Operational Data to Assess Mobility and Crash Experience during Winter Conditions

tech transfer summary

Integrating historic crash data with expanded maintenance and traffic data can supplement efforts to prepare for and respond to winter conditions and may help prevent weather-related crash events.

Objective

The primary emphasis of this project was to demonstrate the integration of historic crash data with expanded maintenance and traffic data in Iowa to better understand the winter conditions before, during, and after crash events.

Problem Statement and Solution

Historically, the relationships among winter weather maintenance practices, safety, and mobility have been difficult to systematically assess and quantify, particularly because monitoring and analysis have been somewhat limited to locations with permanent infrastructure, like fixed cameras and traffic sensors.

Data resulting from snowplow-based automated vehicle location (AVL) and traffic analytics acquisition initiatives now make more comprehensive analysis and assessment feasible.

Background

Winter weather poses a significant transportation problem in Iowa. The Iowa Department of Transportation (DOT) Systems Operations Bureau employs multiple strategies to ensure mobility and safety to the traveling public on Iowa's primary roadways, including during and after winter weather events.

Beginning in 2010, several Iowa DOT initiatives created new opportunities to analyze traffic and operations data, with one initiative focusing on winter maintenance operations. This initiative involved equipping snowplows with additional equipment, such as AVL and cameras.

Image captured from a snowplow in Iowa near a winter weather-related crash

CWIMS
Center for Weather Impacts on Mobility and Safety

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RESEARCH PROJECT TITLE
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The Center for Weather Impacts on Mobility and Safety (CWIMS) focuses on research to find better and safer ways to travel whenever weather is a problem. CWIMS is an Iowa State University Center administered by the Institute for Transportation.

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Another broader initiative involved acquiring traffic analytics data for more than 8,500 centerline miles of Iowa roadways. In 2014, the Iowa DOT entered into a contract with INRIX to obtain real-time traffic speed data through "probes," such as mobile phones and fleet vehicles with global positioning sensor devices.

Project Description

Multiple datasets were collected and utilized as part of this study. The following primary datasets were used:

- Iowa DOT crash data
- Iowa DOT snowplow AVL data
- Iowa DOT snowplow images
- INRIX traffic analytics data

Other datasets included the following:

- Iowa DOT roadway data
- Iowa DOT maintenance crew-based operations and weather reports
- Iowa DOT fixed-location camera images
- Iowa DOT road weather information system (RWIS) data, including Wavetronix traffic data and fixed-location camera images
- National Weather Service (NWS) Cooperative Observer Program (COOP) snowfall data

Because of the expansive nature of the datasets, the research team opted to focus on analyzing the Interstate 80 crash experience, maintenance crew reports and snowplow AVL crash-based data, and traffic speed data. The data utilized were collected during 2013 and 2014. Analysis was limited to 2 hours before and after each crash.

Key Findings

- Along the I-80 corridor, winter weather-related crashes were proportionally higher during the morning hours, which may be influenced by several factors. Crashes that occur when people are typically departing for work and school highlight the need for appropriate and accurate motorist-directed messaging.
- More crashes occurred as the time interval increased between the last snowplow pass and the time of the crash. The snowplow pass interval of 90 minutes to 2 hours before the crash and within 30 minutes after the crash had the single highest percentage of crashes.
- The majority of winter weather-related crashes involved multiple snowplow passes within 2 hours before and after the crash. This may indicate that crashes occur early in the weather event, during periods of high snowplow activity, and/or along multilane sections.
- From a safety perspective, Phase 1 winter maintenance operations appear broadly successful and to have occurred during appropriate times.
- As snowplow frequency increases for a specific amount of snow, the volume of traffic crashes per million vehicle miles traveled decreases. This demonstrates, in part, the safety-related effectiveness of winter maintenance.

Recommendations for Future Research

Spatial and temporal integration of crash and image datasets may facilitate after-action assessment and investigation of location-based conditions before and after a crash. These conditions may also be compared to conditions in locations where no crash has occurred to provide perspective. Better understanding of crash conditions may help assess whether operational expectations were satisfied and if modifications should be considered.

Development of an expanded statistical model that includes additional weather-related and other parameters may be warranted. Micro-level case studies may also be beneficial in quantifying the impacts of extraneous factors.

Opportunities may exist to utilize localized speed monitoring coupled with weather data to identify unstable and changing conditions, with subsequent messaging informing motorists of traffic conditions.

Implementation Readiness and Benefits

This project promotes the use of extensive, rich datasets to investigate weather-related impacts on mobility and safety and evaluate opportunities for improving winter maintenance operations. In this research, new capabilities were introduced; existing capabilities were expanded; and limitations, challenges, and potential areas for additional investigation were identified.

Ultimately, this work can help the Iowa DOT further mitigate the impacts of winter weather. The Iowa DOT may use the resources developed in this study to supplement existing efforts to monitor traffic, weather, and surface conditions and direct its corresponding activities.