Resources to Support Road Weather Management Capability Maturity Framework Users

The Road Weather Management Capability Maturity Framework (RWM CMF) assesses the institutional capacity of an agency or a region to respond to adverse weather conditions from both a maintenance and operations perspective.

The following resources, organized by capability dimensions and sub-dimensions, provide examples of existing capability throughout the country.

These resources provide users of RWM CMF with relevant information as they consider their identified actions for improvement. When multiple examples are available, they are included as "additional examples" in the table.

Click below to go directly to resources pertaining to a particular dimension of capability:

- Business Process
- Systems and Technology
- Performance Measurement
- Organization and Workforce
- Culture
- Collaboration

For more general resources and publications pertaining to road weather management: FHWA Road Weather Management Program Publications.

Business Process

Business processes, in the context of roadway weather management, refers to activities such as planning, programming, agency project development processes, and those organizational aspects that govern various technical or administrative functions such as training, human resource management, contracting and procurement, information technology, or coordination. In many cases, the business process elements go beyond the day-to-day operational activities and require broader institutional support and involvement to address. All of these processes are fundamental to the success of operations and management activities. Without the right procurement processes, partnering commitments, sustainable funding, internal awareness, and support, there could be a limited capacity to be able to implement more complex operations programs and activities. Table 1 provides a list of resources for this area.

Table 1. Business Process Resources for RWM CMF

Sub-Dimensions	Primary Example
Strategic Planning Actions under this sub-dimension focus on the ability of an agency to participate in strategic planning related to road weather and winter maintenance activities. Actions focus on multi-year planning, the ability to identify operational and maintenance needs, funding requirements and necessary investments to ensure that the effectiveness of road weather management programs are sustained.	Washington State Department of Transportation (DOT) has a Snow and Ice Plan which details the agency's policies, processes, and goals related to snow and ice management.
Program and Budget Actions under this sub-dimension focus on the ability of an agency to program road weather management needs into the budgeting and procurement process emphasizing not just the capital expense but also the operations and maintenance costs. Actions emphasize approaches to manage existing and future road weather management assets while continually monitoring and maintaining the performance of these management assets.	The Executive Summary of Ohio DOT's "Snow and Ice Control Best Practices" 2011 report describes how the agency has a dedicated budget exclusively for snow and ice control, which is further divided into five categories: Equipment, Materials, Guidance, Applications, and Research.

Sub-Dimensions	Primary Example
Regional Process Coordination Actions under this sub-dimension increase the capability of an agency to respond to events, ensuring that business processes are set up for appropriate dissemination of weather conditions and alerts.	Kansas DOT's yearly winter maintenance activities make sure snow and ice processes are coordinated between regions including preparations for snow and ice control are done by mid-October every year, including: - Readying equipment / mounting attachments to trucks used year-round - Stocking materials - Training employees - Reviewing assigned routes - Placing snow fences
Operational Response Process Actions under this sub-dimension increase the capability of an agency to respond to events, ensuring that business processes are set up for appropriate dissemination of weather conditions and alerts.	New York State Thruway Authority's Guidelines for Use of Variable Message Signs (VMS) includes a library of sample VMS messages in Appendix One.

Systems and Technology

Use of the appropriate processes for design and implementation of systems will ensure that the needs of the region are appropriately addressed, that systems are implemented in an efficient manner, and that interoperability with other systems is achieved. Table 2 provides a list of resources for this area.

Table 2. Systems and Technology Resources for RWM CMF

Sub-Dimensions	Primary Example
Weather and Road Weather Data Quality Management Actions in this sub-dimension ensure the quality of weather and road weather observation systems and technologies. Actions include processes for maintenance, quality checking and restoration of observation and monitoring capabilities.	Idaho Transportation Department Winter Maintenance Performance System for repairing and monitoring Road Weather Information Systems (RWIS) sites. **Additional Example** • NCHRP Report: Benefit/Cost Study of RWIS and Anti-Icing Technologies provides information on RWIS data usage
Use of Systems Actions under this sub-dimension support better utilization of existing systems including providing the ability to tailor and target information to the right personnel for decision making.	Oregon DOT's active traffic management system on OR-217 illustrates how weather and road weather information was factored into congestion management and system reliability improvements.
Systems Engineering and Interoperability Actions in this sub-dimension are geared towards building robust and interoperable road weather management systems using sound systems engineering principles.	The development of the Wyoming DOT Connected Vehicle Pilot (which utilizes various CV technologies to reduce the impact of adverse weather conditions on freight vehicle travel in the I-80 corridor in Wyoming) followed a robust systems engineering process. Several documents are available that describe the systems engineering efforts for the pilot.

Sub-Dimensions	Primary Example
Decision Support Actions in this sub-dimension aim to improve the level of decision-support available to an agency during adverse weather by utilizing existing systems and technology. Actions include processes for establishing rules and operating procedures that allow for operational and maintenance decisions to be made for current and predicted weather conditions with progress towards a robust Decision Support tool that utilizes available data to suggest and automatically implement responses.	South Dakota DOT utilizes a Maintenance Decision Support System (MDSS) to reliably recommend sound winter maintenance treatment strategies during storms.

Performance Measurement

Performance measurement is essential as the means of determining program effectiveness, determining how changes are affecting performance, and guiding decision-making. In addition, operations performance measures demonstrate the extent of transportation problems and can be used to make the case for operations within an agency and for decision-makers and the traveling public, as well as to demonstrate to them what is being accomplished with public funds on the transportation system. Table 3 provides a list of resources for this area.

Table 3. Performance Measurement Resources for RWM CMF

Sub-Dimensions	Primary Example
Performance Measure Definition Actions in this sub-dimension relate to how performance measures for road weather management are defined. Actions include processes to enable an agency to move toward tracking outcomes and normalizing the performance based on event, location, and season.	Minnesota DOT defines snow and ice management performance by measuring the frequency of achieving bare lane status within a targeted number of hours. A summary of this performance measure can be seen on page 19 of the Annual Minnesota Transportation Performance Report.
Performance Measure Utilization Actions in this sub-dimension are focused on enabling an agency to use defined performance measures effectively to meet internal and external stakeholder needs.	Idaho Transportation Department's performance measurement dashboard illustrates how road weather metrics are utilized and communicated in conjunction with other performance measures. **Additional Examples** • Ohio DOT's performance measures are defined in Ohio DOT's Recommended Performance Methods. • Michigan DOT uses a salt efficiency performance metric Michigan DOT Salt Efficiency Performance Metrics (see slide 16).

Organization and Workforce

Efficient execution of processes supporting effective programs requires appropriate combination of coordinated organizational functions and technical qualified staff with clear management authority and accountability. Table 4 provides a list of resources for this area.

Table 4. Organization and Workforce Resources for RWM CMF

Sub-Dimensions	Primary Example
Staff Development Actions in this sub-dimension enable an agency to develop workforce resources necessary for current and future road weather management program needs. Actions address professional development and training required to support agency staff in road weather management.	The University of Minnesota Center for Transportation Studies (CTS) created 22 modules for use in teaching Winter Maintenance Supervisors and Operators on a variety of topics relating to roadway snow and ice control, as part of the Clear Roads Pooled Fund Study.
Program Structure Actions in this sub-dimension support the development of road weather management program structure that enables lines of communication between and outside the agency around managing the transportation system during adverse weather.	2015 Final Report by Connecticut Academy of Science and Engineering detailing Connecticut DOT's entire winter highway maintenance and operations program structure **Additional Example** • The I-80 Winter Operations Coalition was established to better service the public in the States of California, Nevada, Utah, Wyoming, and Nebraska through improved and coordinated maintenance and traveler information services.

Culture

Culture is the combination of values, assumptions, knowledge, and expectations of the agency in the context of its institutional and operating context, and as expressed in its accepted mission and related activities. Table 5 provides a list of resources for this area.

Table 5. Culture Resources for RWM CMF

Sub-Dimensions	Primary Example
Operational Objectives Actions in this sub-dimension focus on clearly articulating the objectives of the road weather management program.	Vermont Agency of Transportation clearly lays out their operational objectives for road weather management in their Snow and Ice Control Plan. Given limited resources, the agency prioritizes specific corridors to maintain certain levels of service during winter storms.
Leadership Actions in this sub-dimension help an agency identify internal leadership required for effective road weather management.	The state government of Arizona published an article blog about Mark Trennepohl, the State's de-facto road weather management program leader. Mr. Trennepohl is well-known by the community as somebody who leads by example, as he frequently ventures out into storms with his four-wheel drive truck and dash-mounted camera to live-record and narrate real time road conditions; many of his videos get picked up by local news stations and have even gone viral.
Outreach Actions in this sub-dimension enable effective outreach to internal and external stakeholders on the effectiveness of road weather management.	Arizona DOT put together a comprehensive YouTube video series titled "Know Snow," which are short, high-quality educational videos showing the types of strategies and technologies Arizona DOT uses for battling adverse winter weather (including interviews with leaders of the State's road weather management team). **Additional Example** • Example of Ohio DOT District 4 Internal News Release

Collaboration

The development and implementation of roadway weather management requires a collaborative approach. The effectiveness of most strategies is dependent on improving the coordinated response of each partner. Table 6 provides a list of resources for this area.

Table 6. Collaboration Resources for RWM CMF

Sub-Dimensions	Primary Example
Meteorology/Weather Enterprise Actions in this sub-dimension promote an increased degree of collaboration between meteorology/weather groups and the transportation agency. Actions include approaches to engage the public and private sector weather providers in road weather management as well as enabling the use of meteorological expertise in decision-making at various levels of the transportation agency.	UDOT has started the Traveler Information (TI) Weather Program to provide the public with high quality road-specific forecasts before weather events, and timely road condition observations during and after events. The TI Weather program consists of three contracted meteorologists located in Utah DOT's Traffic Operations Center (TOC). TI meteorologists distribute working hours among themselves to fully cover hazardous weather events. They work alongside the TOC's maintenance and operations weather forecasters (who are also contractors), but serve public motorists specifically. **Additional Examples** • Wyoming DOT's use of videos to share weather forecasts from in-site meteorologists • A list of case studies on this topic has been assembled as part of the Weather Savvy Roads Initiative
Public Engagement Actions in this sub-dimension strive to increase engagement with the public for road weather management, increasing the scope and sophistication of an agency's involvement with the traveling public before, during, and after weather events.	The Montana Department of Transportation (MDT) provides extensive traveler information to the driving public through the Traveler Information System. This system provides information about winter roadway conditions, highway construction projects, road closures, accident and incident reports, load and speed restrictions, and a variety of other traveler information. **Additional Examples** • Example of Ohio DOT Public Info Card, "Ice & Snow: Take it Slow" • A list (with hyperlinks) of Colorado DOT's publications, radio PSAs, and television PSAs for winter weather driving

Sub-Dimensions	Primary Example
Field Personnel Communications Actions in this sub-dimension are geared toward improving communications between center and field personnel during weather events and promoting greater consistency of information exchange between the groups.	Pennsylvania DOT began a pilot including 119 plow trucks in 2014-15 with the system Automated Vehicle Location (AVL) System Pilot, which uses in-truck technology to log and share data in real-time for that truck. **Additional Example** • Wyoming Automated Road Condition Reporting System (RCRS)