SHRP2

STRATEGIC HIGHWAY RESEARCH PROGRAM

Accelerating solutions for highway safety, renewal, reliability, and capacity

Regional Operations Forum
Performance Measurement

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OF THE NATIONAL ACADEMIES

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

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 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

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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

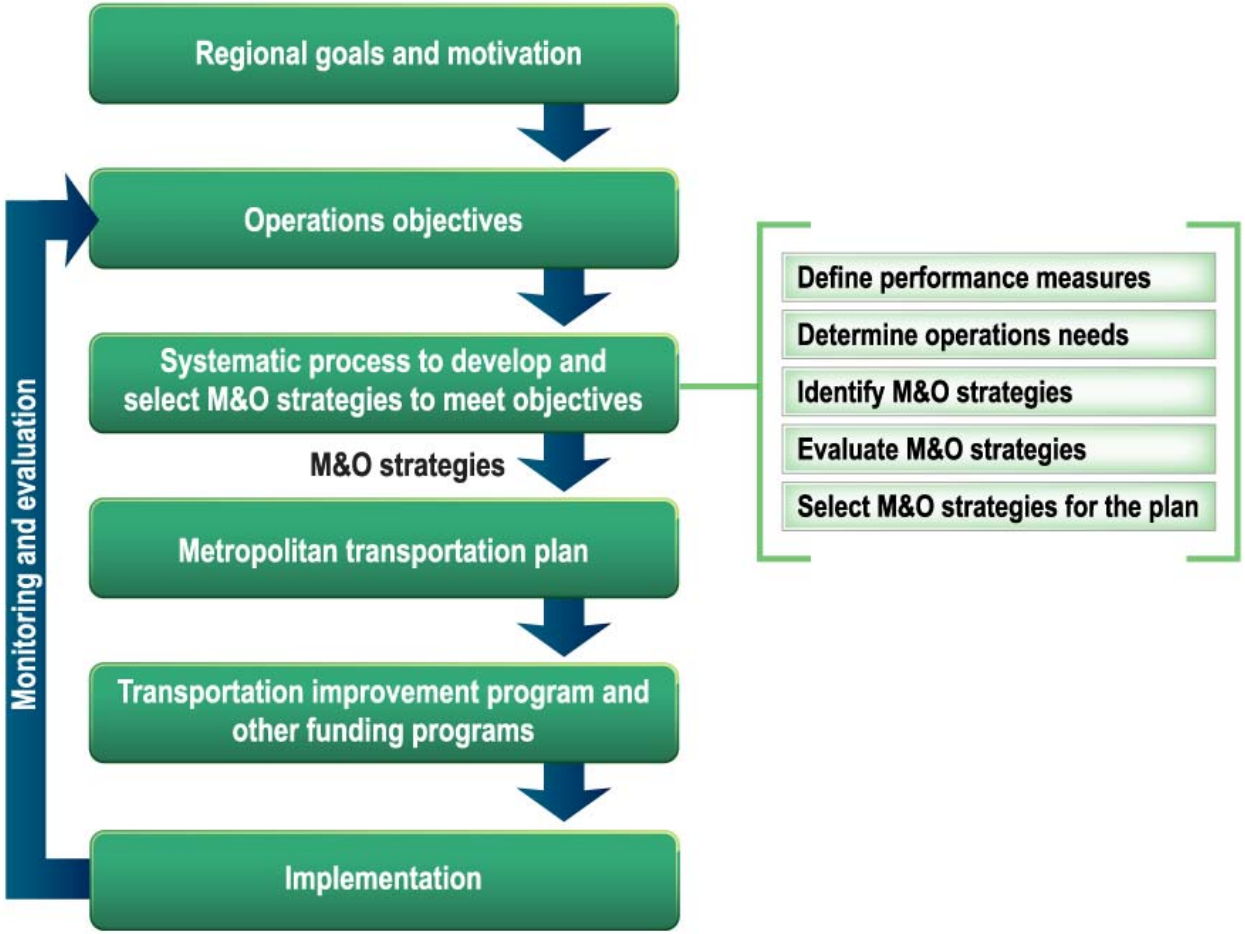
Performance Measures: Key Considerations

- 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



Selecting Operations Performance Measures (Metrics)

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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 <u>assists</u>
- Outcome
  - Measures typically experienced by the user
    - E.g., average travel speeds, on-time transit performance

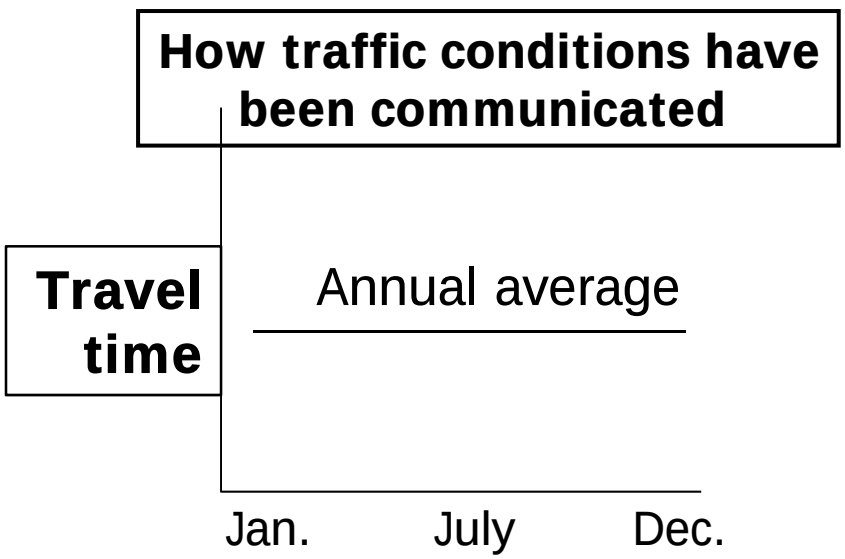
Examples of Transportation System Performance Measures

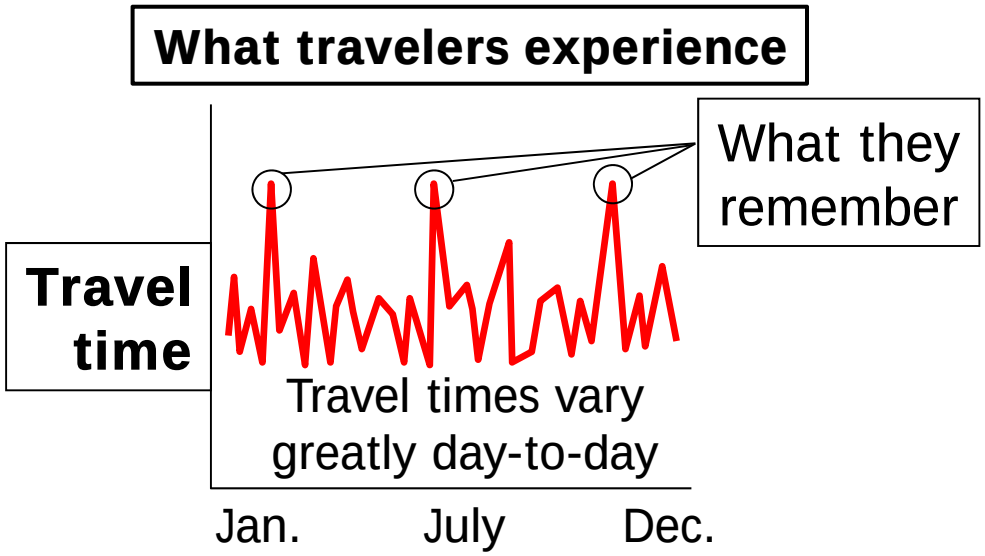
Travel time	Average travel times; Average travel speeds
Congestion extent	Lane miles of congested conditions Average hours of congestion per day
Delay	Vehicle-hours of recurring delay Non-recurring delay
Incident occurrence/delay	Median minutes from time of incident to clearance
Travel time reliability	Buffer time; Buffer time index
Transit performance	On-time performance Transit travel times in comparison to personal vehicle travel times
Customer satisfaction	Percent reporting being satisfied
Person throughput	Peak hour persons moved per lane

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”

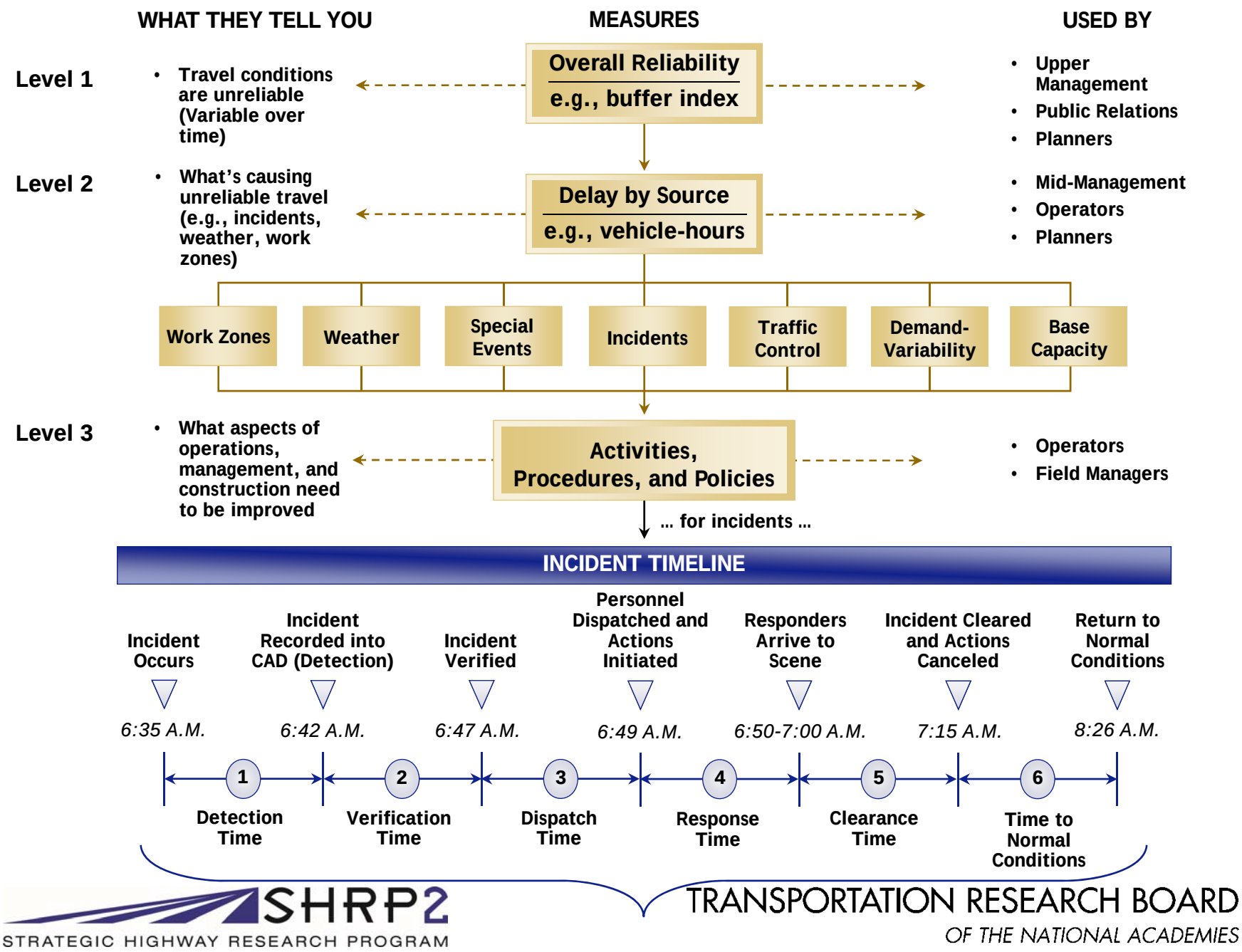
Averages don't tell the full story





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

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



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USING OPERATIONS PERFORMANCE MEASURES IN DECISION-MAKING AND COMMUNICATION

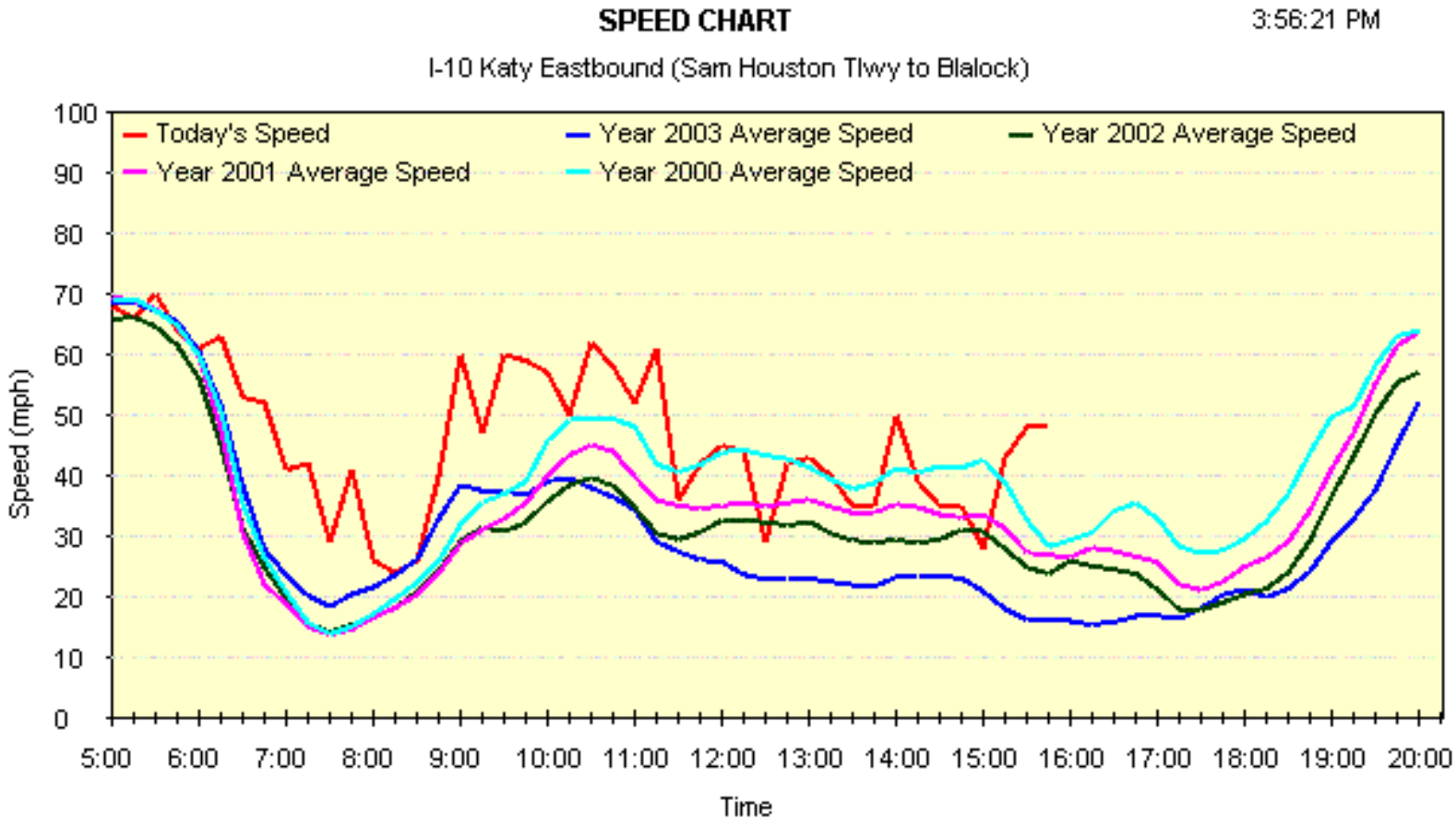
Reporting, Accountability, Decision Making

- 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

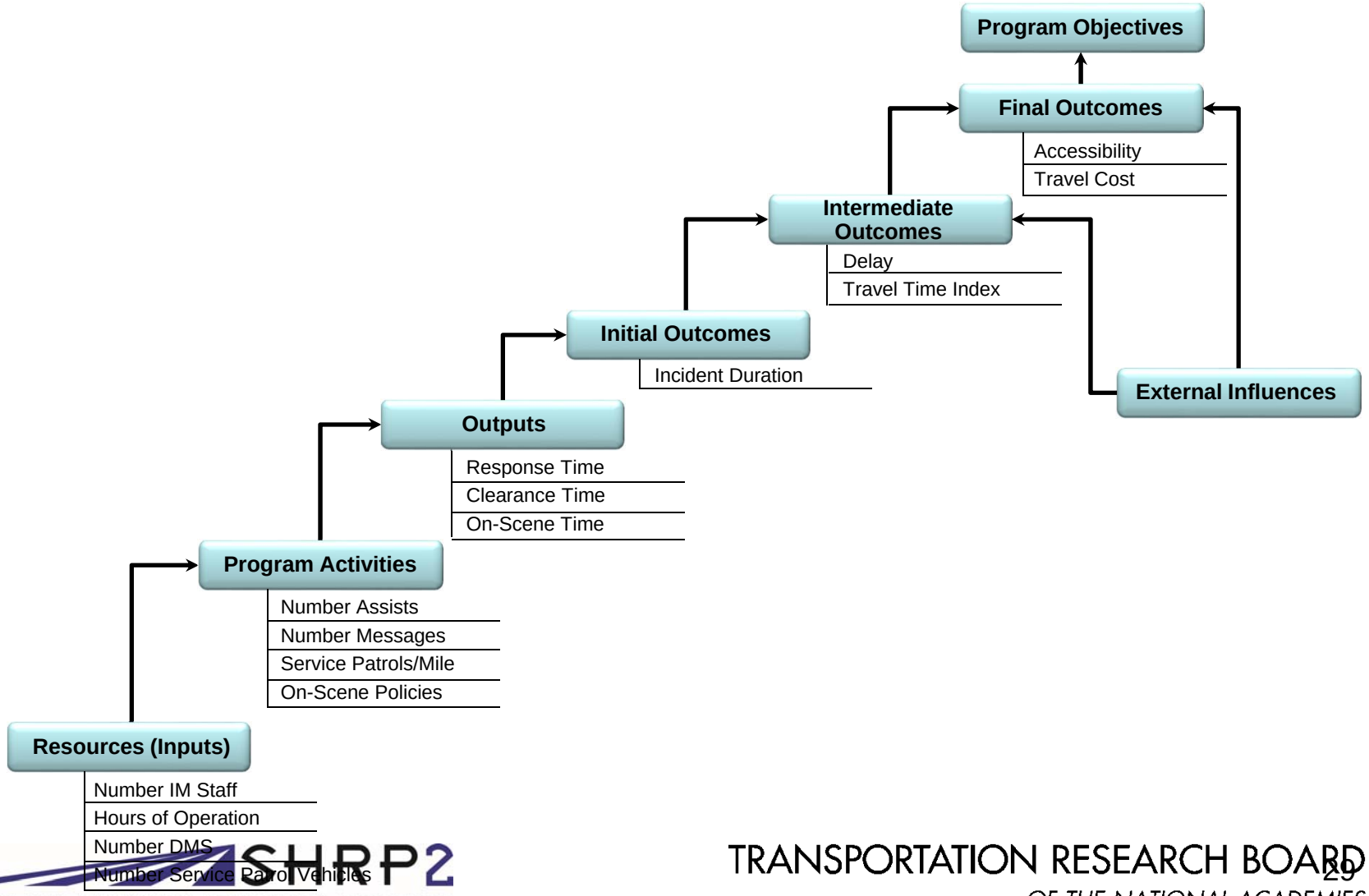
Real-Time vs. Historical



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



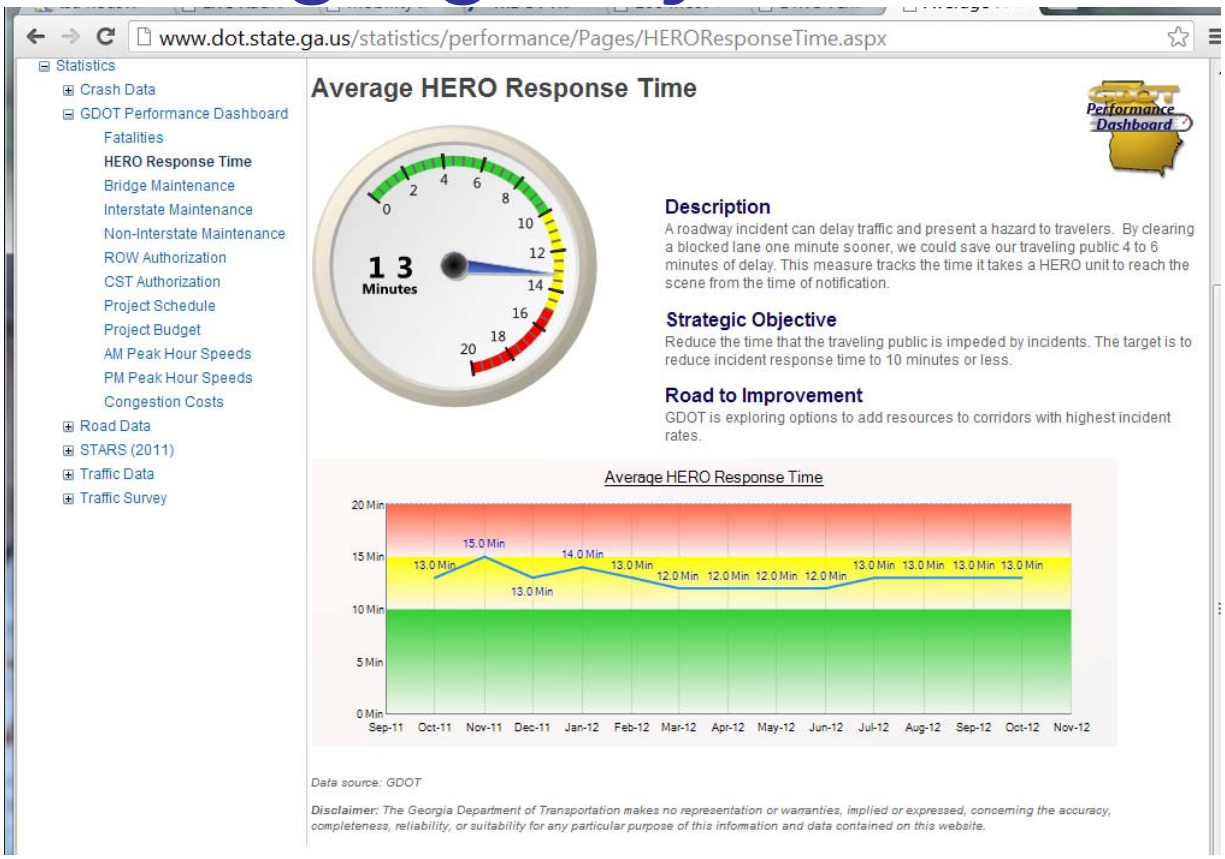
Other System and Program Evaluations

- 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

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Houston SAFEClear Rapid Towing Response

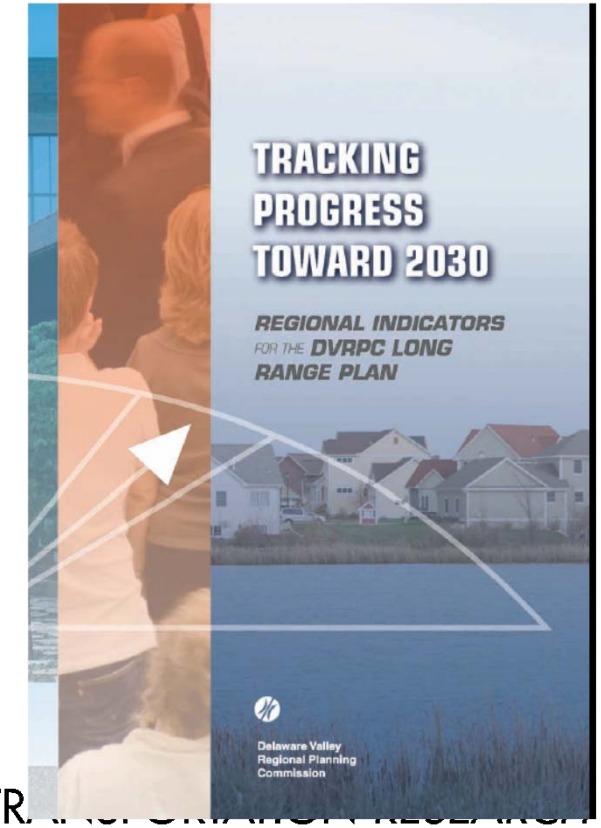
- Response time requirement held towing companies responsible (90% within 6 minutes)
- Clearance time & crash reduction used to justify City expenditures
- Reduction in secondary crashes an important component on public support
- $5M program => $30+M crash reduction

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



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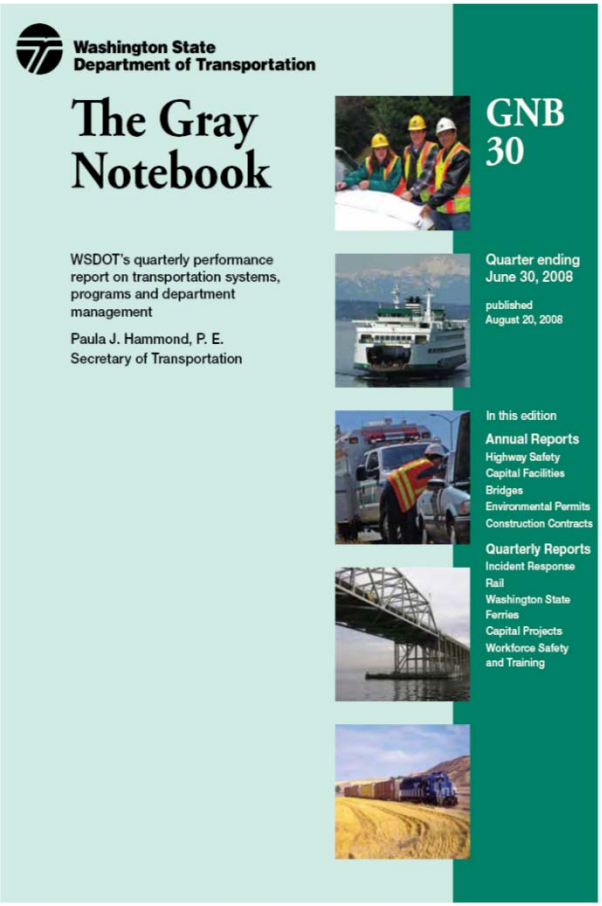
WSDOT's *Gray Notebook*

- 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

✓ Goal has been met. ↑ Performance is trending in a favorable direction. ↔ Trend is holding. ↓ Performance is trending in a unfavorable direction.

Policy goal/Performance measure	Previous reporting period	Current reporting period	Goal	Goal met	Progress	Comments
Safety						
Number of **traffic fatalities** per 100 million vehicle miles traveled (VMT) in Washington State (annual measure, calendar years 2006 & 2007)	1.12	1.0	1.0	✓	↑	Working toward additional reductions through *Target Zero*
Yearly **OSHA-recordable injury and illness rate** per 100 WSDOT maintenance & engineering workers (annualized: FY08 Q4, FY09 Q1[6])	5.3	4.2	6.0	✓	↑	Continuing to aggressively improve worker safety
Preservation						
Percentage of state **highway pavements** in fair or better condition (annual measure, calendar years 2006 & 2007)	93.5%	93.3%	90.0%	✓	↔	Performance level exceeds goal - challenges ahead
Percentage of **state bridges** in fair or better condition (annual measure, calendar years 2006 & 2007)	97.4%	97.0%	97.0%	✓	↔	Performance level meets goal - trending downward
Mobility (Congestion Relief)						
Average clearance times for **major (90+ minute) incidents** on key Puget Sound corridors (quarterly: FY08 Q4, FY09 Q1[6])	153 minutes	147 minutes	5% reduction	✓	↑	Met 5% goal, included in "*Moving Washington*" initiative
Percentage of **Washington State Ferries** trips departing on-time[2] (quarterly: FY08 Q4, FY09 Q1[6])	92%	87%	90%	---	↓	Quarterly performance declined with busy summer season
Percentage of **Amtrak *Cascades*** trips arriving on-time[3] (quarterly: FY08 Q4, FY09 Q1[6])	62%	61%	80%	---	↔	Performance is holding steady after improving last quarter
Annual weekday **hours of delay** statewide on highways compared to maximum throughput (51 MPH)[1] in thousands of hours (annual measure, calendar years 2006 & 2007)	23,330	25,490	N/A	---	↓	The rate of growth in delay declined from 35% to 8% between 2007 and 2005

High Level Dashboard and over 120 detailed, regularly published performance measures and metrics

Dashboard excerpt from Gray Notebook 31, published November 25, 2008

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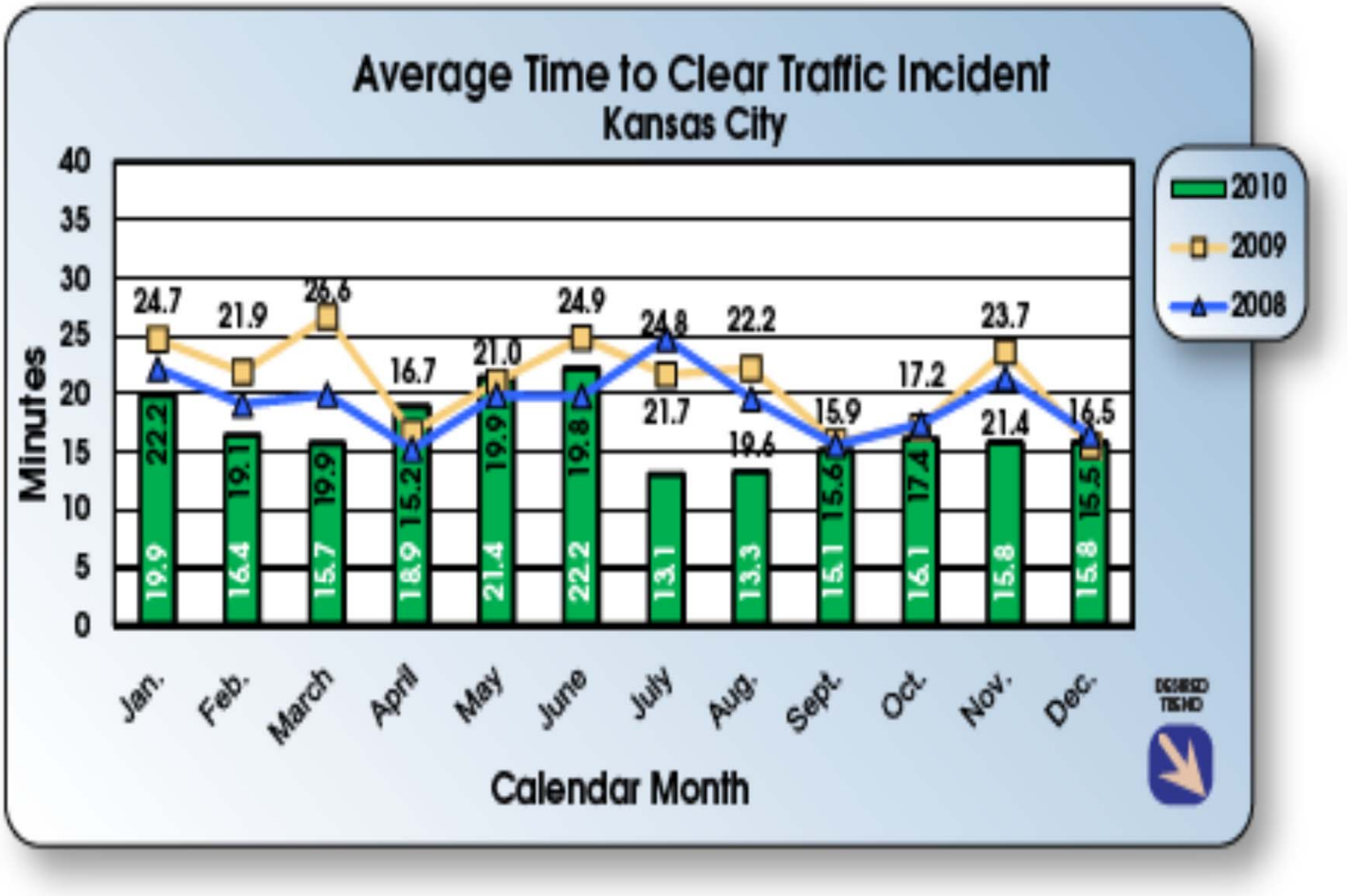
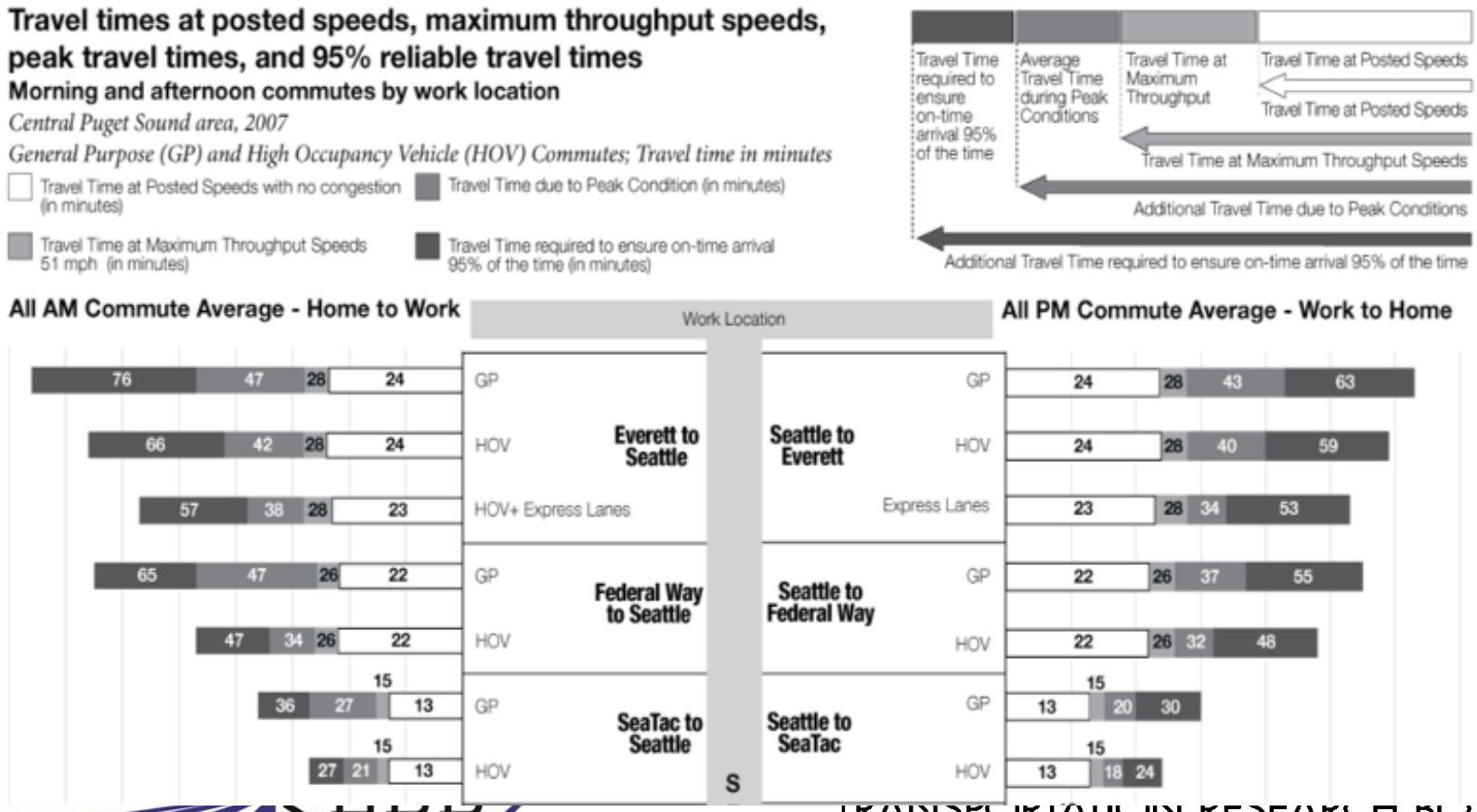
KC SCOUT Clearance Times



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



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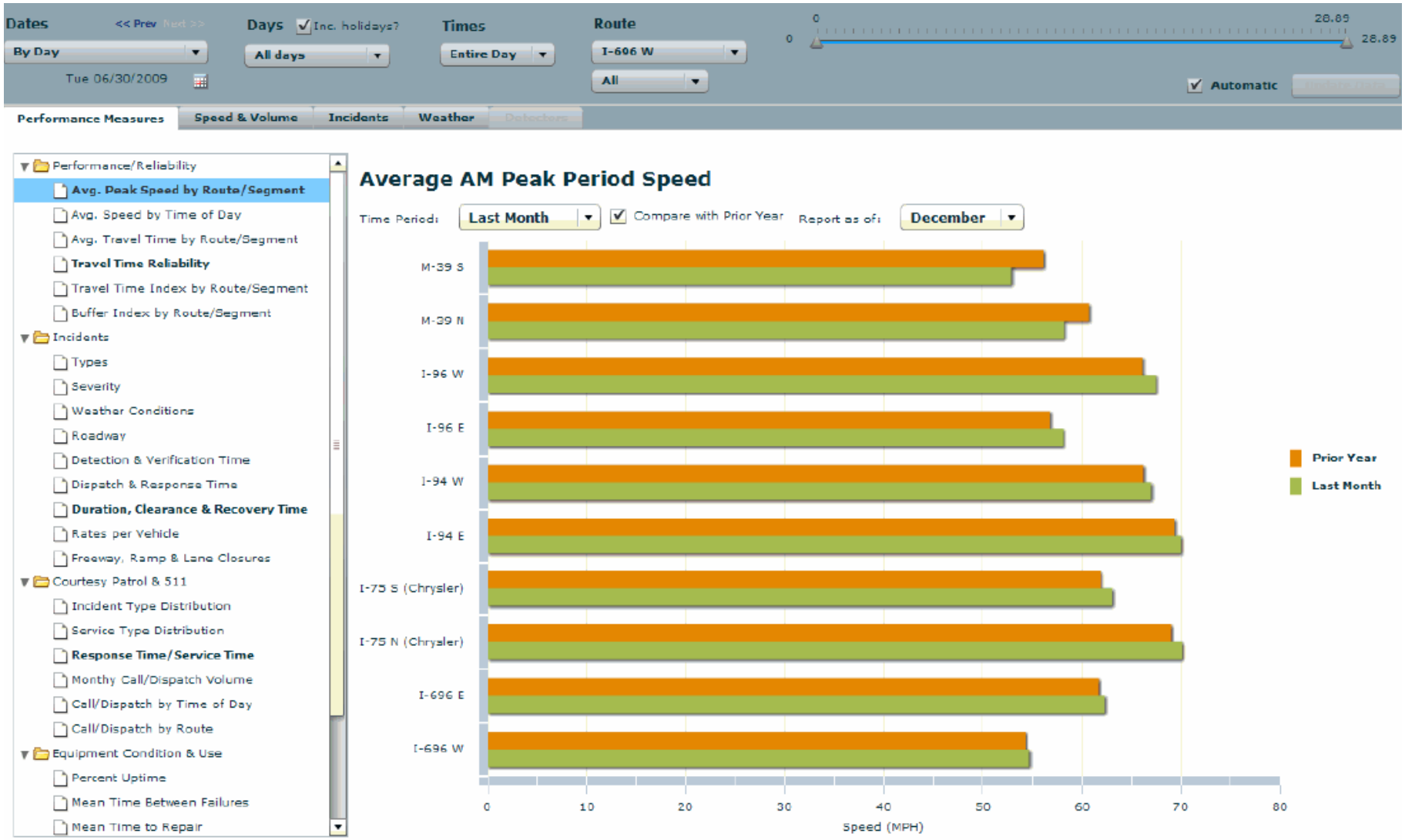
Detroit Average Annual Speeds



National Capital Region Congestion Report (Beta) 4th Quarter 2011 *Snapshot*

Congestion on Freeways
Delay in Q4/2011

All time in Q4/2011

12.3 Hours → $237* per traveler per month during Q4/2011

+9 % 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

+6 pp* vs. Q4/2010

PM Peak (3 – 7 PM)

236% of free flow travel time

+11 pp* vs. Q4/2010

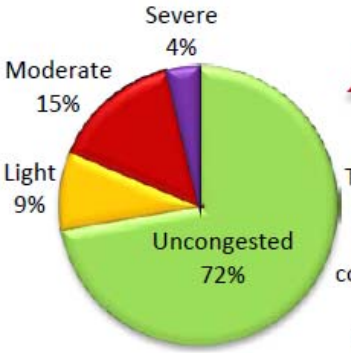
*pp: percentage points.

**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)

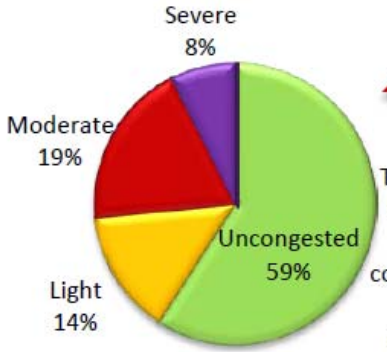
Percentages of Freeway Lane-Miles by Congestion Level in Q4/2011

AM Peak (6 – 10 AM)



+1 % The change of moderate & severe congested lane-miles in Q4/2011 vs. Q4/2010.

PM Peak (3 – 7 PM)



+3 % The change of moderate & severe congested lane-miles in Q4/2011 vs. Q4/2010.

Congestion level	Ratio of experienced travel time to free flow travel time
Uncongested	< 1.15
Light	1.15 - 1.3
Moderate	1.3 - 2
Severe	> 2

(see p. 5, 6 & 7)

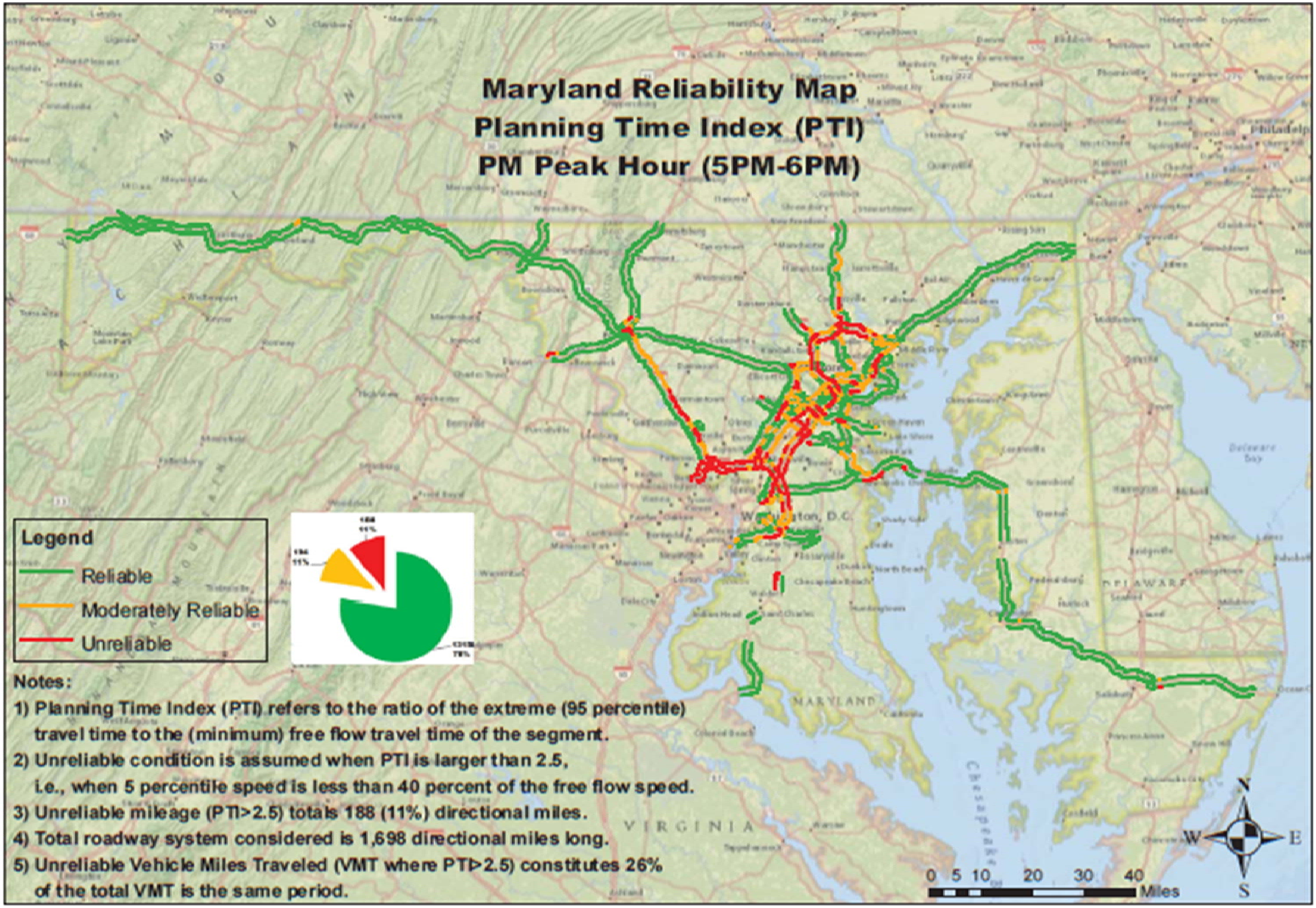
Spotlight

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.



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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