Using data, snow and ice control fleet managers achieve goals and automate key systems

ITD has developed a system to automate snowplow truck operator work orders. The system uses spreading data recorded by an electronic spreader control system installed on ITD trucks.

Fleet managers across the Snowbelt upfit snowplow trucks with automated electronic spreader control systems that collect and record accurate data on the amount of salt and other deicing materials and liquids applied to winter road surfaces.

Twenty-five years ago the goal for a winter road maintenance fleet manager was straightforward — keep highways safe for travelers and don't worry too much about the amount of salt applied to roadway surfaces. Automating key snow and ice control systems was not on any fleet manager's short list of projects.

Fast forward to 2017. Fleet managers are now accountable for keeping roads safe for winter travelers, controlling costs and being environmentally responsible by reducing the amount of salt applied to roadways, and in some states, complying with legislated mandates regarding the amount of salt to apply per lane mile. Automating key processes has moved into the forefront of snow and ice control projects.

To balance the multiple goals of today's snow and ice control industry, including changing the approach to winter road maintenance, fleet managers from the Massachusetts Department of Transportation (MassDOT); the town of Penfield, New York; the city of South Burlington, Vermont; and the Maine Department of Transportation (MaineDOT) have installed automated electronic spreader control systems on their snowplow trucks. These facilities have also implemented a winter road maintenance system that generates reports and maps based on the data collected and recorded by electronic spreader control systems. In the Western U.S., the Idaho Transportation Department (ITD) is automating two key systems using data from an automated electronic spreader control system installed on its snowplow trucks.

BALANCED GOALS

MassDOT implemented its winter road maintenance system in September 2012. To date, MassDOT has upfitted approximately 50 of its 125 state-owned snowplow trucks with an automated electronic spreader control system. MassDOT snowplow trucks and private contractors are responsible for snow and ice removal on over 20,000 lane miles

of highways. The state-owned trucks are responsible for winter road maintenance on the Massachusetts Turnpike. The toll road is the easternmost 138-mile stretch of Interstate 90 and runs from the New York border to downtown Boston.

To comply with the state's salt-spreading mandate and to be environmentally responsible, MassDOT has been programming its snowplow truck spreaders to apply 240 pounds of pre-wetted salt (NaCl) per lane mile for the last 10 years. During much of this time, however, MassDOT was not able to confirm how close it was to its goal application rate. "Now, with our winter road maintenance system and its use of ground speed control and wireless download, we're able to verify that we're in compliance and that's what we're talking about to the legislature and regulators," said Paul Brown, snow and ice engineer for MassDOT District 1. "We're also letting them know that we're being responsible. We're using the right application on the right road at the right time and we're getting very good results. You can't do that unless you're able to prove what the trucks are doing."

Even though MassDOT has saved close to 10,000 tons of salt a year since implementing its winter road maintenance system, "the real value of the system is that it makes a lot more people accountable for their actions, in the sense they're doing what policy requires, and MassDOT now has the data to back up their actions," said Brown.

In western New York, the town of Penfield relies on 18 snowplow trucks and their operators to remove snow and ice from 434 lane miles of highways. Fifteen of the trucks have been upfitted with an electronic spreader control system.

MaineDOT has outfitted its snowplow trucks with an electronic spreader control system that accurately records the amount of granular materials and liquids applied to winter roadways.

COMPONENTS OF A WINTER ROAD MAINTENANCE SYSTEM

A winter road maintenance system for snowplow trucks integrates vehicle sensors, an automated electronic spreader control system and wireless data transfer to provide accurate data for building maps and reports that snow and ice control fleet managers need to improve operations and reduce costs.

- ***GPS sensors*** collect and record data on a snowplow truck's heading, speed, geographical location, and the date and time. Other sensors installed on a truck record data on ground speed, spreader operation, plow position, and air and road surface temperatures.
- The ***automated electronic spreader control system*** provides calibrated spreading of salt and other deicing materials and liquids. Using the system's sensors, the spreader controller detects the ground speed of the snowplow truck and adjusts the truck's material delivery rate in proportion to its speed. Using spreader sensors, the closed-loop ground speed spreader controller automatically relates the speed of a truck and the calibrated speed of its salt/sand or liquid flow rate on the discharge end. The controller uses both data sources, and may also use air and surface temperatures, to control the spreader application rate.
- The ***spreader controller*** collects and records data — every six seconds — on the amount and type of granular or liquid materials applied to winter roadway surfaces. The controller can be programmed to spread materials and liquids at a specific rate per lane mile.
- A ***wireless data transfer system*** collects, compiles and automatically downloads to a server the snowplow truck spreading application data at regularly timed intervals. Fleet managers can then access accurate "raw" data as well as easy-to-use reports and maps on spreading activities using any PC with web access.

The aftermath of an ice storm in Massachusetts.

Penfield is located 10 miles east of Rochester and close to the southern shore of Lake Ontario.

Penfield set up its winter road maintenance system in 2010 with this goal: "to cut salt consumption and reduce the amount of salt settling in catch basins, and eventually the Irondequoit Bay, which flows into Lake Ontario," said Al Marrale, auto mechanic foreman. Penfield is also using its new system to comply with the state's requirement of applying 250 pounds of material per lane mile. In the last six years, Penfield has reduced its salt use by approximately 20-30 percent.

To the northeast, the city of South Burlington, Vermont, uses its winter road maintenance system, and in particular, its detailed spreader application data to compare where it stands from year to year, help forecast its salt budget for the following year and compile data on salt use costs. "When the city council asks us what our costs are, so they can make a judgment on how often they want snowplow truck operators to go out, we can tell them, 'Every time we go out for an average storm, it's $1,500 in salt for a four-hour run with three operators,'" said Adam Cate, South Burlington operation manager.

After each storm event, Todd Gregory, an engineering technician for South Burlington, collects the spreader data downloaded from each snowplow truck. "Basically, at the end of each shift, I put together a spreadsheet with gallons and pounds per driver, per truck, per storm. I can break the information down to an average cost per operator, per hour for a storm on regular time or overtime."

"I also think when truck operators have an opportunity to see the numbers, to see what they're using, it makes a difference going forward, as to the way they think about putting salt and liquid down," said Gregory. Since installing its winter road maintenance system in 2010, South Burlington has cut its salt use by approximately 25 percent.

South Burlington is located a few miles from the eastern shore of Lake Champlain in northern Vermont. For each storm event, the city uses nine snowplow trucks to maintain about 255 lane miles of roads.

CHANGING THE APPROACH

To combat the frequent ice events that befall Maine, and the Northeast U.S. in general, MaineDOT used to apply a large amount of sand — over a half million cubic yards each snow season — on its 8,300 lane miles of highway. Maine municipalities, counties, reservations and the Maine Turnpike Authority are responsible for snow and ice removal on the remainder of Maine's nearly 19,200-plus centerline miles of roadways.

Beginning in the late ’90’s, MaineDOT changed their entire approach to snow and ice control. “We switched over to an anti-icing approach, which is strategic use of salt at the right time,” said Brian Burne, MaineDOT highway maintenance engineer. “To successfully implement our new program without wasting salt, we knew we would need to upfit our 400 plow trucks with pavement temperature sensors, liquid pre-wetting and electronic spreader control systems that accurately record the amount of salt applied to road surfaces.”

In more recent years, MaineDOT has been upgrading those original electronic spreader control systems with a new spreader control system and implementing its own winter road maintenance system. In addition to accurately tracking its salt use, MaineDOT decided to install the new electronic spreader control system on its trucks for a couple of other reasons.

“One, it’s just being environmentally responsible to know what you’re putting out for materials and where,” said Burne. “The other is general cost accountability. Knowing how much material is going out on certain routes and how much material is being used overall is essential. Because of the spreader controllers and our maintenance management system’s data and reports — after the spreader controller data is reviewed and approved in a report from the winter road maintenance system, it’s entered into MaineDOT’s maintenance management system — we’re able to say how much salt was used, how many hours the trucks were in operation and how many people worked how many hours shortly after a storm ends.”

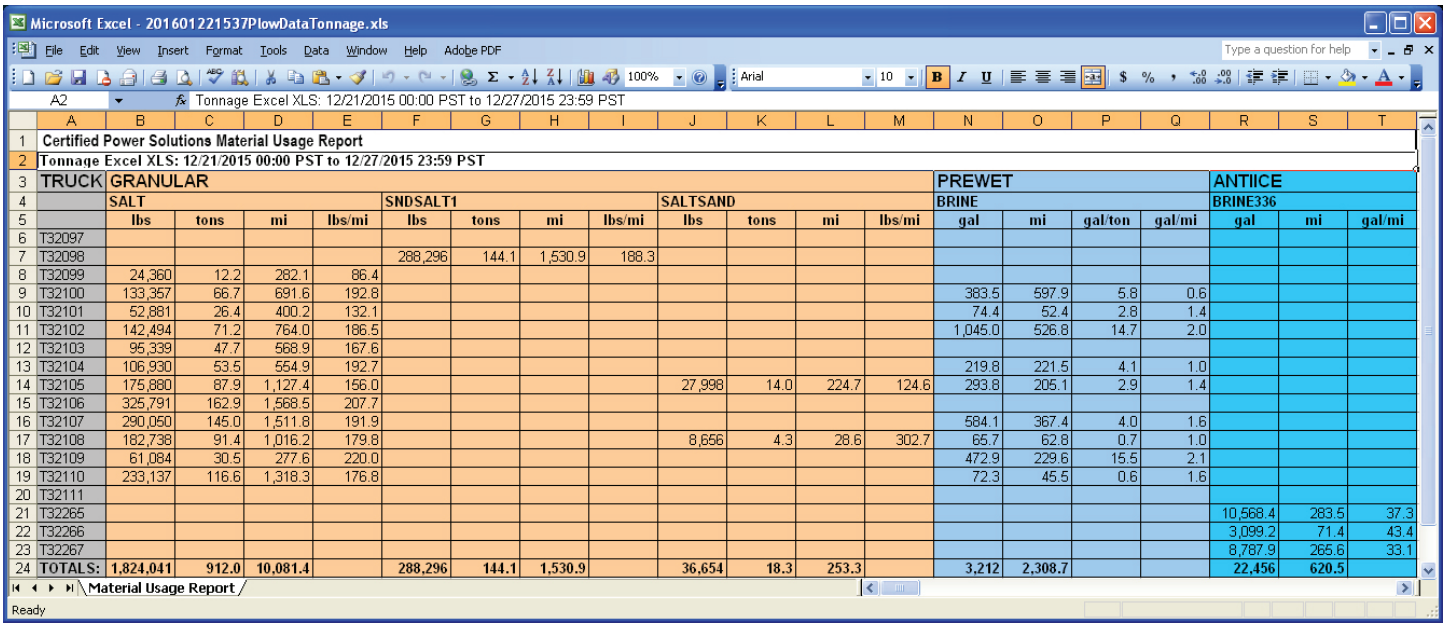
To transfer and download the data recorded by the spreader controllers to its facility server, MaineDOT uses a wireless Wi-Fi data transfer system rather than an automatic vehicle location (AVL) system. An AVL system provides a real-time connection for each plow truck, however, it also requires a monthly connection fee for every truck. “We weren’t interested in that kind of system,” said Burne. “We didn’t see the return on investment for the Maine taxpayers.”

An ITD snowplow truck equipped with the SpreadSmart Rx electronic spreader control system from Certified Power Solutions.

AUTOMATING KEY SYSTEMS

Automated operator work orders

Far from the East Coast, ITD experiences much different weather and weather events are defined as storm events when the temperature is below 32 F and there’s precipitation on the roadway. Near the 130 road weather information system (RWIS) sites located along ITD’s 12,000-plus highway lane miles, the number of storm events ranges from seven to eight at a few locations to up to 65 to 70 in the most storm-prone areas.



Microsoft Excel - 20160122153 7PlowDataTonnage.xls

Certified Power Solutions Material Usage Report

Tonnage Excel XLS: 12/21/2015 00:00 PST to 12/27/2015 23:59 PST

	TRUCK	GRANULAR												PREWET				ANTIICE		
		SALT				SNDSALT1				SALTSAND				BRINE				BRINE336		
		lbs	tons	mi	lbs/mi	lbs	tons	mi	lbs/mi	lbs	tons	mi	lbs/mi	gal	mi	gal/ton	gal/mi	gal	mi	gal/mi
6	T32097																			
7	T32098					288,296	144.1	1,530.9	188.3											
8	T32099	24,360	12.2	282.1	86.4															
9	T32100	133,357	66.7	691.6	192.8									383.5	597.9	5.8	0.6			
10	T32101	52,881	26.4	400.2	132.1									74.4	52.4	2.8	1.4			
11	T32102	142,494	71.2	764.0	186.5									1,045.0	526.8	14.7	2.0			
12	T32103	95,339	47.7	568.9	167.6															
13	T32104	106,930	53.5	554.9	192.7									219.8	221.5	4.1	1.0			
14	T32105	175,880	87.9	1,127.4	156.0					27,998	14.0	224.7	124.6	293.8	205.1	2.9	1.4			
15	T32106	325,791	162.9	1,568.5	207.7															
16	T32107	290,050	145.0	1,511.8	191.9									584.1	367.4	4.0	1.6			
17	T32108	182,738	91.4	1,016.2	179.8					8,656	4.3	28.6	302.7	65.7	62.8	0.7	1.0			
18	T32109	61,084	30.5	277.6	220.0									472.9	229.6	15.5	2.1			
19	T32110	233,137	116.6	1,318.3	176.8									72.3	45.5	0.6	1.6			
20	T32111																			
21	T32265																	10,568.4	283.5	37.3
22	T32266																	3,099.2	71.4	43.4
23	T32267																	8,787.9	265.6	33.1
24	TOTALS:	1,824,041	912.0	10,081.4		288,296	144.1	1,530.9		36,654	18.3	253.3		3,212	2,308.7			22,456	620.5	

Material Usage Report

Ready

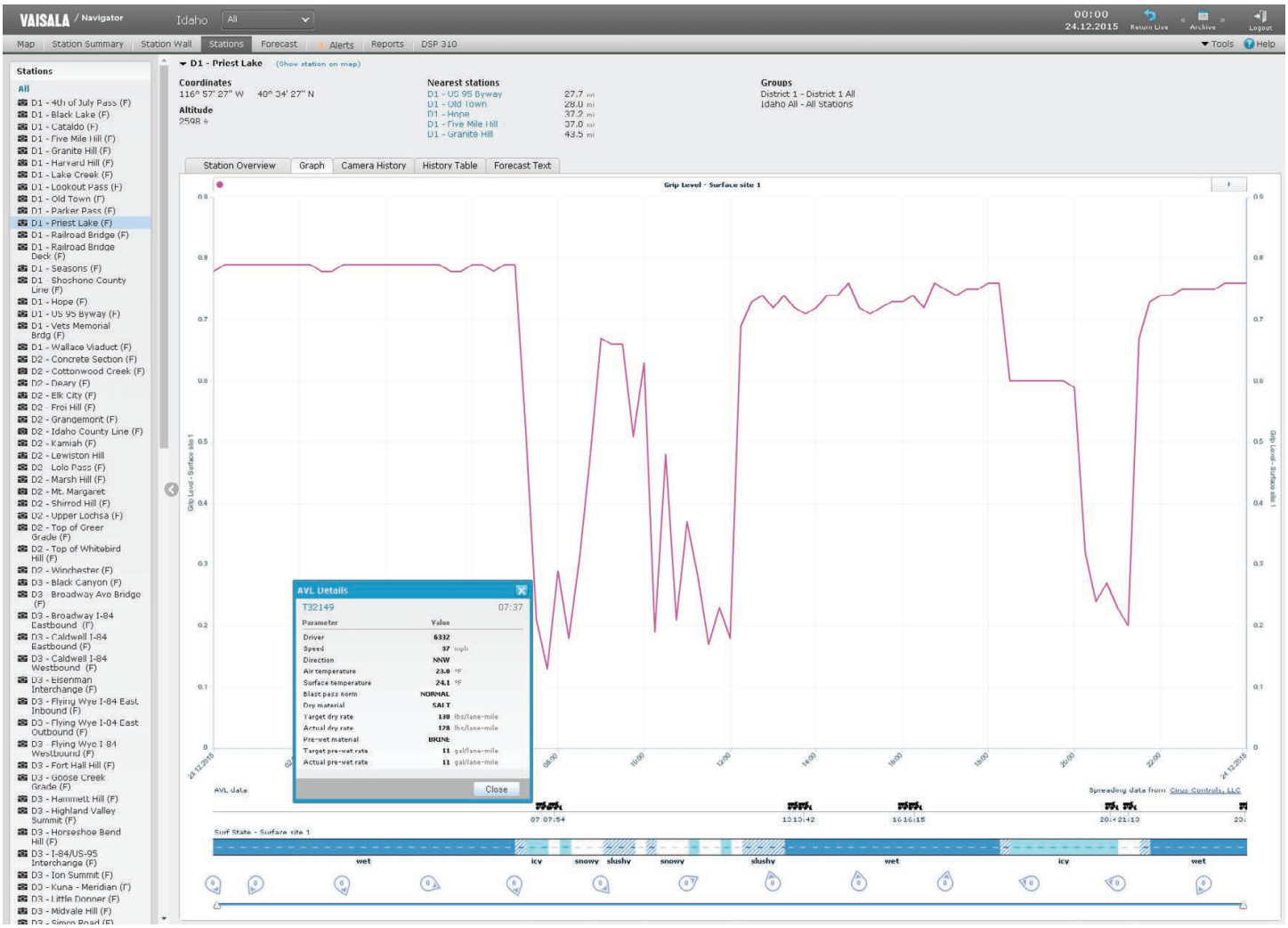
A material use report generated by a winter road maintenance system. Data on granular materials and prewet and anti-ice liquids applied to road surfaces were recorded by an electronic spreader control system upfitted to ITD snowplow trucks.

Until recently, ITD snowplow truck operators manually completed a work order documenting their spreading activities after each shift. At times, however, the orders were too generalized and lacked details needed by ITD fleet managers for analyzing operations. “Extracting the data from the handwritten orders was difficult and very time consuming,” said Dennis Jensen, ITD mobility services-winter operations coordinator. To address this issue, ITD began installing an automated electronic spreader control system and sensors on its trucks in 2011. To date, ITD has upfitted 409 of its 430 trucks with sensors and the spreader control system.

ITD next developed its Winter Automated Reporting System (WARS). The system went online in February 2016 and converts the GPS-coordinates-based data supplied by its electronic spreader control system to ITD’s linear-referencing system, which is based on routes and milepost positioning. From the converted data, WARS identifies the specific spreading activities of a truck and generates an automated work order.

After the end of each work shift, ITD operators bring up WARS to download and approve a daily summary of spreading activities. “The WARS review and processing the detailed data takes less than five minutes a day and reviewing the data for operational critiques takes only a minute through WARS reporting extractions,” said Jensen. After an operator approves the summary and clicks “accept,” the information is automatically fed into ITD’s asset management system.

“We have extremely important granular data telling us exactly how we fought the storm for post-review critiques of what we did and when we did it. Then we can also evaluate how effective we were with the treatment,” said Jensen. “Prior to WARS, we just captured our efforts. Now we have a whole system to gauge cost



ITD has automated the analysis of winter road maintenance operations by developing a system that overlays data collected by an electronic spreader control system installed on ITD snowplow trucks to an RWIS graph.

versus effort plus accomplishment with our RWIS sites."

In regard to return on investment (ROI), "We're estimating we'll save approximately 750 man hours per year just with the reduced time for manually inputting the operator work-order data. Other sources of ROI involve reduced material use," said Steve Spoor, ITD maintenance services manager. "Based on our original assumptions, we believe the payback period will be around four years for a 12-year life of the spreader controller."

Automated analysis of snow and ice removal results

ITD's system for automating the analysis of winter road maintenance operations went live the fall of 2015. The system builds a geo-fence or a bounding box around an RWIS site, and as a snowplow truck passes through the bounding box, the system captures the truck's spreading activity data and overlays it on an RWIS graph. The RWIS graph provides detailed information on the condition of the roadway surface.

The analysis system has been of great value to ITD because operators can see the effectiveness of the application matrix they're using. If the application matrix is not working as planned, operators can adjust and modify it as needed throughout the winter season. "The system improves our performance significantly since we're now able to better match a storm event with the right product," said Jensen.

At the end of the day, the old operations adage, "You can't manage what you don't measure," still rings true. But thanks to data from automated electronic spreader control systems installed on snowplow trucks, and the reports and maps available in a winter road maintenance system, fleet managers can measure and manage their use of salt, and other deicing materials and liquids applied to winter road surfaces, to effectively achieve and balance their facility's specific set of goals.

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