

# *Predicting Travel Time Reliability for Projects: The SHRP2 Tools*

*presented to*  
Tennessee Model Users Group

*presented by*

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Think  Forward

# *What I'll Cover*

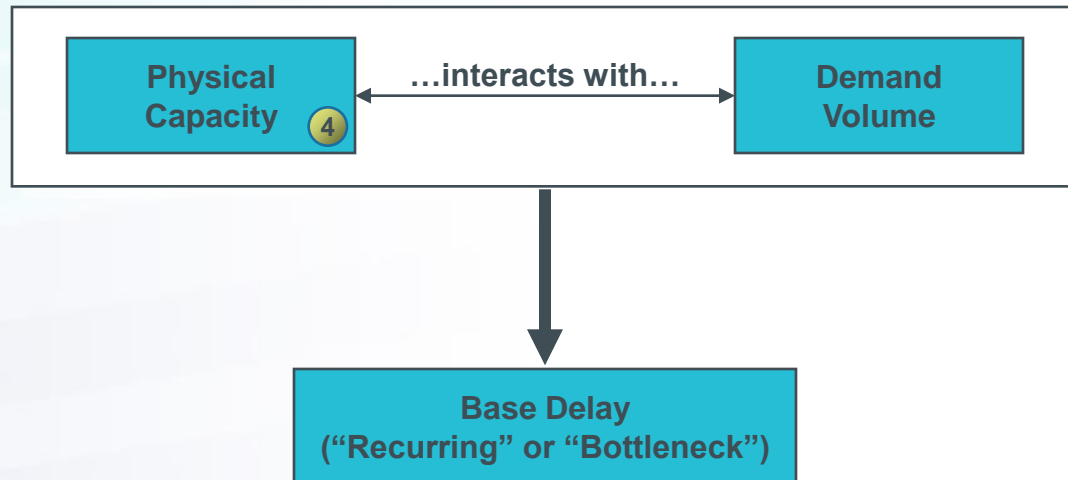
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- Definition of travel time reliability (TTR) and why it's important
- Forecasting reliability
  - » SHRP 2 products
  - » Example applications: Florida MPOs, Maryland SHA, and Knoxville TPO

# ***TRAVEL TIME RELIABILITY DEFINED***

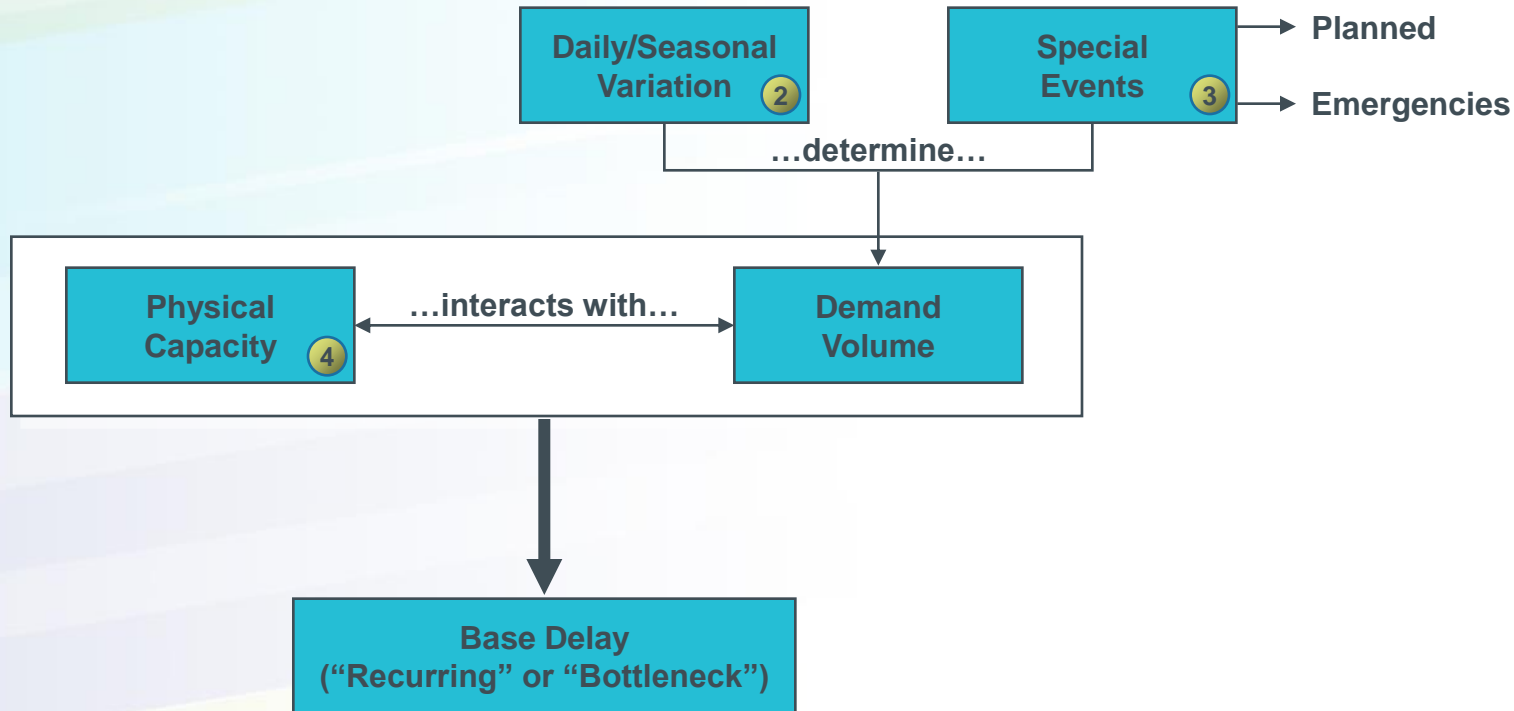
# *A Model of Congestion and Its Sources*

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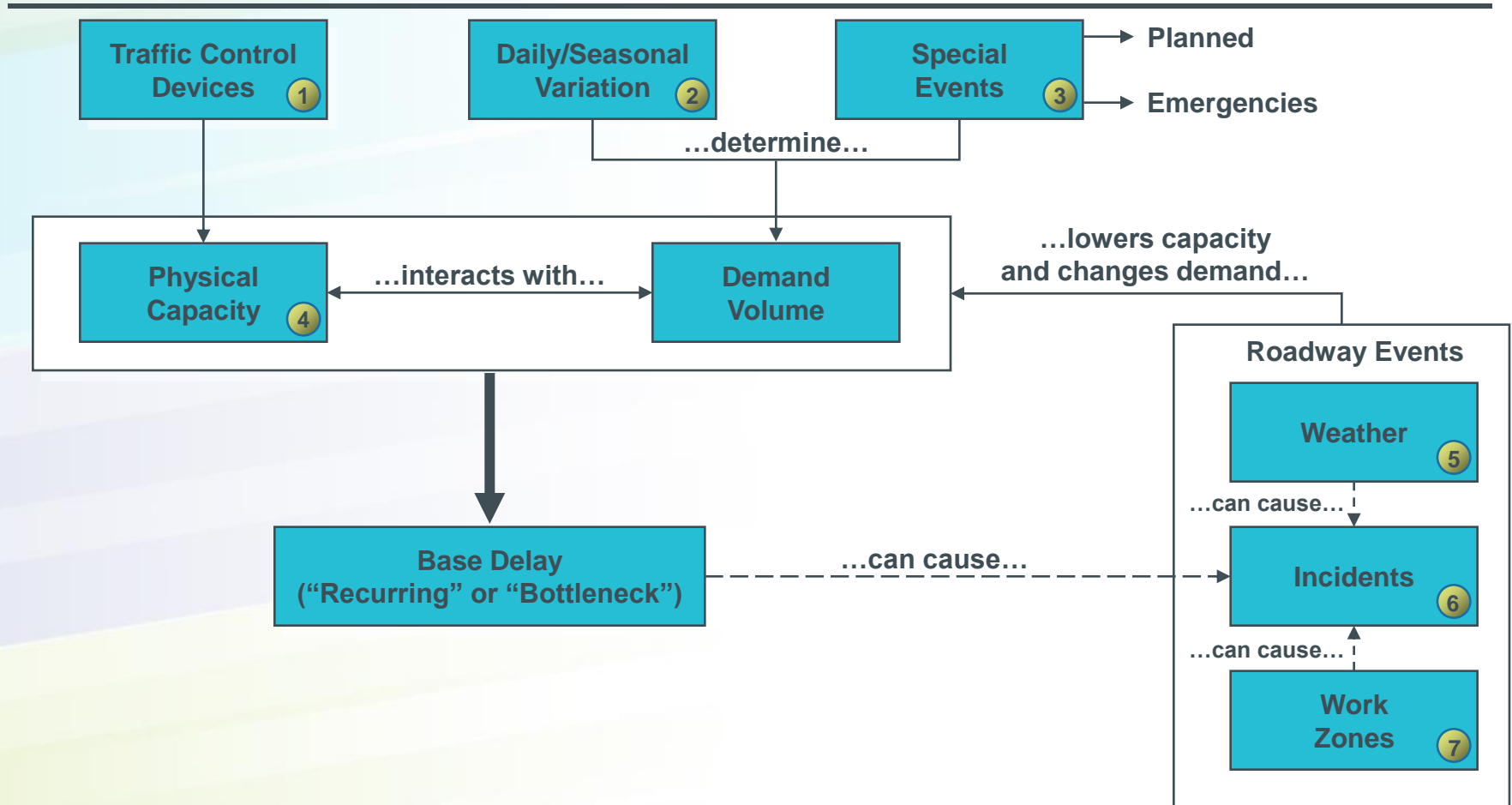
 = Source of Congestion

# *A Model of Congestion and Its Sources*



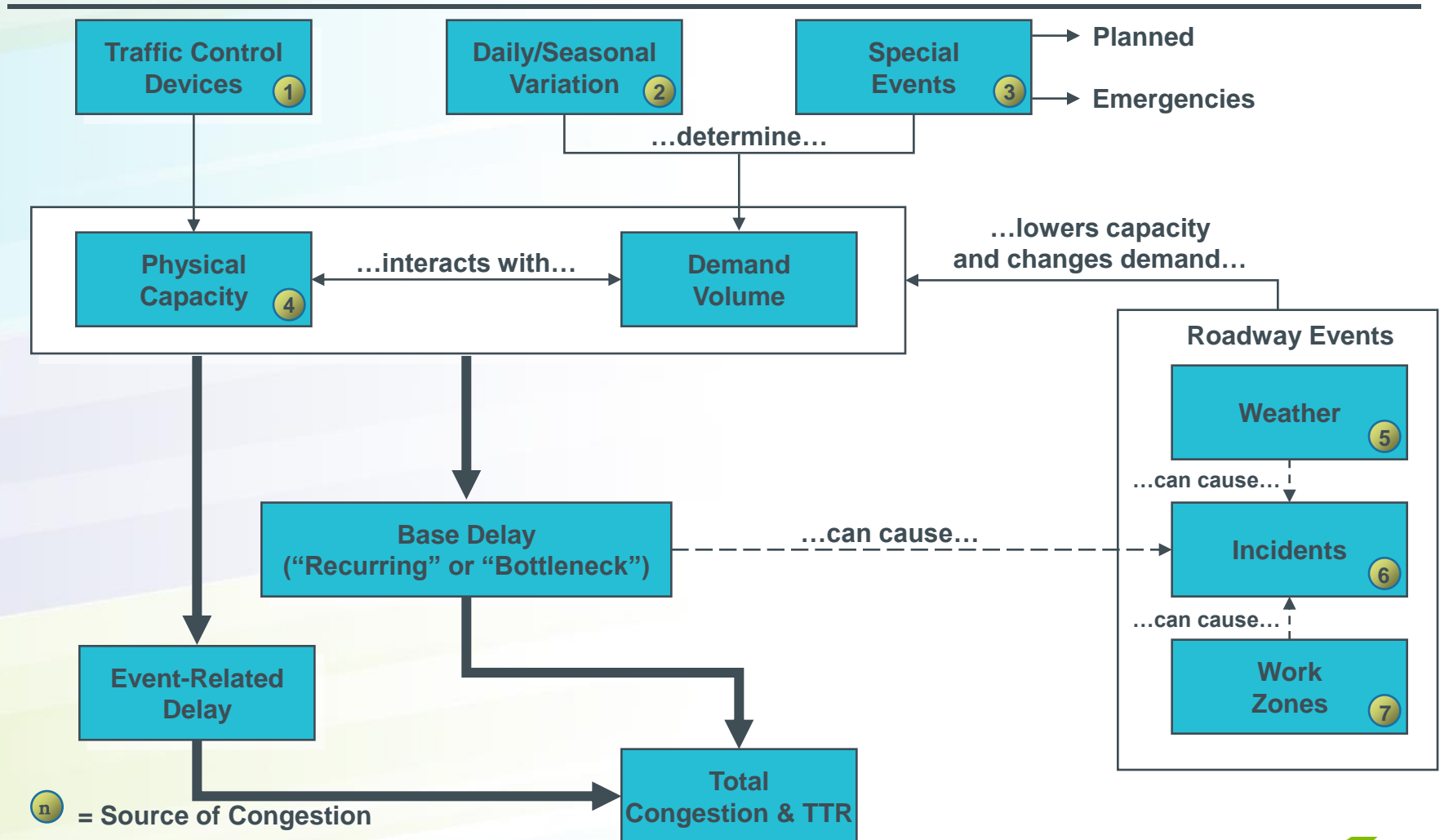
 = Source of Congestion

# *A Model of Congestion and Its Sources*



**n** = Source of Congestion

# A Model of Congestion and Its Sources



# *Travel Time Reliability*

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- Measured by how travel time of a trip varies over time (from day-to-day) for a specific time period (e.g., peak period)
- In other words, reliability is measured as the variability of travel times
  - » “How long will my trip take today compared to the same trip at the same time on any average day?”
  - » ... this implies ...
  - » Travelers should have the ability to predict travel time for a trip and to arrive at destination within an “on-time window”



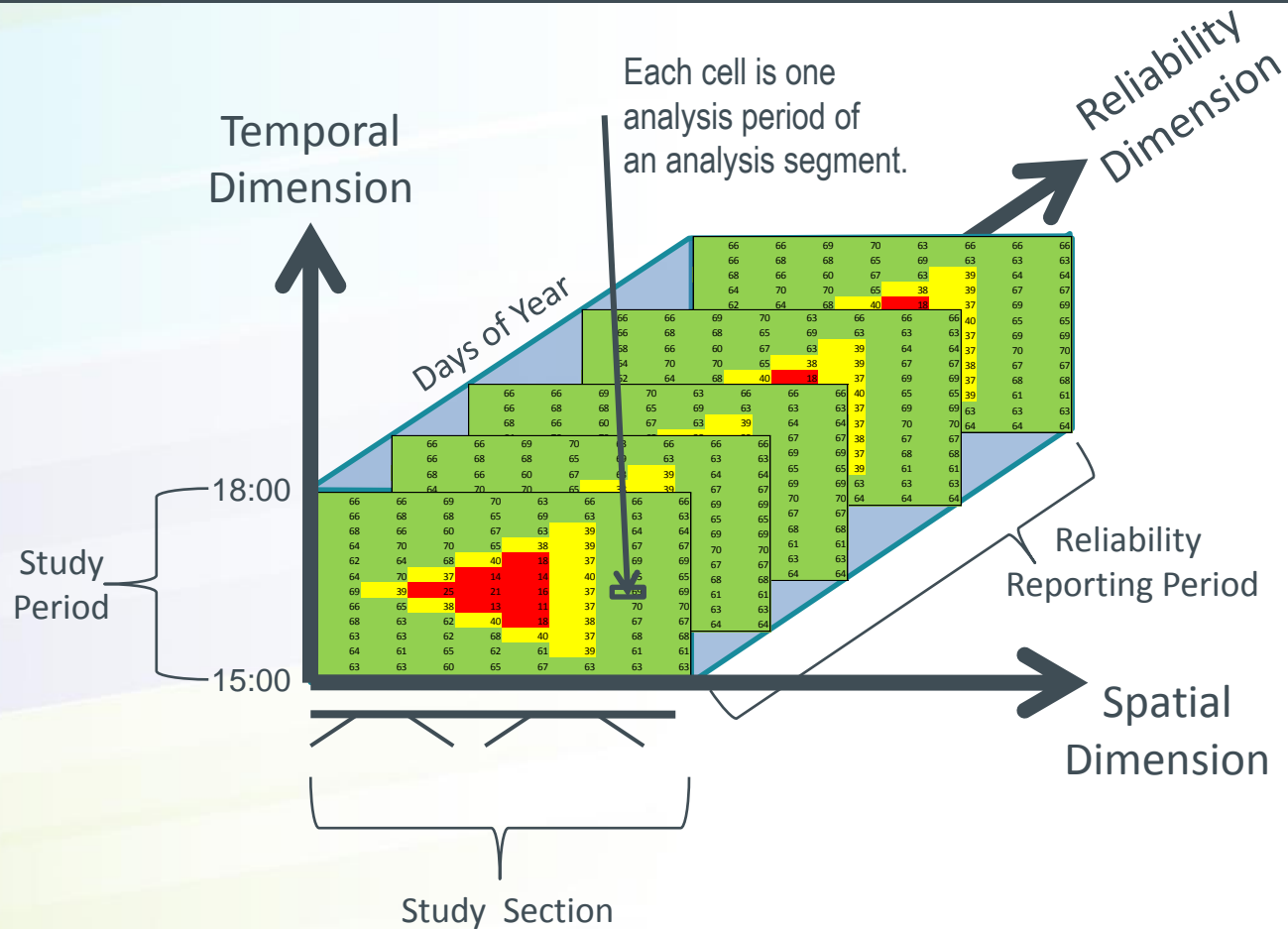
# Why Is Reliability Important?

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- Planning for unreliable travel has costs for users
  - » In the past we assumed only the average travel time for a trip was valued, ...but..
  - » Studies have shown that variability/unpredictability has cost too
    - VOR ~ 80% of VOT, higher for trucks
- Can be treated cost-effectively by addressing roadway “events” through operations strategies
  - » But any capacity increase or demand reduction will also improve reliability
- ***Considering reliability is basically analysis of the “full year” rather than the “perfect day” – it’s how facilities actually operate and what users actually experience***

# ***MEASURING RELIABILITY***

# Reliability in Concept

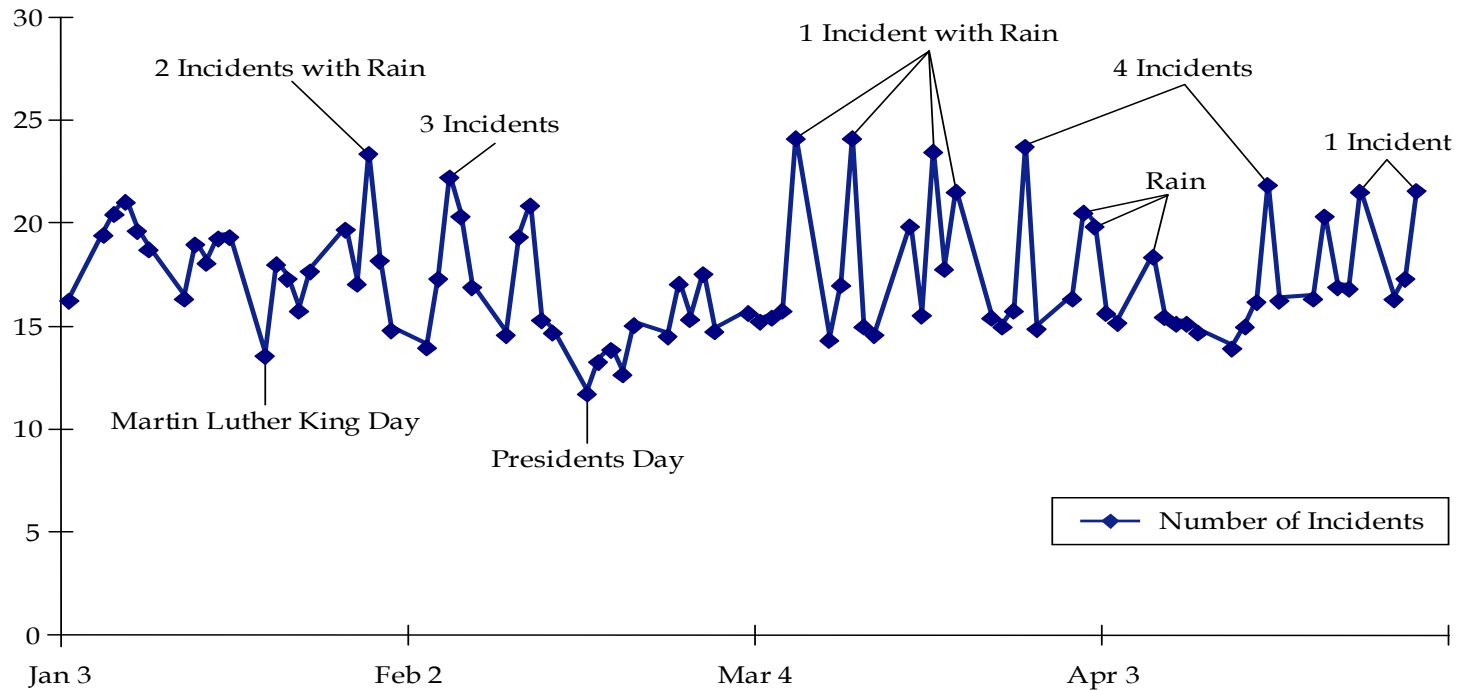


# Effects of Incidents and Weather

## Weekday Travel Times

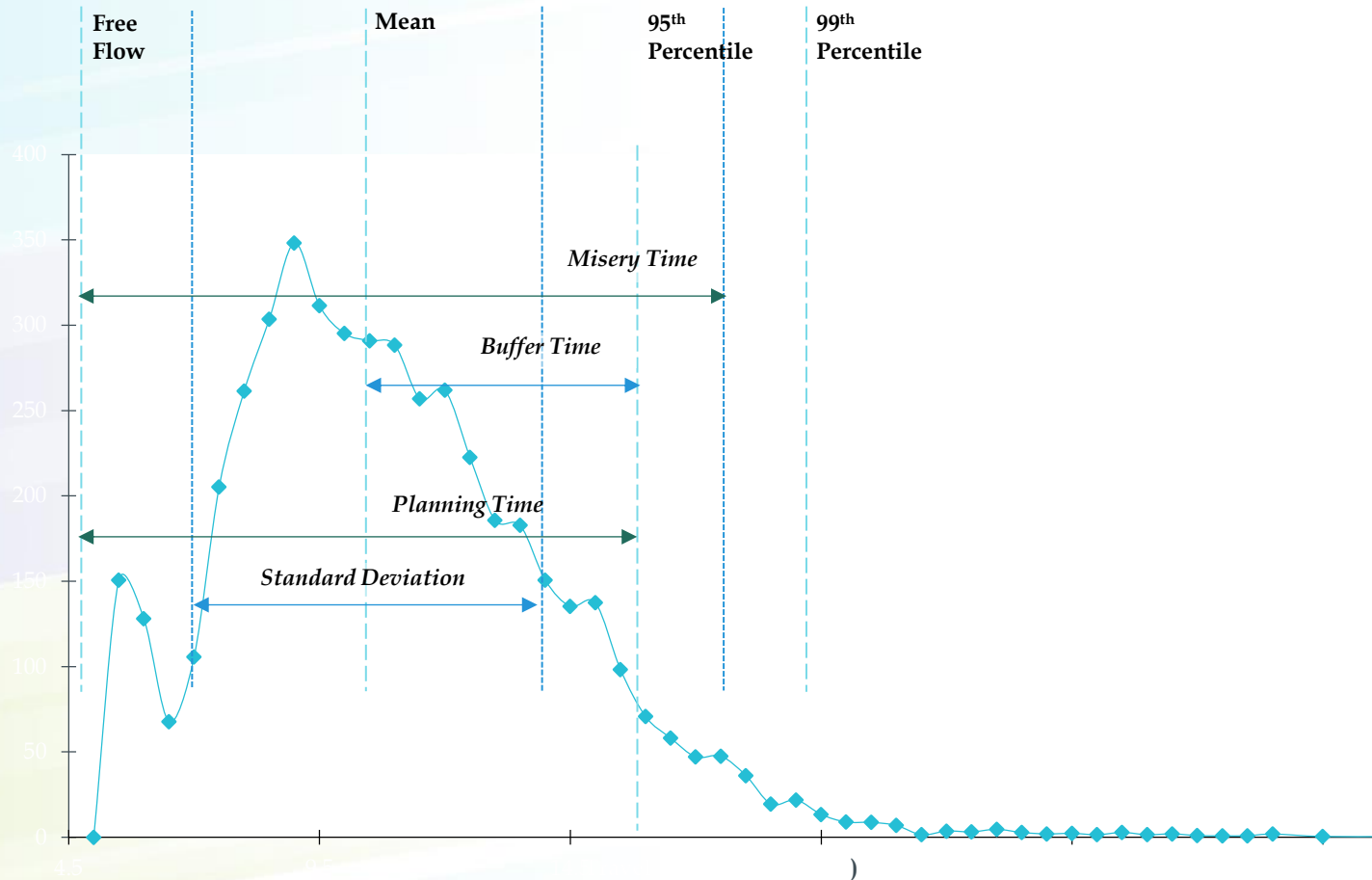
5:00-6:00 P.M., on State Route 520 Eastbound, Seattle, WA

Travel Time (in Minutes)



# Travel Time Distribution is the Basis for Reliability Performance Measures

Number of Trips  
(in Thousands)



# ***PREDICTING RELIABILITY***

## *Reliability Prediction: SHRP2 Tools*

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| <b>SHRP2 Project</b> | <b>Analysis Scale (in order of increasing complexity)</b>   |
|----------------------|---|
| <b>C11</b>           | <b>Sketch planning; system or project level</b>   |
| <b>L07</b>           | <b>Detailed sketch planning; mainly project level</b>   |
| <b>L08</b>           | <b>Facility analysis using HCM scale of analysis</b>  |
| <b>C10</b>           | <b>Regional planning using linked travel demand and mesoscopic simulation analysis</b>                |
| <b>L04</b>           | <b>Corridor planning using linked travel demand and mesoscopic or microscopic simulation analysis</b> |

# C11 Sketch Planning Tool

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## ➤ Original Product

- » Designed for project level analysis (one project at a time)
- » Used national defaults for reliability prediction curves
- » Standalone spreadsheet
- » Recurring (bottleneck) and incident delay only

## ➤ To be more useful, why not link to travel demand model so that the reliability of system-wide projects can be developed?

- » Can be used to produce not only the common reliability measures but the MAP-21 measures and other travel time-based measures



# *C11 Post-Processor: Enhancements*

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## ➤ Functionality

- » Post-Processor to TDF models; uses loaded network file

## ➤ Analytics

- » Custom reliability relationships, including arterials
- » Library of operations improvements and their impact factors

## ➤ Maryland SHA

- » Statewide model
- » Allows capacity and operations projects to be considered

## ➤ Florida MPOs

- » Safety prediction

## ➤ Knoxville TPO

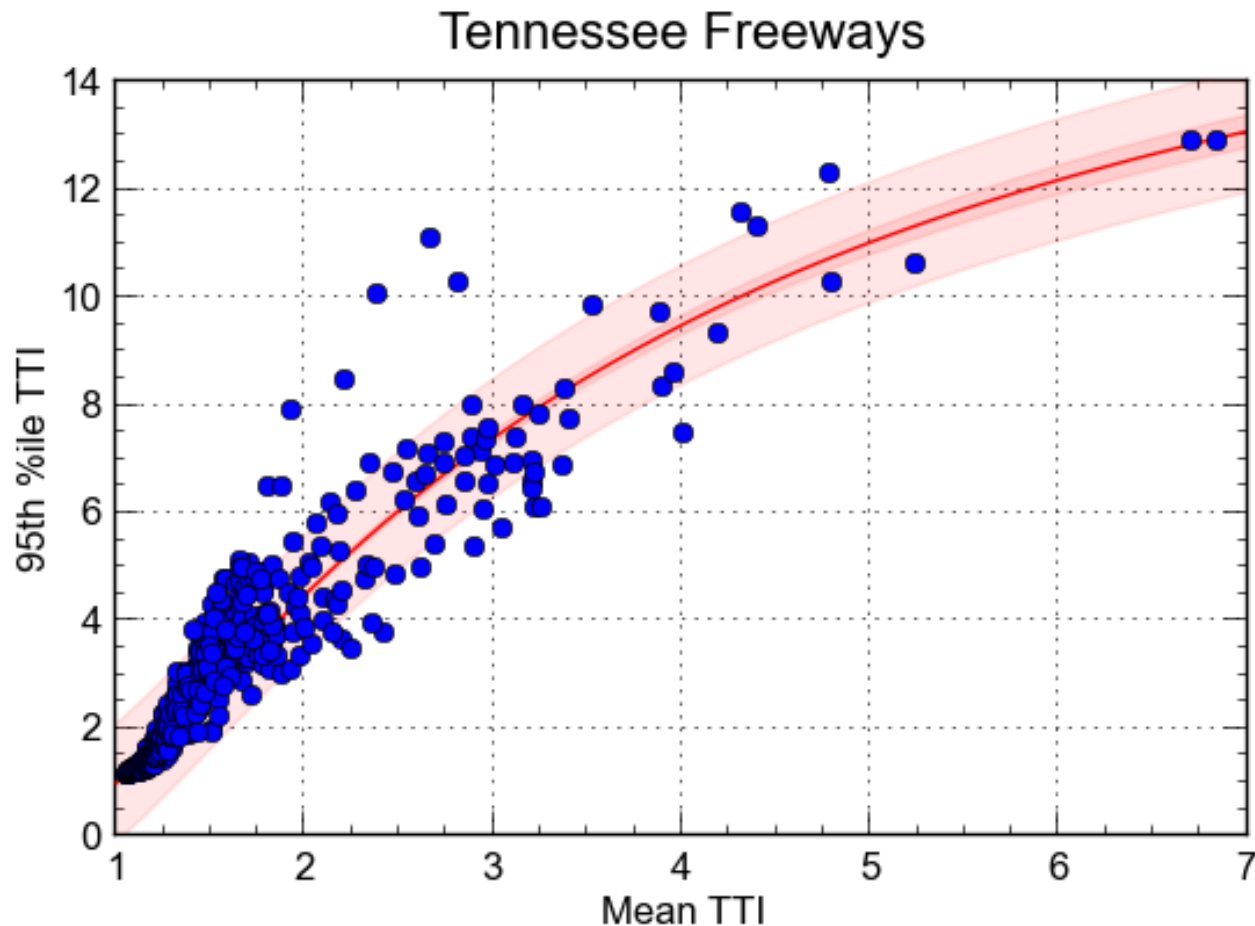
- » Delay due to weather (NOAA data for TYS) and traffic variability (Knoxville ITS data)

# *C11 Post-Processor: How It Works*

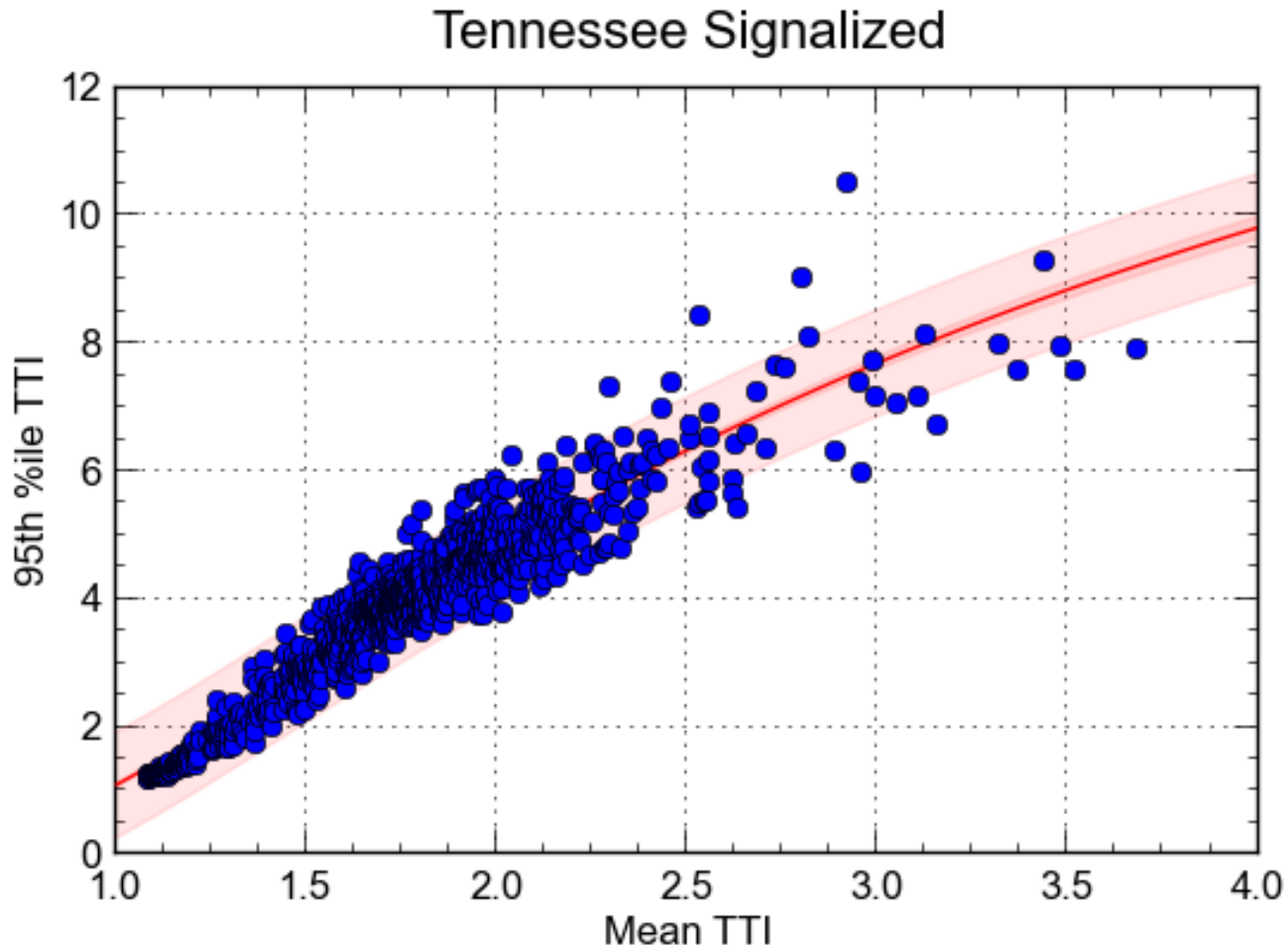
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- Traffic data gathered from loaded network file
  - » Volumes and capacities are critical; model values may need adjusting
- Users define:
  - » Corridors for tabulating results
  - » Assign improvements to corridors
- Recurring congestion uses a VDF (modified Davidson)
- Incident delay uses IDAS equations
- Improvements affect capacity, delay, or incident characteristics
- Reliability predicted from average conditions

# *NPMRDS-Based Relationships for TN*



## *NPMRDS-Based Relationships for TN (cont.)*



# Knox County 2040 Results

| Route         | Mean TTI | 80 <sup>th</sup> %ile TTI | 95 <sup>th</sup> %ile TTI | MAP-21 % Reliable (PM) | Total Excessive Delay (PM) |
|---------------|----------|---------------------------|---------------------------|------------------------|----------------------------|
| Alcoa Highway | 1.108    | 1.138                     | 1.416                     | 97.1%                  | 549                        |
| I-140         | 1.214    | 1.300                     | 1.706                     | 93.8%                  | 771                        |
| I-275         | 1.072    | 1.077                     | 1.232                     | 100.0%                 | 235                        |
| I-40/75       | 1.507    | 1.645                     | 2.749                     | 51.0%                  | 2,558                      |
| I-640/75      | 1.134    | 1.147                     | 1.436                     | 100.0%                 | 270                        |
| Chapman Hwy   | 1.264    | 1.354                     | 2.029                     | 93.6%                  | 554                        |
| Kingston Pike | 1.400    | 1.595                     | 2.465                     | 86.8%                  | 1,173                      |

# *C11 Post-Processor: Next Steps*

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- Currently “not ready for prime time software” – can be run for an MPO as a service
- Ideally, “user grade” software should be created
- Calibration to NPMRDS speeds
  - » Adjust capacity (as per the HCM) to match observed speeds
  - » TDF models not usually calibrated this way – will it change interpretation?
- Can help with MAP-21 target setting
  - » Planning Rule states that projects in LRTP and TIP need to “show progress toward targets
  - » Time periods for MAP-21 measures do not coincide with TDF model periods very well

# Questions?

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# ***MAP-21/FAST ACT MOBILITY PERFORMANCE MEASURES***



# Overview

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- Known by many names but Rule refers to them as “System Performance Measures”
  - » MAP-21, FAST ACT, PM3 are other names you hear
- Final rule is slightly different from the proposed rule, but is still a mix of measures and targets for the measures
- Measures now based on both based on travel time vs. other forms of data
- Implementation of the Final Rule was delayed twice as new administration reviewed it
- Measures to be based on empirical data: the NPMRDS or approved “equivalent”

## *Proposed vs. Final Rule*

| Proposed Rule   | Final Rule   |
|---|--|
| System Reliability                                      | <b>System Reliability</b>  |
| Peak Hour Travel Time Ratio                             | (dropped)  |
| Truck Travel Time Reliability                           | <b>Truck Travel Time Reliability</b>                                   |
| Average Truck Speed                                     | (dropped)  |
| Excessive Delay   | <b>Peak Hour Excessive Delay</b>                                       |
| CMAQ On-Road Emissions                                  | Percent Non-SOV Travel   |
|   | Percent Change in Tailpipe CO2 Emissions (now in administrative limbo) |
| <b><i>Bold indicates travel time-based measures</i></b> |  |

# National Performance Management Research Data Set (NPMRDS)

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- FHWA just switched contractors from HERE to a UMD/INRIX /TTI team
- First new data expected in July
- NPMRDS #1 went through February but ***is now unavailable***
  - » Old data **MAY** become available through new contract
- New features
  - » Conflated to HPMS
  - » “Probe Data Indicators” – TBD
  - » Data based on a mix of spot speeds and path processing
    - Should help signalized highway estimates
  - » More TMCs included (links)
    - Break out small links that are internal to intersections and interchanges; these were previously aggregated onto adjacent links

# *Opportunities for Modeling*

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- NPMRDS speeds being used to calibrate simulation models – can be used for TDF models and sketch planning tools as well
- Ability to predict the System Performance measures
  - » Planning Rule states that projects in TIP, STIP, and LRTP should, “to the extent possible”, indicate how projects contribute to progress toward the target
  - » Standalone (e.g..) HCM vs. integration with travel demand and simulation models
  - » **Perhaps part of a larger Model Applications Guide**
- Challenges
  - » Multiple time periods considered by the new measures – beyond what users typically consider

# *Where the Modeling Can Help*

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- Forecasting activities for performance management
  - » Target setting
  - » Statistical controls in before/after studies
  - » Evaluating proposed projects, especially how they make progress toward targets
- New HCM Reliability procedures “hit the sweet spot”
  - » More rigorous than sketch planning, less data and resource intensive than simulation