

## RESULTS SUMMARY

A review of snowplow route optimization projects showed that detailed data about a plow route network and close collaboration between route modelers and the operators who drive the routes are critical factors in an optimization project's success.

## PROJECT DETAILS

**Project Title:** Identifying Best Practices for Snowplow Route Optimization

**Project Number:** CR14-07

**Project Cost:** \$68,305

**Report Date:** January 2017

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# SUCCESS FACTORS FOR SNOWPLOW ROUTE OPTIMIZATION

**W**ell-designed snowplow routes allow winter maintenance agencies to make the most effective use of their fleets. Route optimization has the potential to reduce the total distance a fleet of plow trucks has to travel to clear a road network, which typically results in faster traffic speed recovery after winter storms and reduced maintenance costs. Because winter maintenance is a major expense, even small improvements in efficiency can translate into significant savings.

## Need for Research

Route optimization software is already well-established for applications such as garbage pickup and mail or package delivery. Optimizing winter maintenance routes, however, is a more complicated process. Optimization must account for variations in truck capacity and size, which can restrict the turns some vehicles can make or even the roads on which some trucks can travel. Winter maintenance trucks also need to cover every lane of a roadway, and operations need to be conducted within a small window of time.

Despite these challenges, several agencies have conducted snowplow route optimization projects. These often produced significant benefits: One agency reported reducing the total length of time it took to cover its winter maintenance route networks by 50 percent; several other agencies reported 5 to 10 percent reductions. Reducing route length can result in both labor and fuel cost savings, and improve mobility for the traveling public.

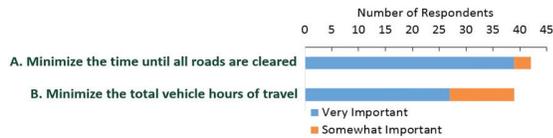
Clear Roads initiated this research project to help agencies understand the route optimization options that are available and share lessons learned in previous optimization projects.

## Objectives and Methodology

Researchers conducted a survey of state and local winter maintenance agencies and provincial winter maintenance agencies in Canada about their route optimization efforts. In the survey, agencies were also asked about the relative importance of route optimization goals and routing constraints that optimization software features should accommodate.

## Snowplow Routing Survey: *Optimization Goals*

How important are each of the following route optimization features to your agency?



Most survey respondents rated minimizing time until roads are cleared and reducing total vehicle hours as important route optimization goals, although these sometimes conflict. The route on the left, for example, reduces time until clearance by using two plow trucks, but increases total vehicle hours compared to a route serviced by only one vehicle (right).

Investigators conducted in-depth reviews of nine route optimization projects that have been completed or are underway. These reviews included interviewing agency staff and examining available published reports from those projects. Four of these projects were identified through the survey, while the other five were identified by Clear Roads Technical Advisory Committee members.

Researchers used the results from these reviews to identify factors that contributed to successful route optimization efforts and practical steps that need to be taken to prepare for routing projects. They also generated a project matrix that shows the different features of the optimization software packages used.

## Results

Survey respondents overall put greater priority on minimizing the time until all roads are cleared as a goal for route optimization than on minimizing the total vehicle hours of travel, although many respondents rated both objectives as important. The five most important optimization software features identified in the survey were accounting for roadway prioritization, accounting for different vehicle load capacities, allowing reloading at remote material storage facilities, lane-specific routing, and accounting for vehicle/road compatibility limitations. The project matrix shows that there are several commercial software packages that offer all or most of these features.

One important lesson learned: Agencies need to have accurate, detailed information about their networks in a format that is compatible with optimization software. This information includes the location of garages, shops, material storage and turnarounds that can accommodate plows. Agencies also need to know their current cycle times to accurately judge whether the optimization process has the intended impacts.

While optimization can be a valuable tool, the routes it generates are not perfect. There should be close cooperation between the people conducting the optimization and the winter maintenance professionals, who fully understand operational constraints that the optimization algorithms might miss. Agencies need to use this expertise to review the routes generated before implementation.

Once optimized routes are implemented, agencies should monitor them to make sure that the plans are being followed. An automated vehicle location/Global Positioning System is valuable for this monitoring and can also provide drivers with turn-by-turn directions.

## Benefits and Further Research

Clear Roads hopes that this research will provide information and resources that can encourage state and local winter maintenance agencies to implement route optimization. The practical guidance provided in this research explains what agencies must do to prepare for any implementation, including the data that must be gathered.

No further research is currently planned, although it may be worthwhile to conduct a follow-up study as more agencies implement route optimization.

“We had been hearing from states and cities that prioritizing routes had improved efficiency a lot, but we wanted to find out exactly what is going on across the United States and lay out a path for other interested agencies to follow.”

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