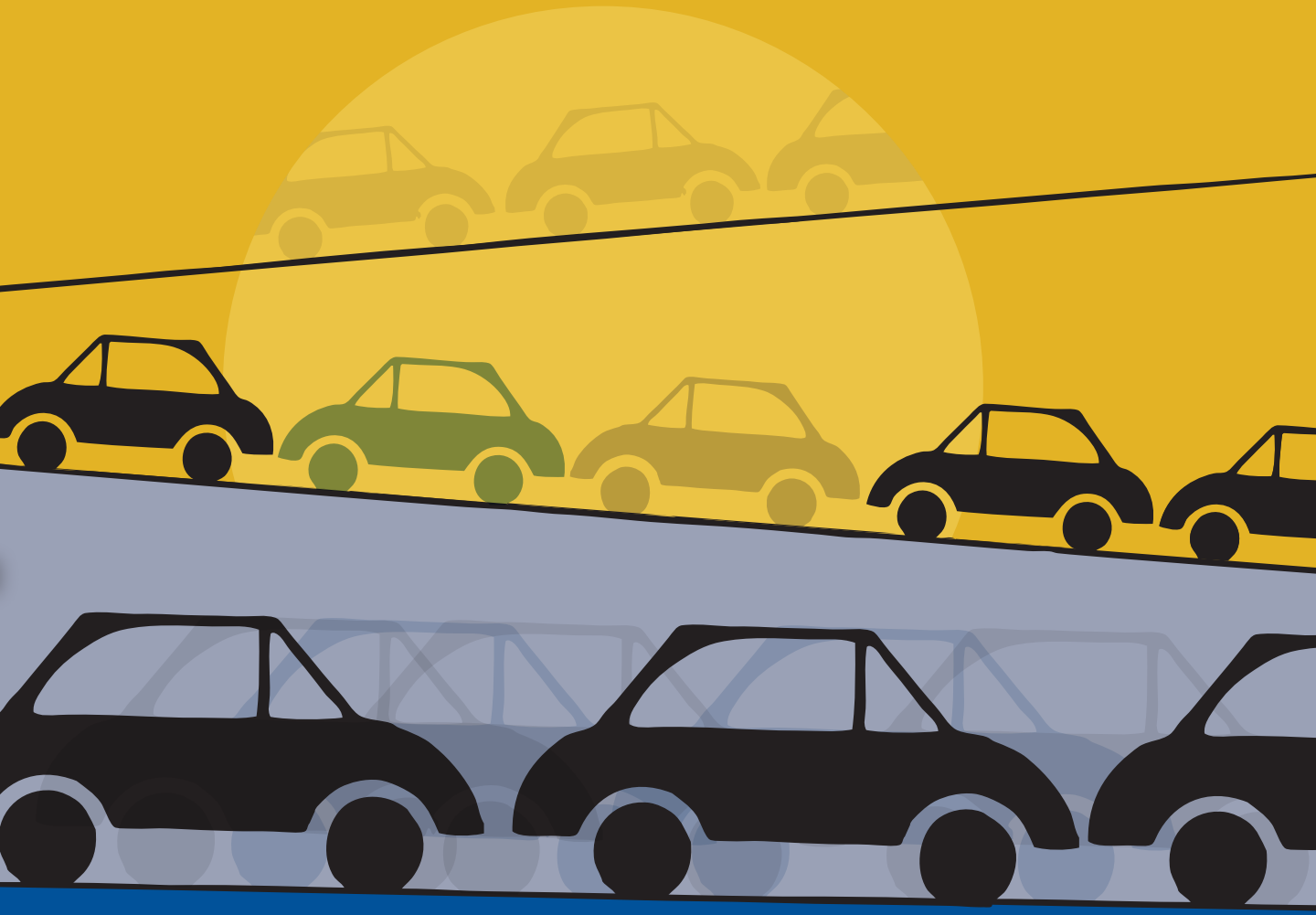
TRAVEL TIME RELIABILITY

MAKING IT THERE ON TIME, ALL THE TIME



U.S. Department of Transportation
Federal Highway Administration

TRAFFIC CONGESTION IS A DAILY REALITY IN MOST OF THE LARGE URBAN AREAS IN THE UNITED STATES.

It's to be expected—large numbers of people all trying to reach their destinations at the same time, usually during peak hours. Drivers are used to the everyday congestion and they plan for it. They don't like it, but they leave home early enough to get to work on time. It's the unexpected congestion that troubles travelers the most from day to day. A trip that usually takes a half-hour, with little or no warning, takes an hour.

Now the motorist is late for work, has missed a doctor's appointment, or is facing hefty childcare penalties for picking up the kids late. Maybe a trucker gets held up in unexpected traffic, making shipments late to the manufacturer, disrupting just-in-time delivery, and losing the competitive edge on other shippers.

Travelers want travel time reliability—a consistency or dependability in travel times, as measured from day to day or across different times of day. Drivers want to know that a trip will take a half-hour today, a half-hour tomorrow, and so on.

WHY IS TRAVEL TIME RELIABILITY IMPORTANT?

Most travelers are less tolerant of *unexpected delays* because such delays have larger consequences than drivers face with everyday congestion. Travelers also tend to remember the few bad days they spent in traffic, rather than an average time for travel throughout the year (see Figure 1).

In order to improve travel time reliability, the first step is to measure it. Measures of travel time reliability better represent a commuter's experience than a simple average travel time. For example, a typical before-and-after study attempts to show the benefits of an incident management program (see Figure 2). Looking at average travel time, the improvement may seem modest. However, travel time reliability provides a different perspective of the improvement: the worst few days have been dramatically improved. Travelers make it to their destinations on time more often or with fewer significant delays.

HOW DO AGENCIES MEASURE TRAVEL TIME RELIABILITY?

Travel time reliability measures are relatively new, but a few have proven effective. Most measures compare high-delay days to those with an average delay. The most effective methods of measuring travel time reliability are 90th or 95th percentile travel times, buffer index, and planning time index, explained in the following sections.

Several statistical measures, such as standard deviation and coefficient of variation, have been used to quantify travel time reliability. However, they are not easy for a nontechnical audience to understand and would be less-effective communication tools. They also treat early and late arrivals with equal weight. But the public cares much more about late arrivals.

Figure 1. Averages don't tell the full story

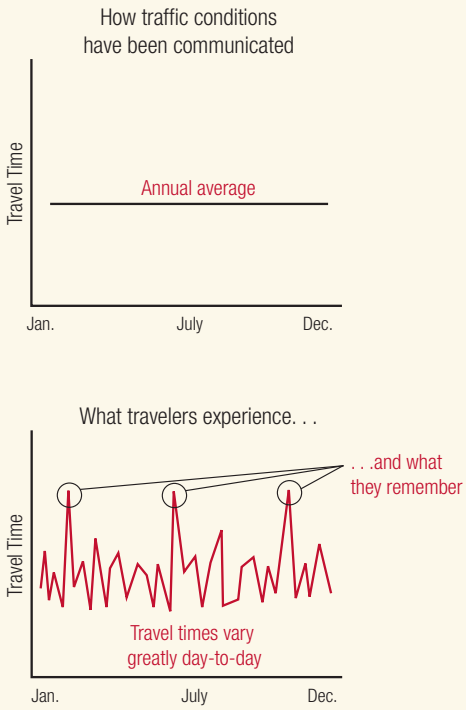
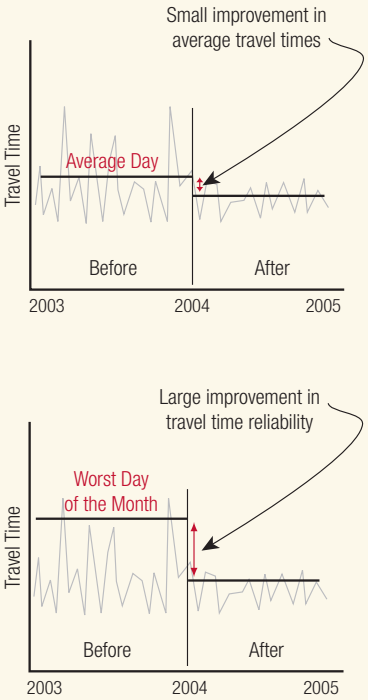


Figure 2. Reliability measures capture the benefits of traffic management



90th or 95th percentile travel times

This method, the *90th or 95th percentile travel times*, is perhaps the simplest method to measure travel time reliability. It estimates how bad delay will be on specific routes during the heaviest traffic days. The one or two bad days each month mark the 95th or 90th percentile, respectively. Users familiar with the route (such as commuters) can see how bad traffic is during those few bad days and plan their trips accordingly. This measure is reported in minutes (as shown in Figure 6).

Buffer index

The *buffer index* represents the extra time (or time cushion) that travelers must add to their average travel time when planning trips to ensure on-time arrival.

For example, a buffer index of 40 percent means that for a trip that usually takes 20 minutes a traveler should budget an additional 8 minutes to ensure on-time arrival most of the time.

Average travel time = 20 minutes
Buffer index = 40 percent
Buffer time = 20 minutes × 0.40 = 8 minutes

The 8 extra minutes is called the buffer time. Therefore, the traveler should allow 28 minutes for the trip in order to ensure on-time arrival 95 percent of the time.

Planning time index

The *planning time index* represents how much total time a traveler should allow to ensure on-time arrival. While the buffer index shows the *additional* travel time that is necessary, the planning time index shows the *total* travel time that is necessary (see Figure 3).

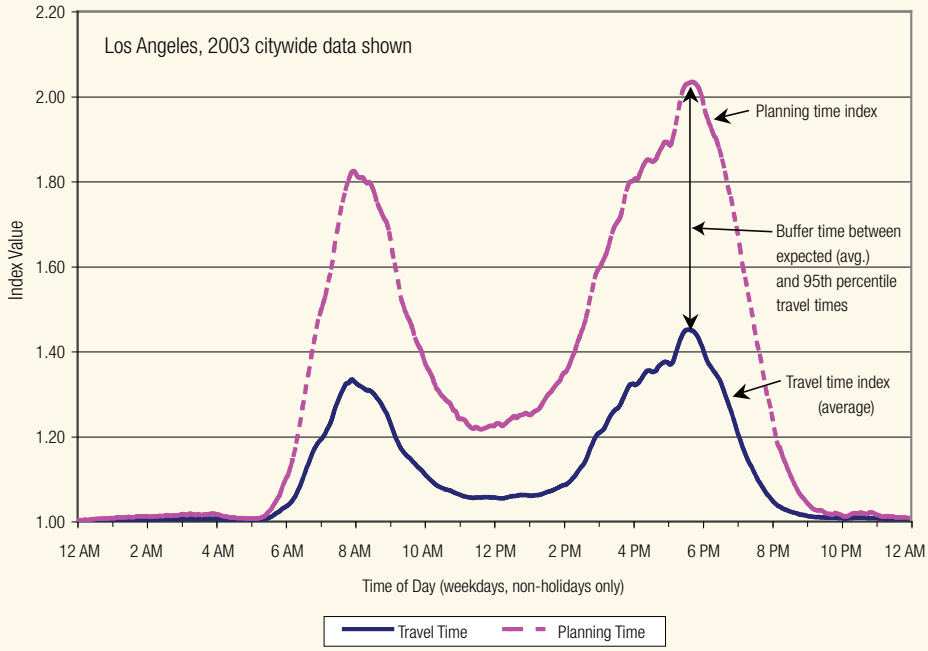
For example, a planning time index of 1.60 means that for a trip that takes 15 minutes in light traffic a traveler should budget a total of 24 minutes to ensure on-time arrival 95 percent of the time.

Free-flow travel time = 15 minutes
Planning time index = 1.60
Planning time = 15 minutes × 1.60 = 24 minutes

The planning time index is especially useful because it can be directly compared to the travel time index (a measure of average congestion) on similar numeric scales. The travel time index is a measure of average conditions that tells one how much longer, on average, travel times are during congestion compared to during light traffic.

Figure 3 illustrates the relationship between the buffer index and the planning time index. The buffer index represents the *additional* time that is necessary, whereas the planning time index represents the *total* travel time that is necessary.

Figure 3. Reliability measures compared to average congestion measures (Source: http://mobility.tamu.edu/mmp/)



HOW DOES AN AGENCY BEGIN USING TRAVEL TIME RELIABILITY MEASURES?

Putting these methods to work requires an overall evaluation and implementation process. Figure 4 briefly shows the steps involved in measuring travel time reliability and how to put that information to work for travelers and traffic managers.

WHO IS CURRENTLY USING TRAVEL TIME RELIABILITY MEASURES?

Even though travel time reliability measures are relatively new, several agencies have already begun using them. Agencies such as the Federal Highway Administration (FHWA), Minnesota Department of Transportation (Mn/DOT), and the Washington State Department of Transportation (WSDOT) have primarily used travel time reliability as a performance measure to supplement measures of average congestion.

FHWA

FHWA supports a national traffic monitoring program that tracks reliability measures in more than 30 cities. FHWA communicates this information to key decision-makers through a monthly dashboard report (see Figure 5). The report includes trend information on the duration (hours of congested travel per day), magnitude (travel time index), and reliability (planning time index).

Figure 4. A methodical approach can be used to develop reliability measures

STEP 1. Determine how measures will be used

- Define the structure and content of program
- Quantify benefits for elected officials and key decision-makers
- Monitor conditions for fine-tuning operational procedures
- Compare alternative multi-modal investment scenarios

STEP 2. Develop a plan based on uses and users

- Define travel modes, routes, trips, days, times of interest
- Define data source and calculation procedures
- Develop communication tools for results

STEP 3. Collect and process required data

- Continuous data collection from Intelligent Transportation Systems (ITS) most desirable
- Other methods to collect or estimate data are possible
- Use quality assurance methods
- Calculate route or trip travel times (basic data element)

STEP 4. Calculate reliability measures

- 95th or other percentile travel time
- Buffer index
- Planning time index

STEP 5. Communicate measures in meaningful way

- Annotated graphics that avoid "tech-speak"
- Relate to traveler's experience

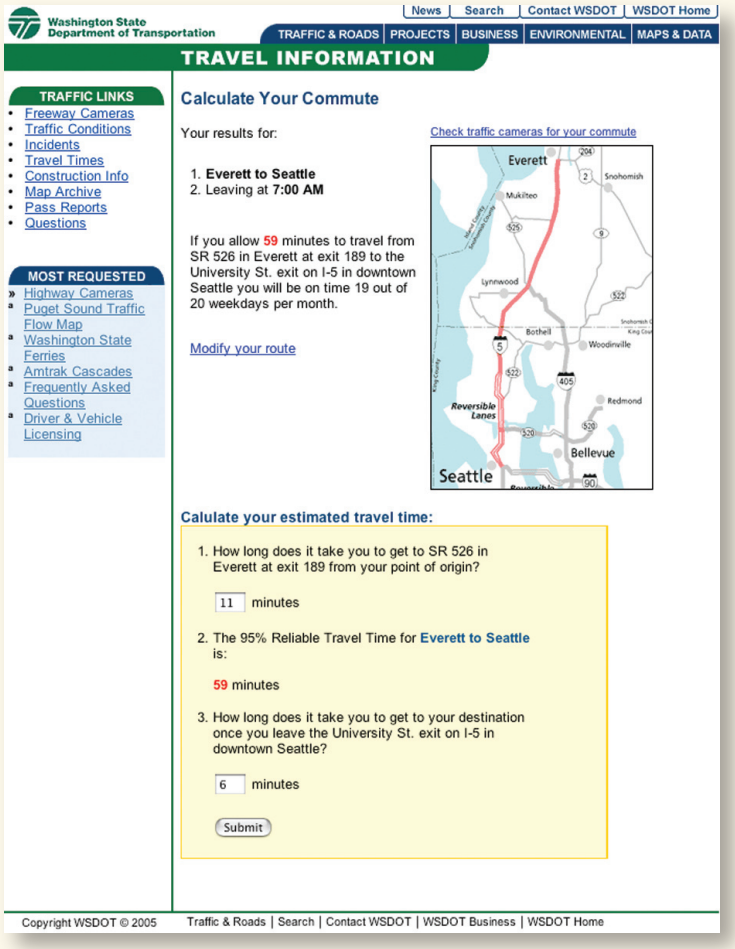
Figure 5. A reliability measure is included in FHWA's Monthly Congestion Dashboard Report

Status: Green Progress: Green	NATIONAL CONGESTION INDICATORS								
	Hours of Congested Travel Per Day			Travel Time Index			Planning Time Index		
Current Quarter	4.823			1.284			1.690		
Same Quarter, Previous Year	5.181			1.294			1.707		
Change vs. Previous Year	6.91% ↓			0.77% ↓			1.00% ↓		
National Congestion Pattern	# of Cities DOWN >5%	# of Cities NO CHANGE	# of Cities UP >5%	# of Cities DOWN >5%	# of Cities NO CHANGE	# of Cities UP >5%	# of Cities DOWN >5%	# of Cities NO CHANGE	# of Cities UP >5%
Total Cities: 19	9	4	6	2	17	0	4	13	2

Mn/DOT

In 2000, Mn/DOT used travel time reliability measures to study the effects of a ramp meter shutdown on Minneapolis-St. Paul freeways. In this study, Mn/DOT reported that turning off the ramp metering system caused travel time reliability to worsen by 91 percent. In comparison, the average travel times worsened by only 22 percent. These findings support the concepts presented in Figure 2—operational improvements have a greater effect on day-to-day travel time reliability than on average travel times. As a result of this legislatively mandated study, Mn/DOT was able to continue operating its ramp metering program in 2001.

Figure 6. WSDOT provides reliability measures for traveler information (Source: http://www.wsdot.wa.gov/traffic/seattle/traveltimes/reliability/)



WSDOT

WSDOT tracks travel time reliability in its performance-monitoring efforts and provides reliability estimates to commuters. A page on the WSDOT website (see Figure 6) allows commuters to select a trip and generate a 95th percentile travel time based on historical data. Commuters can then use the travel time estimate to ensure they arrive on time for that particular trip.

WSDOT also uses reliability measures in reporting the performance of freeways and high-occupancy vehicle (HOV) lanes (http://depts.washington.edu/hov). In particular, WSDOT uses the 90th percentile travel time and the frequency of congestion performance measures to determine operating strategies and prioritize improvements.

WHERE CAN I FIND MORE INFORMATION?

A guide to travel time reliability is available at http://www.ops.fhwa.dot.gov/. It contains supporting information and technical details on developing travel time reliability measures.

CONTACT INFORMATION

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