



U.S. Department of Transportation
Federal Highway Administration

OFFICE OF OPERATIONS
<https://ops.fhwa.dot.gov>

FHWA-HOP-21-066



RELIABILITY DATA AND ANALYSIS TOOLS (L02/L05/L07/L08/C11)

A tool suite to help transportation planners and engineers improve data monitoring and analysis to achieve more consistent, predictable highway travel.

CASE STUDY

Massachusetts Department of Transportation

Validating the Adaptability of Travel Time Reliability Measurements

ABOUT THIS CASE STUDY

The second Strategic Highway Research Program (SHRP2) developed data and analysis tools to improve the measurement and management of travel time reliability by transportation practitioners. The SHRP2 Program provided funding to help agencies test the tools and incorporate reliability into their business practices. The Massachusetts Department of Transportation (MassDOT) project included the following tools:

DATA COLLECTION

L02 Guide to Establish Monitoring Programs for Travel-Time Reliability

Guidebook, visualization tools, and methods for integrating data to analyze reliability, including causes and locations of unreliable performance and identification of potential mitigating strategies.

BETTER DECISIONS

L05 Handbook for Incorporating Reliability Performance Measures into Transportation Planning and Programming

Guide to the institutional arrangements and technical steps needed for State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs) to incorporate reliability into their decision-making.

Concluded in 2020, MassDOT's objective in this study was to incorporate the measures into its planning and project prioritization process by building a Mobility Monitoring Dashboard Proof of Concept.

For its analysis MassDOT selected multi-lane high-traffic routes (figure 1) with significant daily congestion radiating out of the Boston core to the circumferential highway, historically named SR-128, but now designated I-95 from Danvers to Canton and I-93 from Canton to Braintree. The routes are:

- Interstate highways: I-90, I-93.
- Divided highways: US-1, SR-2, SR-1A.
- Commuter arterials: SR-9.
- Massachusetts Department of Conservation and Recreation (DCR) Parkways: Veterans of Foreign Wars (VFW) Parkway, Jamaicaaway, Riverway.

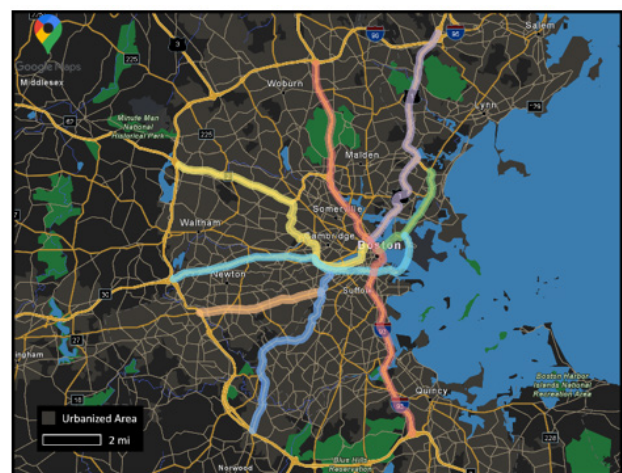


Figure 1. Map. Selected Boston, MA Metropolitan Area Multi-lane Highways. Source: MassDOT. Map Data © 2020 Google.

BACKGROUND

MassDOT, with the support of a consultancy, used the SHRP2 L02 and L05 guides as a framework to review and analyze MassDOT data sources for their usability and feasibility in creating travel time reliability (TTR) performance measures for the State's highway network.

PRODUCT IMPLEMENTATION

Data

MassDOT analyzed a range of data sources to determine their applicability to reliability measurement and the extent of their coverage of the State’s highway network. Table 1 summarizes the candidate data sets.

Table 1. Candidate Data Set Feature Summaries.

DATA SET	DESCRIPTION	ASSESSMENT
TRAVEL TIME DATA		
National Performance Management Research Data Set (NPMRDS)	GPS-based probes from INRIX®	Good for National Highway System (NHS) routes
GoTime	Bluetooth® sensors on MassDOT-controlled highways	Useful for certain non-NHS highways
511	GPS-based probes from HERE™ Technologies	Possible to fill in non-NHS highways; may be restricted use and not currently archived
Waze®	Crowd-sourced travel time	Questionable for rigorous analysis
Uber Movement®	Anonymized Uber® trip data	Emerging data source; questionable for rigorous analysis
INCIDENT AND WORK ZONE DATA		
MassDOT Highway Division Event Reporting System (ERS)	Incident and work zone data input by traffic operations personnel	True event duration not provided; Uncertain availability of archive data
Waze	Same as above	Same as above
WEATHER DATA		
MassDOT Road Weather Information Systems (RWIS)	Weather observations	Twenty stations; coverage inadequate

L02

MassDOT used the L02 product to review the department’s reliability monitoring capabilities. The research team reviewed the sources and availability of candidate data sets, including those for continuously-collected travel time, incident and work zones, and weather. The team identified the data MassDOT had on hand and determined any gaps that existed in those data.

MassDOT held a workshop to discuss reliability data and brainstorm ideas for how the data might be used. Workshop participants included representatives from the Boston Region MPO and MassDOT’s units for safety, freight, performance management, planning, and intelligent transportation systems (ITS). The study team determined that the NPMRDS data was the best fit for further analysis toward the production of travel time performance measures and that other data sets were not detailed enough for comprehensive analysis.

L05

MassDOT used the L05 product as a guide to establish how the agency could forecast reliability, use reliability measures in the planning and programming processes, and ensure that operations projects are considered on equal footing with other improvement types. To scope out MassDOT’s internal department requirements for incorporating reliability into its processes, the study team held a workshop with participants from MassDOT’s ITS, capital planning, and performance management teams to discuss their decision-making processes for project initiation, prioritization, and programming.

The research team produced a technical memorandum specifying how to include reliability measures in the following MassDOT processes and reports:

- MassDOT’s Annual Performance Management Report Card for external stakeholders, called *Tracker*, which summarizes the department’s performance using an array of measures in several categories, including Customer Experience.
- The Massachusetts Long-Range Transportation Plan (LRTP).

The research team also reviewed the following program and project decision-making processes to determine how reliability and operations improvements might be included similarly to other improvement types and plans:

- The Massachusetts Project Intake Tool (MaPIT), which manages MassDOT’s formal 3-step initiation process for new projects.
- The Project Selection Advisory Council (PSAC) scoring algorithm for Economic Impact, one of eight scoring criteria that determine which modernization and expansion projects are funded in the Capital Investment Plan (CIP).
- Freight program addition to the CIP.
- MPO Long-Range Transportation Plans.
- MPO Transportation Improvement Programs (TIPs) and State Transportation Improvement Program (STIP).

The team developed prototype heatmaps and storymaps for inclusion in reports, such as *Tracker*, to illustrate reliability and congestion performance. These could be elements in a future Mobility Monitoring Dashboard. Using the NPMRDS data, the study team explored visualizing various performance measures for the selected routes, including:

- Speed Ratio (figure 2)
- 80th Percentile Travel Time Index
- Level of Travel Time Reliability
- Truck Travel Time Reliability
- Bottlenecks and queueing

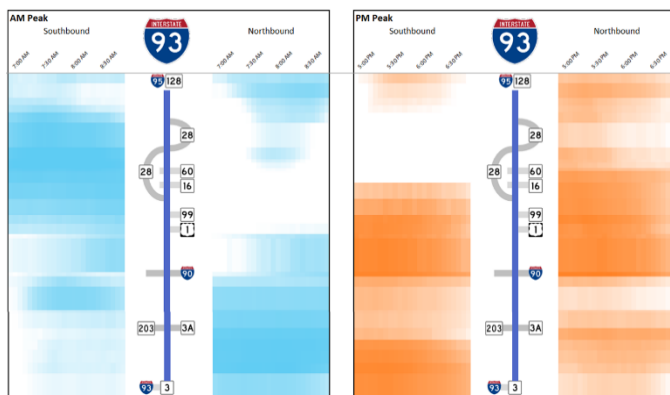


Figure 2. Example of Speed Ratio Heatmap comparing Northbound and Southbound, AM and PM Peak hours on I-93. Source: MassDOT

ASSESSMENT OF THE TOOLS: BENEFITS, CHALLENGES, AND RECOMMENDATIONS

The L02 and L05 Guides gave MassDOT a firm foundation for incorporating reliability analyses into its processes and performance management reporting.

L02

The L02 guide provided a good basis for understanding how to explore a broad range of reliability-related data. MassDOT found the NPMRDS dataset to be the most robust and useful; however, MassDOT intends to expand the data in its reliability analyses to include weather, work zone and incident, and other pertinent data sets.

L05

The SHRP 2 L05 guide supported planning and decision making by allowing MassDOT to explore existing key decision points, stakeholders, and policies and make recommendations for how to enhance them. MassDOT used L05 to discuss long range planning; program trade-off analysis; project notification and initiation; and project prioritization and programming within TIP and STIP. A challenge was conveying the meaning and importance of the concept of reliability as initial steps were taken to increase the use of reliability for MassDOT programming and planning.

IMPACTS ON BUSINESS PRACTICES

The MassDOT SHRP2 L02 and L05 project was successful in bringing multiple staff disciplines at MassDOT and the Boston Region MPO together to ensure that operations projects and reliability are integrated into the capital improvement and long-range planning processes. The project demonstrated the need for coordination across organizational boundaries to gather the data needed for reliability analysis and for incorporating the analysis into MassDOT’s ongoing programming and planning processes. The disciplines engaged in the project included operations, planning, freight, and safety, among others. A principal outcome was the sharing of plans and potential coordination regarding the acquisition of relevant data sets applicable to TTR analyses.

MassDOT identified the following additional opportunities to apply TTR analyses:

- Providing input on the effects of tolling discounts on congestion
- Prioritizing interchanges for future investments

- Scoping an upcoming intelligent transportation systems (ITS) strategic plan
- Shaping MassDOT analysis of Federal traffic reliability performance measures

CONCLUSION

As a result of completing this project, MassDOT has launched several agency initiatives to incorporate reliability into its processes, including the TIPs and STIP. MassDOT reported gaining a rich appreciation for the applicability of reliability analyses to the improvement of its internal processes and the delivery of excellent services to the public through the SHRP2 reliability tool project.

FOR MORE INFORMATION

Boston Region MPO Congestion Management website:

<https://www.ctps.org/cmp>

FHWA SHRP2 Home Page:

<https://www.fhwa.dot.gov/goshrp2>

Except for any statutes or regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide information regarding existing requirements under the law or agency policies.

The U.S. Government does not endorse products, manufacturers, or outside entities. Trademarks, names, or logos appear in this document only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

CONTACTS

Bob Frey

Massachusetts Department of Transportation

bob.frey@dot.state.ma.us

Derek Krevat

Massachusetts Department of Transportation

derek.krevat@dot.state.ma.us

Tracy Scriba

Federal Highway Administration

tracy.scriba@dot.gov