A Tutorial on Establishing Effective Work Zone Performance Measures

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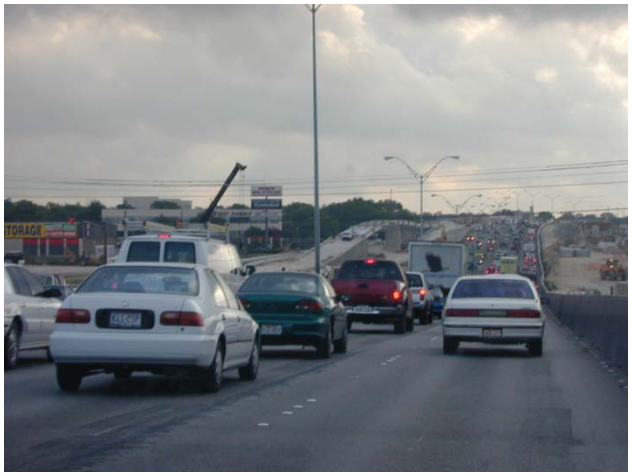
What is Work Zone Performance Measurement?

- Determining progress or level of attainment towards specific defined agency objectives regarding:
  - Safety
  - Mobility
  - Customer satisfaction
  - Agency/contractor efficiency and quality
- Evidence based

Why are Work Zone Performance Measures Important and Useful?

- Quantifies work zone impacts
  - Effects on motorists
  - Actions taken to mitigate impacts
  - Effects of actions taken



Why are Work Zone Performance Measures Important and Useful?

- Guides investment decisions, policy development, and program priorities
  - Identify trends
  - Refine policies and procedures
  - Emphasize accountability

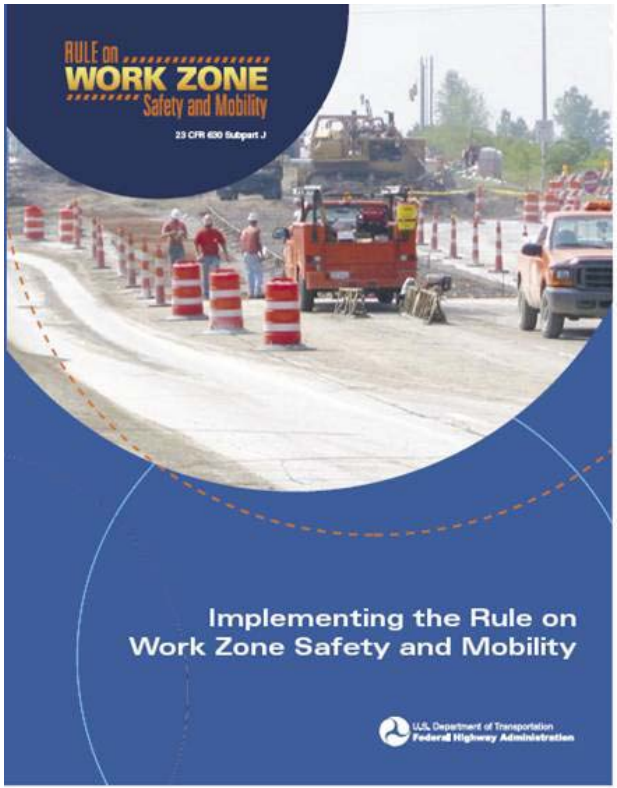
Why are Work Zone Performance Measures Important and Useful?

- Assists in communication and outreach
  - Aids agencies in "telling their story"
  - Facilitates better public understanding and acceptance
  - Ensures that elected officials have correct information

WZ Rule: WZ Data and PMs

- Rule Goal: Better understand and manage WZ impacts
- Related Provisions:
  - Impacts Assessment
  - Use of Data
  - Process Reviews

➢ Move practice forward



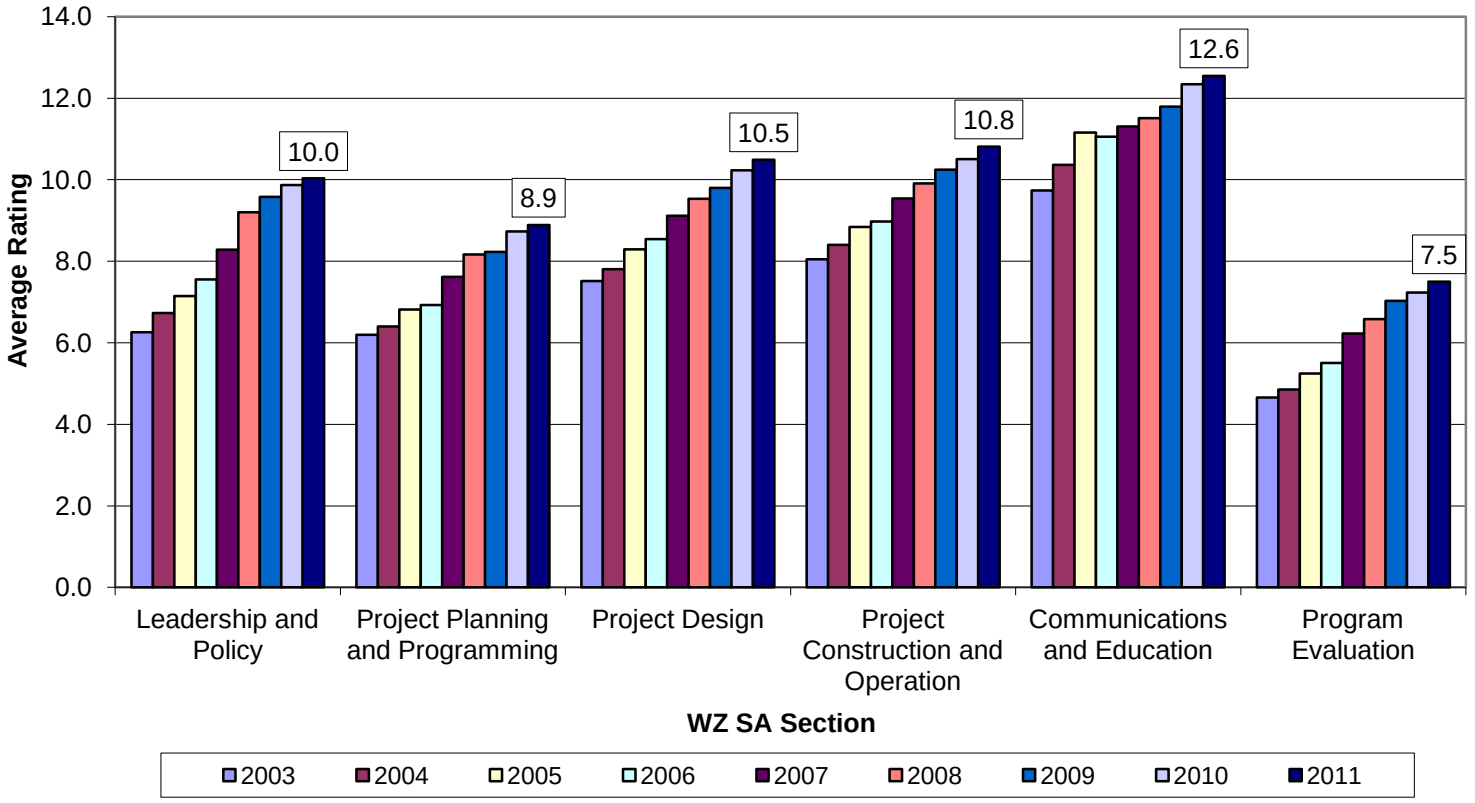
RULE on WORK ZONE Safety and Mobility

WZ Rule Data Provisions

- Requires agencies to use WZ data at both the *project* and *process-levels* to manage and improve work zone safety and mobility
  - *Project level: Improvements while projects are underway*
  - *Process level: Broad improvements over time*
- Recommends that agencies maintain data and information resources to support the use of WZ data for the above activities

Work Zone Performance Nationally: Work Zone Self Assessment

- Done annually since 2003
- 10.3 average (0 to 15 scale)



Challenges in Measuring Work Zone Performance

- Defining objectives that are:
  - Acceptable
  - Realistic
  - Useful
- Identifying and obtaining useful data
- Allocating sufficient resources (staff and money)

Work Zone Performance Measurement Myths

- "Measurements must be obtained for all work zones"
  - Reality: It may be only necessary to monitor a set of key work zones
- "Measurements must be continuous at the work zones that are monitored"
  - Reality: It may only be necessary to obtain a few key measurements during the right times and at the right locations in a work zone

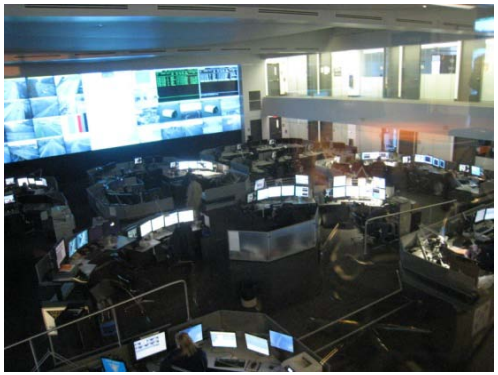
Work Zone Performance Measurement Myths

- "A lot of time and money must be spent on data collection"
  - Reality: Depending on project characteristics, low-cost data collection methods may be available and appropriate

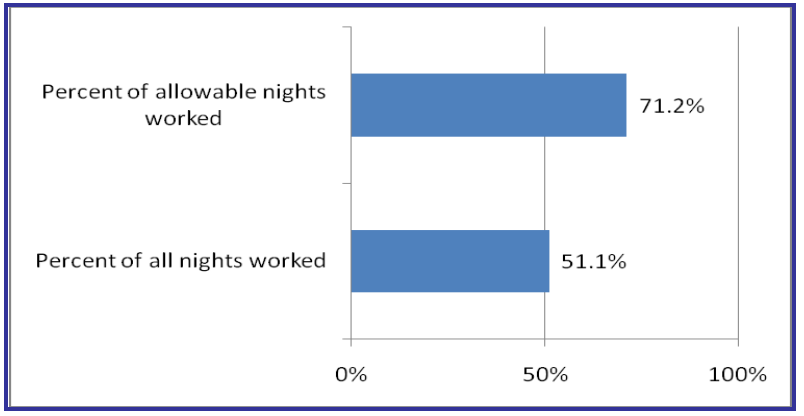
Work Zone Performance Measurement Myths

- "A lot of time and money must be spent on data collection"
  - Reality: depending on project characteristics and agency goals, low-cost data collection methods may be available and appropriate

Work zone performance measurement is simply a tool that can help an agency accomplish its mission more effectively



Making Work Zone Performance Measurement Happen in your Agency

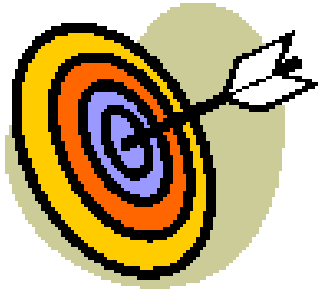


Key Steps

1. Identify and engage stakeholders
2. Select appropriate measures
3. Identify available data sources
4. Define analysis requirements
5. Assign roles and responsibilities
6. Define methods for disseminating results
7. Periodically review and refine measures

1. Identify and Engage Stakeholders to Define:

- Needs for performance measures
- Performance goals or targets (based on policy and procedures)
- Performance measurement "champions"



2. Select the Measures

- Base on the performance goals or targets identified
- Keep to a manageable number
- Consider data needs
- Start simple, refine and expand as needs and uses dictate

Measures to consider

- Exposure
  - Vehicle exposure
  - Work activity exposure
- Safety
  - Crashes or accidents
  - Safety surrogates
- Mobility
  - Queues
  - Travel times or delays
  - Travel time reliability
  - Agency ratings
  - Customer complaints or ratings

3. Identify Data Needs and Sources

- Exposure data
  - Project plans
  - Agency construction management database
  - Inspector diaries
  - Lane closure request databases
  - Automatic traffic recorder (ATR) counts
  - Planning division AADT estimates
  - Manual counts
  - Real-time electronic traffic surveillance data
- Safety data
  - Statewide crash database
  - Agency collected work zone crash data
  - Occupational safety records
  - Agency field reviews
  - Service patrol or EMS dispatch logs

3. Identify Data Sources (cont'd)

- Mobility data
  - Electronic traffic surveillance technologies
  - Observations and documentation of queues by field personnel or transportation management center operations staff
  - Travel time runs by staff or interns
  - Agency inspection scores
  - Customer survey responses
  - Customer complaint files

Electronic Traffic Surveillance Sources

- Point measurements of speed, volume
  - Existing transportation management system spot sensors
  - Work zone ITS deployments
  - Portable traffic monitoring devices
- Point-to-point travel times
  - Automatic vehicle location, identification systems
  - License-plate recognition systems
  - Cellular telephone signal tracking
  - Bluetooth
  - Purchase of private-sector data

Manual Documentation of Queues

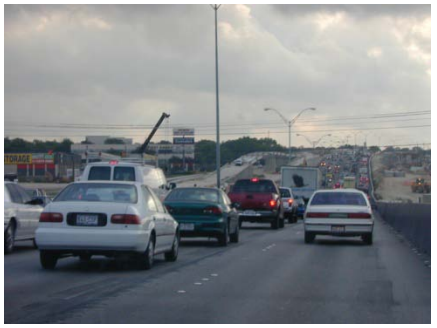
Project: _____

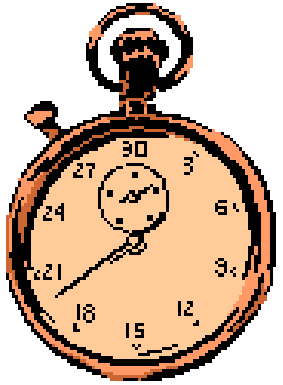
Date	Times of Work Activity				Times of Work Activity with Lane Closures					Queuing During Work Activity with Lane Closures							
	Time Begin	Time End	Dir of Travel	Loc of Work	Time Begin	Time End	Dir of Travel	Loc of Clo-sure	# Lns Clsd	Time Q Starts	Time Q Ends	Q Lngth Hr 1	Q Lngth Hr 2	Q Lngth Hr 3	Q Lngth Hr 4	Q Lngth Hr 5	Q Lngth Hr 6

Notes:
Estimates of queue lengths approximately every hour are desired. However, the time can be adjusted slightly as necessary, as long as the reporting time is noted.
Locations of work and lane closures can be noted using mile markers, stations, etc.

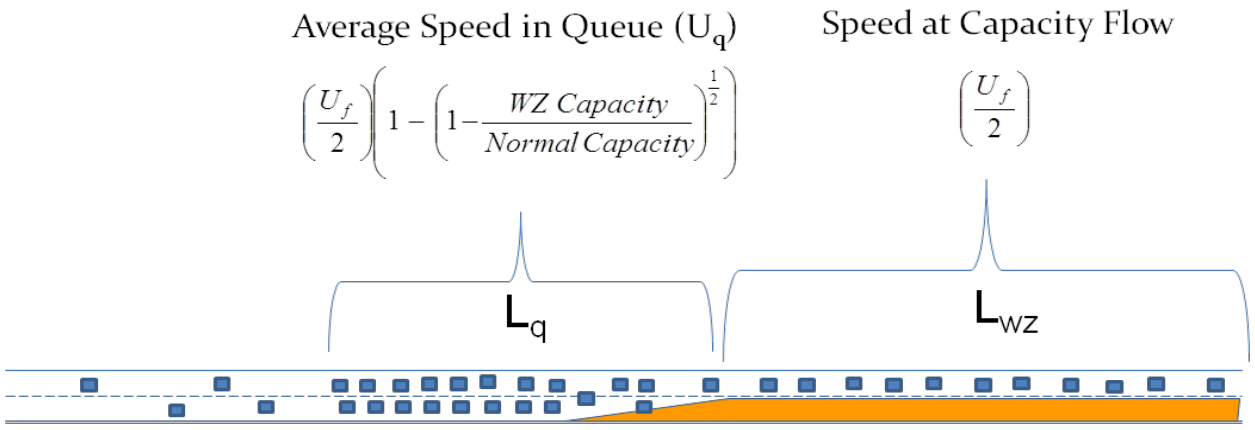
4. Define Analysis Requirements

- Estimating travel times and delays from queue length documentation
- Estimating queue lengths from spot sensor data





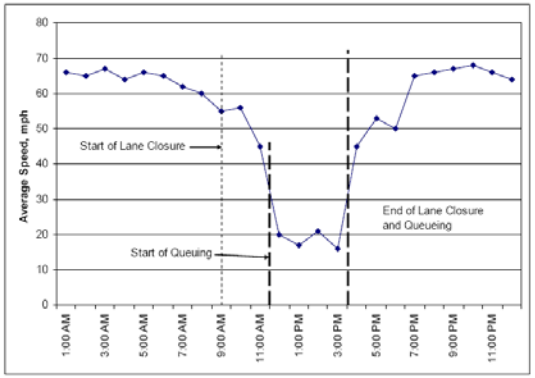
Travel Times from Queue Lengths

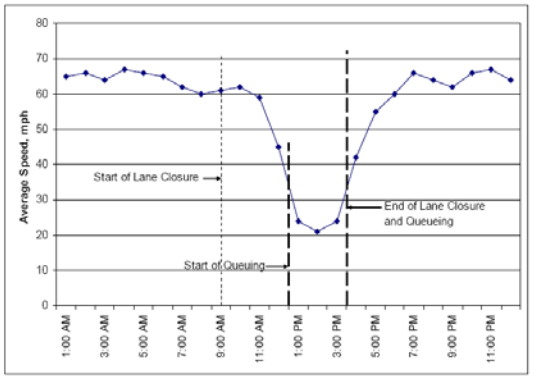


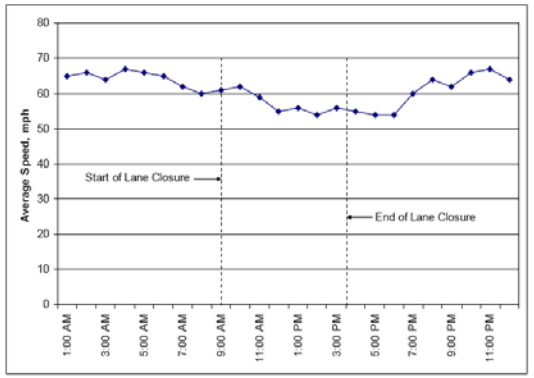
- Notes:
  - Appropriate only if pre-work zone conditions do not experience queues
  - Other speed/density/flow relationships could be assumed

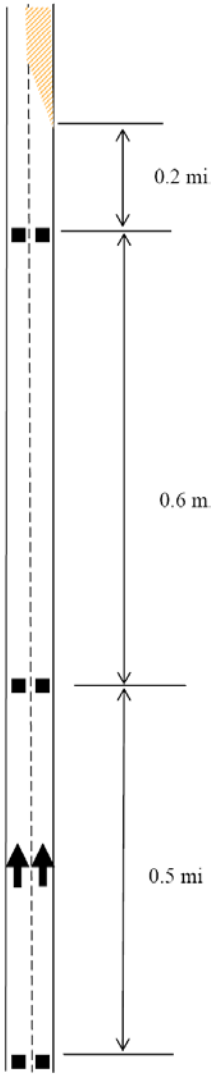
Queues from Spot Speed Sensors

- Steps:
  - Divide roadway into segments of uniform speed
  - Examine speeds and volumes hour-by-hour
  - Compare speeds across sensors
  - Sum regions where speeds are below thresholds
  - Compute individual and vehicle-hours of delay









5. Assign Roles and Responsibilities

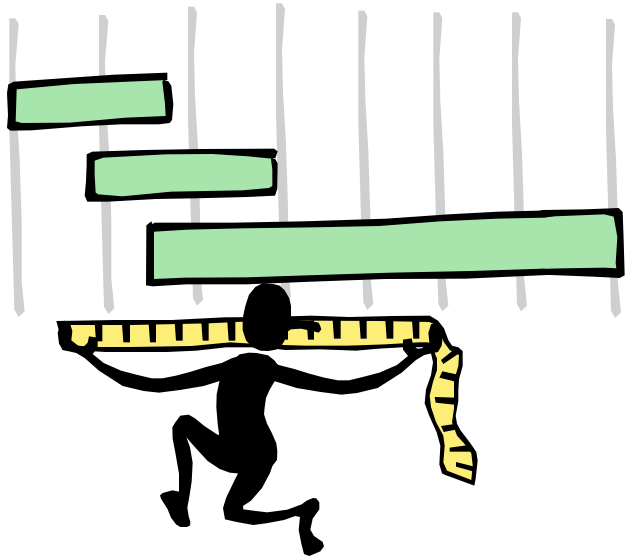
- Data collection
- Analysis
- Decision-making
- Dissemination

6. Define Methods for Disseminating Results

- Consider key users
  - Technical managers and decision makers
  - Public and political leaders
- Tailor messages to each user group as appropriate

7. Review and Refine Measures

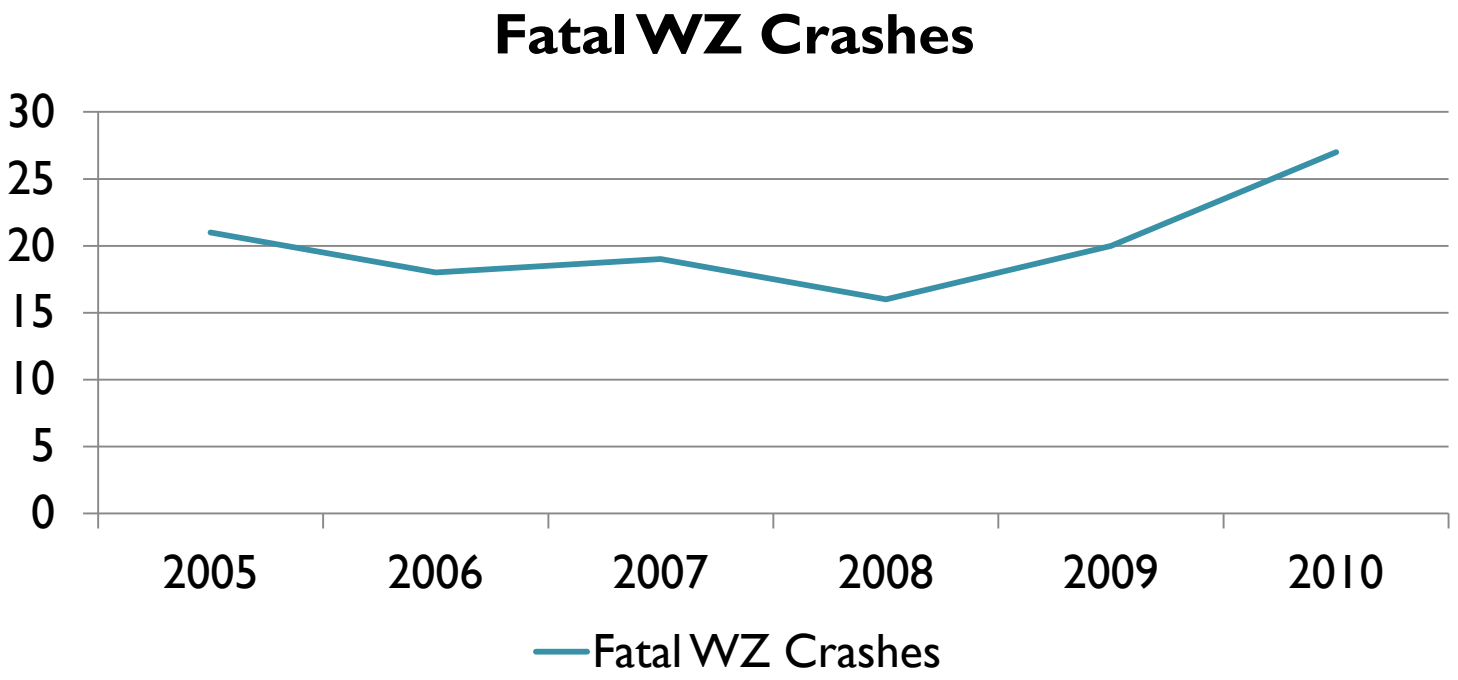
- Key questions:
  - Do measures aid in evaluating progress?
  - Do measures point to changes that may be needed in policies or procedures?



Work Zone Performance Measurement – Getting Started

One Example…

- An agency currently reviews its total fatal work zone crashes each year



The Agency Selects a Measure:

- Change in severe (injury + fatal) crash rates from pre-work zone conditions
  - Initial focus will be on freeway work zones
  - Each of 4 districts to evaluate two of its work zones annually

Results

District	Severe Crash Rate Before	Severe Crash Rate After	Change
1	2.7/100 mvm 4.6/ 100 mvm	3.5/100 mvm 4.3/100 mvm	+30% -7%
2	1.2/100 mvm 1.5/100 mvm	1.3/100 mvm 2.5/100 mvm	+8% +67%
3	1.7/100 mvm 0.9/100 mvm	2.4/100 mvm 1.9/100 mvm	+41% +111%
4	3.1/100 mvm 1.6/100 mvm	3.0/100 mvm 2.1/100 mvm	-3% +31%

- Observations made by the agency
  - Rates do trend higher
  - Increases are highly variable
- Agency performs detailed analysis of projects
  - Project durations and volumes vary widely
  - Identifies some good practices, issues to address

They also modify their analysis methodology…

Crash Analysis Results the Following Year

District	Severe Crashes Expected[a]	Severe Crashes That Occurred	Difference
1	3.6 19.1	5 26	+1.4 +6.9
2	1.1 10.4	0 12	-1.1 +1.6
3	35.4 4.9	48 3	+12.6 -1.9
4	26.6 3.2	40 4	+13.4 +0.8
Overall	104.3	138	+33.7 (+32%)

[a] Expected crashes computed using Highway Safety Manual approach

Another Example…

- An agency has adopted a policy that no work zones will create more than a 15-minute delay for motorists
  - 9 complaints per month from motorists
  - Are delays occurring, and are they greater than 15 minutes?
- Institute procedures for inspectors to document all queues that occur and estimate delays

Results (out of 31 projects)

Inspector	Queues	Per Vehicle Delay	Total Delay
1	5 days Length: Ave = 0.4 miles, Max = 3.1 mi Duration: Ave = 2.1 hrs, Max = 4 hrs	Ave = 7.6 min Max = 58.9 min	2394 veh-hrs
2	1 day Length: ave = 1.4 miles, max = 1.8 mi Duration: 1.5 hrs	Ave = 2.0 min Max = 2.8 min	75 veh-hrs
3	15 days Length: Ave = 0.8 miles, max = 1.2 mi Duration: Ave = 1.5 hrs, Max = 2.0 hrs	Ave = 1.4 min Max = 2.1 min	840 veh-hrs

Observations

- Impacts being observed at a small (< 10 %) number of projects
- Unclear how many motorists are being excessively delayed
- Adjust monitoring to determine % of vehicles experiencing greater than 15 minutes of delay

Recomputed Results …

Inspector	Queues (Speeds < 35 mph)	Per Vehicle Delay	% Vehicles with > 15 min Delay	Total Delay
1	5 days Length: Ave = 1.4 mi Max = 3.1 mi Duration: Ave = 2.1 hrs Max = 4 hrs	Ave = 7.6 min Max = 58.9 min	1.2 % of total ADT 15.1 % of queued vehicles	2394 veh-hrs

- Next steps taken:
  - Interns are hired to assist in traffic monitoring (requested by project engineers)
  - Requirement to document queues is extended to the maintenance section
  - Percent of projects that exceed agency delay threshold is added to dashboard metrics on agency website

A Final Example

- The director of an agency assigns the traffic operations division to establish a work zone performance measurement program…

1. Identify and Engage Stakeholders

- Key agency staff
  - Division staff
  - District engineers
  - Public information office
  - Project design division
- Performance targets
  - Vehicle delays < 15 min
  - 85% of users who encounter a delay warned in advance
  - Crashes no more than 20% greater than expected without a work zone present

2. Select Appropriate Measures

- Individual vehicle delays during hours of delay
- Percent of customers indicating awareness of when and where delays were going to occur
- Ratio of actual severe crashes to expected crashes

3. Identify Data Sources

- Project designers:
  - identify any projects with peak-hour volume-to-capacity > than 0.9
- Interns:
  - conduct peak-hour travel time studies at projects after each phase change
- Inspectors:
  - document queues during any short-term lane closures in Districts

3. Identify Data Sources (cont'd)

- University:
  - conduct annual survey of customer opinions about work zones
- Statewide crash database to be used to evaluate 5 high-volume projects annually

4. Define Analysis Requirements

- Interns to gather and analyze project inspector data on queues monthly
- Interns compute delays based on queue data
- Safety division to provide expected crash frequencies at selected project locations (based on Highway Safety Manual procedures)
- University – customer survey analysis

5. Assign Roles and Responsibilities

- Division staff
  - Hiring and supervising interns
  - Coordinating information collection and analysis on key projects
  - Assessing implications of measures on agency policies and operations
- District engineers
  - Issue requirement regarding project inspector documentation of queues

5. Roles and Responsibilities (cont'd)

- Project design division staff
  - Identify key projects
- Safety division staff
  - Develop baseline crash frequencies
- Public information office
  - Creation of summary document for director
  - Posting results on agency website (dashboard)

6. Define Methods for Disseminating Results

- Executive summary document
  - Director, public officials
- Dashboard summary on website
  - General public
- Presentation of results at annual short course

7. Periodically Review and Refine Measures

- Revisit every two years as part of process assessment
- Stakeholders to meet to discuss need to expand or contract effort, identify additional information needs or issues to be examined

Resources

- A Primer on Work Zone Safety and Mobility Performance Measurement
- Work Zone Performance Measures Pilot Test
- Domestic Scan on Work Zone Assessment, Data Collection, and Performance Measurement

Available at
http://www.ops.fhwa.dot.gov/wz/decision_support/performance-development.htm

Questions?

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