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

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

CASE STUDY

North Carolina Department of Transportation

Implementing a Suite of Travel Time Reliability Tools in North Carolina

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 North Carolina Department of Transportation (NCDOT) project included the following tools:

DATA COLLECTION AND INTEGRATION

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.

ANALYSIS

L07 Reliability by Design

Spreadsheet-based treatment analysis tool to assess how different design improvements affect reliability, delay, safety, and benefit vs. cost over the lifecycle.

L08 Incorporating Travel-Time Reliability into the Highway Capacity Manual

Highway Capacity Manual (HCM) update to estimate travel-time reliability performance measures on major freeways and urban arterials.

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.

BACKGROUND

NCDOT, in collaboration with the Institute for Transportation Research and Education at North Carolina State University, participated in the SHRP2 Implementation Assistance Program (IAP) with a proof-of-concept pilot study ending in 2020 that used the SHRP2 reliability and data analysis tools. NCDOT sought to improve their travel time reliability (TTR) monitoring, modeling, and analysis capabilities. NCDOT evaluated how well the SHRP2 reliability tools could support their TTR systems and program.

After reviewing other States' implementation efforts, NCDOT selected three SHRP2 reliability products for the pilot project: L02, L05, and L08. NCDOT also assessed the L07 tool at a high level. The tools were applied to freeways in the Research Triangle region of Raleigh, Durham, and Chapel Hill:

- A 48.7-mile segment of I-40 between I-95 and North Carolina Highway 147. A mixture of rural and urban interstate, NCDOT studied this route in several portions, which experience differing levels of congestion.
- I-440, a 16.4-mile beltway partially encircling central Raleigh.
- I-540, a 25.8-mile component of the Raleigh Outer Loop beltway.
- Wade Avenue Extension, a four-lane freeway linking I-40 to I-440.

PRODUCT IMPLEMENTATION

Data

Using these SHRP2 tools requires various types of data, including travel time, traffic flow, incident rates, planned special events, and weather data.

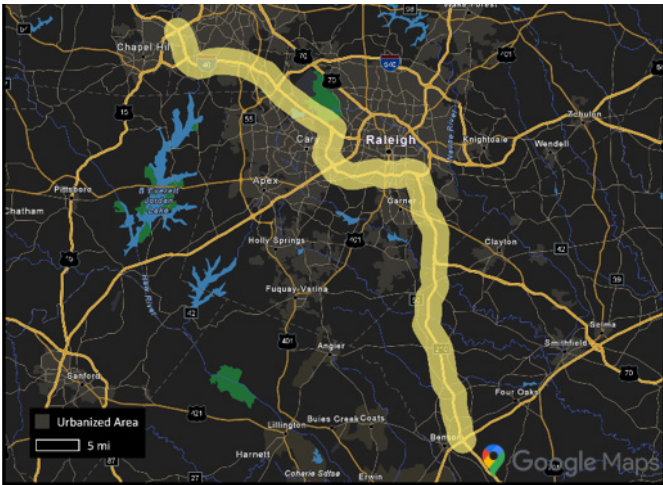


Figure 1. Map. I-40 project segment in the Research Triangle area. Source: NCDOT. Map Data © 2020 Google.

NCDOT used speed and travel time data from INRIX®, segmented by Traffic Message Channel (TMC) segment. Flow data for the study year was sourced from 60 radar sensors deployed across the Research Triangle. Incident data was sourced from the NCDOT Travel Information Management System. Planned special events on weekdays, such as football games and concerts, were counted as special demand generating events. The study used two types of weather data: observational data from local weather stations, and adverse weather warnings from the National Weather Service.

L02

NCDOT used the L02 reliability monitoring guide on all four highways in the Raleigh area. NCDOT assembled data of travel rates, flow rates, weather, incidents, and planned events that spanned 206 TMC segments. The TMC segments provided data at 5-minute granularity for the entirety of 2010. After gathering the data, the research team classified observations of operating conditions as either “normal” or “abnormal” and tagged observations with explanations of what abnormality occurred.

After preparing the data, NCDOT developed statistical distributions to visualize how roadway conditions vary. The team separated the performance by time of day and different operating conditions using the “normal” and “abnormal” tags. NCDOT performed facility-wide and route-based analyses for all four facilities, along with additional incident- and special event-focused analyses for I-40.

At a facility level, NCDOT found incidents significantly increased travel rates during all analysis periods. Results for I-

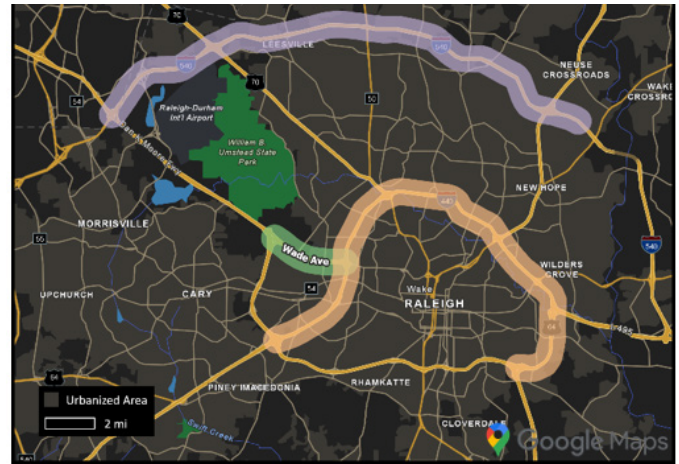


Figure 2. Map. Project segments: I-440 (orange), I-540 (purple), and Wade Avenue Extension (green). Source: NCDOT. Map Data © 2020 Google.

440, the only facility with significant geometry changes along the route, showed that the structural bottleneck has a greater impact on travel time than abnormal events.

L05

The project team presented key findings and recommendations from the L05 project to other NCDOT and MPO officials. The partners agreed that providing reliable transportation options is important to the citizens and businesses of North Carolina, but that TTR is difficult to understand and articulate. Therefore, NCDOT needs to pursue continued internal discussions and dialog with MPOs before the department can determine how and at what level TTR monitoring and analysis should be included in project planning and programming.

L07

The project team implemented the L07 tool on a 12.5-mile segment of I-40 to compare its segment-based approach to the L08 facility-based approach. The research team provided facility geometry, demand, weather, and incident rate inputs meant to be representative of a 12.5-mile segment of I-40. NCDOT found that L07 tends to estimate less congestion and travel time degradation than L08 because the tool does not account for effects of bottleneck queuing. For this reason, the NCDOT team did not explore the tool further.

L08

NCDOT implemented the L08 tool on four freeway routes, varying in length and conditions, along I-40 in the Triangle region. NCDOT implemented the L08 tool using 15-minute

