

Making a Case for Operations: Measuring the Benefits and Impacts of Operational Strategies

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**Intelligent Transportation Society Tennessee:
Annual Meeting – Memphis, Technical Session 09-30-11**

Measurement Challenges in Systems Operations

...The biggest challenge of performance measurement, especially when applied to the operations side of transportation, is that the field is behind the curve of both other professions and other areas of the transportation profession...some areas of transportation have embraced performance measurement for nearly two decades. Applying performance measurement to operations is much more of a recent focus...

(from Bertini, You are the Traffic Jam; 2006)

...but lots of people are thinking about it: National & International Efforts Related to Operations Measurement and Reporting

- National Transportation Operations Coalition (NTOC) -Recommended Performance Measures: focused on quality of service (outcome).
- I-95 Corridor Coalition
- Texas Transportation Institute (TTI's) Urban Mobility Report (annual)
- American Society for Testing and Materials (ASTM) ITS data standards
- “National Strategy to Reduce Congestion on America's Transportation System and Urban Partnership Project (USDOT)
- National Traffic Incident Management Coalition (NTIMC): National Unified Goal (NUG) for Traffic Incident Management (TIM)
- International Efforts, UK, Japan, Australia, Netherlands, China etc.
- AASHTO: The 21st Century Operations-Oriented State DOT
- Strategic Highway Research Program (SHRP-2)'s Reliability Focus Area

Measurement Challenges: It is Complex!

- Highway Systems (aka Mobility) performance measurement is a very complex, and often politically sensitive measurement area
- No “magic bullet” measurement system exists - One size does not fit all.
- Cultural shift to active, real time, customer focused system management continues to be difficult to achieve
- Real-time data needs pose significant challenges
- Mobility and operational measures are constantly evolving - It's an iterative process and, and for many new

What is System Performance & Congestion?

“Yes, It’s all Relative but what is your goal?”

Congestion

- The inability of the highway to carry sufficient vehicles to meet demand, resulting in lower speeds and highways operating at below maximum efficiency
- A topic generating extreme passions; focus of politics and political races; one of the most critical public policy issues in some regions
- A good thing: a sign of economic success
- A bad thing: keeps businesses away
- A good thing: gets folks out of their cars using alternatives
- A bad thing: has economic and personal costs
- You know it when you see it or if you are in it.....
- Depends ontime of day; day of week; region; expectations; reliability....it’s relative



Congestion relief and safety are the outcomes – metrics support budget asks and help prioritize projects & programs.

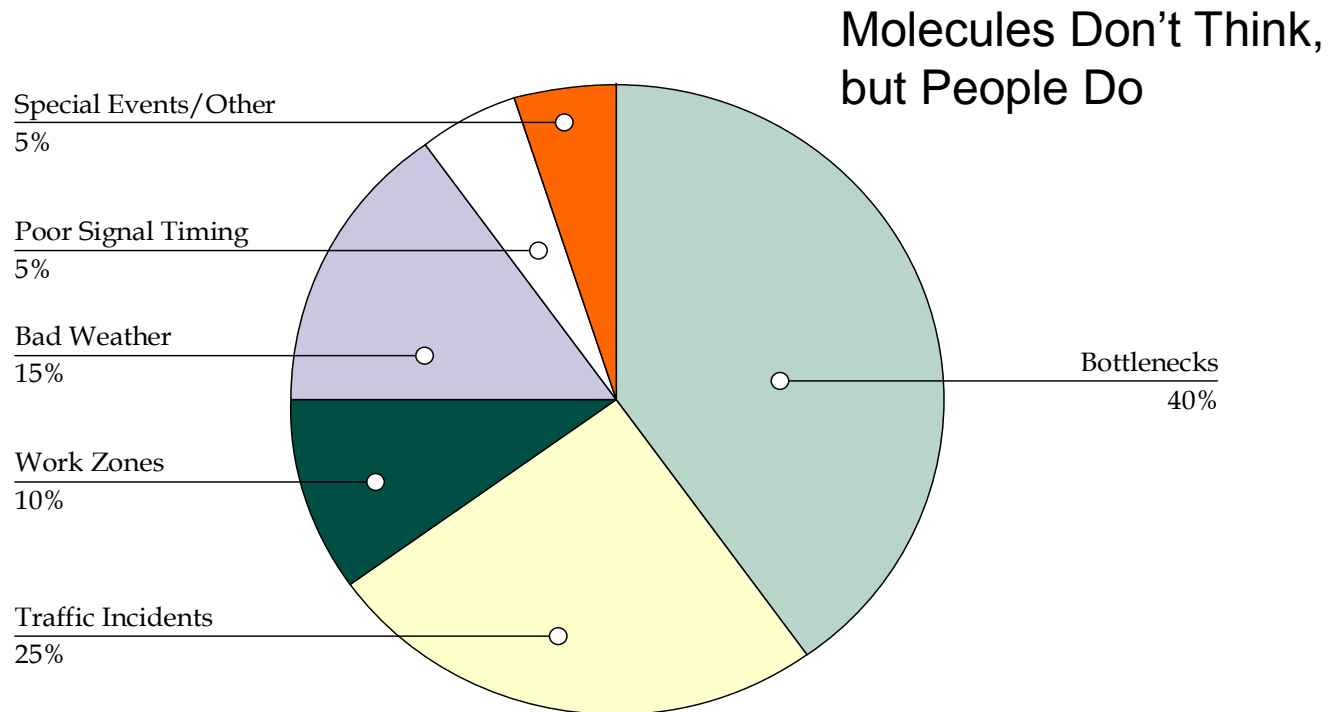
Measurement Challenges: Defining Objectives, Goals or Targets

For example: Assuming Optimization:

- Maximizing vehicle/people/freight throughput?
- Maximizing traffic safety?
- Maximizing revenue?
- Maximizing investments?
- Maximizing speed?
- Maximizing reliability/predictability?
- Minimizing disruptions to traffic flow?
- Minimizing delays?
- Maximizing benefit gained from each dollars spent (cost/benefit and efficiency)?

What Causes Congestion?

Figure 5.10 The Sources of Congestion
National Summary



Source: NCHRP 3-68, Cambridge Systematics, et al. *Guide to Effective Freeway Performance Measurement*.

Source of Congestion: Recurring and Non-recurring

	Cause of Delay	Large Urban Areas (>1 million)	Small Urban Areas (0.1-1.0 million)	Rural
Reporting Causes	Network Capacity Exceeds Demand	29-37%	20-26%	0
	Poor Signal Timing	4-5%	7-13%	2%
Total Recurring		33-42%	32-33%	2%
Non-Recurring Causes	Crashes	35-36%	19-26%	26%
	Breakdowns	6-7%	6-10%	25%
	Workzones	8-19%	26-27%	39%
	Weather	5-6%	7-10%	7%
	Special Events	1%		
Total Non-Recurring Causes		58-67%	67%	98%

Data Source: Lockwood, 21st Century DOT. Breakdown averaged from TTI and ORNL larger urban area figures as reported by FHWA

Source: TRB Project 20-24 The 21st Century Operations-Oriented State DOT.

What is your Performance Goal?

WSDOT Manages to Maximum System Throughput

WSDOT's goal is to manage the current highway system to achieve maximum vehicle and person throughput and system productivity:

Another way of looking at the Speed-Flow curve

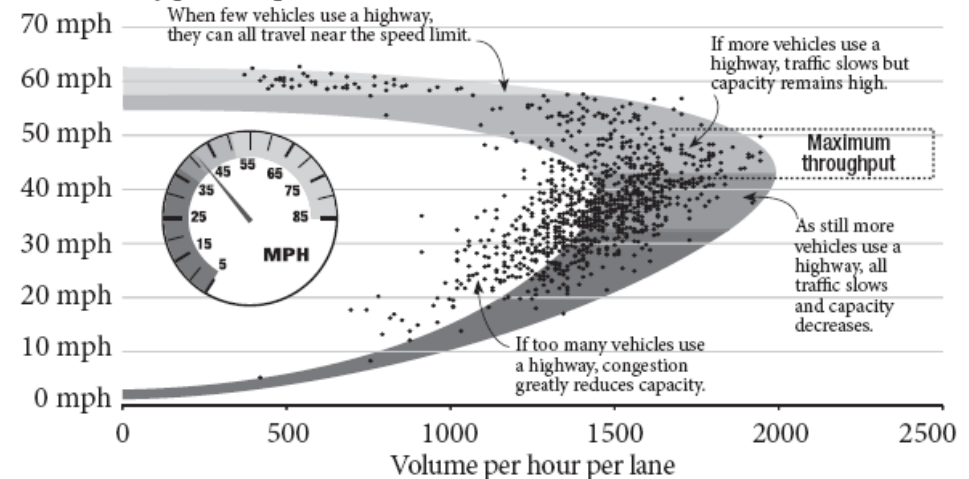
Maximum Throughput

(optimal flow) is reached at roughly 42-51 MPH with the system serving as many as 2,000 vehicles per hour per lane on the state freeway system (not arterials)

During congestion, speeds drop below max throughput speeds, vehicle throughput productivity declines dramatically

Understanding maximum throughput: An adaptation of the speed/volume curve

I-405 northbound at 24th NE, 6am-10am weekdays volume in May 2010
Speed limit 60 mph; Maximum throughput speed ranges between: 70%-85% of posted speed



Data source: WSDOT Northwest Region Traffic Office.

Making a Case for Operation Strategies

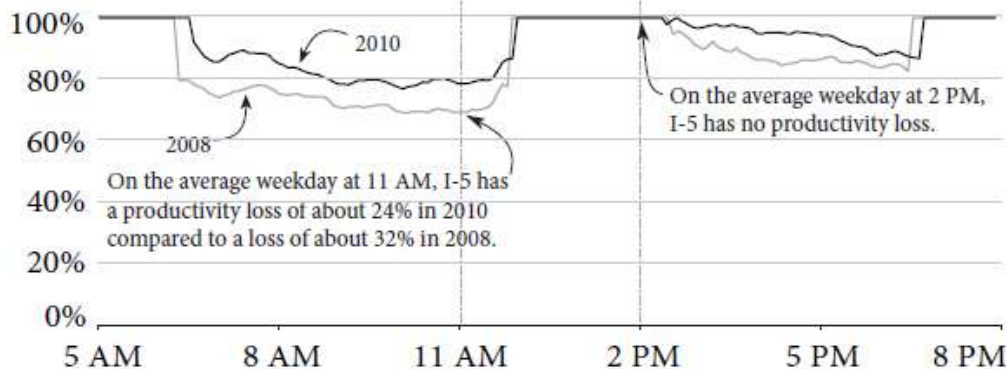
Measuring and Communicating Lost Throughput Productivity

WSDOT monitors vehicle throughput at strategic locations on the central Puget Sound freeway system using real-time data.

Lost throughput productivity measures the percentage of a highway's vehicle throughput capacity that is lost due to congestion in terms of vehicles per lane per hour.

Vehicle throughput productivity: example

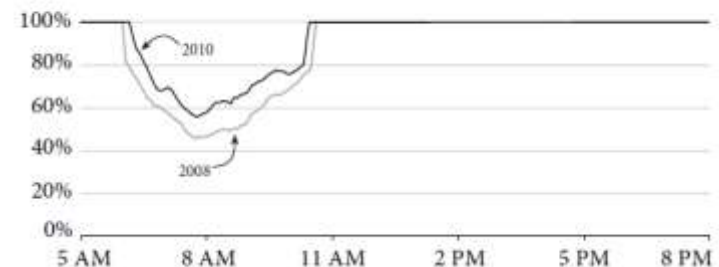
Based on the highest average five minute flow rates observed on I-5 at I-90 MP 164, for northbound commute direction of traffic in 2008 and 2010



Data source: WSDOT Urban Planning Office.

NB I-405 at SR 169 (MP 4.0)

Based on highest observed 5 min flow rate; northbound = 1,630 vphpl



Measuring Operational Strategies

Demonstrating Impacts and Benefits:

Measurement and Communicating Impacts and Benefits of Operational Strategies:

Systems Operations and Management (SO&M) is a set of strategies to anticipate and manage traffic congestion, and minimize the other unpredictable causes of service disruption, delay, and crashes.

- Incident Response
- Ramp Metering
- Signal Coordination
- Variable Message Signs /Traveler Information
- HOV Lanes
- Work Zone
- Active Traffic Management
- Operational Effectiveness

Traffic Incident Management (TIM) – Performance Measurement Definitions

“Roadway” Clearance Time

- Time between first recordable awareness of an incident (detection/notification/verification) by a responsible agency & first confirmation that all lanes are available for traffic flow.

“Incident” Clearance Time

- Time between the first recordable awareness & time at which the last responder has left the scene.

Secondary Crashes

- Number of secondary crashes beginning with the time of detection of the primary incident where a collision occurs either a) within the incident scene or b) within the queue, including the opposite direction, resulting from the original incident.

1. Incident Response: Why we collect data – why we measure

- [Video of an incident on the I-5 Seattle Ship Canal Bridge](#)

1. Incident Response: Why we collect data – why we measure

FRIDAY, FEBRUARY 16, 2007 | The Seattle Times | Local B3

2 small collisions cause 1 big mess

I-90 BACKUP RUNS 11 TO 14 MILES

Fewer lanes, timing prove “catastrophic”

BY PEYTON WHITELY
AND CHRISTINE CLARRIDGE
Seattle Times staff reporters

Two small accidents, one big backup.

A couple of minor collisions Thursday morning on west-bound Interstate 90 caused a “catastrophic” traffic backup that stretched an estimated 11 to 14 miles from Mercer Island to Issaquah, state traffic officials said.

So how do two small collisions cause a major backup?

Fewer lanes, timing and location added up to trouble.

said Martin Dedinsky, state Department of Transportation traffic engineer.

“You’ve clamped off two-thirds of your capacity; there you go, you have a 10-mile bottleneck,” he said.

The roots of the jams started with timing, he added, with the accidents taking place just after 7 a.m., at the peak of rush hour.

The collisions also took place on a part of I-90 that’s already between two existing bottlenecks, one where traffic from I-405 flows into I-90, and another where traffic tends to slow because of tunnels on Mercer Island, with the tunnels themselves forming a visual distraction.

“You put an accident here, and you’ve connected two bottlenecks,” he said.

State Patrol Trooper Jeff

Merrill described the backup as “catastrophic” and “one of the worst backups during the morning rush that we’ve had in a long time.”

The first accident occurred on I-90 in the Mercer Island tunnel and the second occurred in the aftermath of the first collision, Merrill said.

One accident involved a semi-truck and the other involved a box van, he said, adding that they likely were caused by drivers making careless lane changes.

There were no serious injuries, but one driver was taken to the hospital as a precaution, Merrill said.

Dedinsky said a little bit of arithmetic helps explain the extent of the traffic jam.

The three lanes of I-90 at that point normally carry

about 5,500 vehicles an hour in free-flowing conditions, or approximately 1,800 to 2,000 in each lane in each hour, he explained.

With two lanes blocked, he said, that capacity was cut to a third of its normal volume.

“You’re probably getting 1,500 an hour” through the remaining lane, he said.

The results aren’t difficult to calculate.

Assuming a car is about 20 feet long, and 4,000 of them are backed up in bumper-to-bumper traffic, that’s 80,000 feet of cars. Divide that by 5,280 feet, the distance in one mile, and it comes to 15.15 miles — about what drivers faced on I-90 Thursday morning.

Peyton Whitely: 206-464-2259 or
pwhitely@seattletimes.com

1. Incident Response: What to measure- what data to collect ?

- **Characteristics of the Incident** – Location, type, severity
- **The Incident “Timeline”** – Key actions and milestones related to response actions – incident clearance vs. lane clearance
- **Details on the Blockage Characteristics** – Whenever lane or shoulder blocking changes, it is noted
- **Details of Incident Response** – What agencies responded, what equipment was used

Percent of Lost Throughput Capacity Due to Lane or Shoulder Blocking Incidents

Based on 2000 vehicles per lane per hour highway capacity

# of lanes	Shoulder Blocked	Lanes Blocked		
		1	2	3
2	19%	65%	0%	n/a
3	17%	51%	83%	0%
4	15%	42%	74%	87%
5	13%	35%	60%	80%
6	11%	29%	50%	74%

1. Incident Response Measurement

Challenges – many players, many partners



Washington State
Department of Transportation

INCIDENT RESPONSE TEAM



WASHINGTON
FIRE CHIEFS



WASHINGTON STATE
FIRE FIGHTERS'
ASSOCIATION



U.S. Department of Transportation
Federal Highway Administration



ntimc
National Traffic Incident
Management Coalition

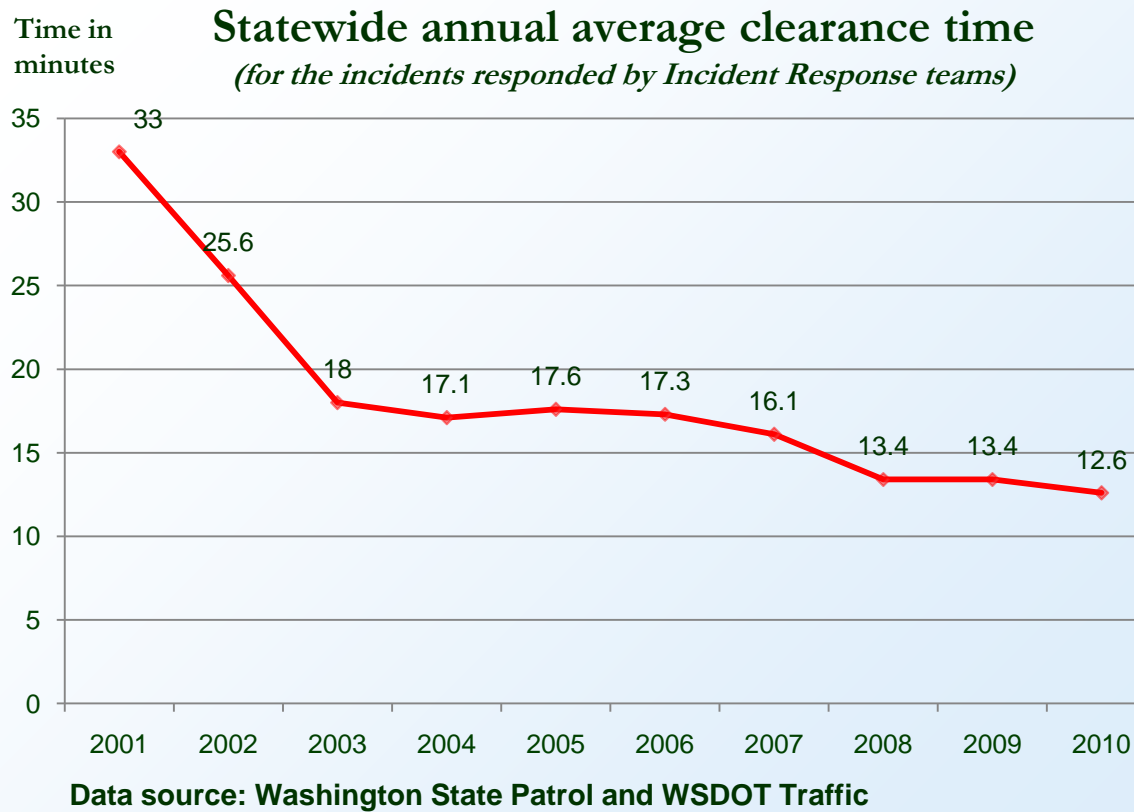


Washington Ambulance
Association



1. Incident Response: Showing Trends in Clearance Times

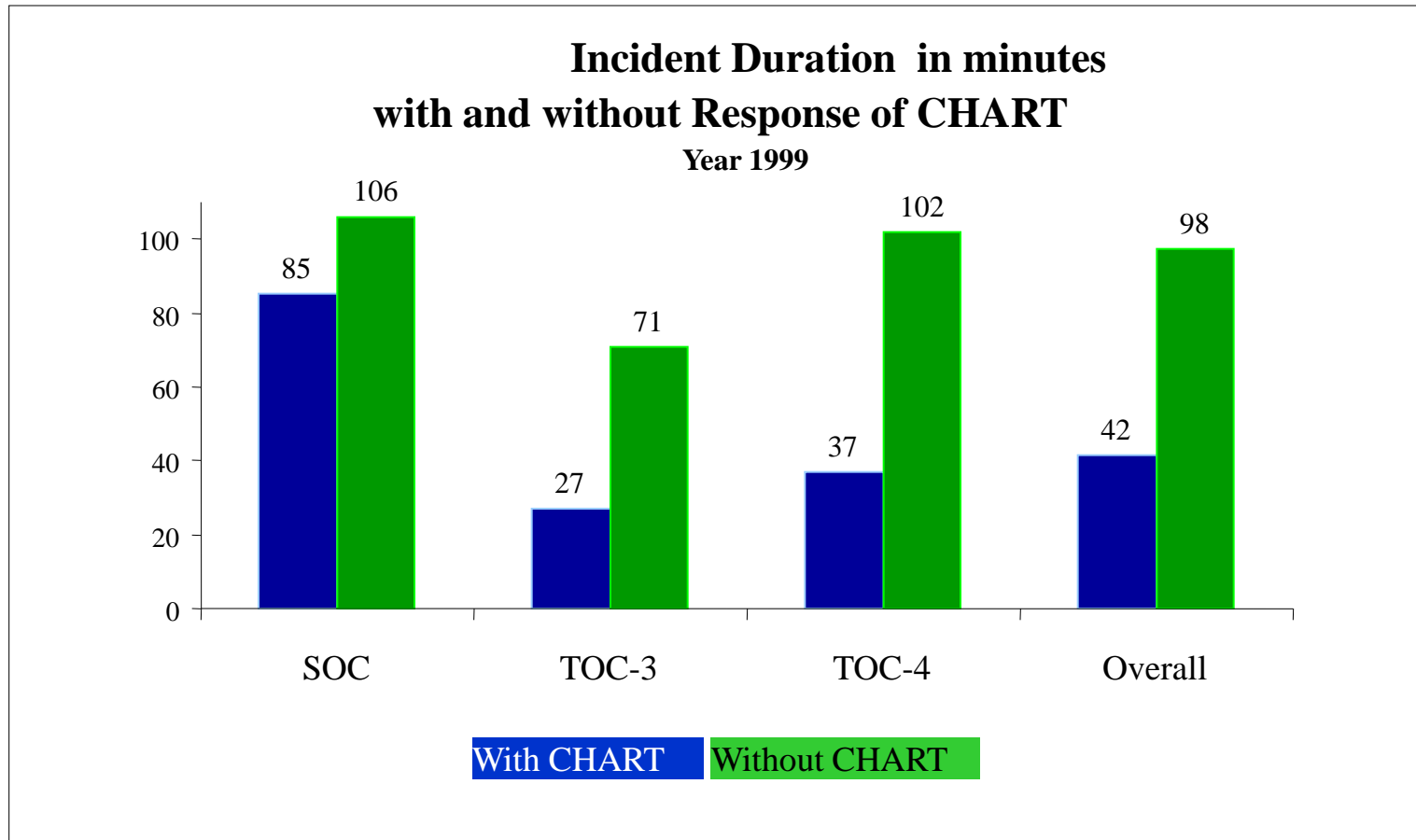
Incident Clearance Time (incident clearance)



(January 2001 – December 2010)



1. Incident Response: Showing Trends in Clearance Times (Duration)



1. Incident Response: Quantifying Benefits

- Incidents are a significant cause of roadway delay
- High correlation between volume and delay: the greater the volume, the longer a delay an incident is likely to cause and the more costly to economy
- Delay/Dollar savings-CHART

TOTAL REDUCTION IN INCIDENT CONGESTION DELAY

The CHART incident management program continues to provide safety and economic benefits to motorists and commerce in Maryland. By June 2008, this program is anticipated to save motorists and commercial traffic approximately 30 million vehicle-hours annually, equivalent to \$570 million a year in cost-savings.

Performance Measure	Calendar Year			
	2003	2004	2005	Target
Reduction in incident congestion delay	26.8 million vehicle hours saved	25.9 million vehicle hours saved	27.9 million vehicle hours saved	30.0 million vehicle hours saved

From: MDOT 2007 Attainment Report on Transportation Performance

1. Incident Response: Quantifying Benefits

WSDOT-UW Transportation Center – Research on Incident Response...preliminary results...

What is the average cost of an Incident?

- For every minute of 'Incident'...It would cost on an average \$244
- For example on an average,
 - 15 min incident would cost **\$3,660**
 - 30 min incident would cost **\$7,320**
 - 90 min incident would cost **\$21,960**

What is the average cost of an Lane Closure?

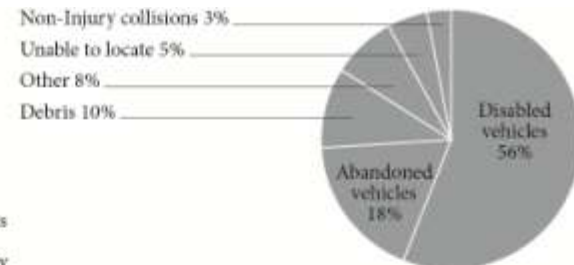
- For every minute of 'Lane Closure'...It would cost on an average \$345
- For example on an average,
 - 15 min closure would cost **\$5,175**
 - 30 min closure would cost **\$10,350**
 - 90 min closure would cost **\$31,050**

For example: Quarter 1(2010) the 8,887 (15-min) incidents costs tax payers (\$244 X 15 X 8,887) \$ 32 Million

Source: University of Washington Transportation Center

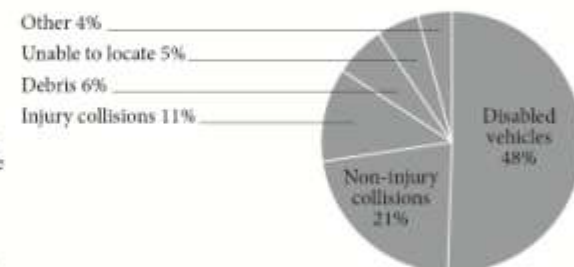
Incidents Lasting Less Than 15 Minutes (8,887)

Fatality, Injury and Police Activity were less than 1% (not shown). There were 13 Fires and 5 Hazardous Materials events involved incidents in addition to or as a result of above incidents. 12 incidents involved WSDOT property damage, and 223 were located in work zones.



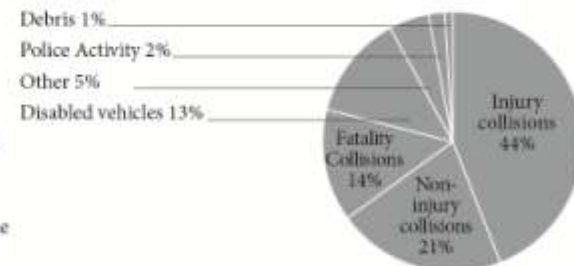
Incidents Lasting 15 to 90 Minutes (2,656)

Police Activity and Fatality collisions were less than 1% (not shown). There were 81 Fire, and 8 Hazardous Materials involved incidents in addition to or as a result of above incidents. 145 incidents involved WSDOT property damage, and 187 were located in work zones.



Incidents Lasting 90 Minutes and Longer (101)

There were 11 Hazardous Materials and 21 Fire involved incidents in addition to or as a result of above incidents. 43 incidents involved WSDOT property damage, and none were located in work zones.



Data Source: WSDOT Traffic Office and Washington State Patrol

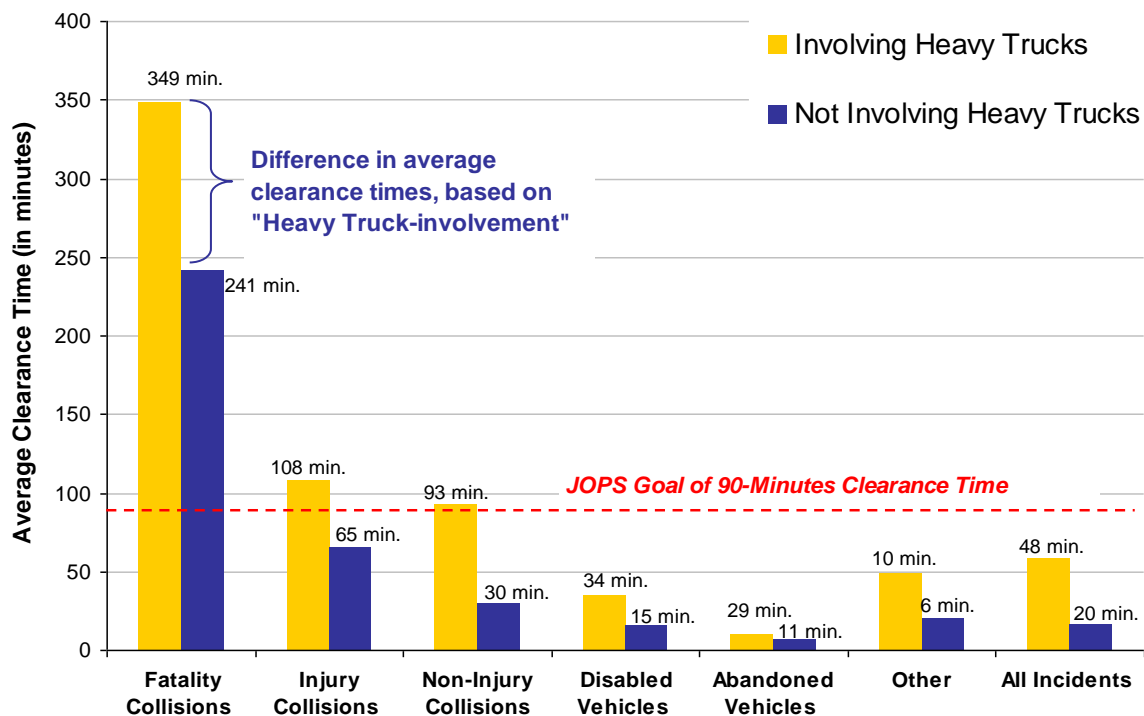
Note: "Closure" incidents involve the closure of one or more lanes and are a subset of all incidents.

1. Incident Response- Special Targets

For example: Heavy Truck Involvement

Average Clearance Time of Incidents* By Heavy Truck-Involvement

12-Month Period (July 2005 - June 2006)



Major Incident Tow (MIT):
WSDOT's 2007-09 *Budget Request* included funding for a tow performance program for heavy trucks, (was funded in 2007).

- Modeled after successful program in Florida that is responsible for clearing 94% of heavy truck collisions in under 90 minutes.
- Provide incentives to the towing industry to improve equipment standards, improve training, and agree to a performance agreement.

1. Incident Response- Special Targets

Factors associated with longer clearance times

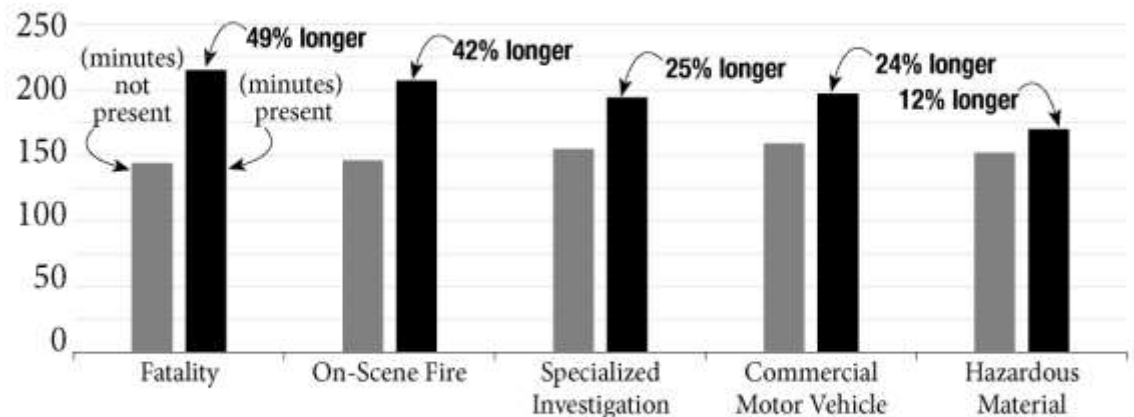
Sample analysis of “over 90 min” incidents

WSDOT and WSP conducted a review of 50 incidents from 2009 to identify factors that influence response and clearance times, and determine opportunities for performance improvement consistent with nationally-recognized best practices.

This review revealed five common factors to be associated with longer clearance times.

1. Fatality
2. On-scene Fire
3. Specialized Investigation
4. Commercial Motor Vehicle
5. Hazardous Material

Five factors associated with longer clearance times
*Percent increase in average 2009 clearance time, in minutes, when factor was present or not present**



Data Source: WSDOT Traffic Office and WSP.

* Based on analysis of 50 major incidents (those lasting longer than 90 minutes) randomly selected from all 309 major incidents occurring in 2009, on the nine routes tracked for GMAP. The routes include I-5 from Oregon to British Columbia, I-405, SR 18 from Federal Way to I-90, SR 16 from Tacoma to Purdy, SR 167, SR 520, SR 512, and I-205.

1. Incident Response: Customer Feedback Showing Trends/ Leveraging Public Opinion

November 13, 2002

"This is a good use of my tax dollars. Car couldn't be fixed at the time but he really tried and he got me off the road safely. Very pleasant and helpful, keep him. He is very good!"

December 13, 2002

"The WSDOT person was outstanding and ensured my safety. Gladly pay taxes to ensure this service!"

December 26, 2002

"Please keep this service, we need it bad. Thank you so much!"

TIM Performance Measurement Focus States Initiative

Eleven States working together to develop **consensus on national program-level TIM** Performance Measures

Representatives from Law Enforcement and Transportation



TIM Performance Measures

Focus States:

- California
- Connecticut
- Florida
- Georgia
- Maryland
- New York
- North Carolina
- Texas
- Utah
- Washington
- Wisconsin

Focus State Testimonials:

"The [TIM FSI] process helped to crystallize what the measurements are about. It became very clear we are all defining things in different ways." New York FSI Participant

"There were a lot of definitional differences between public safety and DOT. This was a major hurdle [we] overcame." Washington FSI Participant

Determining secondary crashes and the reduction of this through TIM is important for funding for Road Rangers and the expansion of TIM." Florida FSI Participant

1. Incident Response: FHWA Annual TIM Self Assessment Tool

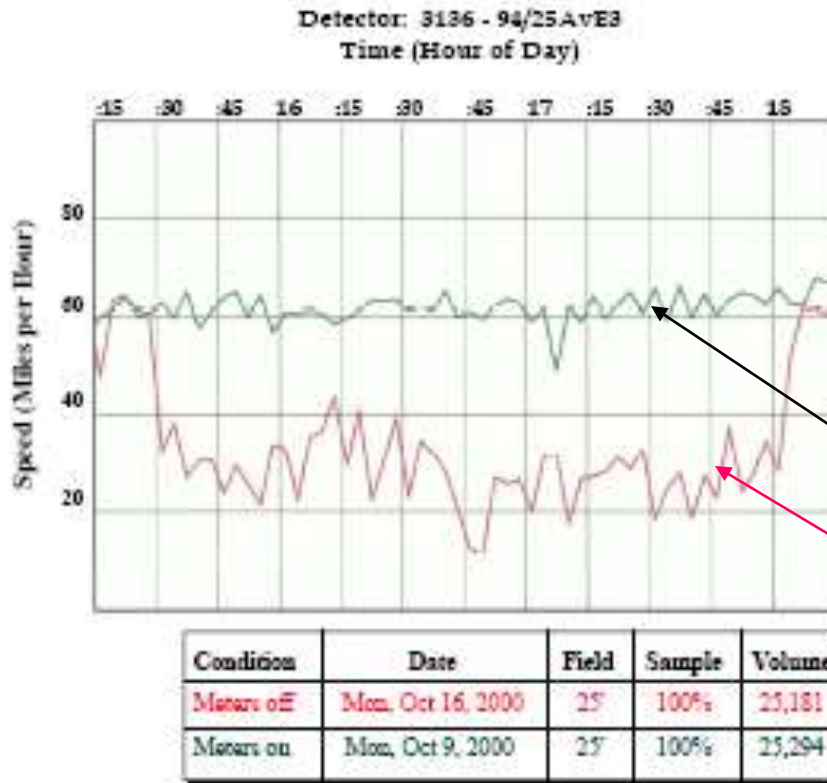
Traffic Incident Management (TIM) Program Self-Assessment 2011: Jurisdiction Summary		
Location:	WA-Seattle	
Overall Score:	91.2%	
Rating Legend Low - Little to no activity in this area. No Activity- No activity or discussion of this issue. Some Activity- Issue has been acknowledged and there has been some single agency activity. Medium - There is some level or a good level of activity in this area. Fair Level of Activity- Some good processes exist, but they may not be well integrated or Good Level of Activity Good Level of Activity- Efforts in this area are strong and results are promising, though there is still room for improvement. High - Activity in this area is outstanding. Efforts in this area are well coordinated with a high level of cooperation among agencies.		
Section 4.1 - Strategic – 30%	25.6%	
4.1.1 Multi-Agency TIM Teams	Rating	Comments
<i>Does the TIM program:</i>		
4.1.1.1 Have a TIM multi-agency team or task force which meets regularly to discuss and plan for TIM activities?	Good	WaTIMCo ramping up, MIT continued by legislature (regular meetings w/ MIT management team)
4.1.1.1.a. What agencies are represented on the team/task force?		
4.1.1.1.b. How frequently does the team/task force meet?		

Measuring incident response-The Good News: there is lots of help

- I-95 Corridor Coalition – Quick Clearance toolkit
- Operations academy (University of Maryland)
- TIM Self Assessment Promotion
- USDOT TIM Handbook Revision
- SHARP-II – Training & Certification of Responders
- TIM Performance Measures Focus States Initiative
- Traffic Incident Management Community of Practice
- Transportation Safety Advancement Group
 - TIM Case Studies Webinars
- Emergency Responder Safety Ins. Training
- State-level NUG Adoption & Implementation

2. Ramp Metering: “Before and After” Measurement Approach

Figure ES.5 Example of Increased Speed Variability (I-94 Corridor Location)



Twin Cities
Ramp
Metering
Evaluation
Project

Speed (MPH)
variability with
and without
ramp meters
on

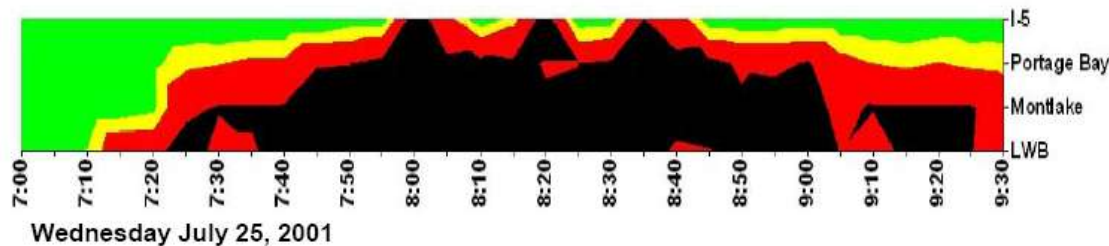
Twin Cities Ramp Meter Evaluation, Cambridge Systematics, 2001

2. Ramp Metering: Measuring Effectiveness using “Before and After”

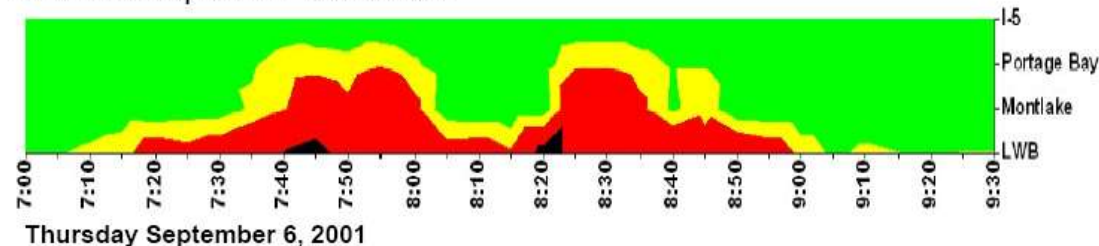
Ramp Metering

SR 520 Westbound Ramp Meter Effects

BEFORE a series of ramp meters were activated: EB morning congestion, I-5 to Lake Washington Blvd:



AFTER ramp meter activation:



Wide Open ■ Moderate ■ Heavy ■ Stop and Go ■

“Brain Scan”

Colors denote level of congestion based on volumes by time of day and location (extent)

Green-Wide open

Yellow -Moderate

Red- Heavy

Black - Stop and go

On SR 520

2. Ramp Metering: Measuring Conflicts Between Drivers – breaking actions

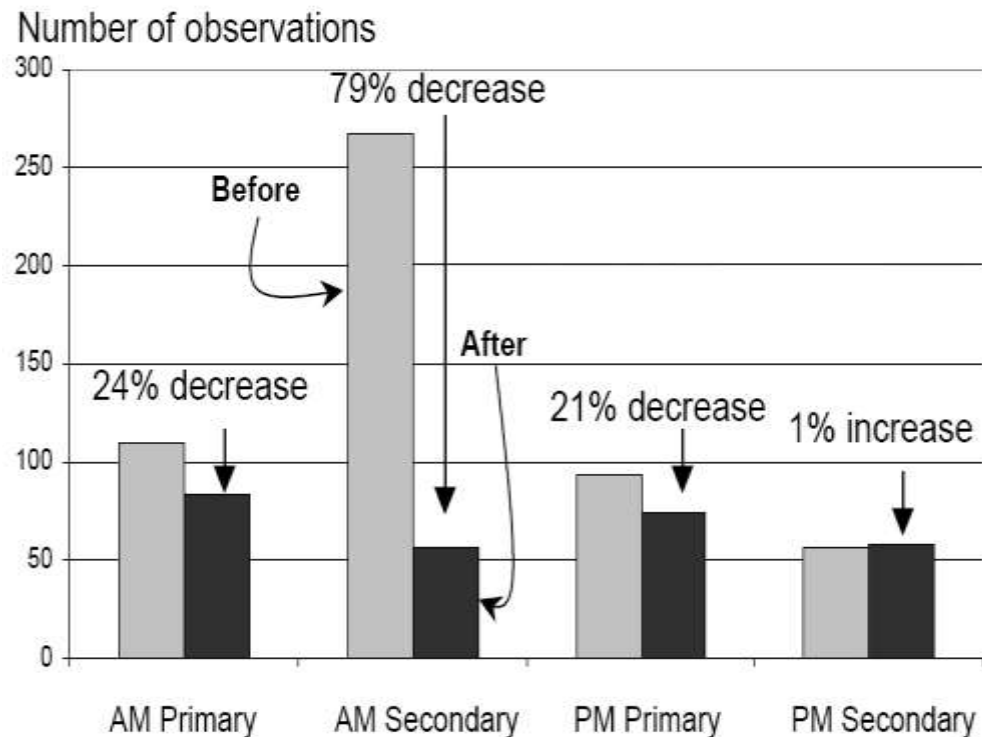
SR 167 at S. 212th St.

Before and After Ramp Meter Activation Analysis (2000) based on observation data

Primary conflicts: when either the merging Behind or the adjacent mainline vehicle brake to avoid each other.

Secondary conflicts: mainline drivers behind a primary conflict that also must brake.

Conflict Results at S 212th St. to NB SR 167

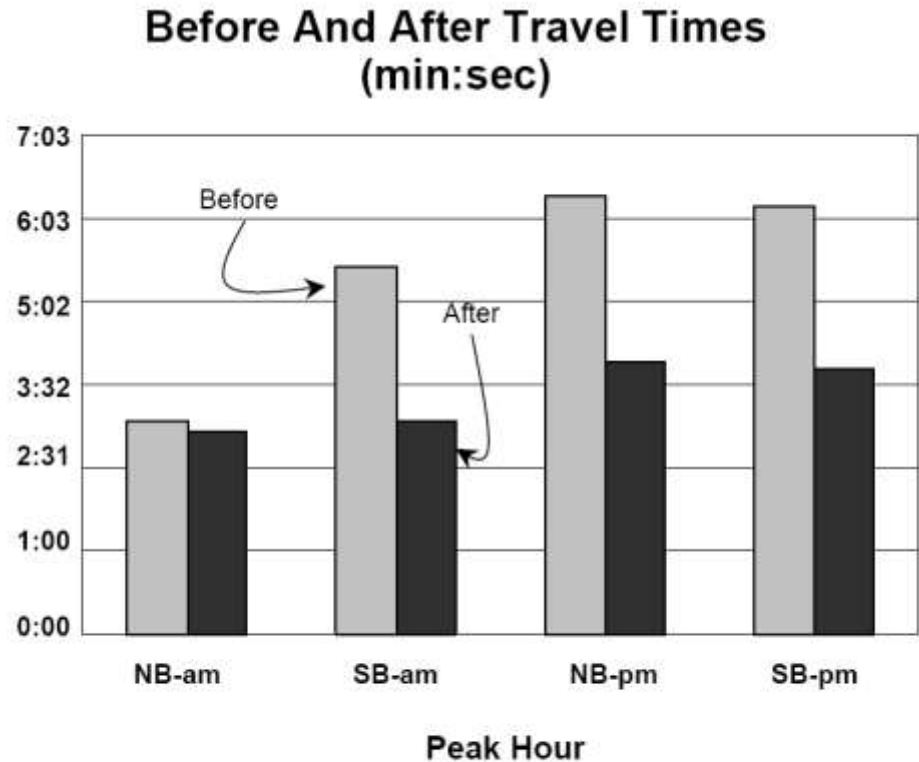


3. Signal Synchronization/Coordination: “Before and After” -using travel times

Before and After Study

Average vehicle travel times were reduced ranging from 16 seconds (NB AM peak period) to 2 minutes and 27 seconds (NB PM peak period).

Stated otherwise, travel times improved 41% for the SB morning commute, and 38% for the NB evening commute.



Study conducted by the City of Bothell on retiming traffic signals on SR 527 between 228th Street SE and SR 524.

3. Real Time Signal Coordination: Before and After Analysis SR 532

Project Need: Increased development and rise in population in Stanwood along SR 532

Project Limits: From 72nd Ave. to 102nd Ave. along SR 532

ADT: 20,000 vehicles per day

Project Cost: \$60,000

Solution: Signal improvements and coordination –Add video detection and connect signals to TMC in Shoreline to remotely adjust the signal timing to improve traffic flow.

Result: Immediate and significant travel time benefits

- Westbound travel time savings – 6 minutes
- Eastbound travel time savings – 2 minutes

Location of SR 532 Signal Improvements



Signal Improvements

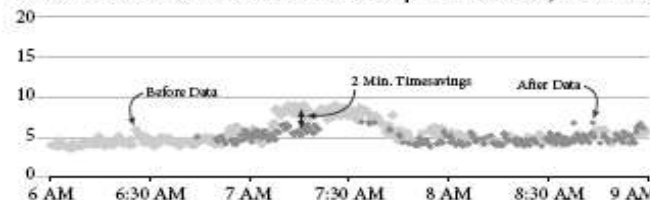
WSDOT interconnected and synchronized the signals to improve traffic flow through the city of Stanwood. Newly added electronic traffic detection devices and five cameras provide up-to-the-minute information on the WSDOT website.

Data Source: WSDOT Northwest Region.

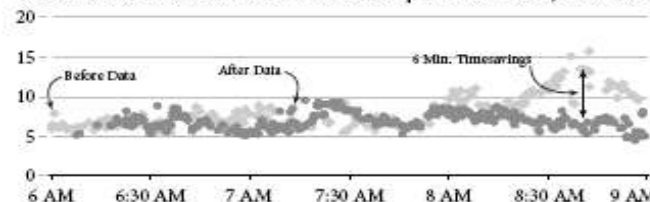
SR 532 Before and After Travel Times

Travel Times in Minutes by Time of Day

Eastbound SR 532 A.M. Travel Times at Mileposts 3.05 to 5.9, 2.85 Miles



Westbound SR 532 P.M. Travel Times at Mileposts 6.83 to 3.7, 3.13 Miles



Data Source: WSDOT Northwest Region.

4. Variable Message Signs: Real-time information



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Reliable Travel Times

text size: T T T

Local Traffic Info

- [Puget Sound Traffic Cameras](#)
- [Traffic Conditions](#)
- [Incidents](#)
- [Travel Times](#)
- [Local Construction](#)
- [Map Archive](#)

WSDOT - 95% Reliable Travel Times

Where are you starting from ?

Issaquah

Where are you going ?

Belleuve

What time do you need to get there?

8

 :

00

AM

Submit

Your 95% Reliable Travel Time is **26** minutes. 95% of the time you would need to leave at **7:34 AM** to arrive by 9:00 AM.

[View route detail](#)

Calculate Your Commute - This feature uses travel time data to provide a reasonable approximation of the "worst case" travel time scenario. By allowing for the calculated travel time, commuters can expect to arrive at the end of the route, on time, 19 out of 20 working days a month (95 percent of trips). These travel times are based on weekday travel time data for 2006. This data is updated annually in late summer or early autumn with data from the previous year. You may also want to view the chart displaying [current travel times](#)

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Seattle Area Travel Times

Seattle Traffic

Travel times as of 10:00 A.M. Wednesday, November 26, 2008

State Route/ Interstate	Route Description	Distance (miles)	Average Travel Time (minutes)	Current Travel Time (minutes)	Via HOV (min.)
	Auburn to Renton	9.8	19	11	10
	Bellevue to Bothell	9.7	11	10	10
	Bellevue to Everett	22.6	26	23	23
	Bellevue to Federal Way	24.7	29	28	26
	Bellevue to Issaquah	9.5	10	11	10
	Bellevue to Lynnwood	14.9	15	15	16
	Bellevue to Redmond	6.9	9	8	8
	Bellevue to Renton	11.2	13	13	11
	Bellevue to Seattle	10.4	14	12	12
	Via Westbound Express Lanes	10.4	14	13	13
	Bellevue to Seattle	10.2	14	13	13
	Bellevue to Tukwila	13.3	17	17	14
	Bothell to Bellevue	9.9	15	10	10
	Everett to	21.1	27	24	24

State Travel Info

Travel Alerts & Slowdowns

Mountain Passes



4. Variable Message Signs: Difficult to Measure Effectiveness



2005 Pilot Project (now permanent):
WSDOT activated four signs in the greater Seattle area and one sign at the U.S./Canada Peace Arch border crossing.)

Qualitative Measure

“Compliment! ...I also heard this morning on the news that it was a pilot program. Please keep it going!! It was great. I think it's a great use of the signs. And to however the time was estimated - it was right on. Thanks again.”

Citizen comment

February 17, 2005

5. HOV Lanes: Reliability Standards

- Reliability Standards: 90% of the time, the HOV lane should be able to maintain an average speed of 45 mph or greater during the peak hour of the peak period
- 90% of time is a tough standard but good metric

HOV lane speed and reliability performance on major central Puget Sound corridors

2006-2010; Goal is to maintain 45 mph for 90% of peak hour

■ = Goal not met

Commute routes	2006	2007	2008	2009	2010
Morning peak direction commutes					
I-5, Everett to Seattle SB	35%	35%	60%	69%	61%
I-5, Federal Way to Seattle NB	47%	33%	67%	92%	86%
I-405, Lynnwood to Bellevue SB	70%	76%	92%	94%	92%
I-405, Tukwila to Bellevue NB	49%	31%	49%	99%	99%
I-90, Issaquah to Seattle WB	100%	99%	100%	96%	100%
SR 520, Redmond to Bellevue WB	97%	97%	99%	94%	94%
SR 167, Auburn to Renton NB ¹	99%	96%	99%	99%	100%
Evening peak direction commutes					
I-5, Seattle to Everett NB	54%	51%	64%	49%	55%
I-5, Seattle to Federal Way SB	46%	47%	57%	67%	77%
I-405, Bellevue to Lynnwood NB	69%	53%	58%	71%	77%
I-405, Bellevue to Tukwila SB	44%	30%	35%	70%	74%
I-90, Seattle to Issaquah EB	100%	100%	100%	95%	99%
SR 520, Redmond to Bellevue WB	61%	59%	68%	71%	61%
SR 167, Renton to Auburn SB ¹	93%	91%	98%	99%	99%

Data source: Washington State Transportation Center (TRAC).

Notes: HOV reliability performance standards are based on the peak hour, the one-hour period during each peak period when average travel time is slowest. To meet the standard, a speed of 45 mph must be maintained for 90% of the peak hour. Numbers represent the percentage of the peak hour when speeds are above 45 mph.

TRAC analyzes performance data for all complete segments of HOV lanes that have a loop detector. In some cases, data is not analyzed for the very beginning and ends of the lanes because there are no detectors at the very beginnings and ends of the HOV lanes.

NB = Northbound; SB = Southbound; EB = Eastbound; WB = Westbound
1 HOT lanes replaced regular HOV lanes on May 3, 2008.

6. Suggested Measures for Work Zone Traffic Management

- Number of work zones by type of activity
- Number of miles lost
- Lane-mile-hours of work zones
- Average work zone duration by work zone type by lanes lost
- Average time between rehabilitation activities
- Average number of days projects completed late
- Ratio of inactive days to active days

Source: Brydia, Background development and concept of operations for a real-time performance measurement monitoring system.

7. Active Traffic Management: SR 167 HOT Lanes Pilot Project – Before and After Analysis

Project Overview: On May 3, 2008, Washington State converted an existing high occupancy vehicle (HOV) lane to a high occupancy toll (HOT) lane on State Route 167. This conversion allows solo drivers to use the lane by paying an electronic toll.

Project Limits: SR 167 between Auburn and Renton

Performance Update: The SR 167 HOT Lanes Pilot Project is successfully demonstrating that variable tolling can make better use of existing carpool lanes and improve traffic flow.

Performance Metrics (Speed and Volume):

Since project implementation, peak-period, peak-direction traffic speeds and volumes have increased in both the general purpose and HOT lanes.

General Purpose Lanes:

- Average speeds increased by **21.5%** (from 40.5 to 49.3 mph)
- Average volumes increased by **11%**

HOT Lanes:

- Average speeds increased by **6%** (from 57 to 61 mph)
- Average volumes increased by **4%** northbound
- Average volumes are stable southbound



7. Active Traffic Management (ATM) aka Smarter Highways – How to measure performance?



[Video of ATM in action...](#)

- Variable message signs
 - Traffic cameras
 - Variable speed limits
 - Lane control
 - Automatic, instant traffic information
 - Traffic Management Centers
-
- Signs every half mile warn of slower traffic and blocked lanes ahead to prevent collisions that cause at least 25% of congestion.
 - Information instills trust; trust means compliance, keeping drivers safe
 - Making highways safer and more efficient

8. Suggested Measures for Operational Effectiveness

- Percent of freeway directional miles with traffic sensors, surveillance cameras, DMS, service patrol coverage
- Percent of equipment (DMS, surveillance cameras, traffic sensors, ramp meters, RWIS) in good or better condition
- Percent of total device days out-of-service (by type of device)

Source: NCHRP 3-68: Guide to Effective Freeway Performance Measurement

9. Measuring Arterial Performance Measures

- Researchers at Portland State University proposed metrics such as traffic density, total delay, predicted travel time, and signal coordination effectiveness.
- Minnesota DOT worked in collaboration with University of Minnesota to develop a Real-Time Arterial Performance Monitoring Using Traffic Data from Existing Signal Systems called **SMART-SIGNAL** (Systematic Monitoring of Arterial Road Traffic Signals) system.
- Researchers at Washington State Transportation Center (TRAC) and StarLab at University of Washington are developing methodologies to capture arterial performance based on archived and real time data.
- Real time data archival systems like PeMS have a capability of using the link-based, point sensors, signal phases to relay link travel times, control delay estimations, GIS map display to show flow, density, and average speed.

Resources

Ausfahrt

- **Moving Washington Website:** <http://www.wsdot.wa.gov/movingwashington/>
- **WSDOT's Congestion Website:** <http://www.wsdot.wa.gov/Congestion/>
- **WSDOT's Annual Congestion Report:** http://www.wsdot.wa.gov/NR/rdonlyres/49910195-CB08-4FE9-AFAD-6D543C0F2FCC/0/2011_Congestion_Report.pdf
- **WSDOT's Accountability Website:** <http://www.wsdot.wa.gov/accountability/>
- **Real Time Travel Times Website:** <http://www.wsdot.wa.gov/traffic/seattle/traveltimes/>
- **Plan Your Commute– 95% Reliable Travel Times Website:**
<http://www.wsdot.wa.gov/Traffic/Seattle/TravelTimes/reliability/>
- **WSDOT's quarterly performance report: the *Gray Notebook*:**
<http://www.wsdot.wa.gov/Accountability/GrayNotebook/navigateGNB.htm>
- **Performance Measurement at WSDOT, four page folio**
http://www.wsdot.wa.gov/NR/rdonlyres/91089378-E709-49EF-AE42-AE80BC44A91C/0/TRB_Performance_Folio.pdf
- **WSDOT's Strategic Plan:** <http://www.wsdot.wa.gov/accountability/publications/StrategicPlanWEB.pdf>
- **Performance Journalism:** http://www.wsdot.wa.gov/NR/rdonlyres/685F6B37-9082-47DE-81FC-676EE95C5EE9/0/Bridging_Gap_PJ_TRBprintedvsn.pdf
- ***Making the Case for Funding: The WSDOT Experience*** (2008, Transportation Research Record)
http://www.wsdot.wa.gov/NR/rdonlyres/E5D34B36-6662-4464-B4BA-1E858BBD710D/0/2007_TRB_Making_Case_Funding.pdf
- ***Maximizing Highway System Capacity: Measuring and Communicating System Performance in an Evolving Field***–(2008, Transportation Research Forum) http://www.wsdot.wa.gov/NR/rdonlyres/464B9718-C441-470E-9E83-C9F0D3F1D238/0/2007_TRB_Measuring_System_Performance.pdf

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