Use of Mobile Sensors and Maintenance Decision Support for Automated Road Condition Reporting

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Session A3: RWIS: Continued Evolution to Meet Needs
Introduction and Background
Project Objectives Statement
Tasks to be Completed
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Introduction and Background

- Project is a collaboration between Iteris/Meridian and the North/West Passage Pooled Fund Study states.

Predominately rural states that face similar transportation issues related to traffic management, traveler information and commercial vehicle operations.

Within the corridor states, numerous systems collect, process and integrate traveler and road work information.

At present, this information is not readily shared across state borders.
The concept of mobile sensors reporting weather and driving conditions from moving snowplows in real time has been developed and tested by multiple state Departments of Transportation (DOTs) in recent years.

Several approaches for mobile sensors have been deployed and tested in operational environments.

States have deployed mature MDSS systems that are capable of predicting road conditions.

Most states presently manually report road conditions.
Project Goal

- Perform a synthesis of the best practices of deploying and using mobile sensors. The synthesis will document the successful deployments that remain in operation today and document what can be learned by approaches that did not succeed.

- Explore the current state of the MIDSS initiatives and research if MDSS (perhaps combined with mobile sensors) is a viable option for automating road condition reporting systems.
Tasks to Perform

✿ Task 1: Project Management
✿ Task 2: Interview Public Agencies that have deployed Mobile Sensors and MDSS
✿ Task 3: Interview Mobile Sensor and MDSS Private Contractors/Vendors
✿ Task 4: Interview National Weather Programs
✿ Task 5: Research Automated Road Condition Reporting
✿ Task 6: Final Best Practice Report
Task 2: Interview Public Agencies That Have Deployed Mobile Sensors and MDSS

- A survey was established with 41 questions
- State Project Managers responsible for or familiar with the road reporting activities, MDC/AVL systems, and MDSS programs within their states were targeted.
- Survey was designed to collect information about current practices in:
  - Road Condition Reporting
  - AVL/MDC usage within the agency
  - MDSS Deployment
Road Condition Reporting

- Road conditions are generally reported during the winter months (Oct – April)

- Who reports road conditions?

![Graph showing who reports road conditions from the field.](image-url)
What information is used to make road conditions reports?

In general, what information is used to make your road condition reports? (Check all that apply)

- Field observations: 100.0%
- Camera images: 35.3%
- AVL/MDC mobile sensors: 17.6%
- Maintenance Decision Support System (MDSS): 5.9%
- Road Weather Information Systems (RWIS): 35.3%
- Other (please specify): 0.0%
Road Condition Reporting

“What do you see as the primary limitations of your Agency’s existing road condition reporting service?”

- Timeliness/frequency of the updates
- Adequately report road condition severity
- Can not update road conditions frequently enough to meet user demands
- Inability to update around the clock
- Inaccuracies due to reporting conditions over the majority of the road segment instead of for specific locations.
AVL/MDC Usage

Driver vs Automated Data collection

What parameters are collected and transmitted by your AVL/MDC equipment?
(Check all that apply)

- Other (please specify below)
- Visibility
- Camera image
- Depth of snow
- Rate of precipitation
- Type of precipitation
- Type of weather
- Relative humidity
- Air temperature
- Plow position
- Road condition
- Pavement temperature
- Deicing material application rate
- Deicing material type
- Lane
- Speed
- Location (GPS)
- Date/Time

# of Responses

[Bar chart showing comparisons between driver input and automated collection for various parameters]
“What have been some of the positive outcomes from your deployment of mobile sensors in maintenance vehicles?”

- Ability to better track maintenance vehicle location and material usage
- Improvement of maintenance operator self-regulation of material usage
- Use of real-time data in decision making
- Provide weather radar and forecast information directly to maintenance operators
“What have been some of the negative outcomes from your deployment of mobile sensors in maintenance vehicles?”

- Cost of the deployment
- Increased workload for maintenance of the equipment
- Resistance to the deployment from maintenance operators
“What information does your MDSS use to determine the estimate of the current road conditions on each MDSS segment?”

- Other (please specify)
- Do not know
- Implied conditions based upon simulation using observed weather conditions, pavement parameters, traffic rates, and maintenance actions
- Traffic speeds
- Road condition observations
- RWIS pavement temperature observations
- Road Weather Information System (RWIS) road condition observations
- AVL/MDC road condition reports
“How accurately does your MDSS represent the current road conditions existing on the highway? (Please rate on a scale of 1-10, 1 being Not at all Accurate, 10 being Very Accurate)”
“How accurately does your MDSS represent the forecasted road conditions existing on the highway? (Please rate on a scale of 1-10, 1 being Not at all Accurate, 10 being Very Accurate)”
“How useful would the integration of MDSS-generated current and forecasted road conditions be to support your road condition reporting system? (Please rate on a scale of 1-10, 1 being Not at all Useful, 10 being Very Useful)"

- mean usefulness rating for current information is 6.67
- mean for forecasted information was 7.25.
Task 3: Interview Mobile Sensor and MDSS Private Contractors/Vendors

“What types of information are currently collected by your AVL/MDC system?”

<table>
<thead>
<tr>
<th>Automatically Collected Information</th>
<th>Number of Respondents</th>
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</thead>
<tbody>
<tr>
<td>Engine Codes</td>
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<tr>
<td>Latitude/Longitude</td>
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</tr>
<tr>
<td>Date/Time</td>
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<tr>
<td>Vehicle Speed</td>
<td>4</td>
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<tr>
<td>Vehicle Heading</td>
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<td>Plow Position</td>
<td>4</td>
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<tr>
<td>Pavement Friction</td>
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<tr>
<td>Deicing Material Application Rate</td>
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<tr>
<td>Lane</td>
<td>1</td>
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<tr>
<td>Road Condition</td>
<td>0</td>
</tr>
<tr>
<td>Air Temperature</td>
<td>4</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>3</td>
</tr>
<tr>
<td>Camera Image</td>
<td>3</td>
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<tr>
<td>Visibility</td>
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</tr>
<tr>
<td>Precipitation Type</td>
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<tr>
<td>Precipitation Rate</td>
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<tr>
<td>Other (please explain)</td>
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<table>
<thead>
<tr>
<th>Operator Entered Data</th>
<th>Number of Respondents</th>
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<tr>
<td>Road Condition</td>
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<td>Plow Position</td>
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<td>Deicing Material Application Rate</td>
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<td>Plow Position</td>
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<td>Lane</td>
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<tr>
<td>Air Temperature</td>
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<tr>
<td>Current Weather Conditions</td>
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<td>Snow Depth</td>
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<td>Camera Image</td>
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<td>Precipitation Type</td>
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<td>Precipitation Rate</td>
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<tr>
<td>Visibility</td>
<td>2</td>
</tr>
<tr>
<td>Other (please explain)</td>
<td>3</td>
</tr>
</tbody>
</table>
MDSS Vendors

- Vendors provide current and forecast weather & road conditions.
- “What are some of the barriers to automating road condition reporting from your point of view?”
  
  - Relying on driver input is the biggest hurdle.
  - Getting the operator on board with the concept at an early stage to make them a willing partner in the technology change.
  - No standardization of equipment controller manufactures is becoming more proprietary as they develop their own AVL systems.
Task 4: Interview National Weather Programs

The following National Weather Programs were identified:

- Federal Highway Administration – Road Weather Management Program
- Clarus Project
- USDOT
- ITS JPO
- Office of Federal Coordinator for Meteorological Services
- National Oceanic Atmospheric Administration/National Weather Service
- Aurora
- Clear Roads
- America Public Works Association/North American Snow Committee
- AASHTO SICOP
- National Center of Atmospheric Research
- Western Transportation Institute
National Weather Programs

The five areas of the survey were:

- Current Technology
- Needs
- Information Sources
- Standards
- Role

SAFETEA-LU Section 1201 Real-Time System Management Information Program was mentioned as a national effort for defining traveler road information.
Task 5: Research Automated Road Condition Reporting

- Current state of the practice, road conditions from AVL/MDC units are not automated
  • Conditions need to be manual entered
- AVL/MDC Road Conditions are only available when vehicles are on the road
  • If agency does not perform 24/7 maintenance conditions are not available to traveler 24/7
- MDSS can fill gaps in field obs to provide updates 24/7
- Accuracy concerns with information being shared with travelers
Vendors have begun to develop sensors that can detect road conditions without operator input.

Agencies within the project have not deployed these sensors operationally at this time.
Conclusions

- Each agency within the NWPassage report road conditions differently to their traveling public.
- Information from automated process will have to be pre-processed before being transmitted to the general public.
- AVL/MDC units in current deployments require operator data entry for road conditions.
- MIDSS solutions can provide both current and forecasted road conditions.
  - Not all solutions account for on-going maintenance actions during storm events.
Thanks!

Questions?

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