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U.S. Department of Transportation
Federal Highway Administration

WEATHER-SAVVY ROADS

INTEGRATING MOBILE OBSERVATIONS CASE STUDY

WEATHER-SAVVY ROADS

West Des Moines: A City's Approach to Vehicle-based Technologies

Background

The Weather-Savvy Roads effort deploys two distinct road weather management solutions that allow State and local agencies to proactively manage the surface transportation system ahead of and during adverse weather events: Pathfinder and Integrating Mobile Observations (IMO).

IMO promotes the collection of mobile weather, road, and vehicle data from agency fleets to improve situational awareness of road conditions. This case study reviews a local agency approach to leverage available technologies to enhance winter maintenance operations in West Des Moines, Iowa.

The city of West Des Moines is a suburban community in central Iowa of about 68,000 residents with 800 lane miles of pavement that are all maintained by the West Des Moines Department of Public Services. Located at an interstate crossroads, the city's daytime population increases to over 150,000.

West Des Moines Public Services has been very proactive over the years on winter maintenance operations, incrementally enhancing agency practices and continuously improving performance by leveraging available resources to deploy new technologies and equipment. This has included the deployment of road weather information systems (RWIS); infrared sensors for pavement friction determination; automatic vehicle location (AVL); mobile sensors on plows and other agency vehicles; and software, including that for route optimization and a maintenance decision support system (MDSS) for material type and application determination. These efforts have been accomplished by identifying trends and pushing technology to continuously improve and automate agency practices.

Local Agency Approach to IMO

Upgrades have been made incrementally to the entire fleet of snow plow vehicles over about 10 years, beginning with the installation of AVL around 2008. As of winter 2017-2018, all 16 snow plow vehicles—which are a mix of single- and tandem-axle vehicles—are equipped with AVL, automated spread controls, and sensors (Figure 1). This technology determines material spread rates, pavement temperature, and the up or down position of a plow. West Des Moines contracts with a private-sector provider for weather services, such as RWIS information and MDSS outputs for strategies on how to handle storms. The MDSS outputs provide recommendations to operators on the most appropriate treatment strategy given the circumstances, including material and spreading rates. AVL and real-time data from the plow trucks are used to monitor the storm and road weather response, which includes feedback to the MDSS.

West Des Moines also has implemented plow truck route optimization (Figure 2). Although this practice has been used quite extensively for solid waste and transit, the contractor experienced some learning curves to adjust the

Figure 1: West Des Moines Public Services has installed technology and sensors on all 16 plow trucks.
(Source: West Des Moines Public Services)

methodology for plow trucks. For example, left turns are bad for plow routes as a windrow of snow is spread across the intersection from the right side of the plow. Once in place, route optimization allowed West Des Moines to more effectively meet level-of-service goals in a timely manner for arterial, collector, and residential networks.

The availability of plow trucks and abundant road weather data allows agency staff to effectively monitor an event as it occurs. Figure 3 shows the road network and plow locations, with a three-tiered color scheme to show the status of plowed streets. Agency staff also use this archived information to review storm and road weather performance data after the event. In some cases, this reveals the need for education and training, if operators did not follow the strategy.

Performance measures are challenging to develop for effective comparison, given the complexity and differences in winter seasons and specific events. For example, an ice storm may require a lot more material than a 2-inch snowfall. West Des Moines Public Services therefore does several analyses and focuses on the overall trends, as shown in Figure 4, rather than developing the "best" performance measure.

IMO Costs and Benefits

West Des Moines believes the benefits of IMO have greatly exceeded the costs. The up-front technology costs have decreased significantly since IMO was deployed in West Des Moines, while ongoing monthly costs during the winter include

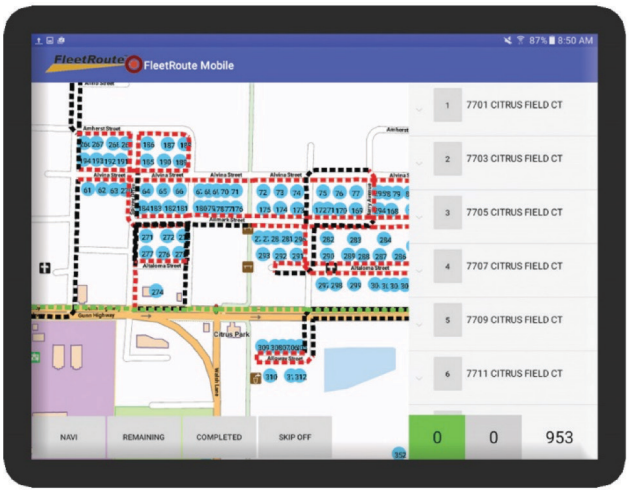

Figure 2: West Des Moines Public Services has implemented route optimization for plow trucks to make routing suggestions that more effectively meet level-of-service goals in a timely manner for arterial, collector, and residential networks. Dashed lines are green to indicate deadheading from the garage to the start of the route, black for plow down, and red to indicate a lane that was previously plowed and treated.
(Source: West Des Moines Public Services)

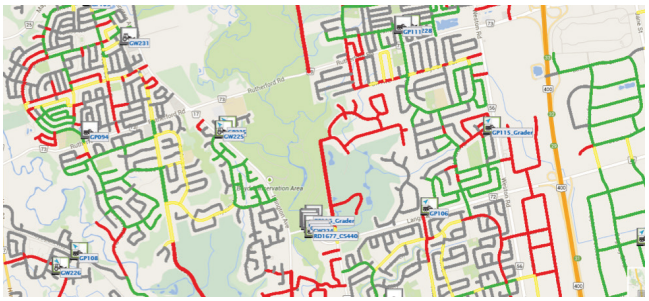

Figure 3: Agency staff and the public can view the location of plow trucks and status of plowed streets.
(Source: West Des Moines Public Services)

about $8,700 per year for contract weather services and MDSS, and $30 per month per plow truck for AVL cellular communications and data management. The benefits include the following two areas:

- **Savings on materials.** Reduced salt and material usage is the primary benefit of this IMO deployment. The MDSS uses real-time road weather conditions and fleet vehicle locations to provide recommendations on material type, application rates, and timing for maintenance staff to make better decisions. Specifically, West Des Moines Public Services has reduced chloride applications by 30 percent while maintaining the same level of service, saving about $150,000 annually.
- **Agency efficiencies.** Route optimization has reduced the time needed to clear various areas, fuel consumption, and wear and tear on the plow truck fleet, resulting in about $50,000 savings per year and the ability to do more with less. With increased data available for review after a winter weather event, agency staff also can examine the storm progression using available road weather data such as friction data and RWIS photos and then compare it to the operational strategy and results. This is used to modify and enhance the operational strategy including truck placement, material type, and application timing of material to better meet level of service goals for future winter weather events.

Tips for Deployment Based on Lessons Learned

While IMO deployment has improved performance for West Des Moines Public Services, the numerous challenges that were identified and overcome have generated valuable lessons learned, including the following tips.

Establish champions. The key to success for any new initiative is having an agency champion or team to manage planning, implementation, and operations. Contractors or vendors may not understand the larger picture of what the agency is trying to do, especially something that is new and innovative, so engaging agency staff is key to seeing a concept through to successful completion.

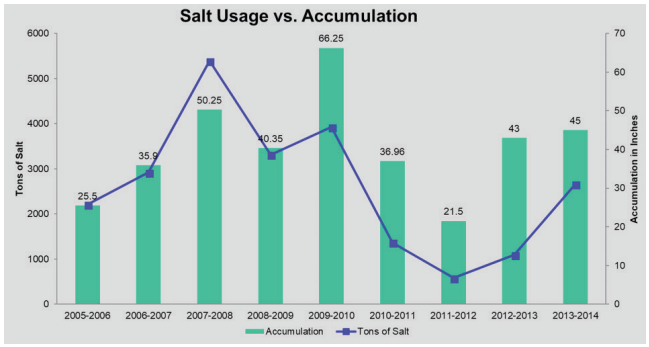

Figure 4: Graph showing West Des Moines annual salt usage and snow and ice accumulation.
(Source: West Des Moines Public Services)

Monitor new technology trends. State transportation agencies may receive federal funding or encouragement to pursue innovative technologies. Local transportation agencies may have to be more proactive to identify technology trends to enhance operations, but may also have more autonomy to do research and try new technologies independently given a smaller bureaucracy than other agencies. Technology continues to become more automated based on real-time conditions rather than relying so heavily on operator decisions.

Anticipate vendor changes. Standardized formats and plug-and-play (i.e., seamless interoperability and inter-connectivity) are common in Europe. In the United States, systems tend to be more proprietary. When West Des Moines decided to get a new AVL hardware provider, the entire existing system had to be replaced. A plug-and-play option with increased interoperability between systems is generally not available. Thus it is important to ask vendors and identify alternatives for service and support. In other words, what can the agency do if the company goes out of business and no longer offers support?

Understand availability of updates. Technology evolves rapidly but yet the core of it may be deployed on plow trucks for use over the next 10 years. Therefore it is important to understand the availability of service, support, and frequency of needed software updates to maintain pace with rapid changes that can quickly cause a system to be outdated.

Staff training and education. Agency staff and management sometimes resist change, which can negatively impact the effectiveness of new practices or technologies. Education and training should address the goals and benefits of new practices and technologies to achieve buy-in. Staff may then be more willing to learn how the new systems work and modify their work activities as needed.

Calibration and acclimation. Regularly scheduled calibration of equipment is essential to ensure optimal performance and quality data. Maintenance staff have found that some sensors can take as much as 15-30 minutes to accurately measure outside pavement temperature after being inside a warmer, garage environment, which needs to be accounted for in data reporting.

Technology integration. Installing sensors adds complexity to plow truck hydraulic and/or electrical systems. If not handled appropriately, this can present challenges between the technology, plow operator, and person maintaining the technology. Although it may seem as if everything works in unison, agency staff must integrate the technology so that the entire system is not shut down if one component fails and the plow truck can continue to operate on the road when needed. Increased collaboration with system vendors may be useful in addressing these issues.

Future Directions for West Des Moines

West Des Moines Public Services continues to examine ways to enhance practices with new technologies. A goal for West Des Moines is to eventually tie all the technology systems into a more unified and automated process that reduces operator decisions to more efficiently improve mobility, reduce environmental impacts, and provide better information to the public.

Recognizing an increasing demand for timely road status information from the public, including increasing views from traffic cameras, West Des Moines is seeking to allow the public to access the agency plowed route status map, shown in Figure 3. The public could then see for themselves the status of plowed streets, plow locations, progress of a storm, and estimated time for when the street will be plowed. Route optimization has made the timing fairly consistent for completing the plowing of arterials first, then collectors, and finally the residential streets.

In the winter of 2018-2019, the department's staff hope to have a prototype infrared sensor mounted on a plow truck to gather pavement friction information. This will expand the agency capability from the one mobile infrared friction sensor already mounted on a regular agency vehicle that has been used to capture differences between street classifications.

Available Resources

A variety of promotional and technical materials to support agencies interested in deploying IMO technologies are available from the FHWA's Weather-Savvy Roads IMO Resource Toolkit: ***https://go.usa.gov/xnS8V***.

For More Information

www.fhwa.dot.gov

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