CLEAR ROADS
research for winter highway maintenance

RESEARCH BRIEF

AUGUST 2014

REDUCING SNOWPLOW DRIVER FATIGUE DURING STORMS

RESULTS SUMMARY

Researchers used naturalistic driving data, actigraph data and surveys to develop recommendations for reducing fatigue levels in snowplow drivers during winter emergencies. Recommendations include the use of breaks and naps, improved fatigue reporting and more personal interaction between managers and snowplow drivers.

PROJECT DETAILS

Project Title: Environmental Factors Causing Fatigue in Equipment Operators During Winter Operations

Project Number: No. CR11-05

Project Cost: $124,991.00

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Fatigue is a serious safety hazard for any motor vehicle operator. Snowplow drivers are particularly susceptible because of the conditions under which they must operate. Reducing this fatigue could improve public safety, operator health and operator productivity.

Need for Research

A significant body of research addresses the factors contributing to fatigue in commercial truck drivers. Although many of these factors also affect snowplow drivers, they face the additional challenge of unusual hours—often working between 2 a.m. and 6 a.m. when human energy levels are typically lowest. The number of hours worked by snowplow drivers is often not limited by the federal guidelines that apply to over-the-road trucking. Snowplow drivers also face the stress of driving during winter emergencies, the hypnotic effect of blowing snow, and the vibration and noise of winter maintenance equipment.

Objectives and Methodology

This project's goal was to identify the unique factors that contribute to snowplow driver fatigue and to propose practical strategies to mitigate it.

Researchers based their recommendations on data collected from three sources:

- **Naturalistic data:** For three months, two Virginia DOT vehicles were equipped with a data acquisition system, including sensors of longitudinal and lateral acceleration, lane tracking, GPS location and continuous video recordings of the driver and roadway. These systems collected 368 hours of on-road data from four drivers, including 338 hours during winter emergency operations.
- **Actigraph data:** The same four drivers wore actigraph devices (approximately the size and shape of a wristwatch) on their nondominant hands throughout the three-month study. These devices measured the quality and quantity of the driver's sleep.
- **Surveys:** Researchers surveyed 1,043 snowplow drivers and 453 supervisors in Clear Roads member states about fatigue, work and rest schedules.

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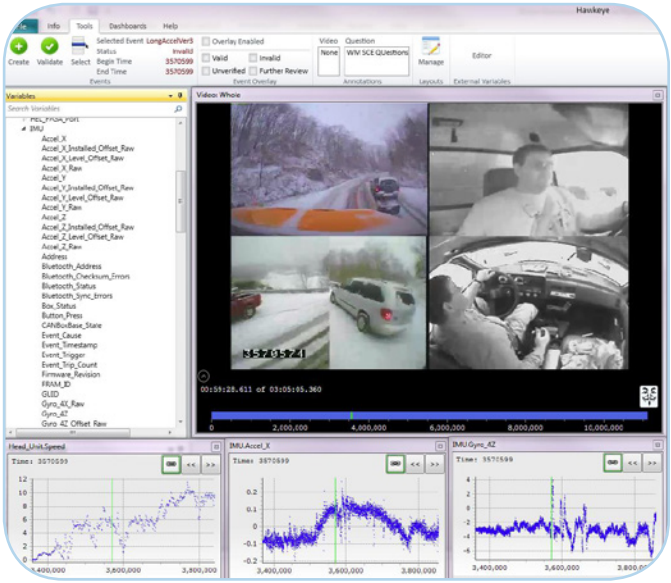

Researchers used Hawkeye software to analyze video and naturalistic driving data to identify SCEs, including collisions, curb strikes, near-crashes that require atypical avoidance responses or illegal maneuvers.

Results

Among the four drivers, naturalistic data identified 92 safety-critical events (SCEs), including crashes, avoidable curb strikes and near-crashes that required atypical maneuvers to avoid collisions. More than half of SCEs took place between midnight and 6 a.m., and more than half took place between five and eight hours into the driver's shift. A data analyst reviewed video and identified the driver as drowsy in 35.9 percent of all SCEs, although a single driver accounted for all of the drowsy SCE instances.

Actigraph data showed that drivers averaged significantly less sleep (7.87 hours) in the 24 hours before a winter emergency than during nonwinter emergency periods (8.98 hours), although much of the difference resulted from a single driver. Lack of sleep also corresponded with reduced safety. In the 24 hours before an SCE, drivers averaged only 7.30 hours of sleep.

The survey showed some discrepancies in responses from managers and drivers. Managers reported that snowplow drivers experienced fatigue more often than drivers self-reported, although snowplow drivers who experienced fatigue while driving a plow were more likely to report greater impacts from fatigue. Managers also reported that snowplow drivers had more lapses in concentration than drivers self-reported, and managers were more likely than drivers to feel that snowplow drivers were pressured to work more than was comfortable or reasonable during a winter emergency.

The survey indicated a high level of awareness of effective techniques for reducing driver fatigue, such as naps, breaks or body movement. However, snowplow drivers were less likely to actually use these techniques.

Benefits and Further Research

Since snowplow drivers work in emergency conditions and often face demanding service level expectations, blanket fatigue-reduction recommendations that apply to all agencies are not feasible. However, researchers do offer several general recommendations, including:

- Encourage the use of breaks and naps to reduce fatigue.
- Encourage drivers to report fatigue.
- Increase vehicle maintenance and use equipment such as segmental snowplow blades or rubber blades that reduce noise and vibration.
- Consider scheduling shifts so they do not start or end during the circadian low between 2 a.m. and 6 a.m.
- Offer shift options.
- Increase personal interactions between managers and drivers, and involve snowplow drivers in the decision-making process.
- Use free resources from the North American Fatigue Management Program and the National Surface Transportation Safety Center for Excellence.

Several avenues for further research would be valuable, including more naturalistic driving data that cover emergency and nonemergency driving for comparison, a data log that would track short naps that actigraph devices do not capture well, more research on the impact of in-cab factors on fatigue and the development of a fatigue management program specifically for snowplow drivers.

> "Our operators work under some extreme conditions. With this project, we're looking out for the health of the operator, the safety of the public and the productivity level a driver provides during a shift."

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