MDOT STATEWIDE RWIS EVALUATION

August 2015
National Rural ITS Conference
Agenda

- Project Overview
- Existing System Evaluation
- Best Practice/Literature Review
- Technology Assessment
- Strategic Deployment Guide
- Current State of Michigan’s RWIS
PROJECT OVERVIEW - MDOT RWIS EVALUATION

Purpose: To take a comprehensive statewide look at the future of the RWIS program

- Determined “best” practices through practitioner interviews and literature review
- Conducted an existing system evaluation
- Conducted a broad technology review and assessment.
- Developed, evaluated, and Recommended deployment strategies for MDOT’s Next Generation RWIS Program
Existing System Evaluation

- Stakeholder workshops over a 3-day period
- Each day the workshop was hosted in a different geographic region
  - Varying needs/practices in Rural and Urban environments
- Three (3) focus groups within each Region
  - Road Maintenance and Operations
  - MDOT Planning Staff and Management
  - Weather Sharing Partners
Existing System – MDOT Statewide RWIS

- MDOT has 73 ESS
  - Pavement temperature (in-pavement and non-invasive)
  - Atmospheric weather parameters
  - MVDS traffic counts
  - Camera images

- Connected Vehicle Implementations
  - AVL/GPS/MDSS
  - Wx-TINFO

- Multi-RWIS Vendor Approach
  - Effective for location
  - Cost efficient
  - NTCIP required

- Performance-based Contract
  - High level of data availability
  - Relatively low cost
Existing System Evaluation - Fixed ESS

- Fixed Environmental Sensor Stations (ESS)
  - Visibility Sensor
  - Air Temperature/Relative Humidity Sensor
  - Barometric Pressure Sensor
  - Wind Sensor
  - Precipitation Sensor
  - Pavement Condition Sensor
  - Subsurface Sensor (12 readings)
  - Remote Processing unit
  - IP Surveillance System (CCTV)
  - Traffic Sensor (MVDS)
Snow Plow AVL/GPS/MDSS

- Snow Plow Truck Data Collection
  - time, lat/long, heading, speed, image, miles driven, engine hours, air & pavement temp, humidity, blade up/down, wing plow usage, spreader information (material type, application rate & amount used)
  - In cab display (forecast/radar & treatment recommendations)
- Benefits: localized atmospheric conditions, material usage, M-5 equipment reports, etc.
- MDOT Fleet Instrumentation
  - 270 Snow Plow Trucks (2013/2014)
  - 2500 (only GPS) light/medium/heavy duty (2015/2016)
Maintenance Decision Support System (MDSS)

- MDSS
  - Weather forecast catered to DOT needs
  - Roadway treatment recommendations based on historical and current weather conditions
  - AVL vehicles and HERE data (travel times & performance measures) Maintenance Decision Support System (MDSS)
MDOT Data, Use, Analysis & Processing (DUAP) Project

ICM, ATM, Etc.

Performance measures

HERE

MDOT Fleet AVL/GPS

OEM Fleet Data

MDOT ITS Data

VIDAS

RWIS Data

MDOT Systems (ATMS)

DUAP

Cut River Bridge

RITIS

USDOT Safety Pilot

Truck Parking Info

ACC IRI PASER

UAV

IMO

AV Data
WxTINFO
## Existing Evaluation - Needs Analysis Example

Table 4-1: Maintenance and Operations User Needs

<table>
<thead>
<tr>
<th>USER NEEDS</th>
<th>Region*</th>
<th>Overall Priority (High, Medium, Low)</th>
<th>How Existing System Performs (Very Good, Average, Poor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance personnel need improved visibility on conditions near the edge of their area of responsibility to help in allocating resources efficiently.</td>
<td>Superior, North, Southwest, Metro</td>
<td>High</td>
<td>Average</td>
</tr>
<tr>
<td>General need for real-time RWIS reporting from the hosted web application.</td>
<td>All</td>
<td>High</td>
<td>Very Good</td>
</tr>
<tr>
<td>General need clear camera images for decision making. Images include clear night images with the use of infrared technology.</td>
<td>All</td>
<td>High</td>
<td>Very Good</td>
</tr>
<tr>
<td>MDOT personnel need to receive forecasts to determine when and where a storm will take place.</td>
<td>All</td>
<td>High</td>
<td>Average</td>
</tr>
<tr>
<td>General need information to determine if maintenance should treat the roadway, how they should treat, and if the treatment was accurate.</td>
<td>Metro, North, Superior</td>
<td>High</td>
<td>Average</td>
</tr>
<tr>
<td>Maintenance personnel need better forecast and/or detection of lake effect snow bands, and squall of snow. Expanded, enhanced, or improved RWIS data made available to weather forecasters will lead to improved forecasts.</td>
<td>All</td>
<td>High</td>
<td>Poor</td>
</tr>
</tbody>
</table>
Existing System - Gap Analysis and Conclusions

- Define Region MDOT Champions
- Better Lake Effect Snow Reporting
- Integrate with ATMS
- Determine Frost Depth Measurement Sensor Locations
- Define Performance Measurements
- Provide Training and Awareness
- Defined High Priority Areas
- Determine Grip Value Calculations
- Better Storm Forecasting
- Improve Mobile Observations
- Mobile Access to ESS Data
Best Practice/Literature Review

- Phone Interview with 20 States/Provinces
- Literature Review yielded areas that have important influence on the direction of the RWIS program.
Best Practice - Summary

- Most accurate and cost effective solution to measure **Pavement Conditions**: non-invasive condition, and simple thermister
- **ESS Siting** to provide representative road weather conditions.
- **Weather Instrumentation Package** should include sensing devices to measure
  - air temperature/RH,
  - horizontal wind information,
  - precipitation type and rate, and
  - visibility
- Consider measurement at **Maintenance Trouble Spots**
- ESS sites should include **Cameras**
- **Performance-based contracts** improves quality of the system output and performance of the system
- **Mobile Data Collection** augments RWIS information and MDSS
- DOTs are integrating **Traffic Monitoring Devices** for performance metrics
Best Practice – Notable Trends

- Additional emphasis on resource considerations to support traveler information requirements

- DOT’s and agencies using MDC/AVL technologies to support operations and management

- Use of Performance measures to assess level of service, maintenance performance are affecting the instrumentation requirements at ESS sites
Technology Evaluation

- Investigate new sensors and technologies to support the RWIS program
- Investigate new ways to utilize road weather data
- Assess how well technologies and techniques will MDOT RWIS needs and gaps.
Technology Evaluation – Evolving NextGen RWIS Approaches

Technologies
- Connected Vehicle Data
  - MDC/AVL
- Virtual RWIS
- IR & Thermal Cameras
- Vehicle Detection with Camera
- FAST

Techniques
- Automated Road Condition Assessment
- Forecasting and Lake Effect Snow Reporting
- Performance Management
- RWIS Applications for Arterial Management
- RWIS Data for ATM Applications
Technology Evaluation – Address Stakeholder Needs/Gaps

- Match gaps identified in the existing system evaluation with newer technologies and techniques (as applicable)

- Example: *Determine Grip Value Calculations*
  - Deploy non-invasive on existing ITS infrastructure such as camera and detector poles.
  - Extract data from MDC units (fleet vehicles)
  - Deploy temporary or permanent leased options where power/communications is difficult
  - Integrate camera imagery as a confirmation or correction tool for road conditions
Deployment Strategy

What is our Vision?

What is the challenge we are trying to address and what are the steps to develop the vision?

Where have we been and where are we Going?

Which needs are not satisfied by the existing system and which strategies will successfully fill those gaps?

Which Strategies are critical for success?

Which statewide strategies will allow MDOT to succeed with their RWIS vision in the near and long-term?
Deployment Strategy - Developing the RWIS Vision

Who are the stakeholders?

What are the needs of stakeholders?

What are the key priorities?

What modifications to the program are necessary?

How will the RWIS resources be used?

VISION THEMES
Modifications to the Program to meet MDOT Needs

**MDOT NEEDS**

1. Better Information for Lake Effect Snow Patterns and Timing

2. Improved Information on Conditions in Outlying Areas

3. Improved Mobile Observations

**POTENTIAL APPROACHES**

- Denser ESS network
- High resolution forecast model
- Collage of camera images
- Mobile & crowd sourcing data

- Fixed and virtual locations to fill voids
- Integrate CV program options into fixed observation network
- Trade-offs between camera imagery and full ESS configuration

- Establish MDOT vision for the CV program
- Establish QC plan to assure quality CV data
## Vision for Road Weather Resources

<table>
<thead>
<tr>
<th>Source Information</th>
<th>Vision</th>
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</thead>
<tbody>
<tr>
<td>Fixed Environmental Sensor Station (ESS)</td>
<td>Provide network of &quot;gridded&quot; information on a continuous 7X24 basis</td>
</tr>
<tr>
<td>Portable ESS</td>
<td>Address unique challenges/requirements</td>
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<td></td>
<td>Address short-term problems (future resources may solve problem)</td>
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<tr>
<td>Connected Vehicle – Fleet Vehicle Data</td>
<td>Further expansion of connected vehicle resources on fleet vehicles (MDOT and partner agency) to complement ESS</td>
</tr>
<tr>
<td>Connected Vehicle – Consumer Vehicle Data</td>
<td>Statewide resource to provide near real-time roadway conditions</td>
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<td></td>
<td>Augment data collected from fleet vehicles and fixed/portable ESS.</td>
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<td></td>
<td>Leverage traffic management strategies for safety, mobility, awareness.</td>
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<tr>
<td>CCTV</td>
<td>Camera resource to cover all state trunk lines, critical state routes</td>
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<tr>
<td></td>
<td>and key signalized interchanges</td>
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<tr>
<td>Vehicle Detection</td>
<td>Provide volume/speed information on all state routes to enhance</td>
</tr>
<tr>
<td></td>
<td>internal and external information reporting.</td>
</tr>
<tr>
<td></td>
<td>Especially for data sets not available from crowd sourcing assets.</td>
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</table>
VISION

To have a robust system that provides stakeholders useful information about road weather conditions around the entire state of Michigan using an array of existing and next generation technologies.

DEPLOYMENT STRATEGY

STRATEGIC INITIATIVES

- Enhance RWIS network to collect representative data for Operational Support
- Enhance traveler information for rural applications
- Deploy fixed ESS where performance measures are highly impacted
- Enhance CV program by expanding MDC on all fleet vehicles
- Central Repository for all RWIS Data (fixed and CV)
- Integration of all RWIS resources into ATMS
- Develop a statewide RWIS Master Plan
- Prepare infrastructure and systems for CV integration
- Integrate RWIS data for improved Performance Monitoring
Final Recommendations Summary - Key Priorities to Meet MDOT Needs

- Develop a performance based **Data Management Program and Contract Option**
  - Similar to approach used for ESS data.
- Continue **RWIS ESS Expansion**
- Enhance system with **Network of Present Weather Sensors** to collect precipitation data
- **Integration of all CCTV Cameras** in to a single resource
- Leverage the **Connected Vehicle Network** to augment road weather information data set
- Continue to develop the “**System of Systems**” that supports RWIS applications
Michigan DOT
Future initiatives/The future is now

- New ESS in Southern Regions
  - Southwest and Grand
- Final ESS deployments in Northern Regions
  - North and Superior
- Bridge and Curve Warning Systems
- Concept of Operations Development and Updates
- Mobile methods of data acquisition
  - Snow Plows and CV
- Co-location with other ITS devices
Michigan DOT
Overall Impact of RWIS System to ITS in Michigan

- **Benefits**
  - Actual observations to initialize forecasts
  - Allows for more accurate and location-specific forecasts
  - Drive more effective and resource-conserving road maintenance operations
  - The result is a higher level of service and safety
  - More efficient and environmentally responsible allocation of equipment, labour and chemicals.
  - Culminating in applications that further benefit the traveling public.
Questions/Comments?

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