Advanced Decision Support for Winter Road Maintenance

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Managing a winter maintenance program today is an increasingly complex endeavor. Just making sure that a plow blade is at the ready when the first flake falls is only a small part of the task. With tight budgets and the high expectation of the public for keeping roads clear of snow and ice, today's maintenance manager has to be able to handle multiple tasks or risk getting behind the onslaught of winter weather. Factor in all of the regulations about chemical applications, environmental impacts, and multiple, often contradictory weather forecasts, and you have got the ingredients for information overload.

The Federal Highway Administration (FHWA) recognized this potential problem in the late 1990's. Generally speaking, there were plenty of weather forecasts, along with a few companies that issued road-specific forecasts, but there was a lack of linkage between the information available and the decisions made by winter maintenance managers. It was this weak link that became the genesis for the winter Maintenance Decision Support System (MDSS).

The MDSS is a decision support tool that has the ability to provide weather predictions focused toward the road surface. These predictions are then merged with customized rules of practice that have been captured from maintenance managers and coded into a computer algorithm. The outcome is a set of treatment recommendations that will help an agency maintain the highest level of service possible given available staff and equipment resources, while minimizing the amount of material applied to the roads.

The MDSS development project has taken several years and the talents of many individuals. As a first step, to capture the way maintenance supervisors do their job, a stakeholder group was established. This group consists of winter maintenance representatives from nearly half of the states, members of academia, and private sector vendors. Meetings have been held at least annually to review progress and to make sure that the course of the project remains grounded to real world conditions. The ultimate goal of the project is to create a prototype system that private sector companies can take, integrate into their product lines, and offer as a service back to states and local jurisdictions. Success will be achieved when the state and local agencies see the benefits of this service through sound investments.

With a limited budget, it seemed impossible that such a system could be built from scratch. However, after developing successful solutions for the aviation community, a consortium of national laboratories offered to provide expertise and modules created for other related projects as the basis for this new system. It was this ability to leverage existing technology and tie them together into an operational prototype that has caught the attention of the winter maintenance community and enabled an idea to evolve into an operational demonstration.

An initial demonstration of the MDSS prototype was deployed and evaluated during the second half of the winter of 2002-2003 in central Iowa. Three Iowa Department of Transportation

(DOT) maintenance garages took part. While there were some startup problems and the recognition that some aspects of roadway weather forecasting are pushing the state-of-the-science of what is currently possible, everyone agreed that the effort was worthwhile, and the system should continue to be developed and tested. After integrating lessons-learned from the winter demonstration and adding additional capabilities, there are plans to conduct a second, longer demonstration in Iowa over the winter of 2003-2004.

FHWA recognizes that road maintenance supervisors, in general, don't want to be meteorologists. On the other hand, it is important that DOT personnel get the right information to make effective decisions (e.g., applying salt only as necessary). The MDSS provides a subset of weather parameters important for maintenance operations. This includes forecast values of air and road temperatures, precipitation start and stop times, precipitation types, and accumulation amounts. Figure 1 shows the main display of the MDSS.

The MDSS generates road treatment recommendations based on its own weather forecast information. This guidance includes recommendations for material (e.g., salt) application times and rates (Figure 2). To assist the end user, the MDSS includes the ability to generate "what-if" scenarios where outcomes based on changing the application type, times and rate can be generated. The maintenance supervisor can then see how these changes could affect roadway mobility, chemical concentration, and the resultant snow depth.

In addition to providing real-time decision support to the winter maintenance manager, the MDSS can be used as a training tool, to play back conditions after the season has ended and to determine if different courses of action would have been more beneficial. In addition, by capturing the current rules of practice, the MDSS could serve as a training tool for new or less experienced maintenance managers.

The MDSS has come this far only through the dedication of the stakeholders and the scientific expertise and professionalism of the national labs. It is hoped that after the winter 2003-2004 demonstration that the system will be mature enough to be championed by the private sector and to be embraced by the states. In doing so, it will push the current state-of-the-practice to new levels, increasing roadway safety and enabling maintenance managers to better address the impacts of weather.

For more information on the MDSS, visit the following web sites:
http://www.ops.fhwa.dot.gov/weather
http://www.rap.ucar.edu/projects/rdwx_mdss

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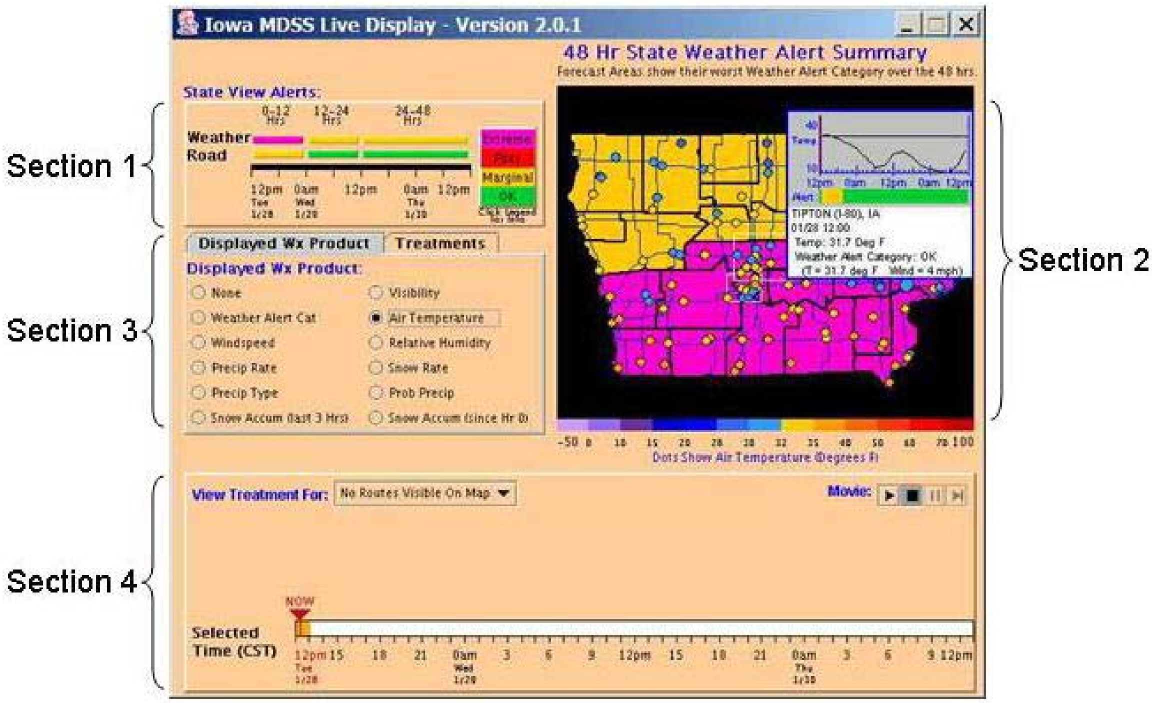

Figure 1 – MDSS main display consisting of four sections including the quick summary display (1), main map display (2), weather parameter selection menu (3) and weather forecast animation control (4)

Figure 2 – Treatment selection display. Users can see the results of the optimized treatments and "what-if" scenarios.