measures

<http://www.flhsmv.gov/PerformanceDashboard.htm>

Traffic Incident Timeline Measures (*Activity & Quality*)

- Roadway Clearance Time
 - The time from detection to confirmation that all lanes are available for traffic
- Incident Clearance Time
 - The time between incident awareness & when the last responder has left the scene
- Incident Duration
 - The time from notification of an incident until all evidence of the incident has been removed
- <http://www.8newsnow.com/story/19778674/state-officials-looking-at-popular-freeway-service>

Other Activity and Quality Measures

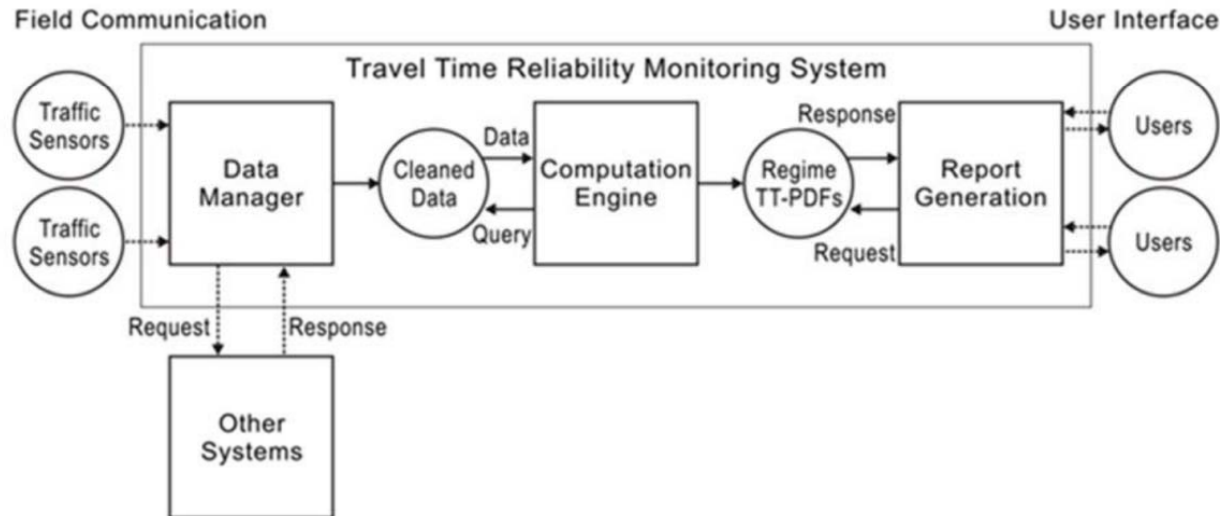
- Secondary crashes – Near time and location
- Work zone – Capacity loss, delay, queues
- Weather – Intensity and location of weather; agency and user costs
- Planned special events
- Arterial streets
- Freight corridors and crossings

Evolving Input Data Sources

- Re-use of operations data (mainly freeways)
 - Detectors – declining (maintenance cost)
 - Toll tag readers
 - Travel time, event & weather information
- Volume must be estimated separately
- Private sector travel time sources growing
 - Comprehensive freeway and street data
 - Competitive RFP procurements
 - Verifiable data standards – performance standards
 - FHWA and many states/MPOs have acquired

SHRP2 L02: Establishing Monitoring Programs for Travel Time Reliability

- Guidebook describing how an agency should develop and use a Travel Time Reliability Monitoring System (TTRMS). (See Figure -- modules shown as box; inputs and outputs shown as circles.)



- The monitoring system is not intended to be stand-alone. Rather, it is intended to mate up with an existing traffic management system.

SHOW AND TELL

***SHOW US A WEBSITE
AND***

***TELL US HOW YOUR
OPERATIONS DATA IS USED***

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

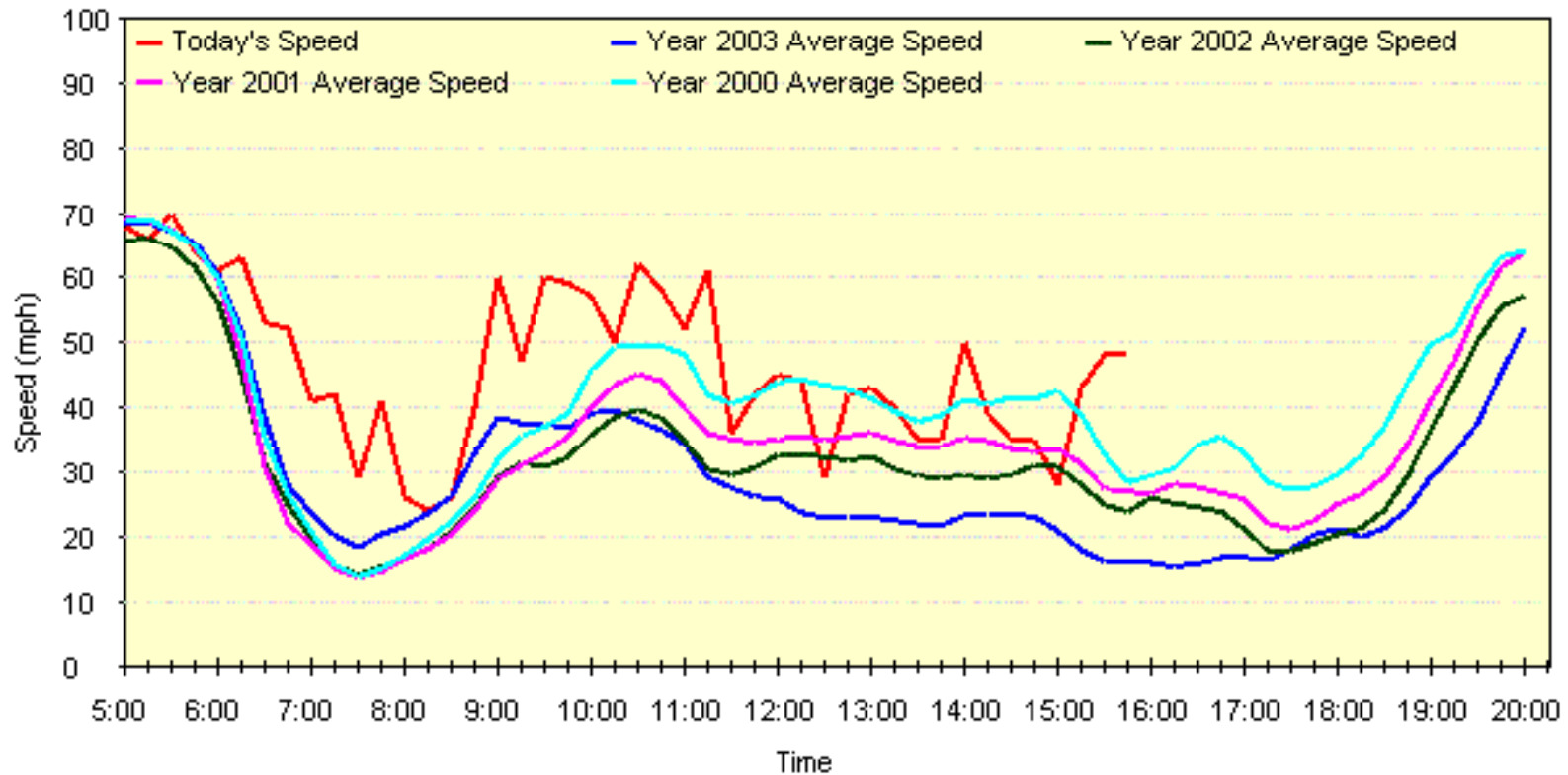
- Tailored to local issues, tastes, public understanding and terms – Whatever works!!
 - Developing “generic” guidelines -- difficult
 - Lots of examples are available
- Use the historical real-time information
 - Relatively new, but detailed data sets
- Peak period usually; off-peak important for just-in-time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

Real-Time vs. Historical

SPEED CHART

3:56:21 PM

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



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?
- Using data and performance measures to change the world...

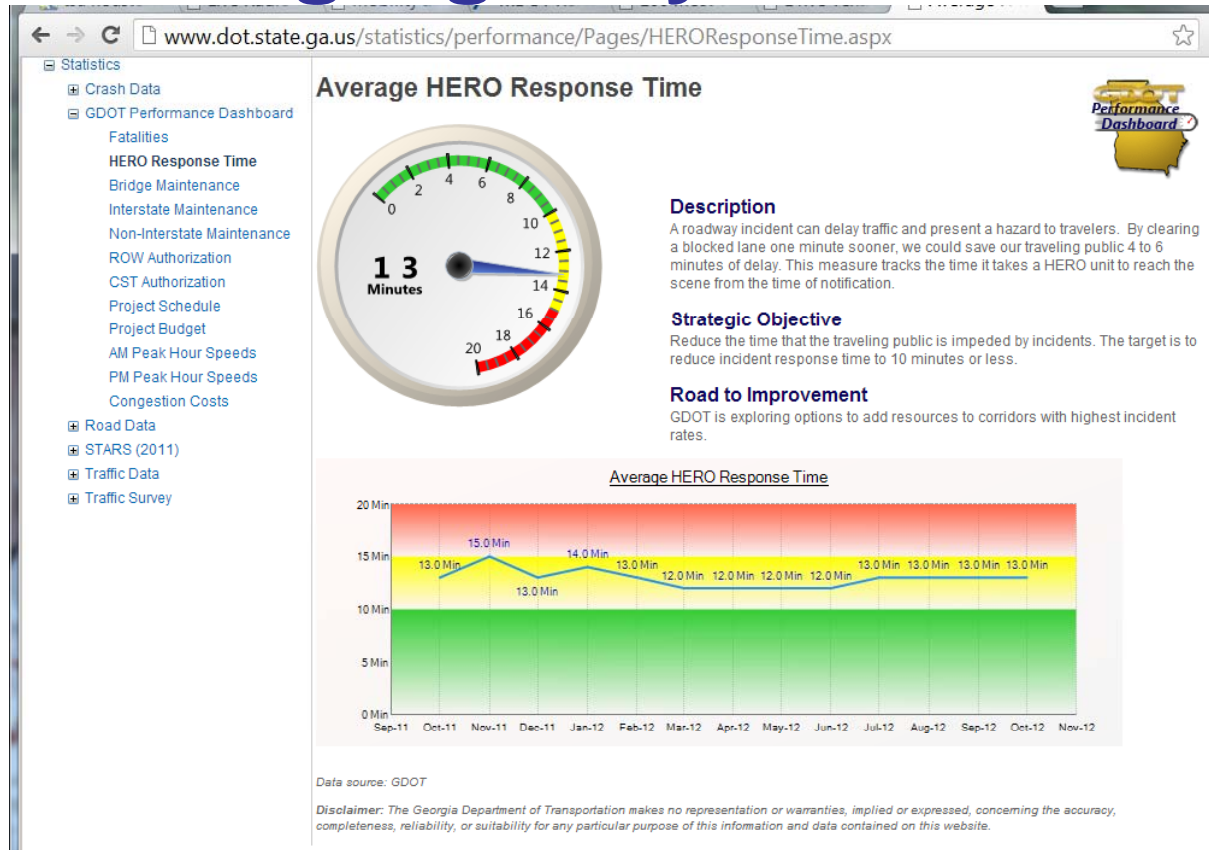
Other System and Program Evaluations

- 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

SHRP2 Project L17

A Framework for Improving Travel Time Reliability

There are four principal audiences whose needs must be met (non-technical info lacking)

- Policy makers (important subsets also exist)
- Practitioners (important subsets also exist)
- Researchers
- Public at large

Branding and Communication

- Effective communication is audience dependent.
- Essential to segregate “sound bites” into the target audiences where they will be the most effective. (Chapter 4 provides the key messages that have been drafted for each of these audiences).

Business Case Primer was developed following the Branding Workshop.

- A brochure targeted to the traveling public
- A fact sheet for implementers to use in spreading the word
- Two slide presentations (one for implementers and one for decision makers)

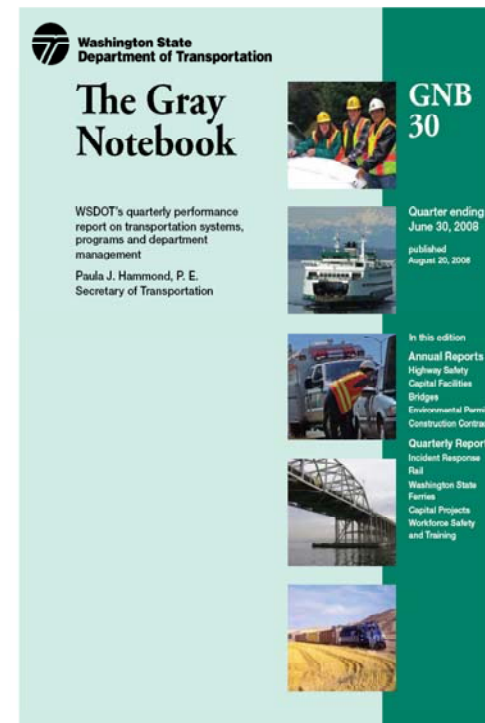
Reporting

- 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”)

WSDOT's *Gray Notebook*

- WSDOT's Strategic Approach since April 2001
 - Accountability & Transparency
 - Comprehensive Performance Analysis and Reporting
 - Adaptive and Dynamic Performance Measurement
- Communicating Two Simple Themes:
 - Accountability
 - Project Delivery

<http://www.wsdot.wa.gov/accountability/>



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?

SHRP 2 Project L35

Local Methods for Modeling, Economic Evaluation, Justification and Use of the Value of Travel Time Reliability in Transportation Decision Making

Project Objectives

1. Select and defend a value or range of values for roadway travel time reliability
2. Use the VTTR in an established process to prioritize operational and capital improvements and determine if (and how) the ranking of projects change
3. Report the step-by-step process used to develop, justify, apply, and assess the use of a VTTR in project evaluation and decision processes.

Final report due in the fall of 2014

ROLLING IT ALL TOGETHER

The Situation

- Your state DOT is attempting to use the basic underpinnings of the MAP-21 performance management requirements to construct a set of operations performance measures for the multi-state corridor. Your boss has asked you to be a team to develop a set of performance measures, the supporting analytical and data tools, and a reporting scheme.
- Create a mock-up of a two-page summary report that could be published every quarter and an additional page that summarizes the other important information – data sources, other data needs, partners, etc.

Considerations

Be sure to incorporate these elements:

- What stories are the most important?
- What do the audiences need to know?
- How do the measures connect with the likely decisions and investment options?
- What are the most important measures?
(Recognizing there will be many measures).
- Where does the data come from?
- Inter-jurisdictional cooperation & coordination

You have 40 minutes

NCHRP & SHRP2 References

- NCHRP Web Report #97: Guide to Effective Freeway Performance Measurement
- L02 - Establishing Monitoring Programs for Travel Time Reliability
- L04 [Active] - Incorporating Reliability Performance Measures in Operations and Planning Modeling Tools
- L05 - Incorporating Reliability Performance Measures into Transportation Planning and Programming Processes
- L35 - Local Methods for Modeling, Economic Evaluation, Justification and Use of the Value of Travel Time Reliability in Transportation Decision Making

SHRP2 References

- L07 [Active] - Evaluation of Cost-Effectiveness of Highway Design Features
- L08 [Active] - Incorporation of Travel Time Reliability into the Highway Capacity Manual
- L17 - A Framework for Improving Travel Time Reliability
- C02 - A Systems-Based Performance Measurement Framework for Highway Capacity Decision Making

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