Maintenance Decision Support System (MDSS)

The FHWA Road Weather Management Program for Decision Support

To the Second MDSS Prototype Review
Hanover, NH June 21, 2001

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Mitretek Systems Inc.
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202 488 5718
Federal Highway Administration (FHWA) Road Weather Management Program

Surface Transportation Weather Decision Support Requirements (STWDSR) project

Maintenance Decision Support System (MDSS) project

Mitretek Role
Mitretek Role

- Mitretek Systems, Inc., is a non-profit, non-competitive, government services corporation
  - Created from Mitre in 1996 to serve non-FFRDC* work.
  * Federally Funded Research and Development Corporation

- Mitre/Mitretek has supported the FHWA Intelligent Transportation System (ITS) program since inception:
  - Research, program development, procurement support.
Federal Road Weather Programs

- Other USDOT Agencies
  - FAA, FTA, FRA, RSPA, USCG
- American Association of State Highway and Transportation Officials
  - AASHTO
- National Weather Service
  - NWS
- Public and Fire Weather and other NWS offices
- Office of the Federal Coordinator for Meteorology
  - Sam Williamson
  - OFCM

Stakeholders:
- State DOTs
- Private Vendors
- National Labs

FHWA
- Federal Highway Administration
  - FHWA
- Operations Core Business Unit
  - Christine Johnson
  - HOP
- Office of Transportation Operations
  - Shelley Row
  - HOTO
- Road Weather Management Program
  - Paul Pisano
  - HOTO
- Highway Research-Operations
  - Rudy Persaud
  - HRDO

ITS Joint Program Office
- Jeff Paniatti
- ITS-JPO

Highway Research
- Gary Larsen
- HRD

National Weather Service
- NWS

Public and Fire Weather and other NWS offices

Office of the Federal Coordinator for Meteorology
- Sam Williamson
- OFCM

Stakeholders:
- State DOTs
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Road Weather Management Program Goals

1. Develop improved weather information systems that meet the demands of all users and operators;

2. Develop improved maintenance technologies for winter mobility, and;

3. Develop traffic operations/incident management procedures under all weather events.
Road Weather Management Program Objectives

a. Build relations between meteorologists and transportation professionals...to create a common vision and support state efforts;
b. Improved decision support systems...;
c. Advanced maintenance technologies...;
d. Road weather management practices for traffic and incident managers...;
e. Develop outreach materials...
**Scope of Road Weather Management Program**

**The ITS**
- Road Weather Information Systems (RWIS)
- Environmental Sensor Stations (ESS)

**Promote and Develop Information Systems to Support Highway Operations (with respect to weather threats)**

**Improve Interfaces to**
- Meteorological Services
- Define Weather Threats

**Improve Transportation Impact (Goals)**
Road Weather Management Program Progress

- Prior FHWA research in RWIS
- FHWA Weather Team Formed from Rural ITS
- FHWA Operations Unit formed
- Surface Transportation Weather Decision Support Requirements (STWDSR) Project
- STWDSR Meetings 1 and 2
- MDSS Reviews 1, 2 and 3
- First Road Weather Symposium
- First OFCM WIST Symposium
- Foretell™ Project launched
- Second OFCM WIST Symposium
- MDSS Project Launched

Timeline:
- 1970-1997
- 1997
- 1998
- 1999
- 2000
- 2001
- 2002
The STWDSR Process

Decision Support System (WIST-DSS)

Goals

System Input

Evaluation

Safety

Operational Techniques (Output)

Mobility

National Security

Productivity

Environment

Outcomes/Goals

The Highway System + Weather

The Decision Maker

Interface

The Intelligent Transportation System (ITS)

Requirements

Needs (decisions)

State of Deployed Resources

State of the Highway System

Environment

Computer-Human Interface (CHI)
Major STWDSR Documents

FHWA Weather Team White Paper 1997-98

STWDSR V1.0 Needs 1999

Stakeholder Meetings Feb, May 2000

STWDSR V2.0 Operational Concept Definition (OCD) July, 2000

STWDSR V2.0 Preliminary Interfaces Requirements (PIR) October, 2000

STWDSR V3.0/V4.0 TM/EM/Traveler Needs Impacts/Benefits Operational Test Requirements

MDSS

FHWA/Mitretek
STWDSR Documentation

- Electronic Documents Library

www.its.dot.gov/welcome.htm

- STWDSR V1.0
- STWDSR V2.0: Operational Concept Definition (OCD)
- STWDSR V2.0 Preliminary Interface Requirements (PIR)
- STWDSR V2.0 Executive Summary

- Contact: gnelson@mitretek.org
## STWDSR Needs

### Operational Scale Winter Road Maintenance

#### STWDSR V1.0

<table>
<thead>
<tr>
<th>Needs Matrix</th>
<th>53 Decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning</td>
<td>Stakeholder Meetings:</td>
</tr>
<tr>
<td>Scales</td>
<td>Value Added Met. Services (VAMS)</td>
</tr>
<tr>
<td>Operational</td>
<td>Maintenance Managers (28 states)</td>
</tr>
<tr>
<td>Planning</td>
<td>National Labs (6)</td>
</tr>
<tr>
<td>10 decisions</td>
<td>16 Clusters by Time Lead</td>
</tr>
</tbody>
</table>

#### STWDSR V2.0

<table>
<thead>
<tr>
<th>426 decisions</th>
<th>44 User Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>426 decisions</td>
<td>44 User Groups</td>
</tr>
</tbody>
</table>

STWDSR V1.0

STWDSR V2.0
STWDSR Operational Concept

Needs (Risk Decisions)

External Information Resources
Transportation, Environmental, Treatment Assets

Tailored Decision Support Applications
(Filtering, Fusion, Presentation)

Learning Feedback

Needs (Risk Decisions)

Highway Performance Goals
Open System Concept

A display

- Some Road Weather Processes
- Some Environmental Sensor Station (ESS) Observations
  - A Road Weather Information System (RWIS) Stovepipe
- Roadway Environment

Swivel-chair Integration!!!

System Evolution

Open System

- Other ITS info
  - Decision Support Application
- Collection & Assimilation
  - EIA*
  - Many Observations
  - EIA*
  - Air/Sea Environment

*Environmental Information Application

Treatment Action!

FHWA/Mitretek
## The Scale Concept

<table>
<thead>
<tr>
<th>Scales</th>
<th><strong>Time Horizon Functions</strong></th>
<th><strong>Corresponding Weather Scale</strong></th>
<th><strong>Winter Road Maintenance Example</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>months + Provides resources.</td>
<td>Climatic</td>
<td>Buying equipment or chemical stocks; Hiring and training staff.</td>
</tr>
<tr>
<td>Operational</td>
<td>hours to days Manages the deployment of resources.</td>
<td>Synoptic/meso</td>
<td>Calling up crews, readying vehicles, dispatching treatment beats.</td>
</tr>
<tr>
<td>Warning</td>
<td>sub-seconds to minutes Operates the resources.</td>
<td>Micro</td>
<td>Operating a treatment vehicle (snow plow and spreader); Control of automatic equipment.</td>
</tr>
</tbody>
</table>
# Needs (Decision) Clusters

<table>
<thead>
<tr>
<th>Cluster ID, Name</th>
<th>Confidence %</th>
<th>Time Lead hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.A Monitor Conditions</td>
<td></td>
<td>29.0</td>
</tr>
<tr>
<td>Aware</td>
<td>46</td>
<td>49.0</td>
</tr>
<tr>
<td>Detect</td>
<td>95</td>
<td>3.8</td>
</tr>
<tr>
<td>2.B Prepare</td>
<td>40</td>
<td>41.0</td>
</tr>
<tr>
<td>2.C Get Ready</td>
<td>72</td>
<td>16.0</td>
</tr>
<tr>
<td>2.D Prepare Expendables</td>
<td>56</td>
<td>14.0</td>
</tr>
<tr>
<td>2.E Select Strategy</td>
<td>70</td>
<td>12.0</td>
</tr>
<tr>
<td>2.F Assign Crews</td>
<td>60</td>
<td>33.0</td>
</tr>
<tr>
<td>2.G Prepare Equipment</td>
<td>75</td>
<td>14.0</td>
</tr>
<tr>
<td>2.H Activate Staff</td>
<td>73</td>
<td>15.0</td>
</tr>
<tr>
<td>2.I Initial Dispatching</td>
<td>77</td>
<td>9.0</td>
</tr>
<tr>
<td>2.J Contracting</td>
<td>85</td>
<td>2.0</td>
</tr>
<tr>
<td>2.K Primary Dispatching</td>
<td>96</td>
<td>0.0</td>
</tr>
<tr>
<td>2.L Remedial Dispatching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.M Mid-Storm Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.N Discretionary Dispatching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.O Termination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.P Cleanup</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Maintenance Decision Support System (MDSS) Project

• The MDSS is one realization of the STWDSR Operational Concept Definition (OCD)
  – For a set of functions and operational-scale decisions of winter road managers

• Continues STWDSR stakeholder alliance
  – National Labs will develop non-exclusive components
  – State DOTs will operate
  – Vendors will provide and integrate into Road Weather Information System (RWIS)
MDSS Documentation

• FHWA Road Weather Management Website

www.ops.fhwa.dot.gov/weather/mdss.pdf

• MDSS Project Plan
• ...with Labs’ contacts
Maintenance Decision Support System (MDSS) Project

Federal Highway Administration (FHWA)
  AOTR: Rudy Persaud, HRDO-04
  Paul Pisano, HOTO-1

Cold Regions Research & Engineering Lab (CRREL)
  MDSS Programmatic Lead Lab
  George Blaisdell (Project Mgr.)

MIT Lincoln Lab
  Bob Hallowell

NOAA National Severe Storm Lab
  John Cortinas

National Center for Atmospheric Research (NCAR)
  MDSS Technical Lead Lab
  Bill Mahoney (Project Mgr.)
  Rich Wagoner (Oversight)

NOAA Forecast Systems Lab
  Paul Schultz

NOAA Environmental Technologies Lab
  Dan Wolfe
Map to WIST-DSS Components

Generate Scenario
- NCAR D
  MDSS Road Weather Forecasting System (Environmental Threat Fusion)

Monitor Conditions
- CRREL D
  Road Conditions
- CRREL E
  Chemical Conc.
- CRREL F
  Snow Drift

Present/Make Decision
- CRREL B
  MDSS GIS Display System
- CRREL C
  MDSS Decision Support Concepts

Update Context
- External Information Resources

Generate Scenario
- Precipitation Algorithms
- MIT/LL G
  Video Processing

Update Context
- Ensembles
- Existing Environmental Observing Systems
- Transportation and Treatment Asset Data

* Letters refer to Appendices of MDSS Project Plan
MDSS: Benchmarks

• Prototype Phase
  — First Prototype Review, January at NCAR
  — Second Prototype Review, now
  — Prototype demonstration (September)

• Further Development Phase
  — Notice of Intent (Federal Register, April)
  — Next presentation
Mitretek Support

- DOT representative travel funding
  — Submit original receipts!!!
- Needs, OCD and PIR tracking
- Monitor progress for FHWA
- Work for recognition/support within surface transportation community

*Our job was to match expertise (National Labs) with user needs and vendor opportunities.*

*From here on, this development track is up to the stakeholders.*