

**Using Technology to Manage Winter Operations and Developments in Best Winter Maintenance Practices**

**Salt and the Environment**

**ABSTRACT**

Some of the most vital tools any agency can use to enhance its winter operations are new technologies and good weather data. In order to run an efficient and sustainable winter maintenance program, agencies need to implement best practices, new technologies and also use weather data to make educated choices regarding when and how to treat their roadways. To accomplish this, agencies need forecast data for planning and real time observations to help an agency to make the best decisions possible. Then the appropriate actions can be taken.

Many agencies in North America have implemented these weather-based technologies. In addition many foreign countries have also implemented these technologies. This paper will discuss how agencies have implemented new technologies and best practices and how they've used that data to enhance their operations. This has led to a more sustainable winter operation for these agencies. It will look at how agencies overcame the costs of implementing and maintaining these technologies and programs and at how the programs, data and measurements have changed the way the agencies conduct winter operations.

Using technologies to manage winter operations means using data and measuring its effect. This can be accomplished by gathering observations and measuring performance for a specific program or technology or on a larger scale. This paper will also include a case study of one of the agencies and how new technologies and programs are being utilized within that agency.

**1. INTRODUCTION**

In winter maintenance there are many proven best practices [1] and technologies that an agency can apply to enhance its operations. Considering there are proven programs or technologies that an agency can implement, that will improve its operation and perhaps reduce its costs or environmental impacts, what would prevent an agency from implementing these?

Lack of implementation of technologies and best practices is one of the questions that has puzzled many in the industry for years and years. One could speculate the causes, perhaps lack of leadership, lack of funding or perhaps lack of knowledge.

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Figure 1. Barriers in implementing best practices

Knowledge is one of the variables that can be influenced. Sharing how other agencies have implemented technologies and programs and sharing their success, may help influence change in the industry. In most cases there is also a cost benefit or return on investment that has been developed or tested to validate the technology or practice as a best practice. There are also countless conferences, studies, papers, videos and web sites [2] on these technologies and best practices. These can be a great asset to an agency that is just beginning a program or looking to implement a new technology.

Leadership can also be influenced, but in many cases it takes a change in leadership before new programs or technologies are implemented. This thinking follows the age old adage “if it isn’t broke, don’t fix it” or “we have always done it that way”. Change [3] can be difficult for many, despite evidence of better results, cost savings and environmental benefits. However, the traditional workforce is changing, and as it does, we see newer generations embracing many of the technologies that are coming forward. For programs and technologies to be successful, they need a champion. They certainly need leadership and management to promote them, but often the champion and the ownership lies with the staff that uses and implements these technologies and programs.

Funding may be more difficult to influence but when the return on investment is clearly shown or performance is greatly improved then funding new technologies and programs should be considered whenever possible. Interestingly, when funding is available, agencies embrace these practices and technologies and move forward quickly. A prime example of this is currently happening in the Chicagoland area where a salt reduction program has been implemented and smaller agencies are given grant money if they can show a reduction of salt usage. Suddenly these agencies are looking to implement new programs and technologies with these funds. So when funds are given to agencies they are more than willing to apply them and reap the benefits. It also begs the question, is funding truly the issue? Perhaps it is, and agencies must make difficult decisions with existing funds despite knowing and understanding the benefits of these best practices. Perhaps we can relate to this by using a common everyday example. Consider a homeowner who could purchase an energy efficient hot water heater for their home.

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The cost-benefit of installing this unit reflects that it would pay for itself in a five year period. The existing water heater is still working, however, it would be more efficient to install a new one. So the homeowner must decide to expend funds now or to continue to use the existing system. Similarly agencies are faced with the same decisions. Continue using the technologies and the practices they are now or invest in changes that will be more beneficial in the long run. It comes down to funding availability and priorities.

Many of the advancements in technology and in best practices are not necessarily new. Many have been around for years but have become more widely used recently. Many of those that have been around have been enhanced as years progressed.

Looking at winter maintenance technologies we find the advancements of these technologies are similar to the progression we have seen in other fields. For example, phones have been around for many years but they have continued to evolve from the original rotary dial phones to today's smart cellular phones. Similarly, we've seen the same type of progression in winter maintenance technologies. Take for example material spreading systems. The systems have been around for years and were very basic manual systems to begin with. However, we went from these manual spreading systems to computerized dispensing systems that incorporate ground speed, automatic vehicle location, different material types and data recording. Basically, we have evolved from an un-precise manual system that was only marginally better (in terms of accuracy of placement at least – it was certainly safer) than having a worker with a shovel in the back of the truck applying salt manually to the road, to an extremely precise computerized dispensing system with incredible capabilities. This is only one example of a new technology that can assist agencies in reducing their costs, improving their efficiency, evaluating their performance and reducing their environmental impact.

Winter maintenance technologies are generally in the form of the equipment and data. Winter maintenance best practices incorporate these technologies into proven methods. Some examples of newer technologies are pavement temperature sensors mounted on vehicles, automatic vehicle location equipment with all kinds of data and reporting. There are new advancements on snow plows including dispensing equipment, liquid delivery systems, and newer snow plow designs with multiple edges, new high performance snow plow blades and many others.

Best practices incorporate these technologies into proven methods such as pre-wetting of materials, anti-icing operations, treatment recommendations and maintenance decision support systems. So best practices are reliant on these technologies.

### **IMPLEMENTING TECHNOLOGIES**

What does it take to manage winter operations? I truly believe that there's a misunderstanding or perhaps a lack of knowledge of what goes into managing a winter operations agency. I recall a day when one of the operators in our agency came to me and said "your job is so easy all you

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have to do is wait for it to snow and then call us out”. This enlightened me to the fact, that even within the agency I was managing, there was really no understanding as to all the technology, science and decision-making that goes into overseeing an operation.

Technologies have made that decision making much easier. Easier because you have data and decision support to help you. Today’s technologies help an agency make decisions on pre-treatments, start times, ongoing conditions, end times and subsequent events. It will aide in treatment types and amounts. Data can be seen live and important data recorded so evaluation is possible. It can help staff in their decision making in the vehicle during an event. They can adjust as conditions change. It also aides in providing information to elected officials and the general public on predicted, ongoing and future conditions of roadways often in real time.

Utilizing these technologies allows agencies to reach their levels of service and implement proactive approaches while minimizing their material use. This results in better performance and better maintained roadways prior to and during an event.

So how do agencies that have implemented these technologies and programs go about doing it? How would a new agency proceed? In many cases starting small is the key. Perhaps in a pilot project, a trial or perhaps only equipping one vehicle. As previously stated, networking and information gathering can really aide in implementing a new program - learning from others so mistakes can be avoided. Funding for a pilot is often much easier than implementing a program for an entire agency or an entire fleet. Measuring the success is also important so that the success can be demonstrated if an expansion is desired.

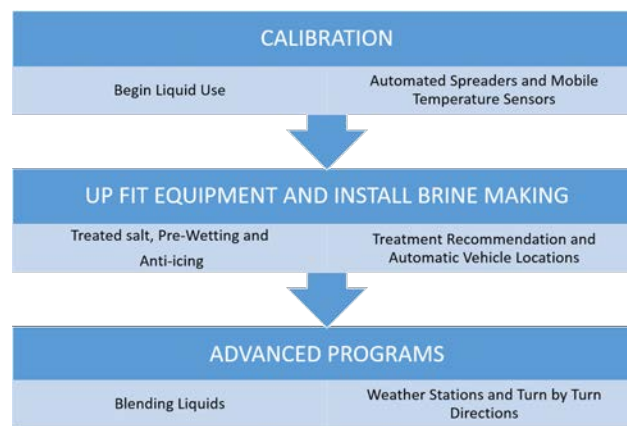


Figure 2. Steps an agency might implement

Get assistance from the vendors. Vendors are the experts in their field and should be willing to help in a pilot or test. They want to see you succeed so they can provide assistance, special pricing or perhaps even a free trial. In some cases, a vendor may even alter or change a program to fit an agency or industry needs.

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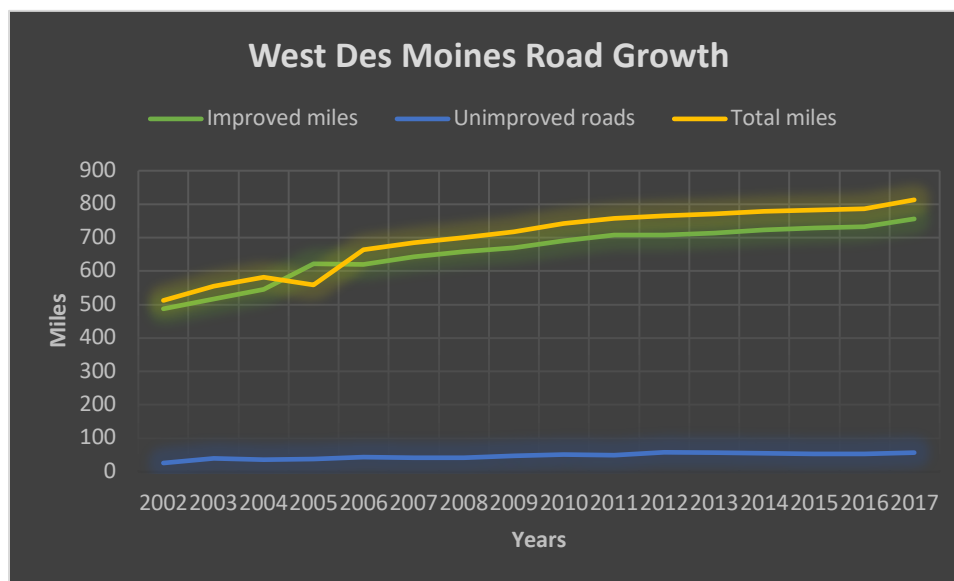
Find a champion. Staff is the key to making any program or new equipment work. Getting them involved from the beginning and allowing their opinions to be heard is vital. It is really important for staff to understand why the agency is changing, what are the expectations and how it will improve the efficiency of the agency.

Have someone else pay for it. There are many grants and federal programs that can be applied for that can be used to implement some of the newer technologies. Research and networking again can provide useful information on how agencies have done this. In some cases it may be that another department within an agency may have similar needs and are willing to pay for a new system or will contribute to its purchase. Including new technology when equipment is replaced is a key way of upgrading. Here the cost can be absorbed in the purchase price. It is important to consider versatility and redundancy when doing this as equipment will change and conformity may be difficult as years pass. Another possibility is leasing to purchase. Many vendors have programs that allow this. Checking with internal purchasing regulations is required prior to entering into a contract like this. Perhaps including the equipment or program in a bigger project is an option. This may be one of the better options when capital projects are needed. The costs may be minimal compared to the overall project and easily absorbed. One example here maybe including a brine making, blending and liquid storage system when a new facility is constructed. Or perhaps including an RWIS (roadway weather information system) site in a construction project or a bridge replacement.

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**2. CASE STUDY – THE CITY OF WEST DES MOINES, IOWA**

A model agency in the area of snow removal and innovation is the City of West Des Moines in Iowa. They are well known in the industry and have embraced winter maintenance technology and best practices. The City sits in central Iowa and serves the 66,728 residents. It is unique in that the population almost doubles during each working day and this demands that major roadways be safe and reliable. It's a large geographical area that serves both a rural and urban environment and has very high service level demands. The agency maintains over 750 lane miles of paved roads, 40 miles of unpaved roads with an additional 5 to 10 miles of roadway added each year [fig 1]. It also has a major interstate running through the heart of the city. Some of the city's major roadways are multi-lane and handle up to 60,000 vehicles each day. The city has also been expanding and developing.



“FIGURE 3: CHANGE IN LANE MILES FOR THE CITY OF WEST DES MOINES, 2002 – 2017.”

The city of West Des Moines service levels (i.e. customer expectations) are very high. Priority 1 roadways require that the city achieve bare pavement on these roadways following any snow and ice event. Priority 2 and 3 roads are not plowed or treated until at least 1 inch of snowfall has occurred. The city primarily uses its own resources however it does contract some of its residential areas during winter events. To achieve their goals the city implemented the industry's best practices and weather forecasting and operational tools.

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The city began its change from typical reactive operations to a proactive operation in the later 1990's. Prior to the change the city would wait until an event was underway and they were notified by local law enforcement or the public that conditions had deteriorated and that roadways needed attention. The force behind this change was Bret Hodne, currently the Director of Public Services for the city. Mr. Hodne began research in the 1990's on ways to improve the city's snow removal efforts and what technologies may be implemented. Mr. Hodne attended various conferences and coordinated with the Iowa DOT to learn and implement new programs and technologies for the city. In other words, to mirror what was noted above, Mr. Hodne created a network that could support the changes that he knew his agency needed to make.

One of the first steps he took was to implement the use of liquids and yearly calibration of their equipment. Mr. Hodne implemented a pre-wetting program fitting new trucks with equipment and retro fitting some of the existing equipment. This was so successful that money saved in the salt budget could be used to implement new programs and so they began an anti-icing program using a trailer and began making salt brine internally. They also needed weather data to make these programs successful and while initially they used data from the Iowa DOT they decided to incorporate a private weather service. This included treatment recommendations and pavement temperature data. In the newer equipment Mr. Hodne was able to include computerized dispensing systems that utilized ground speed control. Again the city saw great value and reduced material use. The city became such a model that vendors were contacting them for the opportunity to test products and develop systems. The city was the first one to ever implement an in-house computerized blending system for liquids. This was designed and built with in-house staff and a consultant. It was a huge success and subsequent blending systems were designed by vendors and first trialed at their facility before hitting the market. Again, this reflects the step of working with vendors noted above.

The city continued to evolve and today they have a state of the art snow removal program. They have implemented an automatic vehicle location system and it will include turn by turn directions. They collect the data from these units and evaluate performance and resolve any complaints. The snow plows are fitted with wings, multi-edge plows, new high performance plow blades, slurry generators and pavement temperature probes. They have a private weather service that gives them consultation with a meteorologist. They worked with a vendor to install 3 RWIS (roadway weather information systems) which they lease. These are state of the art systems that give them atmospheric information, roadway conditions, camera images, roadway temperatures and road friction (grip). This helps the city and the forecasting service to



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give precise forecast and observations on their roadway systems and allows them to evaluate their performance.

How has all this technology and pro-active programs helped the city? Despite continual growth and an expansion of their roadway network, they have seen a steady reduction of their material use and an improvement of their performance in winter operations.

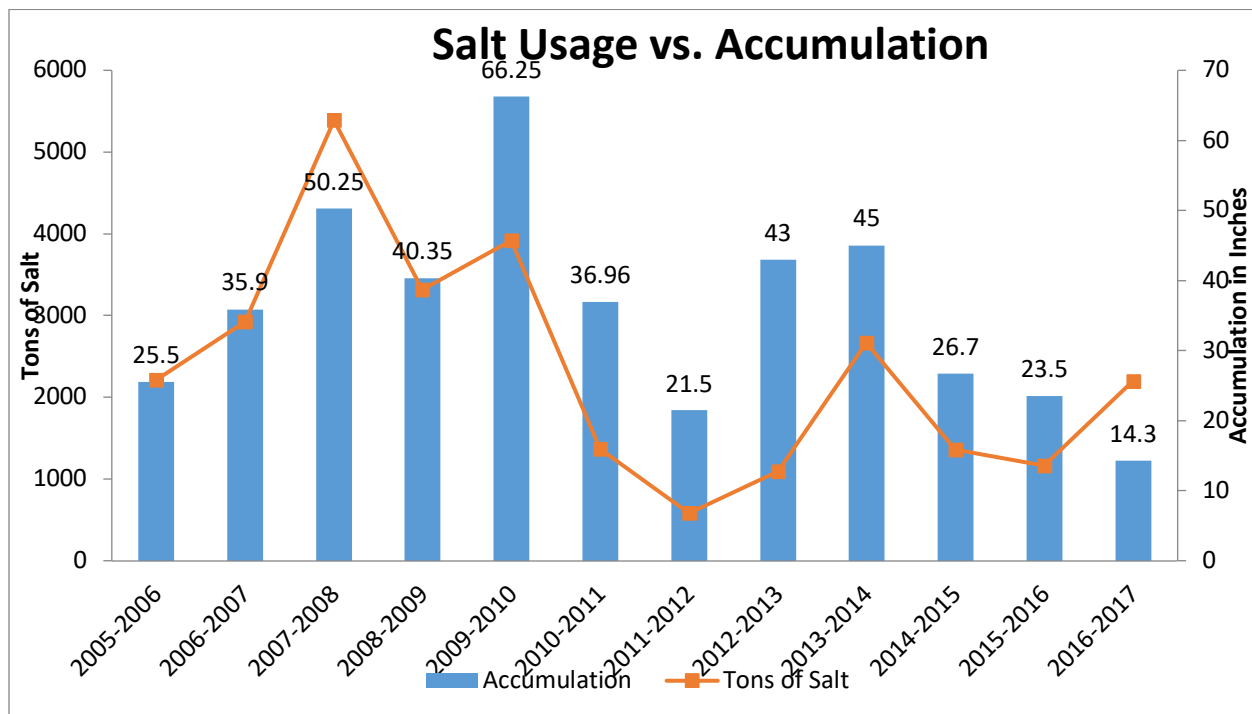


Figure 2: Salt totals for the city of West Des Moines 2005-2017

These figures represent raw salt totals and do not take into account winter severity nor do they take into account icing events, which have become much more common in recent years. The overall trend is a decrease in usage especially during the past 7 years.

### 3. CONCLUSION

Technologies and best practices are vital to agencies of all sizes. When technologies and weather data are combined with pro-active operations, improved levels of service



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can be achieved while utilizing less de-icing materials. This truly makes agencies more sustainable and is a more environmentally friendly approach. In the long term it is fiscally beneficial as well.

Environmental concerns are becoming more prevalent as chemical programs have expanded across the globe. It is vital agencies look for ways to implement new technologies and best practices. Agencies that have not adopted best practices need to do so and in order to be successful and achieve their desired levels of service. Finding ways to implement these practices and programs can be done even on a small scale. Adopting best practices and incorporating new technology along with real time observations will make every agency more successful and achieve a more sustainability operation for the agency and its users.

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