

## RESULTS SUMMARY

Researchers profiled six state agencies that use AVL/GPS in winter maintenance fleets. Strong support by these agencies drives robust use of the technologies for location tracking, asset monitoring and planning for future storms.

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## STRONG AGENCY SUPPORT, MULTIPLE APPLICATIONS DRIVE AVL/GPS USE

**A**utomatic vehicle location (AVL) and GPS have been widely embraced in winter maintenance operations by transportation agencies around the country. But tracking vehicle locations for operational and safety reasons only scratches the surface of these systems' potential uses. Many agencies also use AVL/GPS to collect extensive data for planning, operations, safety and inventory tracking to improve efficiency and response strategies.

### Need for Research

AVL and GPS have been used in winter maintenance operations for several years. While most agencies use AVL/GPS for tracking vehicle location, the technologies offer operational, safety, inventory and planning applications, as outlined in a [2016 Clear Roads synthesis report](#). How agencies actually employ these automatic data collection technologies remains less well-known.

### Objectives and Methodology

The goal of this project was to explore agencies' experiences and best practices in planning, implementing and using AVL/GPS technologies for winter maintenance activities. The investigation began with a survey of state and selected metropolitan transportation agencies about their level of commitment to AVL/GPS implementation and the data the agencies collect, use and share.

Investigators worked closely with Clear Roads to identify levels of usage of the technologies. Then they selected six agencies that represented various commitment levels, interviewed staff from each agency and gathered relevant documents about agency use of AVL/GPS. Using the information obtained during the interviews, researchers prepared case studies of each agency and recommendations for other agencies to further implement and utilize the technologies.

### Results

Twenty-seven of the 38 agencies that responded to the survey reported using AVL/GPS to automatically collect winter maintenance data, while 36 of the 38 agencies indicated plans to add or expand use of the technologies in the future. Based on feedback from these agencies, researchers developed three levels of

## PROJECT DETAILS

**Project Title:** Utilization of AVL/GPS Technology: Case Studies

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AVL/GPS hardware in this Sawyer County, Wisconsin, snowplow mounts below and behind the seat—a secure position that does not inconvenience the operator.

AVL/GPS use and categorized agencies according to the appropriate level.

Tier 1 agencies employ AVL/GPS for basic location tracking or monitoring. Utah DOT has mounted AVL/GPS behind the dashboard of every snowplow and incident maintenance truck (vehicles that assist stranded motorists on Utah's roads and highways) in its fleet. The system connects with plow position sensors, tracks idling time and traveling speed, and reports plow locations on a publicly accessible website.

Tier 2 users add basic data collection, equipment integration and system reporting features to Tier 1 usage, often in concert with other technologies. Washington State DOT's Tier 2 usage integrates AVL/GPS with spreader controllers, plow position sensors, and air and pavement temperature sensors in 80 percent of its fleet to track material use, road weather and operational analysis data. Michigan DOT integrates AVL/GPS with spreaders, plows and dashcams in 94 percent of its fleet to track vehicle location, vehicle diagnostics and material use, and to use for operational analysis and information sharing with the public.

Tier 3 agencies conduct complex data collection, integration and reporting activities with AVL/GPS as part of a suite of instruments and applications that collect and transmit data to users, the agency and, in some cases, the public. Colorado DOT (100 percent of its fleet), Nebraska DOT (33 percent) and Wisconsin DOT (53 percent) link AVL/GPS to data collectors, plows, spreader controllers, pavement and air temperature controllers, and other equipment. Each agency tracks vehicle location, material use, treatment

recommendations, vehicle diagnostics and data for operational analysis, among other uses. Colorado and Wisconsin DOTs share data with a maintenance decision support system; Colorado DOT also shares information with the public.

Keys to success with AVL/GPS include obtaining full organizational and financial support from agency management, piloting the system with vendors and operators to identify objectives for use, providing operators with training that emphasizes the technologies' operational and safety benefits, involving agency mechanics in installation, and using the system data for real-time adjustments to maintenance and resource-allocation strategies.

## Benefits and Further Research

The final report offers information that will be useful to prospective and current adopters, describing best practices in AVL/GPS planning and implementation, procurement, installation, training, data collection and utilization, and operations and maintenance.

Future research may evaluate methods for integrating technologies from various manufacturers into a cohesive, operational system. Turnkey options remain limited, and integrating sensor, camera, data collection and GPS presents a number of technical challenges. Related study may evaluate communication terminology for uniform data sharing between agencies. Follow-up research could also identify the costs and benefits of AVL/GPS to quantify the value of these technologies to users.

Connected vehicle technologies, which use roadside units to communicate with other roadside units and wirelessly with vehicles, offer potential applications for real-time data collection and sharing among plow operators and other stakeholders. The relative value and ability to implement such systems may warrant research and comparison to AVL/GPS.

“The recommendations were very constructive—everything from planning and decision-making to how to best collect data and use it for performance measurement.”

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