

Congestion Measurement and Research

A Review of National Activities

presented to
FDOT ITS Working Group

presented by
Rich Margiotta
Cambridge Systematics, Inc.

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Transportation leadership you can trust.

CAMBRIDGE
SYSTEMATICS

Presentation Overview

- **FHWA Mobility Monitoring Program**
- **FHWA/American Transportation Research Institute (ATRI) Freight Travel Time Project**
- **National Transportation Operations Coalition (NTOC) Performance Measures Initiative**
- **Strategic Highway Research Program (SHRP 2) Reliability Research Program**

FHWA Mobility Monitoring Program (MMP)

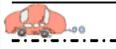
- **Joint effort between Cambridge Systematics and TTI; 2000 through present**
- **Objectives**
 - **Assemble performance data from TMCs**
 - Annual/monthly performance reports
 - Research resource
 - **Develop and promote the concept of Reliability**
 - Currently conducting workshops around the country
 - **Foster local performance monitoring programs**
 - **Special studies**
 - *Traffic Congestion and Reliability Report*

UCR NATIONAL COMPOSITE INDICATORS

YEAR	Congested Hours 	Travel Time Index 	Buffer Index 
2005	3.6	1.44	1.898
2004	3.7	1.34	1.776



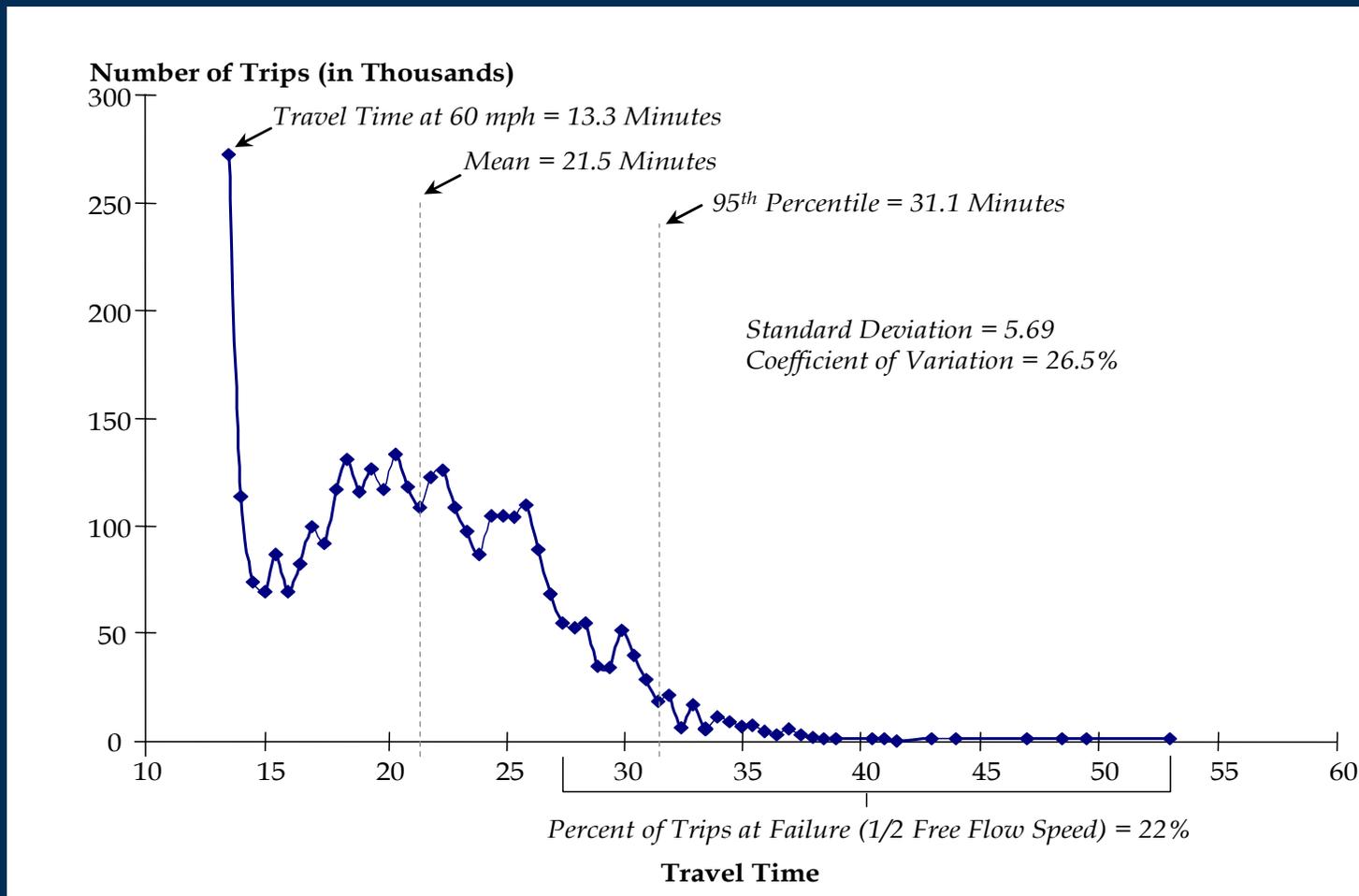
Federal Highway Administration

City	Congested Hours  		Travel Time Index  		Buffer Index  		% Usable Data: 	Contributing Factors Compared to Previous Year (Peak Period)			
	This Quarter	(%) Change vs. Year Ago	This Quarter	(%) Change vs. Year Ago	This Quarter	(%) Change vs. Year Ago		Bad Weather 	Work Zones 	Incidents 	VMT Served 
	Chicago, IL	4.1	36.7%	1.98	16.5%	2.32		23.5%	58%	9%	18%
Sacramento, CA	3.3	17.9%	1.20	26.2%	1.86	14.3%	74%	11%	29%	16%	10%
Tampa, FL	3.7	12.1%	1.21	6.1%	1.66	13.3%	82%	15%	6%	13%	13%
Providence, RI	4.2	10.5%	1.29	2.4%	2.01	20.0%	55%	20%	5%	-2%	2%
R'side-San Bern, CA	1.3	8.3%	1.36	8.4%	1.53	18.5%	57%	-3%	16%	-5%	7%
Los Angeles, CA	4.9	6.5%	1.89	1.9%	2.65	28.2%	77%	-6%	-6%	10%	-4%
San Francisco, CA	6.2	5.1%	1.88	1.7%	2.54	3.3%	59%	-3%	10%	-10%	-12%
San Antonio, TX	2.1	5.0%	1.20	4.8%	1.69	1.1%	70%	-8%	5%	-5%	3%
Detroit, MI	2.3	4.5%	1.22	1.4%	1.88	8.3%	86%	-12%	3%	-4%	5%
Hampton Roads, VA	4.8	4.3%	1.08	1.7%	1.66	2.7%	88%	-6%	5%	7%	6%
Orange County, CA	2.6	4.0%	1.43	1.9%	2.06	5.6%	75%	-4%	1%	4%	1%
Minn-St. Paul, MN	3.9	2.6%	1.29	0.6%	1.89	4.5%	56%	4%	7%	5%	9%
Philadelphia, PA	3.9	-2.5%	1.41	0.0%	2.21	0.1%	53%	-1%	1%	-8%	-7%
Seattle, WA	4.2	-4.5%	1.30	-0.2%	1.88	0.0%	88%	7%	-9%	-13%	-8%
San Diego, CA	3.0	-6.3%	1.30	-0.8%	1.96	1.0%	71%	9%	0%	5%	-9%
Phoenix, AZ	2.6	-7.1%	1.55	-5.0%	2.20	0.0%	69%	-2%	-10%	-14%	-7%
Pittsburgh, PA	3.7	-7.5%	1.26	-0.8%	1.88	-26.3%	72%	-6%	-6%	-9%	-2%
Portland, OR	5.0	-9.1%	1.16	-2.7%	1.62	-10.5%	53%	-8%	-1%	-4%	-4%
Houston, TX	3.3	-10.8%	1.52	-1.7%	1.98	9.0%	57%	-9%	-11%	3%	-2%
Salt Lake City, UT	0.9	-35.0%	1.05	-2%	1.63	10%	98%	2%	19%	3%	2%

Why is Reliability Important?

- **Reliability is an indication of how travel times vary from day-to-day ... OR ...**
 - How consistent is travel?
 - How predictable is travel?
 - How does it perform over time against a predefined standard?
- **Variability in travel times means that extra time must be planned for**
- **In other words, travelers have to leave earlier – they build in a BUFFER to their trip planning, or suffer the consequences**

Measuring Reliability



Why is Reliability Important? (cont.)

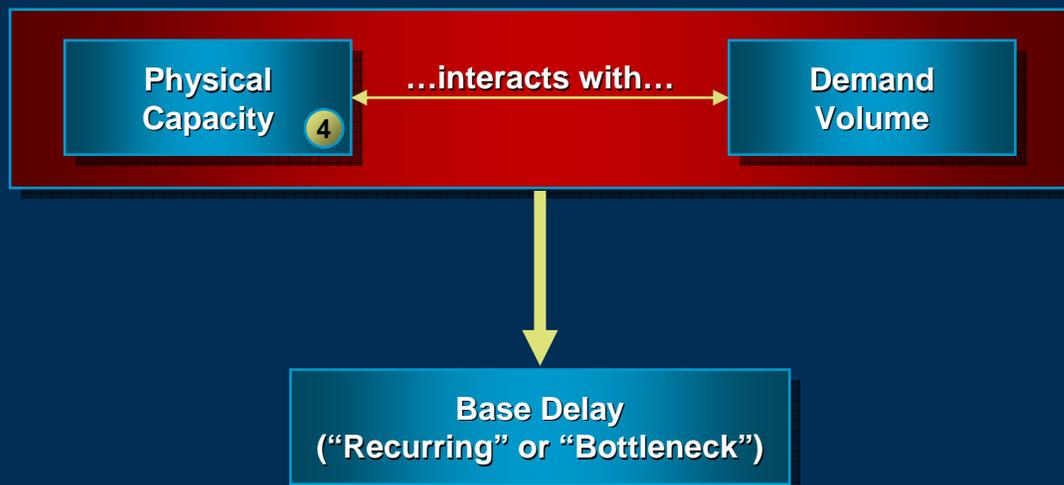
- **The Buffer has costs associated with it**
 - **Planned extra time at least as costly as regular travel time**
 - **Some studies place the Buffer's costs at 1-6 times higher than average travel time**
 - **Some trips will still exceed the Buffer – late penalties**
 - **Some trips will take much less than the Buffer – early arrival penalties**
- ***Reliability (or the lack of it) just says that travel times are inconsistent/variable – it doesn't tell you why!***

So Why Do Travel Times Vary?

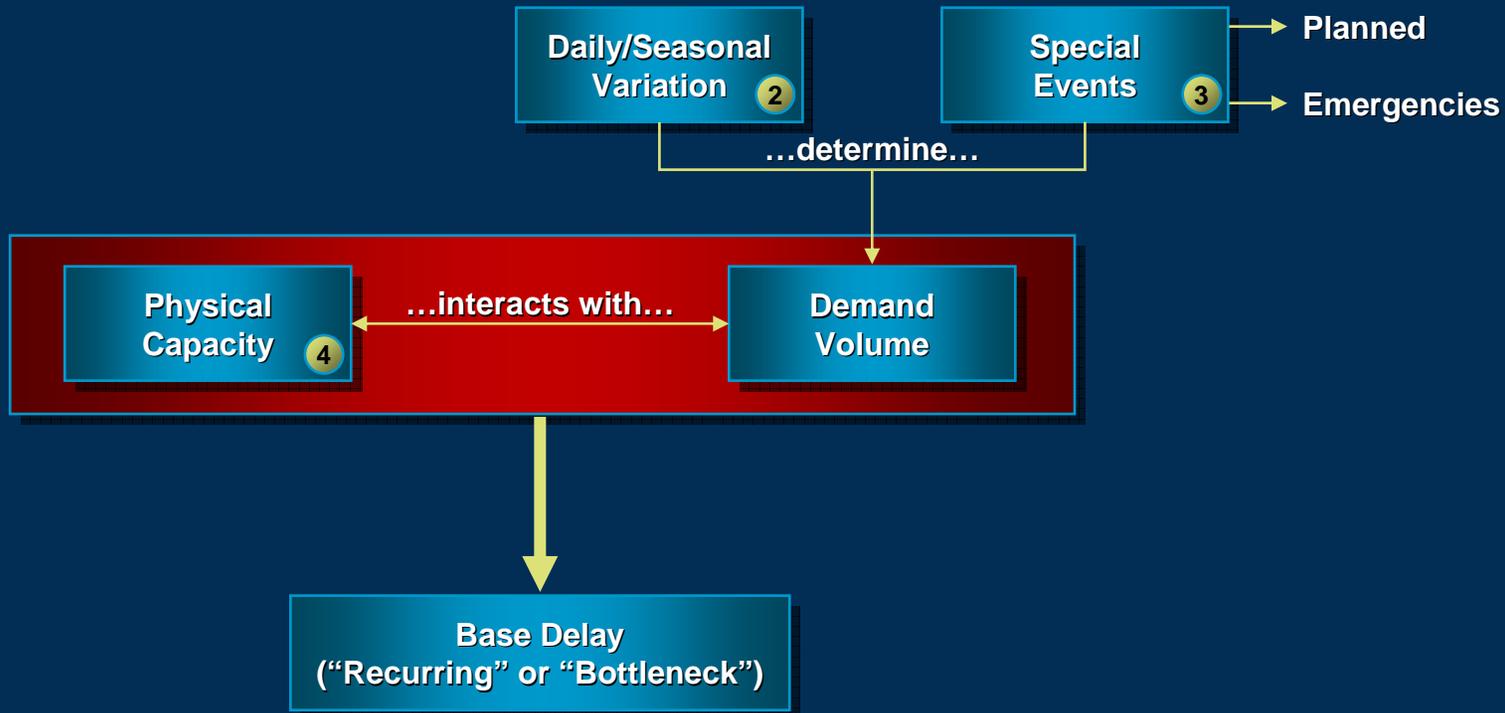
Seven Sources of Unreliability

1. Traffic incidents
2. Special events
3. Work zones
4. Weather
5. Day-to-day demand (volume) fluctuations
6. Traffic control devices (railroad crossing, poor signal timing)
7. Inadequate base capacity

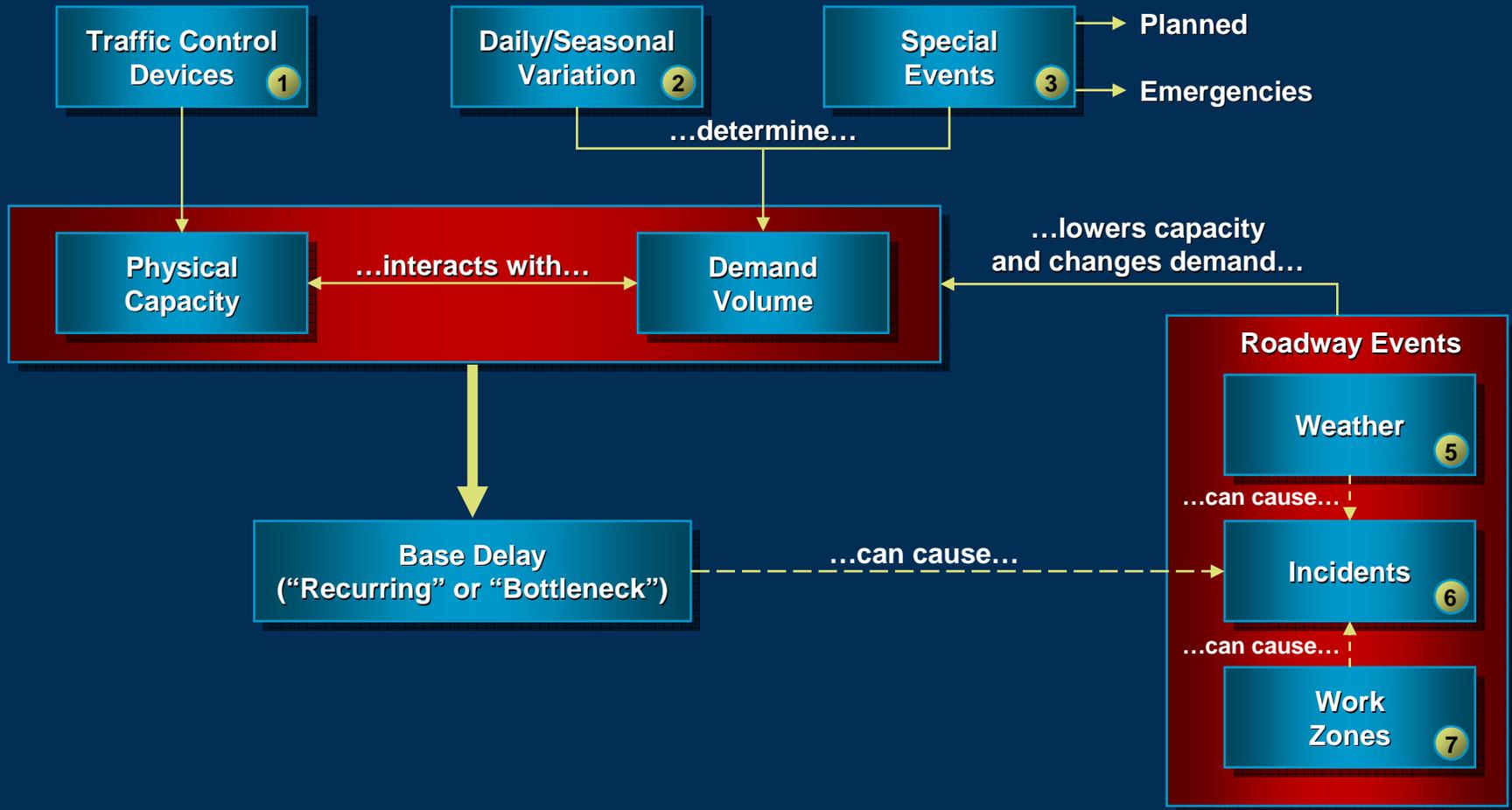
A Model of Congestion and Its Sources



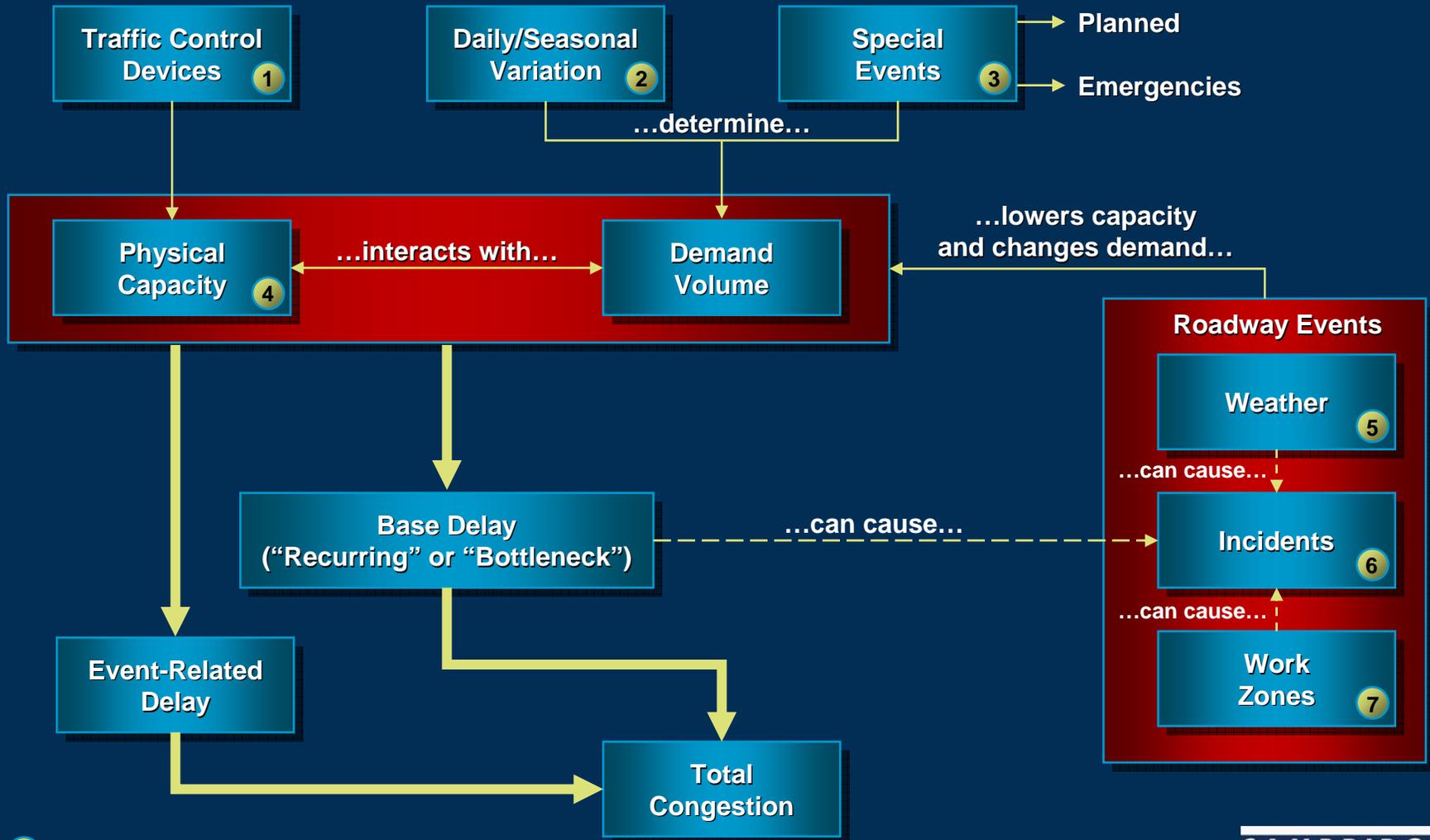
A Model of Congestion and Its Sources



A Model of Congestion and Its Sources



A Model of Congestion and Its Sources



11 = Source of Congestion

Use of Reliability: Performance Measurement

- **Part of a comprehensive program to monitor congestion trends and operational effectiveness**
- **Can be applied at management, planning, and operations levels**
 - **Backward-looking (trends)**
 - **Forward-looking (forecasting)**

WHAT THEY TELL YOU

MEASURES

USED BY

Level 1

- Travel conditions are unreliable (Variable over time)

Overall Reliability
e.g., buffer index

- Upper Management
- Public Relations
- Planners

Level 2

- What's causing unreliable travel (e.g., incidents, weather, work zones)

Delay by Source
e.g., vehicle-hours

- Mid-Management
- Operators
- Planners



Level 3

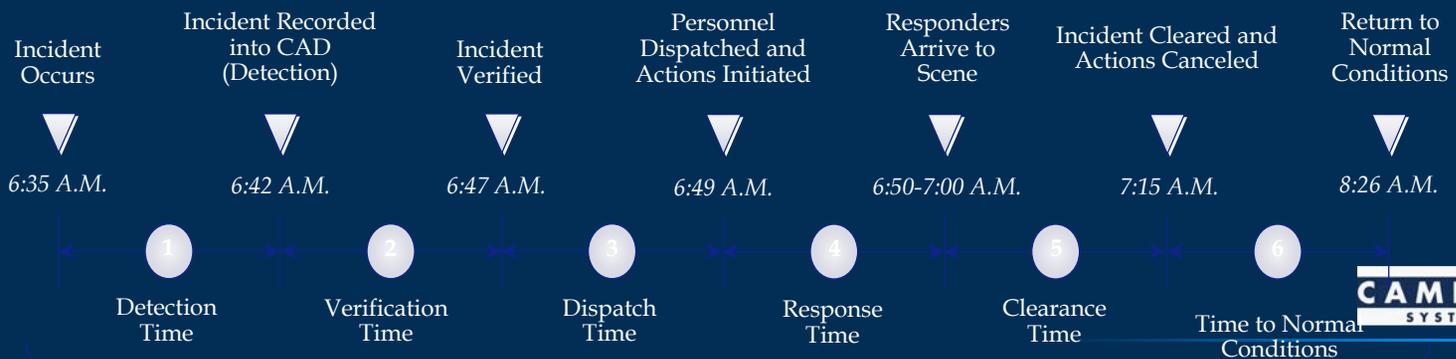
- What aspects of operations, management, and construction need to be improved

Activities, Procedures, and Policies

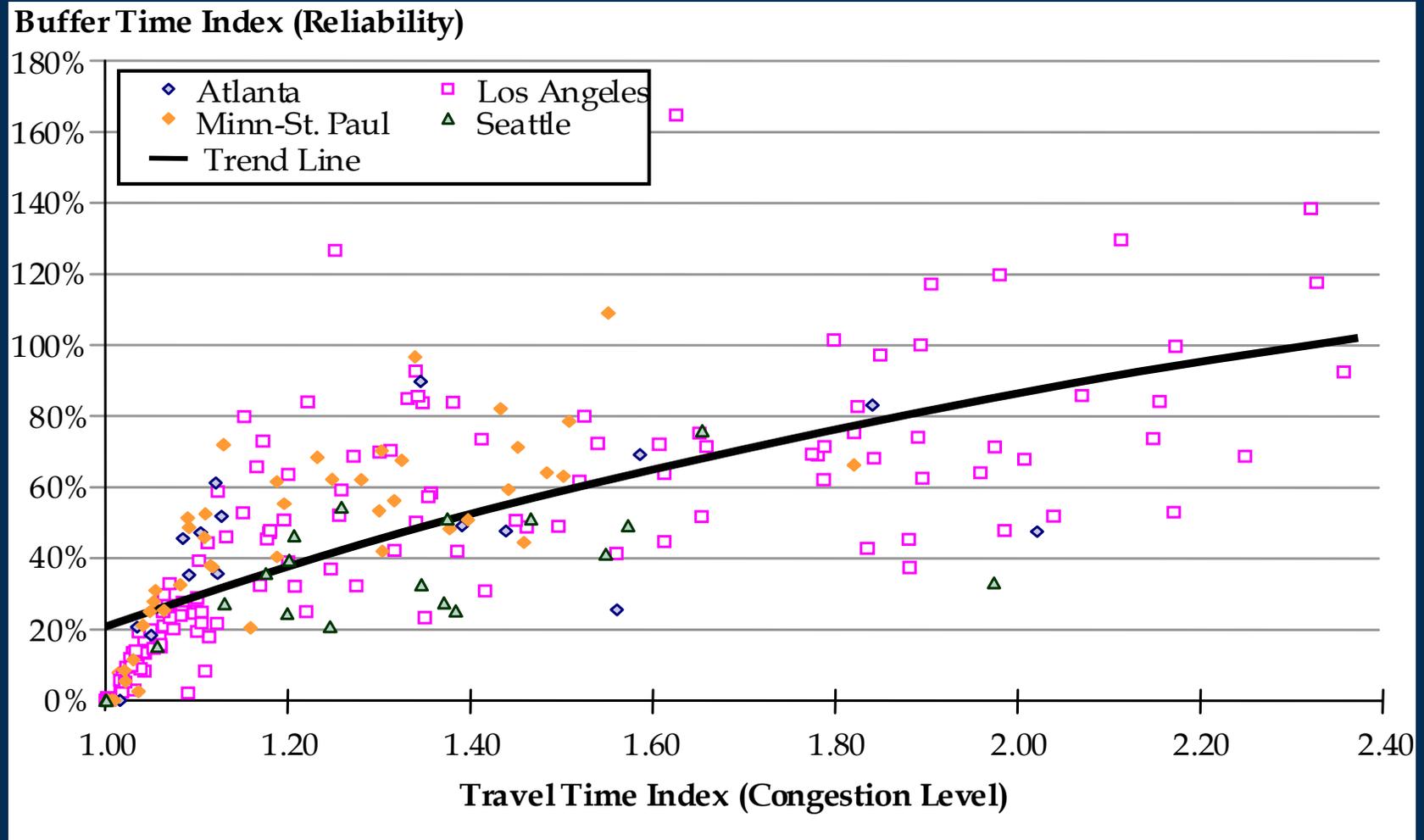
- Operators
- Field Managers

... for incidents ...

INCIDENT TIMELINE



Relationship Between Reliability and Congestion Level





NTOC Performance Measures Project

- NCHRP 20-7 series: *Guidelines for Benchmarking Operations Performance Measures*
- **Identify “a few good measures” that all operations agencies can use to improve performance**
 - Customer Satisfaction
 - Extent of Congestion – Spatial & Temporal
 - Incident Duration
 - Non-Recurring Delay
 - Recurring Delay
 - Speed
 - Throughput – Person & Vehicle
 - Travel Time
 - Travel Time Reliability
- **Currently seeking sites (agencies) to pilot the measures**

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

- **More comprehensive than NTOC**
 - Congestion is focus, but also includes safety and operations
 - Includes the NTOC measures plus many lower level PMs
- **Provides details on data collection and analytics behind PM development**

NCHRP 3-68: *Guide to Effective Freeway Performance Measurement (cont.)*

- **Goals and Characteristics of Freeway Performance Measures**
 - Why undertake freeway performance measurement?
 - History of performance measurement
 - Current state-of-the-practice
 - Political context
- **Performance Measurement as Part of the Planning and Investment Processes**
 - Linkage to traditional planning and programming
 - How to design and implement a freeway performance program
 - Relationship to strategic and business plans

NCHRP 3-68: *Guide to Effective Freeway Performance Measurement (cont.)*

- **Basic Principles for Freeway Performance Measurement**
- **Development of Freeway Performance Measures**
 - How measures were selected for the Guide
 - What categories of performance should be measured?
 - Recommended minimum set of freeway performance measures
 - Setting performance targets
 - Measurement versus modeling

NCHRP 3-68: *Guide to Effective Freeway Performance Measurement (cont.)*

- **Data to Support Freeway Performance Measures**
 - Relationship to other freeway performance activities
 - Mapping data to freeway performance measures
- **Data Collection Activities to Support Freeway Performance Measurement**
- **Data Processing to Support Freeway Performance Monitoring**
 - Data QC, management, fusion, transformation, and analysis
- **Presentation and Communication of Freeway Performance Measures**

SHRP 2 Research Program

- **Four-year focused research program managed by TRB**
 - Modeled after original SHRP from the 80's
 - Similar to NCHRP
- **Four SHRP 2 Program Areas**
 - **Renewal – improved construction techniques (\$48.5M)**
 - **Safety – Basic research into crash causation and potential countermeasures (\$45M)**
 - **Reliability – improved planning and strategies for “event-related” congestion (\$28M)**
 - **Capacity – adding new capacity in the face of economic, environmental, and social constraints (\$19M)**

SHRP 2 Reliability and Capacity Programs – Congestion Measurement Projects

- **L02: *Establishing State and Local Monitoring Programs to Improve Reliability***
 - Technical assistance for practitioners
- **L03: *Analytic Procedures for Determining the Impact of Reliability Improvement Strategies***
 - How do improvements affect reliability measures
- **L04: *Incorporating Reliability Estimation into Planning and Operations Modeling Tools***
 - Provide the ability to forecast/estimate reliability

SHRP 2 Reliability and Capacity Programs – Congestion Measurement Projects (cont.)

- **L05: *Incorporating Mobility and Reliability into the Transportation Programming Process***
 - Making decisions based on reliability improvements
- **L08: *Incorporation of Nonrecurrent Congestion Factors into the Highway Capacity Manual***
- **C02: *Systems-Based Performance Measurement for Highway Capacity Decision Making***
- **C05: *Understanding the Contribution of Operations, Technology, and Design to Meeting Highway Capacity Needs***

Resources

- **Mobility Monitoring**

- <http://mobility.tamu.edu/mmp>

- **FHWA**

- http://www.ops.fhwa.dot.gov/congestion_report/index.htm
- http://ops.fhwa.dot.gov/freight/freight_analysis/travel_time.htm

- **NTOC**

- http://www.ntoctalks.com/action_teams/perf_measure.php

- **NCHRP 3-68, *Freeway Performance Measures***

- http://www.trb.org/news/blurb_detail.asp?id=7477

- **SHRP 2**

- <http://gulliver.trb.org/shrp2/>