

STRIDE

Southeastern Transportation Research,
Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE Project I

Freeway Management for Optimal Reliability

January 1, 2017 – June 30, 2019

Yafeng Yin, Ph.D.

April 15, 2020

1. Project Description

This project will develop tools for analyzing and optimizing system reliability on freeways. These tools include analytical and simulation frameworks for the optimization and near real-time performance forecast of active traffic management (ATM) systems. A key analysis is how to incorporate the effect of incidents on segment capacity and to verify those effects using empirical data gathered by state DOTs. The proposed congestion mitigation toolbox will include local and/or system-wide adaptive ramp metering, integrated ramp metering and variable speed limit control, hard shoulder running, speed harmonization, dynamic pricing of express lanes, optimized traffic diversions and efficient incident response and management. ATM deployment is a means to meet specific reliability goals below a desirable agency specified threshold. This two-year project will develop a methodological framework, a novel integrative process of incident modeling, and select and optimize appropriate strategies from the ATM toolbox to meet reliability goals. We will also test the validity of the proposed approach using data from a minimum of three freeway facilities in the Southeast region at both rural and urban locations.

2. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	3
Technical Report: Number of client-based technical reports published	1 (STRIDE Final Report)
OUTCOMES	
Body of Knowledge: Number of trainings for transportation professionals	2 (STRIDE webinar and UTC training)
Professionals Trained: Number of professionals participating in trainings	64 (27 attendees, 27 YouTube views)
IMPACTS	
Stakeholders: Number of stakeholders met with to encourage adoption or implementation of product(s)	1 (TRB committee on Highway Capacity and Quality of Service)
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	Unknown at this point

3. Products

The team developed a methodology for modeling the evolution of incidents on segment capacity in a time dependent form. The method was calibrated based on actual incidents on a facility in the Triangle Region, NC. The metric is a capacity adjustment factor (CAF) that varies over time. The team also applied the method to recurring congestion periods, and estimated that the HCM freeway capacities are slightly overestimated by about 7-9 %. All testing and calibration was conducted on the sanctioned FREEVAL model in HCM6.

Product 1: Calibrated FREEVAL, a freeway analysis tool, to improve the existing product, particularly for non-recurring congestion effects such as incidents.

Product 2: Developed a new methodology using test site data to estimate and improve CV/AV technology on freeway reliability.

Product 3: Developed an improved methodology for estimating and improving travel reliability to better coordinate freeways and local arterials.

4. Body of Knowledge & Professionals Trained

- 1) Freeway Analysis and Reliability in FREEVAL: A Hands on Workshop Freeway Analysis; a three-hour workshop provided at the 6th Annual UTC for the Southeastern Region, Clemson, SC., 2018 and led by Behzad Aghdashi, Ph.D., and Nagui Roupali, Ph.D. The workshop covered freeway facility methodology currently documented in the HCM 6th Edition with a focus on applications for operational analysis, reliability and model calibration. (10/25/2018; 13 participants)
- 2) STRIDE webinar - Nagui Roupail, PhD and Behzad Aghdashi, PhD, NC State University, "Freeway Facility Reliability: Improved Modeling of Incident Impacts" (11/13/2019; 14 professionals trained; 27 YouTube views)

5. Stakeholder Engagement

- 1) The team discussed the research findings with TRB committee on Highway Capacity and Quality of Service who oversee the content of Highway Capacity Manual (HCM).

6. Adoption/Implementation

The research has yielded a journal publication in an upcoming TRR where it will be available publicly for anyone to evaluate the impact of incidents from routes extracted from the NC statewide segmentation database.

7. Broader Impacts

A more accurate representation of the effects of incidents of freeway reliability – as predicted in FREEVAL-- is critical, as incidents contribute inordinately to the upper tail of the travel time distribution. With FHWA reliability rule making about to take effect, predicting the effects of treatments on incidents will be critical and will provide a solid foundation for such investments. This research acted as the first step in characterizing the behavior of incidents on capacity reduction on the freeway system. Further implementation in the HCM tools is needed to enable wide use of this methodology in the reliability context.