U.S. Department of Transportation
Federal Highway Administration

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

FHWA-HOP-21-070

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

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

Oregon Department of Transportation

Implementing Travel Time Reliability Analysis Methodologies in Oregon

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 Oregon Department of Transportation (ODOT) project included the following tools:

ANALYSIS

C11 Tools for Assessing Wider Economic Benefits of Transportation
Spreadsheet-based tools that expand economic benefits analysis of highway projects to contain network-oriented concepts, including reliability.

BACKGROUND

Through a pilot concluded in 2020, ODOT adapted and applied SHRP2 C11 reliability analysis methodologies as a post-processor to the Highway Economic Requirements System (HERS) model and Oregon's Metropolitan Planning Organization (MPO) travel demand models. The HERS computer model evaluates the relationship between highway investment and system condition, performance, and user cost levels. Over the last 20 years, the State of Oregon successfully used HERS for long-range planning analyses, corridor studies, and development of key performance metrics. ODOT sought to develop an approach to integrate reliability components into its planning and programming decision processes.

To test the post-processing analysis, ODOT selected eight freeway segments to compare more extensive C11-based reliability results with analyses the agency previously completed and to develop scenarios for the reliability effects of planned improvements given projected future traffic growth in those cities:

- Six within the Portland Metro area—I-5, I-205, I-405, I-84, US-26, and OR-217 (figure 1).
- US-97 within the City of Bend (figure 2).
- I-105 within the City of Eugene (figure 3).

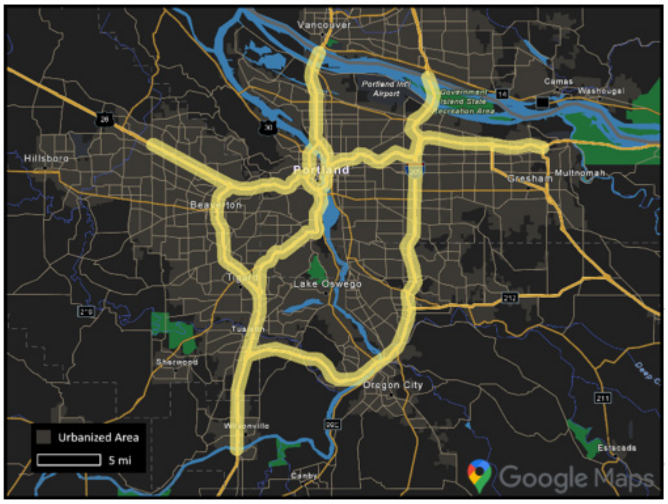

Figure 1. Map. Portland Metropolitan Area Test Freeways. Source: ODOT. Map Data © 2020 Google.

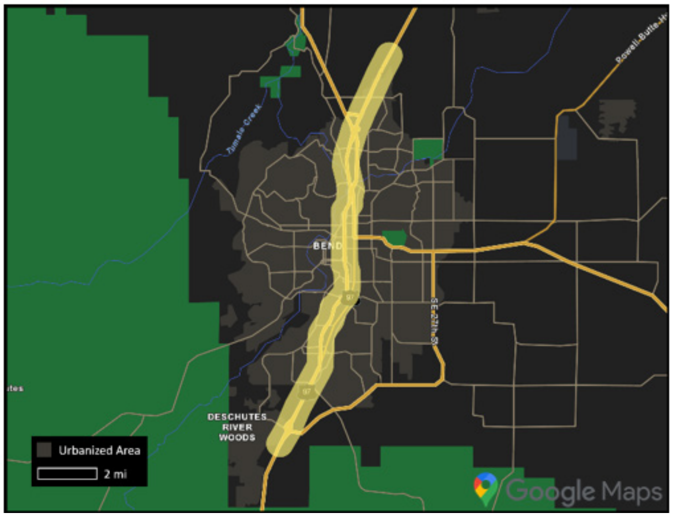

Figure 2. Map. US-97 test site in Bend, OR. Source: ODOT. Map Data © 2020 Google.

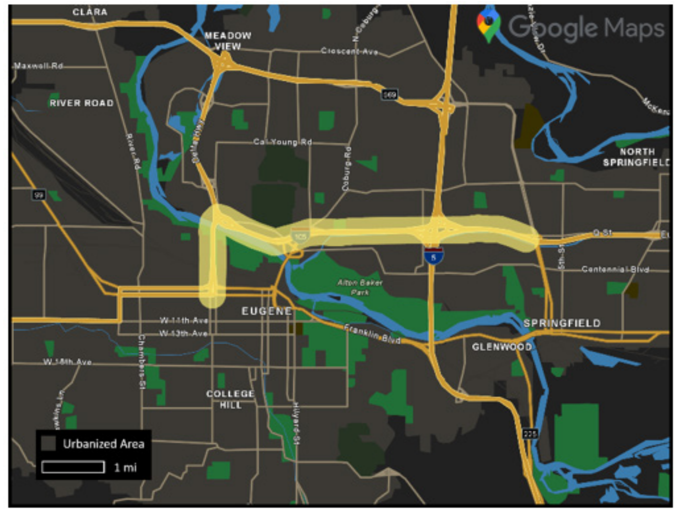

Figure 3. Map. Test site on the I-105 freeway in Eugene, OR. Source: ODOT. Map Data © 2020 Google.

PRODUCT IMPLEMENTATION

Data

The HERS model uses Highway Performance Monitoring System (HPMS) data, which describe the extent, condition, performance, use, and operating characteristics of the Nation's highways. With these data, the HERS model evaluates the base and future performance of the roadway system associated with proposed improvement projects. ODOT determined that the HPMS dataset was compatible with the requirements of the C11 methodology.

ODOT also supports transportation demand modeling for Oregon's smaller metropolitan areas. ODOT uses EMME®, a multimodal transportation network analysis tool, for trip assignments, the last step of the four-step transportation modeling framework.

For this SHRP2 reliability tools project, ODOT used the system performance outputs of HERS and its EMME transportation demand model as inputs to a new C11 post-processor customized for Oregon.

C11 Methodology

The project implemented C11 principles by building a post-processor to modify the HERS output to produce reliability performance measures, such as the Travel Time Index (TTI) and the Planning Time Index (PTI).

The project used the National HERS model for the ODOT project. ODOT has found the delay element set within HERS to be a particularly useful output for reliability analysis. HERS evaluates three types of delay: zero-volume delay, incident delay, and congestion delay:

- Zero-volume delay is the delay associated with traffic control devices.
- Incident delay is the delay associated with crashes. HERS estimates delay due to crashes through a secondary (or inferred) process where the model estimates the delay cost of crashes and then back-calculates the delay estimates due to crash incidents from the cost calculations.
- Other congestion (or recurring) delay is the average delay due to non-incident congestion.

HERS did not have a direct process for evaluating the probabilities of changes in demand and capacity associated with incremental changes in sources of non-recurring congestion, such as weather conditions and special events. However, ODOT had previously developed a model batching process that used capacity and demand adjustments for reliability assessment. ODOT used the results of this legacy process to validate the output of the newly developed post-processor.

With the new process for producing reliability performance measures using C11 principles, ODOT executed the following steps:

- Developed capacity and demand adjustment factors in HERS associated with weather and incident data for the project area.
- Ran the HERS output through the C11 post-processor both with and without facility improvements.
- Analyzed travel time reliability performance measures, such as TTI and PTI.

The study team ran the post-processing tool with a test dataset containing the eight corridors and used ArcGIS® to combine the output with the State highway system. Figure 4 shows the resulting TTI (80th percentile) for the 2015 Base Scenario and the 2035 Build Scenario for I-405 in Eugene. The green center line is the base condition while the yellow split line shows the freeway segment that the methodology projects will experience reduced travel time reliability in the 2035 build condition. The 2035 scenario uses the HERS Full Needs Analysis. The example is for test purposes only and does not reflect the policy and budgeting constraints that might normally be applied.

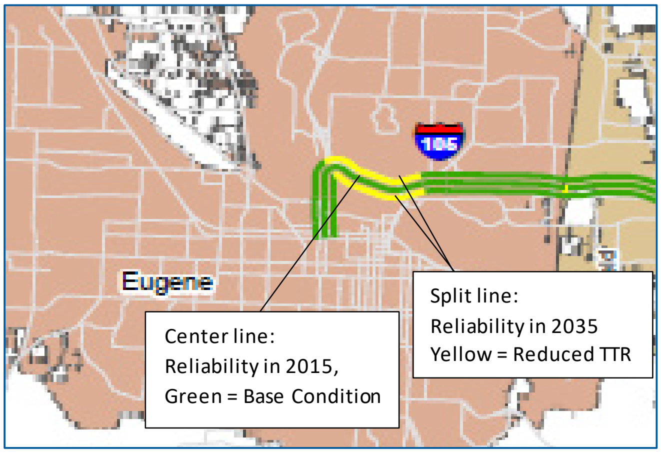

Figure 4. Screenshot. Example from I-105 in Eugene, OR, with reliability in 2015 (center line) and 2035 (split line). Source: ODOT

ASSESSMENT OF THE TOOLS: BENEFITS, CHALLENGES, AND RECOMMENDATIONS

The ODOT project modified HERS and programmed the C11 post-processor and the agency now considers the project complete. The analysis found results consistent with the "batch process" method of reliability analysis that ODOT previously used. The modifications needed for ODOT's travel demand model have also been completed. ODOT's experience with this pilot may inform other communities interested in implementing a similar approach. One challenge faced was in assessing the reliability of the tool to predict future conditions. While ODOT maintains a sophisticated travel demand model, they found staff still needed to spend time post-processing the output and conducting quality assurance checks of outputs to assess the accuracy of the results. This additional staffing need could potentially be a barrier to some States in implementing a similar pilot program. Overall, this project successfully implemented the C11 methodology within ODOT's modeling system architecture.

IMPACTS ON BUSINESS PRACTICES

In the past, ODOT's planning and programming processes had not incorporated travel time reliability. The new C11-based postprocessors allow ODOT to analyze reliability throughout the State of Oregon, enabling them to incorporate travel time reliability more directly in their decision-making process. Through this effort, ODOT grew to appreciate that, although reliability is a major issue for the State's bigger metropolitan areas, it is equally important in smaller areas where traffic volumes are increasing. ODOT continues to employ the models predictively for conditions as far as 40 years into the future where reliability can be used to evaluate facility alternatives with long planning horizons. ODOT regarded this project so highly that it successfully obtained State funding to perform additional work to complete both the HERS and the travel demand model portions of the project.

As a result of the successful pilot project, ODOT is looking for Statewide applications to further integrate and use the tool. The agency intends to use the tool to assess the locations of truck routes, analyze congestion, and identify barriers facing truck traffic.

CONCLUSION

ODOT regarded this project as a key step in fully incorporating reliability analyses into its Statewide planning and programming processes and has begun to seek additional opportunities to use the tool.

FOR MORE INFORMATION

ODOT Reliability Performance Analyses
https://www.oregon.gov/odot/Planning/Documents/HERS-ST-Reliability-Performance-Analyses-Phase-II-Delay.pdf
SHRP Project C11: Reliability Analysis Tool Documentation
http://onlinepubs.trb.org/onlinepubs/shrp2/RFPL38/C11ReliabilityTechnicalDocumentation.pdf
SHRP 2 Solutions
https://www.fhwa.dot.gov/goshrp2

CONTACTS

Richard Arnold
Oregon Department of Transportation
richard.arnold@odot.state.or.us

Tracy Scriba
Federal Highway Administration
tracy.scriba@dot.gov