

Wisconsin Highway Delay Causation Study

Objectives

- Measure recurrent and non-recurrent delays
- Link non-recurrent delays to available causal factors

Benefits

- Provides WisDOT a reproducible method for monitoring delays
- Helps provide cause of delays
- Supports future statewide and corridor-level diagnostics

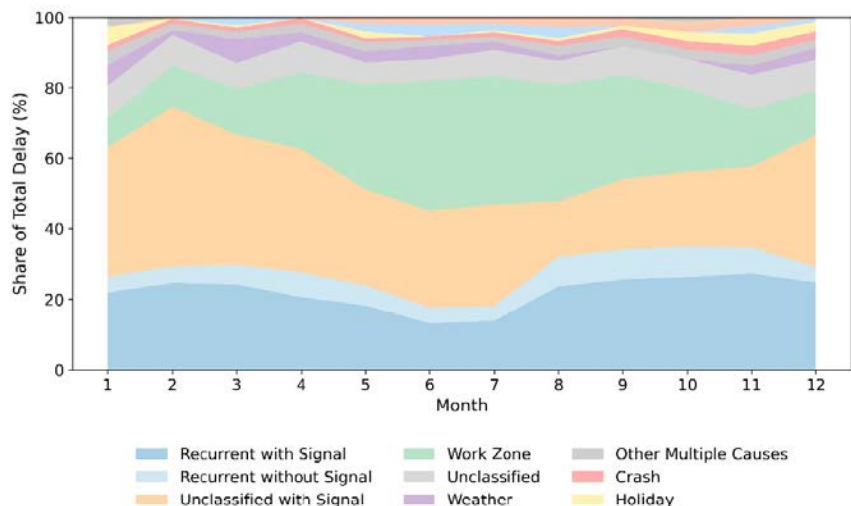
Background

Transportation agencies use delay, travel time reliability, and related mobility measures to monitor system performance, identify operational needs, and support planning and investment decisions. Vehicle-hours of delay (VHD) is a useful metric because it combines congestion intensity with the number of vehicles affected. Delay magnitude alone does not explain why delay occurs. Similar levels of delay may result from routine peak-period congestion, crashes, work zones, special events, weather, traffic signals, or combinations of these factors.

Delay patterns vary across regions, facility types, and corridors. Urban interstate and arterial facilities may experience recurring peak-period congestion, while other corridors may be more affected by work zones, crashes, weather, special events, or localized bottlenecks. These differences require a framework that can classify delay consistently while still supporting localized interpretation. This study aimed to develop a reproducible framework for analyzing highway delay causation in Wisconsin.

Methodology

Researchers integrated National Performance Management Research Data Set (NPMRDS) travel time data with traffic volume estimates, crash and incident records, lane closure and work zone data, special event information, weather data, holiday indicators, signal information, and roadway attributes. Delay was measured using VHD for each Traffic Message Channel (TMC) segment in 15-minute intervals. VHD was calculated by multiplying the per-vehicle delay relative to an adjusted free-flow travel time by the corresponding 15-minute traffic volume.



Monthly Statewide Delay Composition by Cause in 2024

Principal Investigator

Soyoung (Sue) Ahn

University of Wisconsin – Madison
sue.ahn@wisc.edu

Co-Principal Investigator

Pei Li

University of Wyoming
pei.li@uwyo.edu

Project Manager

Benjamin Rouleau

WisDOT
benjamin.rouleau@dot.wi.gov

“This project is a great example of working with the university and consultant community to do practical research answering an important question that impacts drivers in Wisconsin every day. This research will help WisDOT make our transportation system safer and more efficient.”

**– Ben Rouleau,
WisDOT**

Delay was then separated into recurrent and non-recurrent components using a historical recurrent baseline derived from event-free observations.

Observed delay below this baseline was classified as recurrent delay, while observed delay above this baseline was classified as non-recurrent delay and matched to available causal factor indicators, including crashes, non-crash incidents, work zones, special events, holidays, and weather. Delay that exceeded the recurrent baseline but did not match an available event indicator was retained as unclassified. Recurrent and unclassified delay were further separated into delay on signalized TMCs and delay on non-signalized TMCs based on the signal indicator.

Results

Results show that work zones are the largest identifiable cause of delay, accounting for approximately 24% of statewide vehicle-hours of delay. This delay peaks during summer construction months, as expected. Traffic signals play a major role too. Delay on signalized roadways represents about 51% of total statewide delay when combining both recurring congestion and unclassified delay at these locations. Weather-related impacts remain relatively small, peaking during winter months but representing less than 5% of total delay.

Metropolitan Planning Area (MPA)-level results further showed that the Southeastern Wisconsin MPA had large shares of unclassified delay on signalized TMCs, work zone-related delay, and recurrent delay on signalized TMCs, each exceeding 20%, while Madison MPA's work-zone delay share decreased after 2019 to approximately 8% in 2024. The corridor-level application showed that delay causation varies by corridor and facility type. Delay was often concentrated in localized hotspots rather than evenly distributed along the full corridor. These hotspots were generally observed in urban or interchange areas. Work zone delays were still the most common at the corridor level.

Recommendations for Implementation

The results of this study provide WisDOT with a repeatable framework for quantifying delay, separating recurrent and non-recurrent components, assigning delay to available causal factor categories, identifying unclassified delay, and generating statewide and corridor-level reporting outputs. Implementation can build on this framework by

- Updating the analysis with new years of data
- Refining event matching rules
- Incorporating more detailed operational data

Interested in finding out more?
Final report is available at:
[WisDOT Research website](#)

This brief summarizes Project 0092-25-22
Wisconsin Highway Delay Causation Study

Policy Research Program