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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

Florida Department of Transportation

Implementation of Reliability Tools in Programming and Planning

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 Florida Department of Transportation (FDOT) project included the following tools:

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.

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.

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

Through a pilot concluded in 2020, FDOT used the SHRP2 reliability product suite to incorporate travel time reliability (TTR) into their highway project planning and programming decisions. Working with the Hillsborough County Planning Commission (part of the MPO covering the Tampa, Florida region) and a consultancy firm, FDOT sought to estimate travel time reliability (TTR) impacts of planned improvements as they transitioned to probe-based travel time data for performance monitoring and reporting.

FDOT had recently acquired probe-vehicle data. They applied the SHRP2 products directly to their internal planning processes: their Strategic Investment Tool (SIT), their State and regional planning processes, and their Project Delivery and Environmental Management (PD&E) process. FDOT aimed to test if these products helped integrate reliability using the new probe vehicle data. Table 1 indicates which tools were examined for use in the applicable FDOT processes:

Table 1. Applying SHRP2 Reliability Products to FDOT Processes

	SHRP2 PRODUCT			
FDOT PROCESS/TOOL	**L07**	**L08**	**C11**	**L05**
FDOT's Strategic Investment Tool	●		●	
FDOT's Planning				●
MPO Planning			●	
Project Delivery and Environmental Management and Corridor Planning		●	●	●

FDOT used the Hillsborough I-75 Capacity Improvement Project North in the Tampa Bay metropolitan area to assess the use of SHRP2 reliability products for the PD&E process. As implied by its title the I-75 project examined alternatives for capacity expansion due to projected regional growth. The selected highway segment extended over 12.1 miles of the I-75 freeway from US 301 to north Fletcher Avenue. This section includes seven interchanges (figure 1).

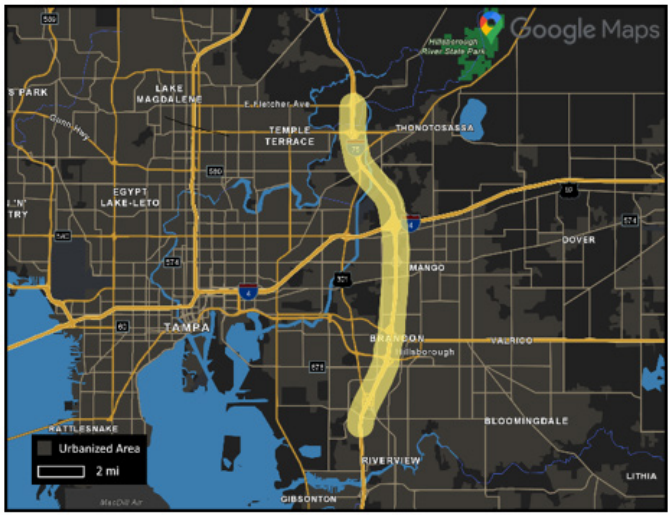

Figure 1. Map. Hillsborough I-75 Capacity Improvement Project North near Tampa, FL. Source: FDOT. Map Data © 2020 Google.

PRODUCT IMPLEMENTATION

Operations and Reliability Prediction in FDOT's Strategic Investment Tool —C11 and L07

The FDOT SIT is a decision support system that ranks highway projects in FDOT's Strategic Intermodal System (SIS) based on current conditions, including reliability. A University of Florida model predicts Travel Time Reliability Indices (TTRI) for SIS highways based on the probabilities of conditions that influence reliability, such as weather or construction. The SIT ranks SIS highways as having high, medium, or low congestion using the predicted TTRI value. The SIS informs Florida's Transportation Plan (FTP).

FDOT sought to further incorporate TTR into the SIT ranking process using probe-vehicle data. The project team compared the C11 and L07 tools and equations against methods already used within the SIT for their applicability to FDOT's process. After FDOT and the project team concluded that the C11 or L07 methods of estimating reliability would not substantially improve the University of Florida method, the focus of this task became:

- Calculating the Planning Time Index (PTI) using probe data obtained from HERE® Technologies.
- Recalibrating the SIS freeway congestion ranking thresholds using the PTI.
- Testing the process on additional road types, such as arterials and two-lane highways.

Incorporating Reliability into FDOT's Planning Processes—L05

FDOT sought to better incorporate reliability into its planning process. The SHRP2 Project L05 Guidebook identifies points in the project programming and development process where planners can apply reliability measures and operations solutions. Siloed, categorical project funding at the State-level hindered the use of reliability and operations tools in Florida's existing planning practices. FDOT desired a seamless process where improvements of all types, including operations solutions, could be matched to deficiencies.

FDOT researched how to incorporate reliability into key policy statements, namely the FTP and the SIS Policy Plan; identified funding mechanisms for operations projects; and investigated how to more effectively include travel time reliability (TTR) in planning processes at District and Central offices.

The key product, the FDOT Planning for Travel Time Reliability Guide, explains where and how FDOT planners can incorporate TTR into the planning process for capacity expansion. This guide describes the planning process for operational improvements, opportunities for collaboration, tools for incorporating TTR, and methods to fund improvements that address TTR.

Incorporating Reliability into MPO Planning Processes—C11

FDOT worked with the Tampa MPO to test how C11 could be used to better integrate reliability into an MPO's planning processes. The Tampa MPO was updating their Long Range Transportation Plan (LRTP), and wanted to add reliability as a performance measure for assessing alternative project bundles at varying investment levels. The suite of C11 techniques for assessing the economic benefits of transportation projects also considers safety impacts, which the Tampa MPO also examined in addition to reliability.

The C11 methodology was useful for providing project-level analyses; however, the Tampa MPO was interested in evaluating impacts at the regional level. Using the C11 methodology, specifically the TTR Sketch Planning Tool, the team constructed a post-processor that integrated output data from their regional travel demand forecasting model (i.e., the Tampa Bay Regional Planning Model). The resulting product predicted cost-benefit results at the regional level, rather than the project level.

The post processor used the following data and parameters:

- Operations project effects from the Highway Economic Requirements System model.
- Operations project costs from the Tool for Operations Benefit Cost Analysis.
- Safety performance functions (SPFs) from the *Highway Safety Manual*, adapted for FDOT by the University of Central Florida.
- Crash reduction factors from the FHWA's Desk Reference.
- Florida reliability data from National Performance Management Research Data Set (NPMRDS).

In the end, FDOT and the Tampa MPO were able to successfully create a post-processor that met their needs, integrating reliability into their existing planning processes and predicting impacts at the regional level.

Incorporating Reliability into Management and Corridor Planning Processes—L05, L08, C11

FDOT developed a methodological framework for using TTR as one of the operational performance measures of effectiveness in alternatives analyses conducted for PD&E studies. FDOT determined that including reliability in its analyses would improve its ability to increase performance robustness and extend the service life of designs. Accordingly, FDOT incorporated a TTR analysis that evaluates performance robustness under a variety of conditions, such as demand surges, incidents, crashes, inclement weather, and work zones.

FDOT accomplished this by demonstrating how traffic analysts can perform TTR analyses using post-processing results from microsimulation tools with theoretical extensions from the SHRP2 L08 tool, which FDOT selected over other methods, including L07 and C11. The proposed method uses microsimulation results to calibrate an L08 HCM reliability model, which then predicts the TTR used to evaluate each project alternative.

The Freeway TTR Analysis Framework was tested on PD&E studies under near real-world conditions. The test reached a positive conclusion by producing results consistent with expectations. For example, the case study results showed the expected benefits of operations strategies, such as hard shoulder running, on travel time reliability.

ASSESSMENT OF THE TOOLS: BENEFITS, CHALLENGES, AND RECOMMENDATIONS

L08

FDOT used the L08 methodology to build its Freeway TTR Analysis Framework, which incorporates reliability analysis into its PD&E studies. The project team assessed TTR estimation methods from the L07, L08 and C11 toolkits and determined that the SHRP2 L08 HCM reliability methods are the most precise of all the TTR predictive models. FDOT found the L08 tools to be consistent with other FDOT traffic analysis tools because they are HCM-based. The study team noted that one L08 tool, FREEVAL, was better suited for analyzing a range of scenario combinations than microsimulation packages such as VISSIM® or CORSIM. Overall, FDOT found that the L08-based HCM predictive tool developed through this project met their needs and successfully integrated reliability analyses into their PD&E processes.

C11

Hillsborough County demonstrated how all Florida MPOs can use the C11 methods to add reliability analysis to preparing LRTPs. FDOT customized the C11 to incorporate travel demand forecasting models already used by Florida MPOs. With support from the implementation grant, the FDOT improved the C11 tool by:

- Developing a user interface that allows easy access to the travel demand forecasting files.
- Updating SPFs and crash modification factors.
- Expanding the list of potential project types.
- Updating impact factors and costs for operations and intelligent transportation systems strategies.
- Predicting travel time reliability using Florida-specific relationships.

Using the customized C11 methods, the Tampa MPO pilot demonstrated the tradeoffs between traditional capacity improvements and safety and operations projects, and tested different cases of investment versus performance. The results were incorporated into the MPO's LRTP update and successfully demonstrated how C11 methods can be used by all Florida MPOs.

L05

FDOT was seeking to increase the knowledge and application of TTR by its staff and stakeholders. FDOT found the L05 Guide to be a valuable and effective standard for incorporating reliability into the agency's planning processes and ultimately based its Planning for Travel Time Reliability Guide on the tool.

IMPACTS ON BUSINESS PRACTICES

Through their experience using the SHRP2 products, FDOT is continuing to update their decision-making processes and tools to include reliability as a performance measure. FDOT and local MPOs are successfully applying the reliability methodologies for planning and programming.

Prior to adapting the C11 methods, the Tampa MPO could neither calculate reliability and safety measures nor evaluate operations and safety improvements for its LRTP. The revised C11 post-processor fits comfortably into existing planning processes by linking the plan directly to the MPO's travel demand forecasting models. All Florida MPOs use the same travel demand software and are thus universally able to use the post-processor.

FDOT's Planning for Travel Time Reliability Guide provides FDOT employees and consultants with tools to better understand how to incorporate TTR into FDOT's planning process for capacity expansion. Other business process impacts were as follows:

- The Florida TSMO Strategic Plan incorporated TTR.
- Planned FDOT Traffic Analysis Handbook updates included a TTR specification.
- FDOT SIT incorporated TTR.

CONCLUSION

FDOT has been developing congestion and reliability measures for many years at both the Central Office and District levels. SHRP2 reliability products enabled FDOT to further its transition to probe vehicle data and to develop new products and processes that promote the use of reliability performance measures by FDOT and Florida's MPO planners.

FOR MORE INFORMATION

Florida Department of Transportation
https://www.fdot.gov/
SHRP 2 Solutions
https://www.fhwa.dot.gov/goshrp2

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