

Incorporating Reliability into the Transportation Planning and Programming Process

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The current federal surface transportation law, Moving Ahead for Progress in the 21st Century Act (MAP-21), requires transportation agencies to use a performance-based approach to planning and programming transportation projects. Travel time reliability and congestion reduction are explicit goals of the act. As agencies work to meet these goals, the timely results of significant research on data and tools to evaluate reliability can help them better understand and predict the variability of travel time and its impact on congestion.

To help transportation agencies integrate mobility and reliability performance measures into the transportation planning and programming process, a SHRP 2 research project on Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes (L05) has developed three reports: 1) *Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes* (Guide), 2) *Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Technical Reference* (Technical Reference), and 3) *Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes* (Final Report). This project brief provides an overview of these three reports.

Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes

The intent of the Guide is to help planning, programming, and operations managers apply the concept of travel time reliability to balance investment in programs and projects. Reliability performance measures help agencies (1) understand and communicate reliability; (2) identify the tools and methods to help them track transportation system reliability; (3) incorporate reliability into their existing analysis tools; (4) identify emerging analysis tools that will better help them evaluate reliability; and (5) make program and project investment choices that address the reliability of the system.

Understanding reliability performance is a critical first step to incorporating it into the planning and programming process. Reliability is different from most performance measures that agencies report on today because it is a measure of variability. Most performance measures, such as pavement or bridge condition, change year to year, but not day to day or hour to hour. The tools that agencies have used to examine system performance (four-step travel demand models, management systems, and the like) typically examine average annual conditions. As travel time reliability becomes a more significant issue, different tools will be needed to directly measure and forecast the type of variability that agencies face.

To incorporate reliability into the planning and programming process, transportation

agencies need different data and tools than are typically used to examine and predict future performance. The Guide and the associated Technical Reference can help agency planners and system operators identify the data, tools, and methodologies for examining reliability. These include emerging analysis tools that can directly estimate or forecast reliability, as well as tools and methodologies that can help an agency measure reliability. The guidance is based on a few key principles:

- 1. A collaborative approach to planning.** To collaboratively address reliability, transportation agencies need to partner with key system supporters, such as emergency response personnel and tow truck operators, who can contribute to the overall reliability of the transportation system by responding and clearing incidents quickly. The SHRP 2 Capacity focus area created a web tool to support collaborative, performance-based decision making throughout the planning process: Transportation for Communities—Advancing Projects through Partnerships, or TCAPP, which is available at <http://www.transportationforcommunities.com>.
- 2. A performance-based approach to investment decision making.** Many agencies already use performance measures to help inform decision making, but MAP-21 began the process of crystallizing requirements around performance-based planning and programming. The Guide is built around these concepts, reliability being one of several measures that an agency may use to evaluate the performance of the system and make investment decisions at both program and project levels.
- 3. A balanced approach to improving reliability that considers all project types on a level playing field.** Because reliability is affected by a variety of transportation challenges—such as incidents, weather, and bottlenecks—a wide range of solutions should be considered when attempting to improve it. Solutions include operations and management strategies—typically targeted at improving the reliability of the system—in addition to capacity additions, safety, and other investments. Because operations and management strategies occur in different project phases than projects to add capacity, examining the full life-cycle cost of investments (and their benefits) is especially critical to ensure the efficient use of limited resources.

The guidance also covers four key areas that are needed to incorporate reliability into the transportation planning and programming process:

- 1. Developing and tracking a reliability performance measure.** Well-defined reliability measures based on quality supporting data are critical for understand-

ing and communicating how the transportation system is performing.

- 2. Incorporating reliability into policy statements.** To incorporate reliability, agencies must establish that reliability is among the core strategic goals or objectives the agency strives to achieve.
- 3. Evaluating reliability needs and deficiencies.** As for any goal area, one first valuable step is to understand the extent of reliability deficiencies and needs. Where are travel times least predictable? What would it cost to address the deficiencies that exist? The outputs of this process (maps, charts, and figures) will provide background when developing policies, setting the size of the reliability program, and prioritizing projects.
- 4. Incorporating reliability into investment decision making.** One key goal of the planning process is to help inform agency investment decisions. This part of the Guide addresses how to incorporate reliability into tradeoffs across investment types (including capacity, operations, safety, and preservation) and project prioritization.

Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes is available at <http://www.trb.org/Main/Blurbs/168855.aspx>.

Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Technical Reference

The Technical Reference, which was designed to accompany the Guide, provides information that technical staff can use to select and calculate the appropriate performance measures to support the development of key planning products, including the following:

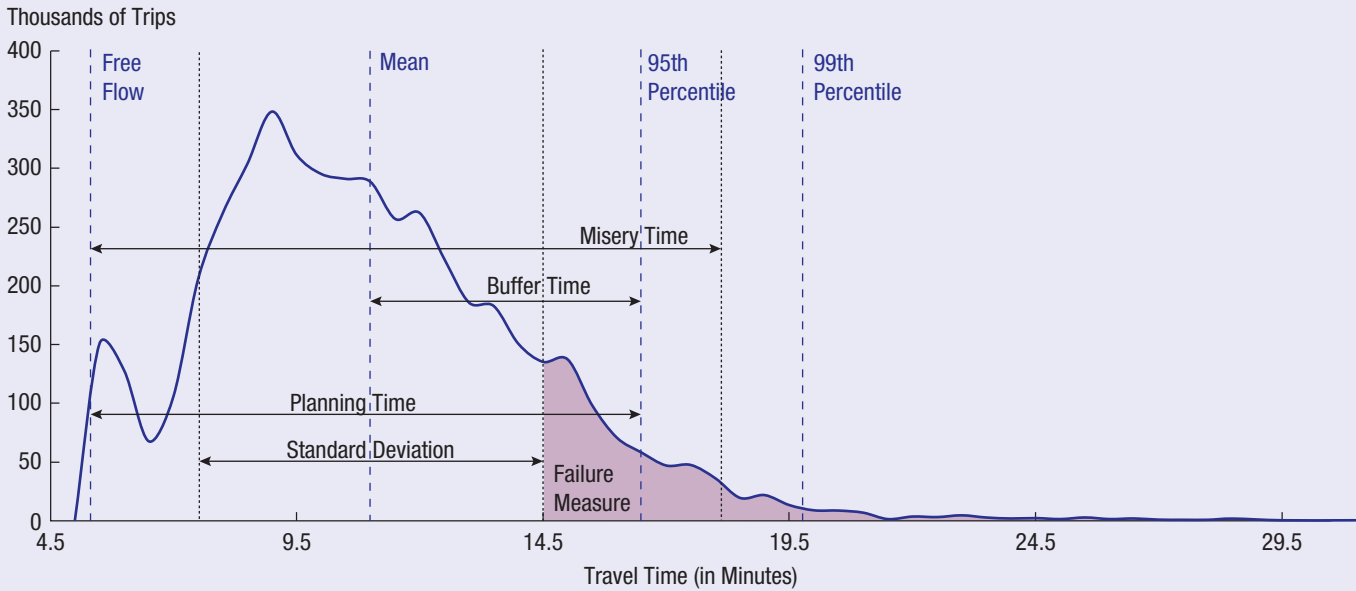
- Long-range transportation plans,
- Transportation programs,
- Congestion management process,
- Corridor planning, and
- Operations planning.

SHRP 2 Project L05 drew from the research and techniques developed by many other SHRP 2 projects, which are referenced throughout the Technical Reference. This document includes a table that summarizes these studies and their relationship to SHRP 2 Project L05.

The Technical Reference includes chapters on the following topics:

- **Overview of Travel Time Reliability.** This chapter summarizes foundational research on reliability, including a practical definition, how to measure

Figure 1. The Travel Time Distribution is the Basis for Defining Reliability Metrics



MEASURE	CALCULATION	DESCRIPTION
Planning Time Index* (PTI)	$\frac{95\text{th Percentile of TT}}{\text{Free Flow TT}}$	The extra time required to arrive at a destination “on time” 95 percent of the time. Can be calculated for trips, corridors, or segments. The PTI is the recommended measure because it gives intuitive and consistent results.
Buffer Time Index** (BI)	$\frac{95\text{th Percentile of TT} - \text{Average TT}}{\text{Average TT}}$ (could replace Average with Median TT)	The <i>extra</i> time required to arrive at a destination on time 95 percent of the time, compared to average or median travel time. A BI of 1.5 indicates that, 95 percent of the time, it will take you 50 percent more time to arrive at your destination than it would under average conditions.
Standard Deviation	$\sqrt{\frac{1}{N} \sum_{i=1}^N (TT_i - \text{Average TT})^2}$	The variation in travel time compared to the average. A standard deviation of 5 minutes indicates that it is not unlikely for it to take 5 minutes more to travel than it would during average congestion.
Semi-Standard Deviation	$\sqrt{\frac{1}{N} \sum_{i=1}^N (TT_i - \text{Free Flow TT})^2}$	The variation in travel time compared to free flow. A semi-standard deviation of 5 minutes indicates that it is not unlikely for it to take 5 minutes more to travel than it would during uncongested conditions.
Failure Measure	$\frac{\text{Trips with TT} < 1.1 * \text{Median}}{\text{Total Trips}}$	The percent of trips arriving on time. A failure measure of 85 percent indicates that 85 percent of trips are arriving on time.
Misery Index	$\frac{\text{Average of the Highest 5 Percent of TT}}{\text{Free Flow TT}}$	How much longer it takes to travel on the worst 5 percent of all trips. A misery index of 4 indicates that the worst trips take 4 times as long as they would without congestion.

Note: * The travel time index (TTI) is the travel time for a point on the travel time distribution divided by the free flow travel time. The PTI is a specific instance of the TTI, calculated at the 95th percentile. A TTI value can be calculated at any percentile of the travel time distribution.

reliability, why reliability is important, and strategies for improving reliability. It is based on previous work in the SHRP 2 Reliability Program.

- Description of Tools and Methods for Estimating Reliability.** This chapter summarizes the types of tools and methods that may be used to estimate reliability measures, including sketch planning, model post-processing, simulation or multiresolution, and monitoring and management.
- Tool/Method Selection Process.** This chapter provides processes for selecting reliability analysis tools and methods and guidance for setting up the analysis.
- Conducting a Reliability Analysis.** This chapter provides systematic guidance in applying reliability analysis methods and tools.
- Benefit/Cost Analysis.** This chapter provides guidance on incorporating the results of the reliability analysis into a benefit/cost analysis.

- **Improving Planning and Programming Capability.** This chapter describes a Capability Maturity Model approach for incorporating travel time reliability into planning and programming.

The Technical Reference also includes appendices on the following topics:

- **Additional Resources.** This appendix provides annotated descriptions of references and other resources where the user may obtain additional relevant information, including descriptions of other parallel ongoing efforts related to performance measurement, analysis tools, and the planning process. It also includes a table summarizing all other SHRP 2 projects referenced in the Technical Reference and the Guide.
- **Trends in Reliability.** This appendix presents an excerpt from *Analytical Procedures for Determining the Impacts of Reliability Mitigation Strategies* (SHRP 2 Report S2-L03-RR-1), which provides an illustrative example of the challenges in interpreting the varied results of a reliability analysis.
- **IDAS Incident Delay Rate Tables.** This appendix presents the look-up tables from the Intelligent Transportation Systems (ITS) Deployment Analysis System (IDAS) tool, which are required for some of the analysis methods.
- **Benefits and Costs of Full Operations and ITS Deployment.** This appendix presents additional information on completing a multiscenario post-processing method.
- **Data Collection Methods.** This appendix presents an overview of various types of traffic data and describes technologies and methods for collecting the data.
- **U.S. DOT Guidance on Performance Measures.** This appendix presents guidance on how to calculate various reliability measures from simulation model outputs.

- **Guidance to Improve Transportation System Management and Operations Planning and Programming Capability.** This appendix presents guidance on the types of actions needed to improve an agency's capability in the seven critical dimensions of transportation system management and operations planning and programming.

Guide to Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes: Technical Reference is available at <http://www.trb.org/Main/Blurbs/168856.aspx>.

Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes

The objective of SHRP 2 Project L05 was to provide guidance to transportation agencies to help incorporate reliability into the transportation planning, programming, and budgeting processes. The Final Report summarizes this effort and provides a foundation of knowledge on the subject. It includes a summary of a literature review, state of the practice survey, and validation case studies conducted to test the concepts and methods evaluated as part of this project. This report also summarizes travel time reliability performance measures, strategies for improving travel time reliability, and tools available for measuring the impacts that the strategies have on travel time reliability. The Final Report also describes a framework for incorporating reliability performance into the transportation planning process. A detailed appendix describes the linkage between this project and the TCAPP web tool.

Incorporating Reliability Performance Measures into the Transportation Planning and Programming Processes is available at <http://www.trb.org/Main/Blurbs/168854.aspx>.

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