The “Perfect World” for Measuring Congestion and Reliability for Performance Management

(and a Federal Update on 1201)

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Agenda

- How do we measure and report congestion/reliability today?
- What else do we need to measure?
- What is the “Perfect World?
- How does this relate to Performance Management?
- What about Section 1201?
- Questions/Discussion

How do we measure and report today?

- **Measure Congestion and Reliability via a variety of data sources and measures**
  - Started by using traffic sensors (infrastructure) and now using probe data more
  - A wide variety of measures can be developed; there is some consistency of use among agencies
- **Report congestion today via a variety or reports**
  - National reports, state reports and dashboards
  - MPOs using in Congestion Management Process
  - Travel times readily available to all

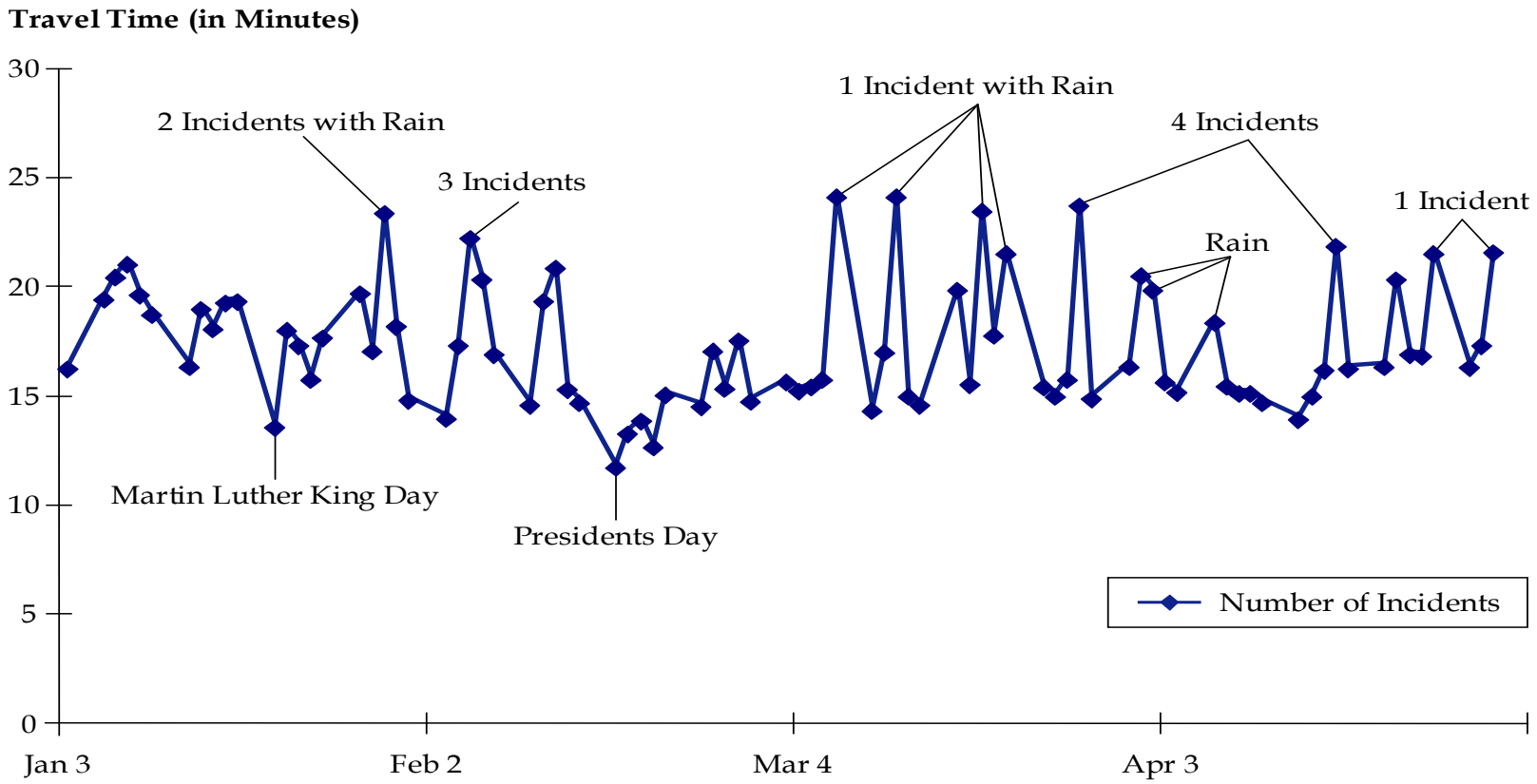
Measures for Congestion and Reliability

- A number of metrics for measuring congestion and travel time reliability have become commonplace

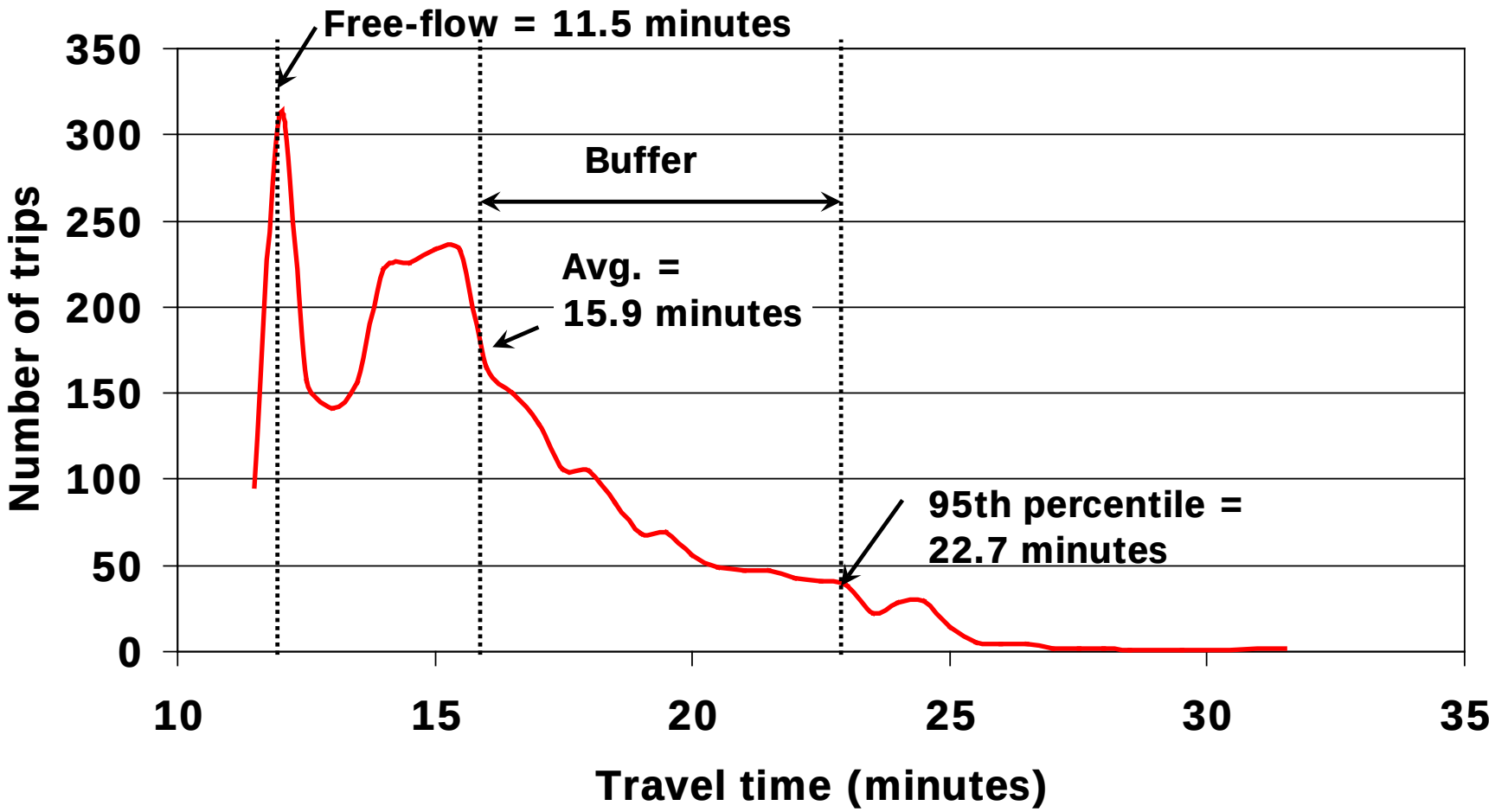
  - Delay, Cost of Delay
  - Travel Time Index (Peak v. Avg. Traffic)
  - Reliability Measures - Planning Time Index (95th or 80th percentile travel time v. free flow speed); Buffer Index
  - Spatial and Temporal Components of Congestion (congested hours, % congested roadways, etc.)
  - Many agencies have tweaked these measures slightly to measure what is important to them

Importance of Reliability

Weekday Travel Times
5:00-6:00 P.M., on State Route 520 Eastbound, Seattle, WA



Understanding Reliability



Reporting Congestion and Reliability

- It is important to report congestion and reliability measures for openness/transparency/ accountability
  - Let the public know how the system is performing
  - Let decision makers know that money being spent is having a positive effect on the system
    - Or that you need more funding to tackle specific problems
- Trend analysis is useful
- Evaluation of projects if even more useful
  - Know what works and can apply it elsewhere

Urban Mobility Report

Exhibit 1. Major Findings of the 2011 Urban Mobility Report (439 U.S. Urban Areas)

(Note: See page 2 for description of changes since the 2010 Report)

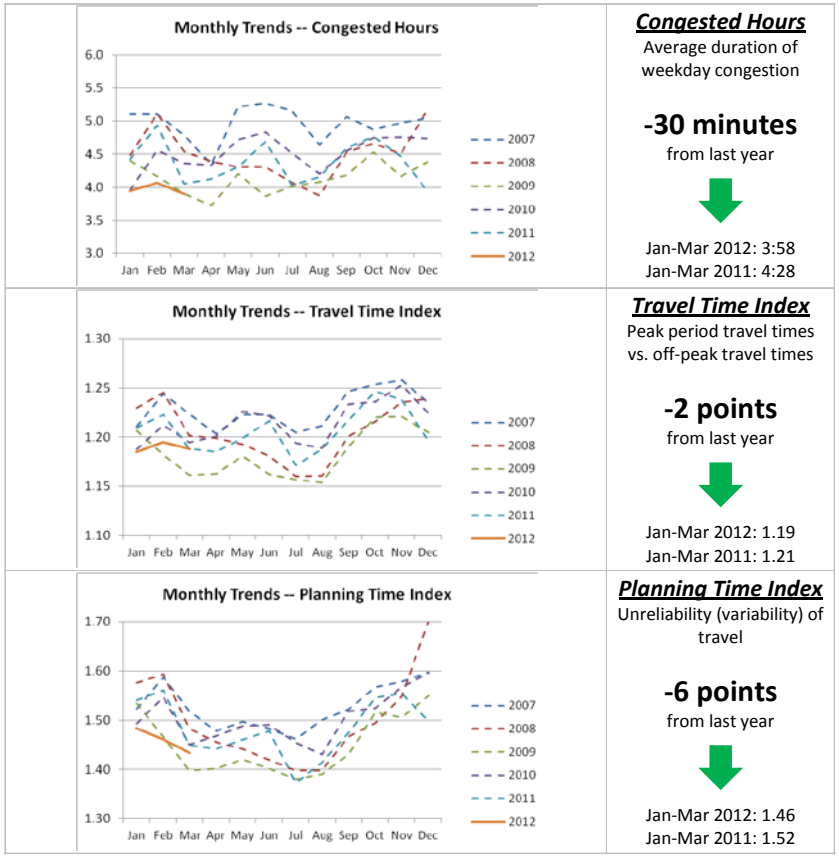
Measures of…	1982	2000	2005	2009	2010
… Individual Congestion					
Yearly delay per auto commuter (hours)	14	35	39	34	34
Travel Time Index	1.09	1.21	1.25	1.20	1.20
Commuter Stress Index	--	--	--	1.29	1.30
"Wasted" fuel per auto commuter (gallons)	6	14	17	14	14
Congestion cost per auto commuter (2010 dollars)	$301	$701	$814	$723	$713
… The Nation's Congestion Problem					
Travel delay (billion hours)	1.0	4.0	5.2	4.8	4.8
"Wasted" fuel (billion gallons)	0.4	1.6	2.2	1.9	1.9
Truck congestion cost (billions of 2010 dollars)	--	--	--	$24	$23
Congestion cost (billions of 2010 dollars)	$21	$79	$108	$101	$101
… The Effect of Some Solutions					
Yearly travel delay saved by:					
Operational treatments (million hours)	8	190	312	321	327
Public transportation (million hours)	381	720	802	783	796
Fuel saved by:					
Operational treatments (million gallons)	1	79	126	128	131
Public transportation (million gallons)	139	294	326	313	303
Yearly congestion costs saved by:					
Operational treatments (billions of 2010$)	$0.2	$3.1	$6.5	$6.7	$6.9
Public transportation (billions of 2010$)	$6.9	$12.0	$16.9	$16.5	$16.8

- Developed by Texas Transportation Institute
- Data sources are INRIX speed data and HPMS volume and roadway inventory data
- Reports associated "costs" of congestion along with delay and the Travel Time Index (Peak)

Urban Congestion Report

Urban Congestion Report (UCR)

A Snapshot of Congestion Trends in the U.S. for **January 2012** through **March 2012**

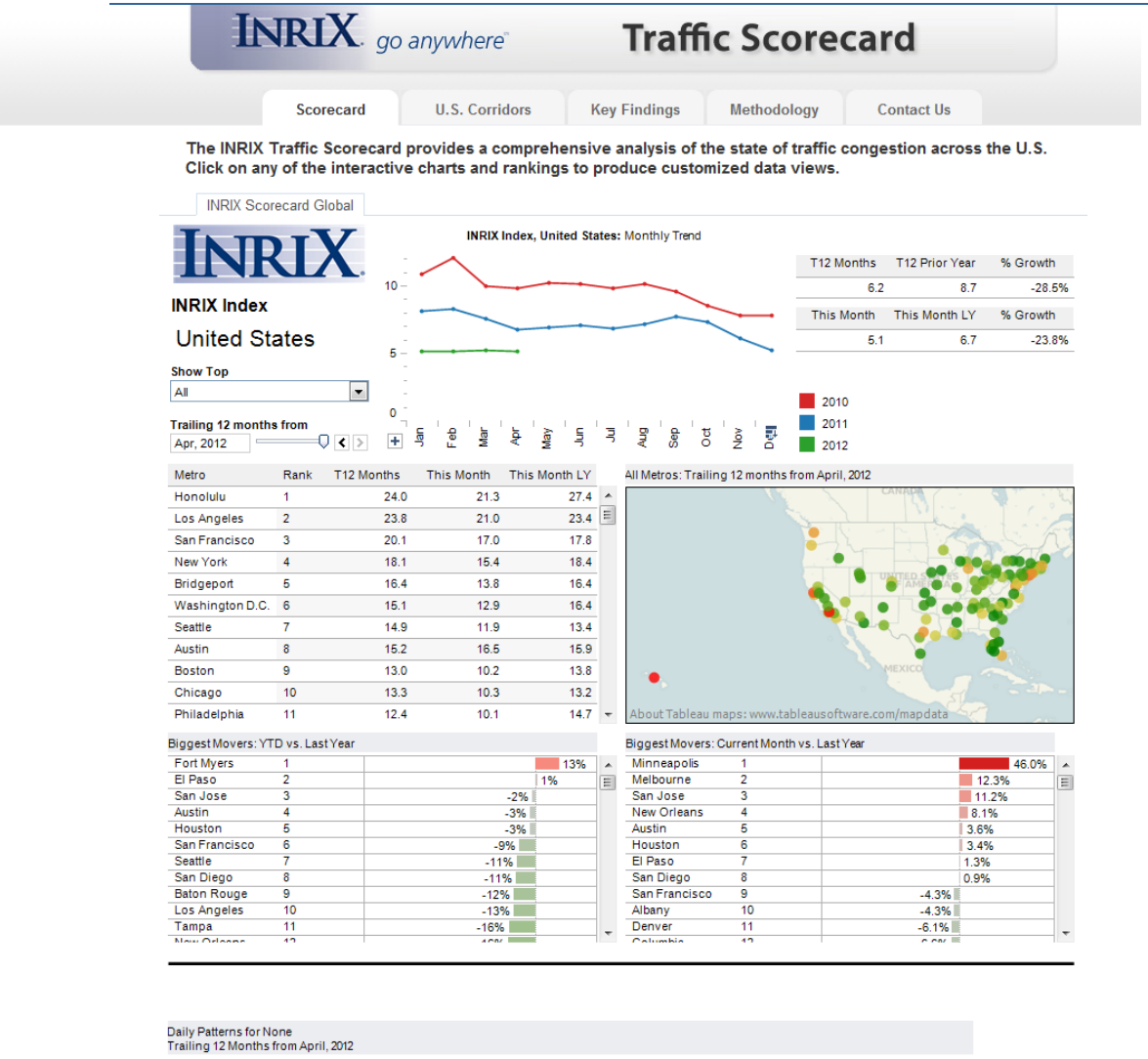


Summary of Nationwide Trends

- Congested hours improved (30 minutes shorter), the travel time index improved slightly (by 2 points), and the planning time index improved by 6 points. All measures compared the most recent 3 months in 2012 to the same 3 months in 2011.
- Nine of the 19 cities (47%) showed improvements in all three measures.
- Three of the 19 cities (16%) showed worsening conditions in all three measures.
- Seven of the 19 cities (37%) had stable or mixed results among the three measures.

- Developed by Texas Transportation Institute under contract to FHWA Office of Operations
- Data Sources: Traffic sensor data from TMCs and public/private partnership with traffic.com in 19 urban areas in U.S.
- Measures
  - Congested Hours (Duration)
  - Travel Time Index (Peak Period)
  - Planning Time Index (Reliability)
- Used as a proof-of-concept and for internal FHWA use in dashboards, budgets, strategic implementation plans, etc.

INRIX Traffic Scorecard



- Developed in-house by INRIX
- Uses INRIX data to report on overall congestion, bottlenecks, corridors
  - Measures include INRIX Index (congestion intensity)
  - Corridor report includes reliability measure
- Tries to relate contributing factors

Other Examples – State DOTs and MPOs

- Many states and MPOs report on congestion and more and more are adding reliability measures
  - Reliability measures are being added to more and more Congestion Management Processes in urban non-attainment areas
  - A variety of reporting methods are being used – web-based dashboards, printed annual reports, web-only documents
- Examples: MWCOG, Washington State DOT, Florida DOT

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

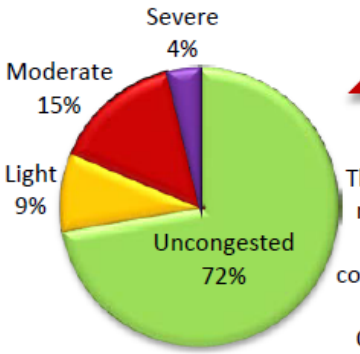
+11 pp* vs. Q4/2010

*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

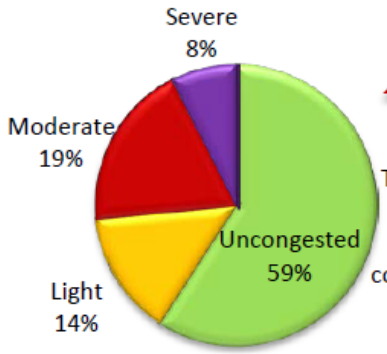
AM Peak (6 – 10 AM)



+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.

Measuring Delay and Congestion Annual Report

Congestion Report Dashboard of Indicators

2011 Congestion Report Dashboard of Indicators	2006	2007	2008[7]	2009	2010	Difference 2009 vs. 2010	Difference 2008 vs. 2010
Demographic and economic indicators							
State population (millions)	6.4	6.5	6.6	6.7	6.7	0.8%	1.5%
Average gas price per gallon (July)	$3.08	$3.05	$4.36	$2.81	$3.06	8.2%	-29.8%
Washington unemployment rate (annual)	5.0%	4.6%	5.5%	9.3%	9.6%	0.3%	4.1%
Washington rate of annual economic growth[1]	4.1%	5.2%	1.0%	-2.4%	1.6%	1.6%	-0.8%
Washington real personal income (billions)[2]	$245.3	$258.2	$263.2	$261.5	$263.9	0.9%	0.3%
Systemwide congestion indicators							
Vehicle miles traveled							
All public roads vehicle miles traveled (VMT), in billions	56.5	57.0	55.4	56.5	57.2	1.3%	3.1%
All public roads per capita VMT, in miles	8,867	8,780	8,440	8,467	8,505	0.4%	0.8%
State highways vehicle miles traveled (VMT), in billions	31.8	32.0	30.7	31.5	31.8	1.0%	3.3%
State highways per capita VMT, in miles	4,982	4,928	4,667	4,717	4,724	0.1%	1.2%
System congestion							
Lane miles of state highway system congested[3]	1,030	1,010	930	950	994	4.6%	6.9%
Percent of state highway system congested[3]	5.7%	5.6%	5.2%	5.2%	5.5%	0.3%	0.3%
Delay on state highways							
Total vehicle hours of delay, in millions of hours[4]	39.6	35.1	34.8	28.1	31.7	13%	-9%
Annual hours of per capita delay on state highways[4]	6.2	5.4	4.9	4.2	4.7	12%	-4%
Cost of delay on state highways (2010 dollars in millions)							
Measured at maximum throughput speeds[4,5]	$1,027	$885	$846	$685	$759	11%	-10%
Measured at posted speeds[5]	$1,449	$1,294	$1,215	$1,062	$1,108	4%	-9%
Corridor-specific congestion indicators							
Congestion on 52 commute routes in the central Puget Sound region							
Annual Maximum Throughput Travel Time Index (MT^3I)[6]	1.50	1.45	1.25[7]	1.31	1.37	4.6%	9.6%
Number of commute routes with $MT^3I > 1$[6]	46	46	41[7]	44	45	N/A	N/A
WSDOT congestion relief projects							
Number of completed Nickel and TPA mobility projects as of December 31st of each year (cumulative)	14	33	43	65	73	8	30
Cumulative project value (dollars in millions)	$206	$998	$1,245	$2,128	$2,524	$396	$1,279

Data sources include: WSDOT, Office of Financial Management; Economic and Revenue Forecast Council; Bureau of Economic Analysis, U.S. Department of Energy - Energy Information Administration; Bureau of Labor Statistics – Consumer Price Index.

Notes: Analysis in the Congestion Report examines 2008 and 2010 annual data, five years of data is provided here for information only. 1 The rate of annual economic growth is measured through Washington Real Gross Domestic Product as reported in chained 2005 dollars. Values shown in the Difference 2009 vs. 2010 and Difference 2008 vs. 2010 column reflect the difference in Gross Domestic Product instead of the difference in growth rates. 2 Washington real personal income is measured in chained 2005 dollars. 3 Based on below 70% of posted speed. 4 Based on maximum throughput speed thresholds (85% of posted speed). 5 Inflation adjusted using the Consumer Price Index (CPI). 6 MT^3I is the ratio of average peak travel time compared to maximum throughput speed travel time. MT^3I greater than one means the commute route experiences congestion. 7 2008 data not available for four of the 52 routes. This lack of data might be a reason for lower average MT^3I and number of commute routes with MT^3I >1. For more information see gray box on page 15 of the 2009 Annual Congestion Report.

- WSDOT's Gray Notebook, a legislatively required performance document, provides a very comprehensive look at congestion
- Washington State DOT Congestion Dashboard includes "Annual Maximum Throughput Travel Time Index"
  - Based on below 70% of posted speed; is the ratio of average peak travel time compared to maximum throughput speed travel time.

FDOT DISTRICT SIX INTELLIGENT TRANSPORTATION SYSTEM

TRAVEL TIME RELIABILITY

Travel Time Index by Roadway*

Time	I-95		I-195		I-75		SR 826					
	NB	SB	EB	WB	NB	SB	NB	EB	NB/EB	SB	WB	SB/WB
0:00	1.06	1.05	1.07	1.04	0.98	1.03	1.02	1.01	1.02	1.00	1.03	1.01
1:00	1.07	1.05	1.07	1.02	0.98	1.04	1.03	1.02	1.03	1.01	1.04	1.02
2:00	1.08	1.05	1.07	1.03	0.99	1.05	1.04	1.03	1.04	1.03	1.05	1.04
3:00	1.07	1.05	1.09	1.03	1.01	1.05	1.05	1.04	1.05	1.02	1.06	1.03
4:00	1.07	1.04	1.08	1.03	1.04	1.04	1.05	1.04	1.05	1.02	1.06	1.04
5:00	1.07	1.04	1.08	1.02	1.03	1.03	1.05	1.04	1.04	1.01	1.06	1.03
6:00	1.07	1.10	1.09	1.01	1.01	1.05	1.08	1.06	1.07	1.12	1.08	1.10
7:00	1.09	1.35	1.13	1.03	1.00	1.16	1.09	1.23	1.15	1.50	1.24	1.37
8:00	1.11	1.63	1.22	1.16	1.00	1.28	1.10	1.27	1.17	1.73	1.39	1.57
9:00	1.10	1.49	1.22	1.09	1.00	1.10	1.12	1.12	1.12	1.44	1.20	1.32
10:00	1.09	1.22	1.17	1.07	1.00	1.07	1.13	1.07	1.11	1.19	1.11	1.15
11:00	1.10	1.16	1.13	1.07	1.00	1.07	1.15	1.08	1.12	1.15	1.09	1.12
12:00	1.10	1.16	1.13	1.07	0.99	1.06	1.14	1.07	1.11	1.20	1.10	1.15
13:00	1.12	1.16	1.16	1.06	0.99	1.06	1.14	1.08	1.12	1.25	1.11	1.19
14:00	1.15	1.19	1.17	1.08	0.99	1.07	1.18	1.08	1.14	1.35	1.16	1.26
15:00	1.29	1.23	1.20	1.16	0.99	1.07	1.25	1.08	1.17	1.44	1.19	1.32
16:00	1.44	1.26	1.15	1.45	1.03	1.06	1.47	1.08	1.29	1.57	1.22	1.41
17:00	1.57	1.36	1.12	1.60	1.17	1.06	1.94	1.12	1.56	1.87	1.35	1.63
18:00	1.44	1.32	1.15	1.16	1.24	1.06	1.76	1.12	1.47	1.60	1.35	1.49
19:00	1.21	1.16	1.14	1.06	1.04	1.05	1.18	1.08	1.14	1.16	1.13	1.14
20:00	1.13	1.08	1.08	1.04	0.97	1.03	1.07	1.04	1.06	1.04	1.09	1.06
21:00	1.10	1.07	1.07	1.04	0.96	1.03	1.06	1.03	1.05	1.03	1.06	1.04
22:00	1.09	1.07	1.07	1.07	0.97	1.02	1.05	1.02	1.04	1.02	1.05	1.03
23:00	1.09	1.06	1.07	1.06	0.98	1.02	1.03	1.01	1.02	1.01	1.03	1.02
FFS**	63 mph	62 mph	58 mph	62 mph	66 mph	66 mph	63 mph	63 mph	63 mph	63 mph	63 mph	63 mph

Maximum Travel Time Index.

Travel Time Index (TTI) is a measure of average conditions that indicates how much longer, **on average**, travel times are during congestion compared to during light traffic.

Real World Example:

A TTI of 1.60 means that for a trip that usually takes 10 minutes in light traffic, a traveler should budget for an additional 6 minutes **on average**.

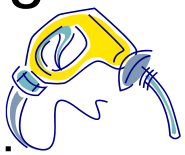
** Eight-month average from July 2011 - February 2012.*
*** FFS: Free Flow Speed*

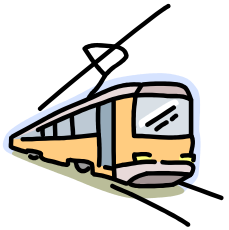
www.SunGuide.org 03/06/2012

- Florida DOT has a number of different congestion and reliability measures that it reports
- This example is from FDOT District Six (Miami-Dade)
- The report shows the Travel Time Index during different hours of the day on the major highways in there area

What else do we need to measure?

- We have access to average speeds on most roadways but that doesn't tell the whole story. What caused travel times to change?
- Contributing Factors:
  - INRIX – traffic volumes, fuel prices and jobs
  - UMR – operational treatments, public transit
  - Office of Operations – weather, work zone, incident management, planned special events, signal timing, bottlenecks





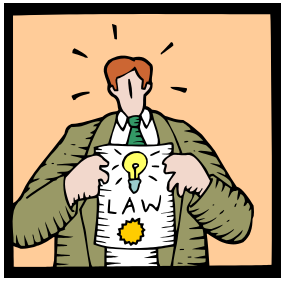
- Getting a better handle in the future on how economic factors directly affect congestion will help us know what effects *our* actions are actually having

What about Performance Management?

- Agencies are focusing on Performance Management as a good business practice and in anticipation of it being included in the next Federal transportation authorization bill
  - FHWA, AASHTO, TRB and other interested parties have been working towards some national goals and related performance measures that will be tracked under such a Performance Management approach
- FHWA is focused on *system reliability* as one such measure

What about Performance Management?

- General elements of Performance Management are applicable to all agencies whether mandated by law or not
  - Identify Goals and related Performance Targets
  - Plan projects/strategy implementation that will help reach those Targets
  - Implement projects/strategies and monitor performance
  - Report performance, evaluate project/strategy implementation for good results
  - Go back to the planning process and use those good results to improve future system performance



What is the “Perfect World”?

- FHWA’s Office of Operations will be holding a workshop early next year to help define what the “Perfect World” for measuring congestion and reliability is
  - Inviting congestion measure experts from academia, state DOTs, MPOs, etc.
  - Results will include a road map/program plan of how to move towards that “Perfect World”
- Part of the focus will be to work towards an “agreement” on the best approach to measuring congestion and reliability for performance management

1201 - Next Steps

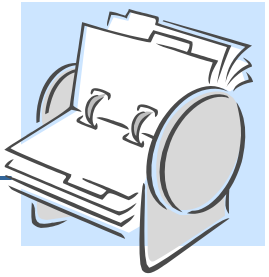
- **Guidelines for Implementation**
  - Information gathering, quality measures, methods for making information available, etc.
  - Potential linkages to other programs (performance management, road weather, etc.)
- **Process Review Guidelines**
  - For FHWA Division Offices
- **Monitor Implementations**
- **Update Data Exchange Formats**
  - System engineering analysis of potential formats
  - Guidelines for appropriate information exchange formats, standards, etc.

Contacts for 1201

For more information:

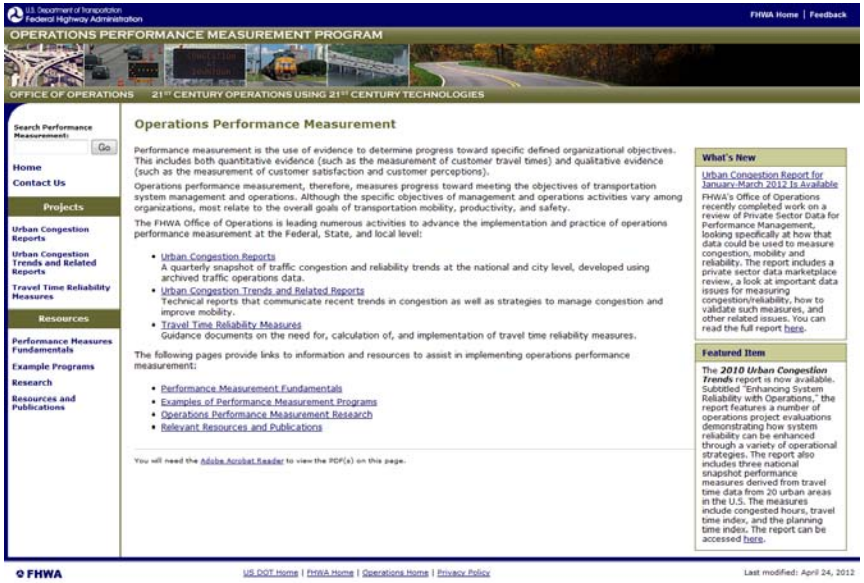
- **Bob Rupert, FHWA, 202-366-2194, *Robert.Rupert@dot.gov (for general Program)***
- **Emiliano Lopez, FHWA, 202-366-2199, *Emiliano.Lopez@dot.gov (for Data Exchange Formats)***
- ***www.ops.fhwa.dot.gov/1201/***

Contact



For more information on Operations Performance Measures and Management :

- **Rich Taylor, FHWA Office of Operations**
  rich.taylor@dot.gov
- **Website:** http://www.ops.fhwa.dot.gov/perf_measurement/index.htm



Questions?