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Winter Maintenance Command Center, The heart of a Winter Maintenance Management System

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Imagine if your left hand did not really know what your right hand was doing, or if your left foot was not in sync with your right foot, how would you walk? How about if you hit your thumb with a hammer? You would definitely remember that and would not like to repeat the experience.

Like the human body, a maintenance operation is a live entity and has many arms and legs that need their functions coordinated to work properly. Similar to the human body, an operation needs to utilize past experiences, apply planning, and not operate on reactionary impulses only.

Road authorities have started to take the issue of winter maintenance into a new, positive direction. A direction where forward thinking is applied to enhance safety, increase efficiency, reduce cost, and adjust to changing demands and emerging technologies.

The last few years have witnessed a leap forward by road maintenance agencies, with the adoption of new materials and new application techniques, such as liquid anti-icing and pre-wetting. The development and proliferation of Road Weather Information Systems (RWIS), Electronic Spreader Controllers, Automatic Vehicle Location (AVL) technologies and various means of data collection have improved decision-making, as well as improved tracking and control of winter operations. This is particularly evident in road salt usage, not only to reduce costs, but also to reduce negative environmental impacts.

However, a not so encouraging trend is the decentralized, and sometimes fragmented, approach for the management of winter maintenance operations, especially with all its new complexities, and the ever-increasing expectation of road users.

The above are concerns, among others, that warrant viewing the operation as a unified system that needs to be run in a closely coordinated fashion. Similar to the human body, the operation needs a center for reasoning, command, control and decision making; it needs a brain. As it commands and controls the rest of the body to survive, succeed and flourish the brain records memories and experiences and is conscious of its surroundings.

To have a successful winter maintenance operation, an agency or a road authority needs to establish a management system that incorporates, at its heart, a command and control center. Such a central location, physical or virtual, would house relevant operational information that would be made available to all operational decision-makers, thus allowing them to make appropriate decisions.

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The concept of a central command and control for an operation is not new, even for winter maintenance. Many jurisdictions use a "Snow Desk" to manage snow clearing operations or snow emergencies.

COMMUNICATION

The essence of any command and control center is communication. Winter road maintainers need to communicate at all levels to consistently ensure safe roads and stay within budget.

Most people in this industry are aware of the importance of communication channels and patterns, vertical/horizontal and internal/external. However, timeline communication needs to be explored further. A winter road maintainer must communicate with past, present, and future elements of the operation.

In a command center, timeline communication is critical for success. A command center is essentially a framework for making decisions. A decision maker readily needs information about the past. The past is composed of known methodologies, established standards, best practices, and even local and legislated requirements.

Keeping proper historical data about the operation will afford operation managers proper analysis of what has worked and what has not, which equipment type had more breakdowns than others, which contractor was consistently delayed, etc.

Historical information is crucial to avoid repeating mistakes. It should also give operation managers realistic data for equipment, labor and material usages and expenditures.

Delving further into communication types, the command center should have information about potential future operational scenarios. What should be done if there is an ice-storm? How many spreaders are required in extreme snow conditions? Which authority should be contacted first and what is their contact information in case of road closures? These are examples of operational data that would not only enhance the preparedness of maintenance officials, but also save a tremendous amount of resources when considered in advance.

"Present" communications take place during the winter maintenance operation itself. This is achieved by ensuring operators are on their routes, examining alternative outcomes and adjusting to achieve operational objectives, and ensuring that no member of the operation is working in isolation.

CENTRALIZATION VS. DECENTRALIZATION

To centralize or not to centralize, that is the question! It seems there are valid arguments for both approaches. Centralization gives you one-stop access to information and a single point for decision-making, while decentralization allows for flexibility and customized reactions to local conditions. However, the disadvantages on both sides are also evident. They can range from multiple and conflicting decisions within the same area to having only one person controlling the operation in multiple districts.

Then, how can winter maintenance operation take the best of both approaches? It is possible. How about "*Centralized Decentralization*"? It may be best to use an example to explain this oxymoronic term. For that, let's look to Europe.

In Denmark, the national road authority collaborated with cities and counties and jointly developed a winter maintenance management system used by road authorities at all levels to manage winter maintenance operations. Denmark's system was designed to be operated locally, e.g. in a county, where RWIS information is obtained from local stations and decisions are made for local roads. The system then collects information from the operation: data from spreaders, plows, contractors, as well as manual inputs if required. All the information is maintained in a database that is synchronized with a national database. This national database collects information from all local users and makes it available to all localities through the internet and local networks. Thus, the whole country is using the same system. Of course, Denmark is a lot smaller than Canada and the U.S.

The concept of "*Centralized Decentralization*" is feasible in any jurisdiction, however. By utilizing new networking technologies , such as the Internet, Local Area Networks (LAN), and Wide Area Networks (WAN), cell phones, video conferencing, and wireless email, road authorities can establish a virtual command center that is accessible by remote means and that allows for all decision makers to access the same information and interact with each other.

A winter maintenance command center or a snow desk does not have to be the classical, physical office where at least one person is available at all times to monitor and respond to the operation. Such command and control concepts can be achieved by having a physical command center for winter maintenance, (some times known as "Snow Desk"), or by having a virtual command and control center providing access to the same information available in a central location.

WHAT'S IN A COMMAND CENTER?

A well-integrated winter maintenance operation includes several

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The Summer, 2004 edition of *Salt and Highway Deicing* featured an article entitled "Are You Sure You are Using the Right Amount of Ice Control Chemical?" We were trying to provide a pre-season heads-up prior to final publication of this table in NCHRP Report 526 "Guidelines for Snow and Ice Control - Materials and Methods" (Nov. 2004). In final publication, Table 3 of our article was somewhat revised. Here is the revised table. The table is based on absolute ice melting ability (over an infinite period of time) as determined from the solution phase curves of the five chemicals (one of many ways of looking at chemical performance). There are large differences among the chemicals in terms of the rate of ice melting and there can be variations in results based on chemical purity and other test conditions. As a result, the table values should be considered as starting points to be refined by local conditions. The table changes nothing with regard to the performance of sodium chloride. All of the other article content is correct. ■

TABLE 3 - Equivalent Application Rates for Five Ice Control Chemicals

Temperature (°F)	NaCl		$CaCl_2$		$MgCl_2$		KAc		CMA	
	100%* Solid	23%* Liquid	90-92%* Solid	32%* Liquid	50%* Solid	27%* Liquid	100%* Solid	50%* Liquid	100%* Solid	25%* Liquid
	lb/LM	gal/LM	lb/LM	gal/LM	lb/LM	gal/LM	lb/LM	gal/LM	lb/LM	gal/LM
31.5	100	45	109	32	90	31	159	30	159	69
31	100	46	111	32	91	32	161	31	161	72
30.5	100	47	111	33	91	32	155	30	155	71
30	100	48	107	33	94	33	158	31	158	74
29	100	49	109	34	91	33	155	31	155	79
28	100	52	109	34	91	33	152	31	152	81
27	100	54	109	35	90	34	153	31	153	86
26	100	56	104	34	96	36	161	33	161	95
25	100	57	102	34	99	35	167	35	167	108
24	100	61	108	38	102	41	167	35	167	114
23	100	62	112	41	102	41	164	35	164	117
22	100	65	110	41	102	42	160	35	160	121
21	100	68	107	40	101	42	155	35	155	125
20	100	70	108	42	98	42	150	34	150	129
15	100	90	103	44	96	44	142	34	142	170
10	100	120	101	49	95	47	138	35	138	265
5	100	165	104	57	96	51	139	37	139	630

NaCl: Sodium chloride.
$CaCl_2$: Calcium chloride.
$MgCl_2$: Magnesium chloride.
KAc: Potassium acetate.
CMA: Calcium magnesium acetate.

* Typical percent concentrations of the solid and liquid forms with the balance being largely water.

General Note:
The above application rates are normalized to 100 lb/LM of dry solid NaCl. The application rates corresponding to a dry solid NaCl rate other than 100 lb/LM are determined by multiplying the equivalent chemical application rates for a given temperature by the ratio of the desired dry solid NaCl rate to 100 lb/LM. For example, if a 200 lb/LM of dry solid NaCl application rate were recommended at a temperature of 20°F, then switching to a 90 to 92 percent concentration of solid $CaCl_2$ would require a slightly higher application rate of 216 lb/LM.

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components that evolve individually as well as collaboratively in order to achieve the desired integration.

- First, road maintainers need access to quality road weather forecasts in order to mobilize their forces more precisely and more effectively. Road weather forecasts are also used to determine the type of road maintenance to be used in a particular situation. Thus, a reliable Road Weather Information System (RWIS) is one of the first components needed at a maintenance command center or snow desk.

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- Second, information about resource utilization and scheduling must be in a manageable format at the maintenance command center. This means having information about the staff, supervisors, equipment, contractors, and service providers.
- Finally, data collected from vehicles during operations, such as salt and sand quantities used, material application rates, plow coverage areas, route coverage (using GPS) is crucial. Whether this information is available real-time, delayed real-time or after-the-fact depends on the requirements, resources, and policies of the particular road authority. Nevertheless, the information needs to be available eventually, if not sooner. By storing all the information at a central location, managers can perform essential data analysis to assess and modify operational decisions.

Building on the Danish Experience

The winter maintenance management system created by the Ministry of Transportation of Denmark is a great model for North American winter maintenance professionals. Its management software captures the steps that any operation needs to undertake to become an effective winter maintenance command center.

Such a system must efficiently combine all information and procedures needed by operators and decision makers in a single decision tool. Once the decision is made to mobilize equipment and staff to control snow and ice on area roads, the system must provide support allowing operators and supervisors to manage all operational activities.

Here's how it works. Agencies must create a comprehensive operational database prior to the start of the winter season. This basic data includes information such as supervisors and operators, their contact numbers and shift assignments. The database will also include information about contractors, prices, material types (salt, sand, liquids) and supply facilities. The system holds information about equipment, vehicles, spreaders, plows, their type, capacity, ownership, etc. The database includes shift schedules, operational beats (routes), and reference routes as well as all related maps.

All this is linked together in several reference plans for different operational scenarios, describing which operator is driving which vehicle on what route, and the time it should be called out.

Ideally, the management system should not bind you to any particular vendor of software, winter maintenance equipment or deicing material. It will allow entry of spreader performance data, for example, from any manufacturer and be able to handle a wide range of data inputs ranging from manual input to the fully automated live data collection.

Whether your winter maintenance command center is a room full of computers and video monitors accessing live traffic videos or a powerful data server receiving RWIS and field data providing information to field supervisors and operators in real time, new communications technologies can relieve a lot of stress and strain from the demanding job of coordinating an agency's response when winter storms strike. And, like coordinating the physical acts of walking or pounding a nail, employing new tools to gather, process and disseminate winter maintenance information, and coordinate operational plans can avoid painful (professional) stumbles and bruises. ■

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You just enjoyed another electronic ***Salt and Highway Deicing*** Newsletter! It helps you make better decisions in your winter maintenance responsibilities and gives even more information by active links to www.saltinstitute.org <http://www.saltinstitute.org> with specific pages to further snowfighter information. Feel free to forward this newsletter to other interested persons so they can also enjoy this informative free quarterly. Be aware Salt Institute never sells or distributes any of your contact information to any outside source. Please sign up at: http://www.saltinstitute.org/subscribe/index.html