IOWA STATE UNIVERSITY
Institute for Transportation

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on Mobility and Safety

Winter Operations Decision Support Tools for the Iowa DOT Maintenance Bureau

tech transfer summary

This project demonstrated opportunities to visualize and aggregate winter operations data to support timely and effective decision making and investigated the performance of a variety of snowplow blades.

Objectives

This project included the following two key objectives:

- Demonstrate opportunities to visualize and aggregate winter operations data to support timely and effective decision making

- Investigate the performance of a variety of snowplow blades by manufacturer in terms of actual blade wear over time by miles of exposure to each roadway surface type

Problem Statements

The Iowa Department of Transportation (DOT) is a leader in the US in having accomplished the difficult task of getting the equipment and communications installed for its snowplows. Now, the remaining hurdle is to support human decision making through visualization tools for this massive continuous stream of data.

To date, the degree of visualization support is limited for supervisors and key decision makers. The increased data capability can now support increased attention and consideration of opportunities to enhance both the quality and timeliness of winter operation decision making.

In addition, the Iowa DOT spends about $1.5 million per year on snowplow blades and purchases nine different types of snowplow blades. Changing out blades takes time away from keeping the roads safe.

Determining which blade type provides the best cost per plowed mile is difficult, especially considering that blade wear depends on multiple factors, from miles used to snow/ice type, pavement type, damage from hitting curbs or debris, and overall plow pressure applied.

Background

The Iowa DOT Maintenance Bureau has a fleet of about 900 snowplow trucks, which are all equipped to continuously transmit important operational data every few seconds while making the roads safer during winter storms. These data provide truck locations using automated vehicle location (AVL) pings and report operational status such as whether the plow is up or down and which materials, if any, are being applied to the roadway.

Research Description

Visualizing the Data using Tableau

Tasks 1 through 3 addressed visualizing winter operations data. The resulting visualization tools in Task 2 and 3 were demonstrated to the project technical advisory committee (TAC). The final project report includes a brief description of effort by task along with links to the resulting visual tools where relevant. Tasks 1 through 3 are summarized as follows:

1. **Data Preparation** – Identify, acquire, and process a variety of data to serve the functionality needs of all project activities

2. **Data Visualization** – Demonstrate the ability to produce a visual data summary including AVL pings, material usage, and the number of truck plow passes by road segment

3. **Maintenance Impacts** – Demonstrate opportunities to visualize winter maintenance impacts by user-defined time periods, locations, crash, and mobility data sources

Analyzing Snowplow Blade Wear

Task 4 focused on conducting an analysis using the variety of data sources to investigate the performance of snowplow blades, in terms of wear, by miles of exposure to each roadway surface type, as follows:

4. **Snowplow Blade-Wear Analysis** – Investigate the performance, in terms of cost, of nine different snowplow blade types using the front-mounted blades only, as these blades are used on different road surface types.

The final project report includes the results of the attempt to conduct an analysis of snowplow blade performance using periodic measurements from specific trucks at the beginning of, and regularly throughout, two winter seasons.

Key Findings

This project included a number of learning opportunities shared between Iowa DOT staff and the research team with some overall conclusions as follows:

- This study found a way to integrate large data streams to a common reference. This included developing techniques to process all of the data within one minute so that supervisors can make timely decisions during a winter storm.

- This process was instrumental in identifying trucks that were not set up correctly, including AVL issues as well as issues with the plow up/down sensors.

- The visualizations demonstrate potential information available for decision making—from snowplow miles driven to number of passes made for a road segment or material applied, along with compliance to application rates by truck.

- The blade-wear analysis was dependent on getting measurements from the field, and, even with these efforts, not enough data were available. Unfortunately, the analysis was not possible given that snowplow operators are faced with too many demands and providing these driver-reported blade measurements was problematic, even with the significant efforts made and refined to secure the data over a second winter season. This provided an opportunity to develop a calibration and data gathering framework for a potential follow-on study, which does not require drivers to report blade wear.

Implementation Readiness and Benefits

The results of this research serve as a beginning point to explore new ways to support timely and accurate decision making during winter operations given the massive stream of data coming from the Iowa DOT snowplow fleet.

The project created visual and tabular summaries of one day of winter operations data to provide practical information based on the interest and needs of both administrative and district maintenance staff. Overall, this project demonstrates the analytical and visual display options available to Iowa DOT staff during winter operations based on the use of both AVL and other roadway data sources.

Beyond demonstration, these types of "data to information" tools and visual aids will support timely decision making, can guide improvements to efficiency, help to monitor data accuracy by fleet truck number, and provide the ability to report on snowplow operator compliance on material application rates.

Future efforts can consider integrating these summaries and similar tools into daily operations. Further integration and refinement of these types of practical tools can support Iowa DOT staff during critical times as well as support overall program efficiency throughout the year.