

RESULTS SUMMARY

This project produced a guide to implementing eight emerging and recently developed winter maintenance technologies. By understanding the options and their benefits, agencies can make better-informed decisions about which technologies to invest in.

PROJECT DETAILS

Project Title: Integrating Advanced Technologies into Winter Operations Decisions

Project Number: CR17-01

Project Cost: \$90,311

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ENHANCING WINTER OPERATIONS WITH NEW TECHNOLOGIES

Decades of innovations in materials, equipment and methods have helped transportation agencies conduct their winter maintenance operations more quickly, safely and efficiently. With so many options for new technologies and processes available, agencies are increasingly challenged to identify—and even anticipate—the next big development that will provide the greatest return on investment.

Need for Research

Technology's rapidly evolving pace means winter maintenance managers face a constant, high-stakes challenge when it comes to allocating budgets and selecting which innovations to invest in. Some technologies may save agencies time and money, while others may not yet be ready for widespread deployment. Clear Roads states needed an analysis of how these advanced technologies fit the needs and capabilities of state departments of transportation (DOTs).

Objectives and Methodology

This project sought to identify advanced technologies that transportation agencies have effectively integrated into their winter maintenance operations and develop implementation recommendations drawn from these successes.

Through a literature search, survey, and follow-up discussions, researchers identified emerging trends in technologies and investigated current best practices. From this foundation, they developed guidelines that agencies can use to make informed investment decisions regarding emerging technologies.

Results

Combining the knowledge gleaned from the three methods of inquiry, researchers created a set of recommendations for eight developing technologies:

- **Mobile sensor systems.** Outfitting an entire fleet with vehicle-mounted data collection devices may be cost-prohibitive, so agencies should consider adding weather and pavement condition sensors selectively—such as on supervisor vehicles or vehicles that maintain routes with less predictable conditions.



Incorporating real-time weather and traffic data into maintenance operations can help an agency allocate resources where they are needed most. (Photo courtesy of Nebraska DOT)

- **Driver assistance systems.** Aftermarket cameras can enhance safety by allowing operators to monitor plow and spreader operations and conditions behind the vehicle. Cameras should incorporate washing systems and heated lenses to ensure clear views, and they should be carefully installed to minimize vibration and other problems that can reduce effectiveness.
- **Connected and autonomous vehicle systems.** Since this technology is not yet widely used, agencies would likely be better served by waiting and evaluating developments before making major investments in infrastructure or vehicle systems.
- **Video analytics.** Emerging video analytics technology can process imagery from traffic camera feeds or vehicle-mounted cameras and extract data on road conditions, visibility and precipitation. Transmitting video from multiple locations can be bandwidth-consuming, so this strategy may be most useful in areas that offer reliable high-bandwidth connections.
- **Communications systems.** Most agencies do not yet have the infrastructure needed to implement 5G technology, which is expected to become more in demand as older networks, such as 3G, 4G and LTE, are phased out by communications carriers. Monitoring 5G deployments by carriers is

“This study gives DOTs the fundamentals they need in order to ask the right questions about what technologies will work best for them.”

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recommended to determine when the technology may become feasible for maintenance operations.

- **Maintenance decision support systems.** Analyzing and modeling data collected from a variety of sources helps maintenance managers optimize their winter operations. Current-generation systems can help transportation agencies reduce costs, improve efficiency and gather objective performance data. Next-generation systems will offer enhanced accuracy and faster performance, but they are not yet widely available.
- **Crowdsourced traffic and weather data.** Since massive amounts of information are already supplied by the public, agencies should attempt to leverage this available data through collaborations with frequently used mobile applications rather than creating their own apps.
- **Data analysis and management tools.** With so much data being collected, agencies can enlist visualization software and other “big data” tools to help maintenance teams and public users more easily identify patterns and trends. These tools complement the development of next-generation decision support and processing of crowdsourced data, but their deployment requires specialized skills and infrastructure.

Benefits and Further Research

The recommendations developed through this study will provide transportation agencies of all sizes with objective guidance as they work to identify their individual priorities and strive to keep pace with advancing technology.

EXAMPLES FROM CLEAR ROADS STATES

- **Idaho Transportation Department** has partnered with a private company on a pilot project involving three of its snowplows. Mobile sensors on the plows collect data on snow and ice thickness and pavement temperature. The data are used to create a thermal map that lets operators identify low-temperature spots in real time and adjust their deicer application rates as needed.
- **Iowa DOT**, in collaboration with a private software developer, is developing a road condition forecasting system as well as a real-time winter maintenance [cost calculator](#) for use by the public.
- **New York State DOT** is testing a system that could incorporate data collected from pavement and air temperature sensors and other sources for use in decision-making.