Integrated Weather Monitoring/Prediction Systems

STW 1

Photo: Courtesy of Jaime Sullivan, WTI

Description: Integrated weather monitoring/prediction systems or road weather information systems (RWIS) communicate local roadway and weather condition information, and alert an agency and the public to inclement weather conditions.

An RWIS consists of the following components:

- Environmental sensor station (ESS): roadway sensors that measure atmospheric, pavement, and weather conditions, including temperature, humidity, wind speed, pavement temperature, pavement condition, etc. An ESS may also have a camera to verify measurements;
- Communications device that transmits weather data to a central location; and
- Support system that allows the collection of field data from multiple ESS and for response to field conditions.

RWIS data can be used in coordination with data from the National Weather Service or other forecasting services to predict and better prepare for inclement weather conditions. Furthermore, RWIS data can be used in coordination with integrated traveler information systems to provide the public with current weather and road condition information.

Rural Transportation Critical Needs

- ☐ Crash Countermeasures
- ☐ Emergency Services
- ☐ Operations & Maintenance
- ☐ Rural Transit & Mobility
- ☑ Surface Transportation & Weather
- ☑ Tourism & Travel Information
- ☐ Traffic Management

Issues Addressed

- ☑ Use of Real Time Road Condition Data
- ☑ Weather Prediction
- ☑ Weather Detection
- ☑ Communication of Weather Conditions
- ☑ Anticipate & Plan for Weather Impacts

Strategies Achieved

- ☑ Road User
- ☑ Road
- ☐ Vehicle
- ☐ Safety Culture
- ☐ Engineering
- ☐ Emergency Response
- ☐ Enforcement
- ☑ Education

Applicability	Partnerships	Key Components
•RWIS are typically implemented in locations that are hard to reach or trouble areas (icy conditions, high crash rates, etc.) RWIS are particularly useful in rural areas where there would otherwise be limited information regarding the weather impacts to the roadway. An RWIS with a camera is particularly useful in a remote location so that an agency does not need to send personnel out to the field as often. This also helps state departments of transportation or local agencies to address any weather impacts on roadways that might otherwise cause safety concerns.	•Applications benefit from collaboration among numerous agencies, which may include: •State departments of transportation •First responders •National Resources Conservation Service (Snotel Sites) •National Weather Service •Trucking industry	•Environmental Sensor Station (ESS) •Weather forecasting service •Sign with flashing lights •Dynamic message sign (DMS) •Cameras •Communications device •Computer •Training for employees for equipment use and maintenance

Examples of Implementation

- **Clarus Initiative**

The Clarus Initiative works to bring together RWIS data from across the United States. The goal of this project is to reduce the effects of inclement weather conditions by making this information easily available to everyone.

- **Idaho Department of Transportation (IDT) Winter Maintenance**

The IDT Winter Maintenance Performance Measures System project began in 2011 and will install 87 RWIS sites across the state of Idaho. In addition, IDT will equip AVL on their snow plows to coordinate with its RWIS to respond quickly to winter storm events.

- **Minnesota Department of Transportation (MnDOT)**

MnDOT has installed maintenance systems on bridges prone to icy conditions. This automatic de-icing system consists of an environmental sensor, signs with flashing beacons, control computer, and pump and delivery system. These systems are called FAST systems (Fixed Automated Spray Technology). These are closed systems, meaning that at this time they do not share the information; they only use the data to determine if they should trigger the anti-icing spray and disseminate signals to drivers. When the environmental sensors record conditions that may indicate the presence of snow or black ice, the control computer turns on the flashing beacons and activates the pump system, which sprays deicing solution.

- **Iowa Department of Transportation**

The Iowa Department of Transportation tested a variable speed limit system during the winter of 2015-2016. This system uses visibility and pavement sensors to detect ice and pavement conditions. If the sensors detect icy pavement conditions, the system will display an advised speed limit and the reasoning behind the speed limit on a dynamic message sign (DMS).

Implementation Considerations (General)	Implementation Considerations (Pro)	Implementation Considerations (Con)
•An agency must consider how much of the RWIS data that it will make available to the public. •The most expensive portion of an RWIS is implementing wireless access and hardwiring each site. When considering where to install an RWIS, an agency should consider the costs to hardwire the system. •An RWIS can take many forms and can be customized in order to help reduce costs. An agency can create its own RWIS using only the necessary sensors and the best mix of equipment for a specific location.	•The systems provide real time information on road and weather conditions. •They can alert travelers and maintenance personnel to inclement weather conditions. •Systems offer weather prediction data in order to prepare for inclement weather conditions (prepare plows, etc.).	•Upfront costs can be prohibitive. •The sensors must be maintained for the system to be accurate.

Opportunities for Future Expansion

- A connected vehicle could be used as an on-the-ground conditions probe in the future. Vehicle systems could record condition information such as: air temperature, windshield wiper settings, ABS brake status, and traction and stability control status. These systems could communicate using vehicle to infrastructure (V2I) technologies with nearby roadside sensors to provide real time weather condition information.
- RWIS information can be displayed on a state's integrated traveler information system or other road condition reporting websites and smartphone applications (Google Maps, Waze, Apple Maps, etc.) to alert the public to current weather conditions.
- RWIS can be used in coordination with crowd sourced data (citizen reporting programs or Waze) or cameras to verify weather/road condition information.
- RWIS can be used in coordination with variable speed limit (VSL) systems: if the RWIS records inclement weather conditions, the VSL can be activated accordingly.

Additional Resources

- *FHWA Road Weather Management Website*, found here: http://www.ops.fhwa.dot.gov/weather/index.asp
- *Every Day Counts Weather-Savvy Roads Resource Toolkit,* found here: https://ops.fhwa.dot.gov/publications/fhwahop19002/index.htm

Useful Tips

Agencies can provide quick access to real time weather condition information on camera images, integrated traveler information systems, or mobile phone application. The RWIS can also be combined with a deicing/anti-icing system to further increase safety. RWIS data can be supplemented by integrating mobile observations (IMO) from government fleet vehicles.

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital cost for this tool is low (less than $50,000) to medium ($50,000 to 100,000), depending on the type of system that an agency installs. The components of an RWIS can be mixed and matched in order to reduce costs. For example, the cost to deploy an RWIS in Abilene, TX was $63,000[1]. The cost to purchase and install a camera to an existing RWIS in Anchorage, AK was $5,100[2].

Operations Costs: The operations and maintenance costs for this tool are low (less than $50,000). Operations and maintenance for an RWIS include the costs to power the system, communications, weather forecasting services, equipment repairs, sensor calibration, and necessary replacements. It is critical for an agency to coordinate with roadside and pavement maintenance crews. Training maintenance crews will help them understand where an RWIS is located and how to make sure it is not damaged during maintenance. In addition, these crews can report any observed problems or damage. For example, the estimated average annual operations and maintenance costs were $8,200 per unit for the project in Abilene, TX[1].

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