Analysis of MDSS Benefits and Costs

Christopher Strong
Western Transportation Institute

David Huft
South Dakota Department of Transportation

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Pooled Fund Study Partners

- California
- Colorado
- Indiana
- Iowa
- Kansas
- Minnesota
- Nebraska
- New Hampshire
- New York
- North Dakota
- South Dakota
- Virginia
- Wyoming

- Meridian Environmental Technology
Project Background

• Field tests have not examined economic benefits and costs of MDSS

• Project Objectives
  – Describe the essential functions of a winter MDSS
  – Describe the resources needed to supply the essential functions of an MDSS
  – Characterize and estimate the costs and benefits of deploying MDSS in state transportation departments
Essential Functions of MDSS

Applications:
1. Real-time assessment of current and future road weather conditions ("Road")
2. Real-time maintenance recommendations ("Resources")

PFS states’ experiences are generally between these levels

“A Tool”
- Use MDSS Application 1
- May Use MDSS Application 2

“A Revolution”
- Rely on MDSS Application 1
- Rely on MDSS Application 2
Resource Requirements

- **Agency Support Costs**
  - Computer Costs
  - Training
  - Administrative Costs
  - Technology Options
    - In-vehicle graphical user interface (GUI)
    - Mobile data collection (MDC)

- **Weather Forecast Provider Costs**

- **MDSS Vendor Costs**
  - Configuration
  - Training
  - Bandwidth
  - Computations
  - Customer service
Goals of B/C Analysis

- Quantifiable
- Incorporates sensitivity and risk
- Reflect different usage alternatives of MDSS
- Actionable
## Benefit-Cost Taxonomy

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Agency</th>
<th>Motorist</th>
<th>Society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software and support</td>
<td>• Reduced labor costs</td>
<td>• Reduced response time</td>
<td>• Reduced environmental degradation</td>
</tr>
<tr>
<td></td>
<td>• Reduced materials use</td>
<td>• Reduced clearance time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduced equipment use</td>
<td>• Reduced motorist delay (through improved LOS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Reduced fleet replacement costs</td>
<td>• Improved safety (through improved LOS)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>• In-vehicle computer hardware</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Administration</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Weather forecast provider</td>
<td></td>
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</tbody>
</table>

**Bold** – included in analysis  
**Italics** – not included in analysis
Benefit Tradeoff

Level of Service

Winter Maintenance Resources

Motorist Benefit

Agency Benefit
Simulation Approach

- Use MDSS as analytic tool to predict future pavement conditions resulting from various maintenance actions
- Use MDSS outputs to compare the outcomes associated with different maintenance philosophies
- Incorporate risk factors to “dampen” potential benefits
Why Simulate?

- Benefit-cost analysis must be quantifiable
- No PFS member state has adequate LOS data to measure tradeoff
  - Simulator can generate objective and complete LOS data
- Simulation can allow for control of outside factors
Calibration

\[ \text{Resources} = f(\text{Rules of Practice, Weather}) \]

Result: Actual Rules of Practice
Application of Calibrated Simulation

- Actual Weather
- Actual Rules of Practice
- MDSS Treatment
- Resources Used
  - Predicted LOS
  - Predicted LOS
  - Resources Used

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Points of Comparison

- **Point 1**: Calibration Point
- **Point 2**: Keep resources same
- **Point 3**: Keep triggers same
Use MDSS as Analytic Tool

- Agency Uses MDSS Recommendations
- Agency Follows Rules of Practice

MDSS

- Material Use Labor Hours
- Level of Service (e.g. % Ice)
- Safety
- Delay

AGENCY BENEFITS

MOTORIST BENEFITS

RANGE OF USE
Case Studies

- Three states (CO, MN, NH)
  - Representative of different climates
  - Good historical data on maintenance practices
- Multiple route segments in each state
  - Capture variety of traffic and terrain conditions
- Simulate using several years of historic weather and maintenance data
  - Helps to “tune” MDSS and provide some validation
- Extrapolate to other routes in each state
MDSS Alternatives

• No implementation
  – Follow rules of practice
• Various levels of following recommendations
  – User acceptance
  – Technology (i.e. in-vehicle GUI)
• Various levels of feedback

If MDSS does not change the way that an agency performs winter maintenance (e.g. application material and rate, timing), there would be no LOS benefit and no resource use benefit, so no tangible benefit would show up in this analysis.
### Initial Proposed Result Format

<table>
<thead>
<tr>
<th></th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
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<tbody>
<tr>
<td>Alt. 1</td>
<td>xx to yy</td>
<td>xx to yy</td>
<td>xx to yy</td>
</tr>
<tr>
<td>Alt. 2</td>
<td>xx to yy</td>
<td>xx to yy</td>
<td>xx to yy</td>
</tr>
<tr>
<td>Alt. 3</td>
<td>xx to yy</td>
<td>xx to yy</td>
<td>xx to yy</td>
</tr>
</tbody>
</table>

- Uses ranges for benefit-cost ratios (xx, yy) based on range of risks, sensitivity
- Alternatives based on factors such as mobile data collection, adherence to recommendations
## Next Steps

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
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<tbody>
<tr>
<td>Finish simulation activities</td>
<td>Oct 2007</td>
</tr>
<tr>
<td>Finish analysis of simulation results</td>
<td>Dec 2007</td>
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<tr>
<td>Presentation of results to PFS</td>
<td>Jan/Feb 2008</td>
</tr>
<tr>
<td>Draft &amp; final report</td>
<td>Feb 2008</td>
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Questions?

• Christopher Strong, P.E.
  Western Transportation Institute
  PO Box 174250
  Bozeman, MT  59717-4250
  Phone: (406) 994-7351
  e-mail: ChrisS@coe.montana.edu

• David L. Huft
  SDDOT Office of Research
  700 East Broadway
  Pierre, SD  57501-2586
  Phone: (605) 773-3358
  e-mail: dave.huft@state.sd.us