

RESEARCH BRIEF

Online Tool Calculates Benefits and Costs of Winter Maintenance Investments

Winter maintenance departments, like all public agencies, must be careful stewards of taxpayer dollars. That mandate holds in every economy, but during tough financial times in particular, questions surrounding capital expenditures become even more pointed. (Is the latest carbide snow plow blade—or zero velocity spreader or road weather information system—worth the cost?) Contractors and private operators too face similar questions about capital expenditures. All winter maintenance managers need to invest in improvements, but making informed spending decisions is absolutely critical.

Need for Research

Winter maintenance technologies are becoming more sophisticated, ranging from improved on-vehicle hardware and controllers to decision support systems that track fleet vehicles or weather in real time. Depending on the technology and the size and scope of a maintenance operation, an investment in these items can start at hundreds or thousands of dollars and go well into the millions.

And while these tools promise savings through more efficient use of resources and improved levels of service, winter maintenance personnel and financial officers alike require compelling numbers to justify investing in these items. A well-established economics approach for weighing capital investments like these is cost-benefit analysis. Attaching a dollar value to the costs and benefits of a capital expenditure for winter maintenance fosters understanding of the bottom-line throughout a road agency and provides a solid foundation for spending decisions. The results of cost-benefit analysis, however, are only as valid as the data driving the calculations.

Objectives and Methodology

Clear Roads undertook a project to create an interactive toolkit that would help users calculate the benefit-to-cost ratio of selected winter maintenance technologies. The effort was conducted in two phases.

First, investigators reviewed literature and surveyed winter maintenance practitioners nationwide to capture and quantify the various costs and benefits associated with specific winter maintenance equipment and systems. Moreover, since the toolkit would not be able to accommodate every new winter maintenance technology, the practitioner surveys also served as a means for investigators to zero in on technologies of greatest interest to practitioners.

The next step was developing the toolkit itself using real-world user data and principles of engineering economics. It needed to allow flexibility of user inputs while providing reasonable guidance and values for costs and benefits. From an interface standpoint, the toolkit had to be user-friendly and accessible on a wide variety of operating systems.

Results

Investigators decided that a Web-based interface best fit the project criteria, and they built a cost-benefit calculator for online use. Based on feedback from practitioners and the Clear Roads Technical Advisory Committee, the toolkit included these winter maintenance items:

Equipment: Carbide blades, front plows, underbody plows, zero velocity spreader

Practices: Anti-icing and deicing

Operations: Maintenance decision support systems, automatic vehicle location and geographic positioning systems, road weather information systems, mobile pavement temperature sensors, mobile air/pavement temperature sensors

Co-investigator



“The toolkit performs the heavy lifting of cost-benefit analysis, taking all the data and all the calculations and providing straightforward, usable information to winter maintenance agencies.”

—David Veneziano
Western Transportation
Institute

Principal
investigator
Xiaming Shi

Project Champion



“The Clear Roads cost-benefit analysis toolkit helps me do my job of making the best dollar-for-dollar investment for winter maintenance purchases. It backs up my assumptions with real numbers.”

—Paul Brown
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The toolkit provides bottom-line guidance on a range of modern winter maintenance items, including equipment such as the articulated plow blade (shown at left); practices such as deicing (center); and operations, including maintenance decision support systems (right).

The completed toolkit features an intuitive user interface. After a user selects from among these winter maintenance items, the toolkit prompts entry of agency-specific data, including financial information (such as discount rate and life-cycle period) and system information relevant to the technology under consideration (including number of vehicles, system lane miles and average labor hours per storm event). Users can also access an interactive benefits calculator to help estimate agency, user/motorist and societal benefits. The automated calculation and analysis processes yield a benefit-to-cost ratio—the number of dollars of benefit for every dollar spent. A number greater than one suggests a smart investment from a benefit standpoint.

Following initial Web site development, researchers fine-tuned the toolkit, verifying its calculations and its online functionality with the help of data from three Clear Roads member states. Investigators also developed a training manual to guide users through the analysis process for each of the winter maintenance items addressed in the toolkit.

Benefits and Next Steps

In the months following a limited launch of the toolkit for more extensive trial by Clear Roads member agencies, DOTs quickly put it to good use. For example, it helped Iowa DOT demonstrate that it could achieve significant savings in the purchase of automatic vehicle location and geographic positioning systems. Massachusetts DOT used the toolkit to assess alternatives for salt spreader controllers and to help support capital spending decisions.

The target audience reaches beyond state DOTs. Once the toolkit is ready for public launch, it will be available for any winter maintenance operator—state, county, municipality or even private contractor. The scalability of the toolkit’s analysis features makes it useful for operators of any size, from those with just a handful of vehicles (or even a single truck) to those with thousands. The critical output is the same: calculations that indicate when a purchase makes sense, when it doesn’t and which among several alternatives is the most attractive.

Prior to being made available to the public, the Web-based cost-benefit analysis toolkit will be further revised and refined, making it easier to use on more Web browsers and operating systems. A planned new feature will also allow users to save their work so they can easily adjust their entry data and compare different “what-if” scenarios to account for contingencies in costs, system characteristics and winter events. The new version of the cost-benefit analysis toolkit should be available for public use by 2012 in time for capital decisions affecting the 2012-2013 winter season.

This brief summarizes project 0092-09-08/CR08-02, “Development of a Toolkit for Cost-Benefit Analysis of Specific Winter Maintenance Practices, Equipment and Operations,” produced through the Clear Roads winter maintenance pooled fund project, #TPF-5(092). Clear Roads’ lead state for this research project is Wisconsin DOT, 4802 Sheboygan Ave., Madison, WI 53707. (In early 2010, Minnesota DOT took over as the lead state for the Clear Roads winter maintenance pooled fund project under TPF-5(218).) Paul Brown of Massachusetts Highway Department is the Clear Roads Technical Advisory Committee Chair (paul.brown@state.ma.us).

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