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Overview



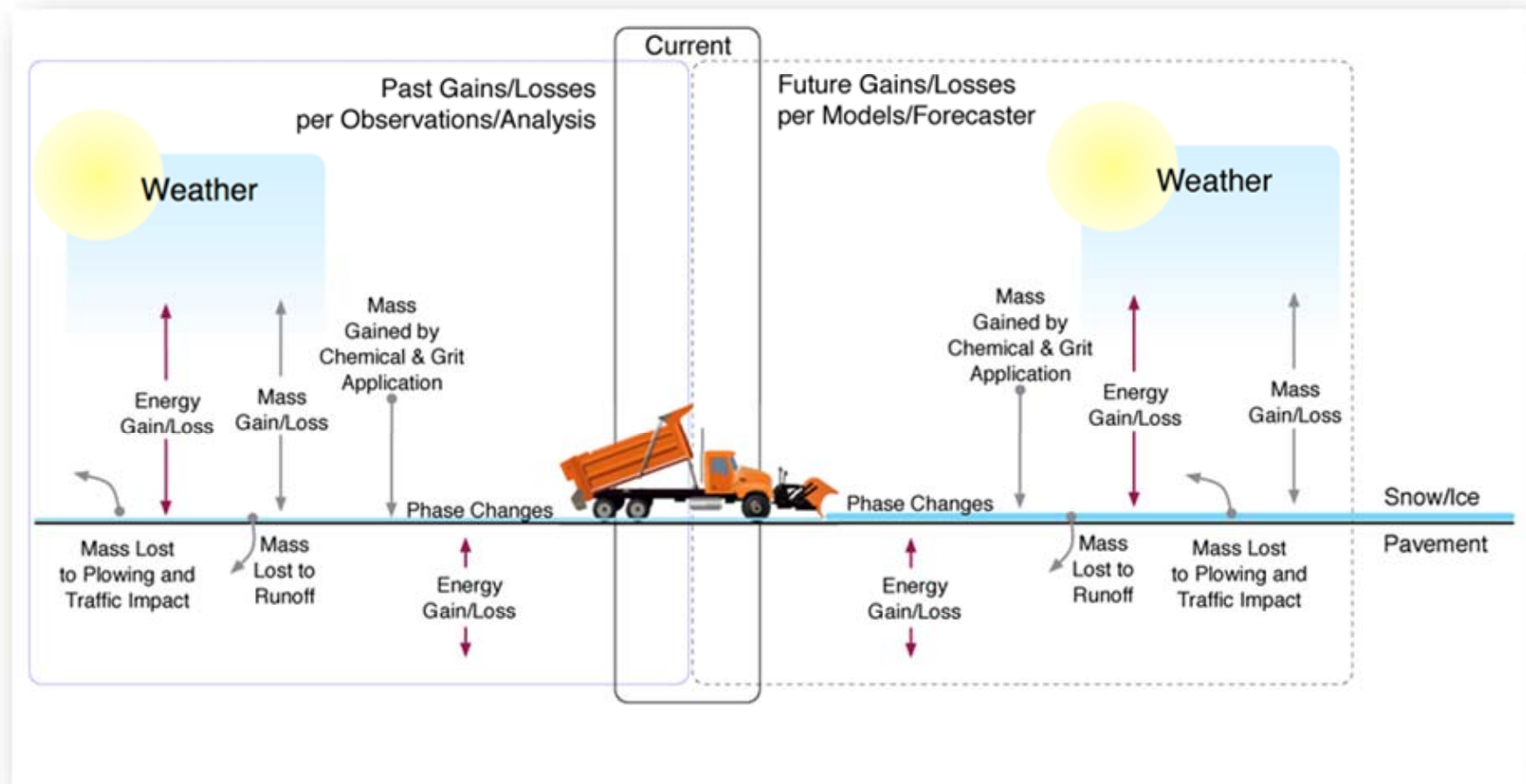
- ❄ Introduction of MDSS
- ❄ Implementation of MDSS within Operations
- ❄ Approach to Accessing Recommendations
- ❄ Results from winter season
- ❄ Future Direction

What is MDSS?

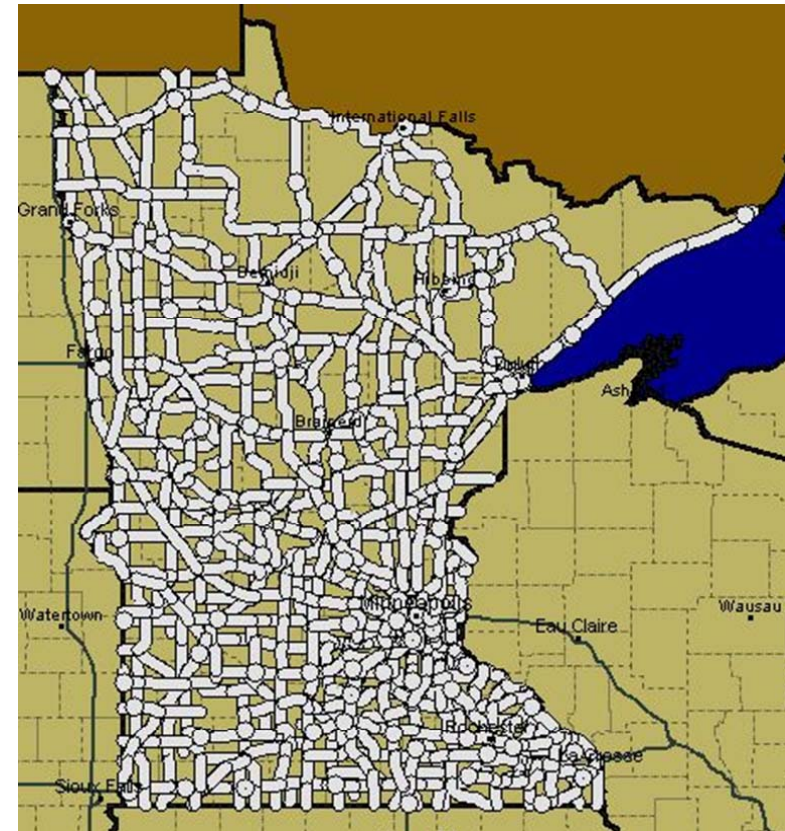
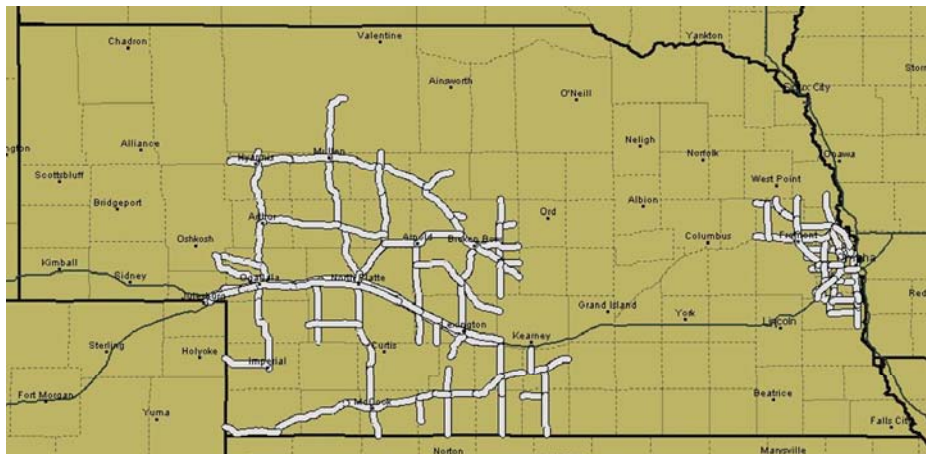
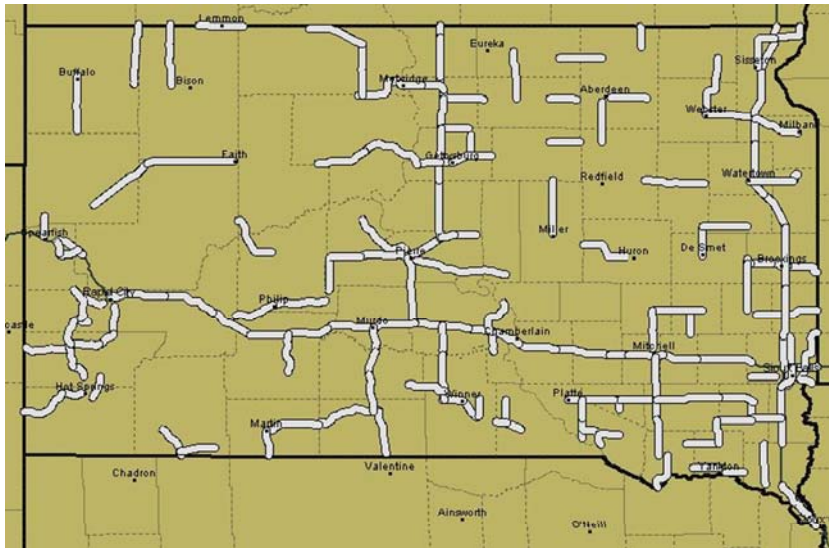


- ❄ A Maintenance Decision Support System is anything helping aid the maintenance decision process.
 - Prior Knowledge (Experience)
 - Snow and Ice Guidance Documents
 - RWIS-ESS Observations
 - Fellow operators/supervisors (Communication)
 - “That’s the way we’ve always done it”
 - A computer system that integrates weather, road and maintenance information to provide scientifically driven recommendations

Pooled Fund Study MDSS Solution



Implementation of MDSS across agencies



Approach to Assessing MDSS Recommendations



- ❄ Approach included Subjective and Objective analysis
 - A feature was added to the MDSS interface allowing users to provide feedback before AND after a treatment action
 - SDDOT included an in-vehicle survey for operators
 - Automated Monitoring of Weather, Road, and Treatment Actions

Assess MDSS Recommendations within the MDSS Application



- ❄ Users have the ability assess 4 different road/weather conditions/properties

A screenshot of a software window titled "Assessment of Recommendation". The window contains a table with five columns: "MDSS", "Precipitation Type", "Road Condition", "Road Temperature", and "Last Maintenance Action". The first row shows "Light snow", "Patchy snow", "32.0", and "N/A". Below this, there is a section labeled "MATCH?" with two rows of radio buttons for "YES" and "NO" under each of the four data columns. The "Road Temperature" column has a sub-label "Temp 29.0 - 35.0" next to the radio buttons.

	Precipitation Type	Road Condition	Road Temperature	Last Maintenance Action
MDSS	Light snow	Patchy snow	32.0	N/A
MATCH?				
YES	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NO	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Assess MDSS Recommendations within the MDSS Application



Assessment of Recommendation

MDSS	Precipitation Type	Road Condition	Road Temperature	Last Maintenance Action
	Light snow	Patchy snow	32.0	N/A
MATCH?				
YES	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
NO	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
ACTUAL CONDITION			Temp 29.0 - 35.0	
A C T U A L C O N D I T I O N	<input type="radio"/> Haze, mist, fog <input type="radio"/> Drizzle <input type="radio"/> Light rain <input type="radio"/> Moderate rain <input type="radio"/> Heavy rain <input type="radio"/> Freezing drizzle <input type="radio"/> Freezing rain <input type="radio"/> Flurries <input type="radio"/> Light snow <input type="radio"/> Moderate snow <input type="radio"/> Heavy snow <input type="radio"/> Light sleet/pellets <input type="radio"/> Moderate sleet/pellets <input type="radio"/> Heavy sleet/pellets	<input type="radio"/> Dry <input type="radio"/> Damp <input type="radio"/> Wet <input type="radio"/> Patchy snow <input type="radio"/> Snow covered <input type="radio"/> Wheel tracks <input checked="" type="radio"/> Compacted snow <input type="radio"/> Blowing snow <input type="radio"/> Thin slush <input type="radio"/> Wet slush <input type="radio"/> Dry sticky slush <input type="radio"/> Frost <input type="radio"/> Thin ice <input type="radio"/> Ice <input type="radio"/> Black ice in wheel tracks	Actual Road Temp <input type="text"/>	<input type="radio"/> None <input type="radio"/> Patrol <input type="radio"/> Plow <input type="radio"/> Abrasives <input type="radio"/> Dry salt <input checked="" type="radio"/> Prewet salt <input type="radio"/> Salt-sand <input type="radio"/> Brine <input type="radio"/> Mg Chloride <input type="radio"/> Ca Chloride <input type="radio"/> Other
				Select material <input type="text"/>
				RATE <input type="text"/> 150 lbs/lane-mi <input type="text"/> gal/lane-mi
OPTION				

Assessment of Recommendation

	Precipitation Type	Road Condition	Road Temperature	Last Maintenance Action
MDSS	Light snow	Patchy snow	32.0	N/A
MATCH?			Temp 29.0 - 35.0	
YES	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
NO	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ACTUAL CONDITION			Actual Road Temp	
A	<input type="radio"/> Haze, mist, fog	<input type="radio"/> Dry	<input type="text"/>	<input type="radio"/> None
C	<input type="radio"/> Drizzle	<input type="radio"/> Damp		<input type="radio"/> Patrol
T	<input type="radio"/> Light rain	<input type="radio"/> Wet		<input type="radio"/> Plow
U	<input type="radio"/> Moderate rain	<input type="radio"/> Patchy snow		<input type="radio"/> Abrasives
A	<input type="radio"/> Heavy rain	<input type="radio"/> Snow covered		<input type="radio"/> Dry salt
L	<input type="radio"/> Freezing drizzle	<input type="radio"/> Wheel tracks		<input type="radio"/> Prewet salt
C	<input type="radio"/> Freezing rain	<input type="radio"/> Compacted snow		<input type="radio"/> Salt-sand
O	<input type="radio"/> Flurries	<input type="radio"/> Blowing snow		<input type="radio"/> Brine
N	<input type="radio"/> Light snow	<input type="radio"/> Thin slush		<input type="radio"/> Mg Chloride
D	<input type="radio"/> Moderate snow	<input type="radio"/> Wet slush		<input type="radio"/> Ca Chloride
I	<input type="radio"/> Heavy snow	<input type="radio"/> Dry sticky slush		<input type="radio"/> Other
T	<input type="radio"/> Light sleet/pellets	<input type="radio"/> Frost		<input type="text" value="Select material"/>
I	<input type="radio"/> Moderate sleet/pellets	<input type="radio"/> Thin ice		RATE
O	<input type="radio"/> Heavy sleet/pellets	<input type="radio"/> Ice		<input type="text" value="lbs/lane-mi"/>
N		<input type="radio"/> Black ice in wheel tracks		<input type="text" value="gal/lane-mi"/>
OPTION	<input type="radio"/> Accept <input type="radio"/> Accept Conditionally <input type="radio"/> Decline <input type="radio"/> Rerun			
Comments	<input type="text"/>			
<input type="button" value="Submit"/> <input type="button" value="Cancel"/>				



Accept / Decline Statistics Total



Count of Evaluation	Column Labels			
Row Labels	ACCEPT	CONDITIONALACCEPT	DECLINE	Grand Total
Maryland	280		46	326
New Hampshire	2		3	45
North Dakota	59		8	113
South Dakota			4	4
Wisconsin	1			1
Colorado	2		1	10
Indiana	1		1	2
Nebraska	4		1	5
Grand Total	349		64	506

Level of acceptance = 82%

Level of acceptance 2014 = 83%

Accept / Decline Statistics



When 3 conditions match

Road Condition **yes**

Road Temperature **yes**

Type of Precip **yes**

Count of Evaluation	Column Labels			
Row Labels	ACCEPT	CONDITIONALACCEPT	DECLINE	Grand Total
Colorado	2			2
Maryland	272		46	318
Nebraska	4		1	5
New Hampshire			25	25
North Dakota	24		3	42
Wisconsin	1			1
Grand Total	303		50	393

Level of acceptance = 90%

Accept / Decline Statistics



When all 4 conditions match

Road Condition	yes
Road Temperature	yes
Type of Precip	yes
Maintenance Action	yes

Four Yeses

Count of Evaluation	Column Labels			
Row Labels	ACCEPT	CONDITIONALACCEPT	DECLINE	Grand Total
Colorado	2			2
Maryland	272	46		318
Nebraska	4	1		5
New Hampshire			19	19
North Dakota	23	3	13	39
Wisconsin	1			1
Grand Total	302	50	32	384

Level of acceptance = 92%

Accept Percentage by Condition




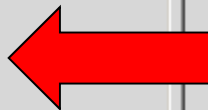
MATCH CONDITION	YES	NO
Type of Precipitation	95	39
Road Condition	84	49
Road Temperature	82	39
Maintenance Action	81	42

- Argues that a RERUN with user observed conditions should provide a more acceptable recommendation
- However, participants did not use the feature often

SDDOT Survey in Maintenance Vehicle



SELECT WEBSITE		 BACK
Local Radar	Safe Travel USA SD	
Weather Forecast		
Recommended Action		
Regional Radar		
Safe Travel USA		



SDDOT Survey in Maintenance Vehicle



MDSS DISPLAY

CHANGE SITE

MAIN MENU

Page loaded 2012-12-12 4:57:08 pm CST

Recommended Actions

Selection	Time	Practice: Rate
For I-90, MM 335.43 to 353, Driving:		
<input type="button" value="Select"/>	-	None: -
For I-90, MM 335.43 to 353, Passing:		
<input type="button" value="Select"/>	-	None: -
For I-90, MM 284 to 308.25, Driving:		
<input type="button" value="Select"/>	-	None: -
For I-90, MM 284 to 308.25, Passing:		
<input type="button" value="Select"/>	-	None: -

SDDOT Survey in Maintenance Vehicle



MDSS DISPLAY

CHANGE SITE

Page loaded 2012-12-12 5:00:02 pm CST

Selected:

None

at

N/A

on

I-90, MM 335.43 to 353, Driving

Send Selection

Cancel Selection

SDDOT Survey in Maintenance Vehicle



MDSS DISPLAY	CHANGE SITE	↑ MAIN MENU														
<p>Page loaded 2012-12-12 4:58:36 pm CST</p> <p>1. Did you follow MDSS's treatment recommendations for this route?</p> <table border="0"><tr><td><input type="radio"/> Yes, was within +/-50 lbs</td><td><input type="radio"/> Unable to get recommendations</td></tr><tr><td><input type="radio"/> Recommended rates were light</td><td><input type="radio"/> Recommended rates were excessive</td></tr><tr><td><input type="radio"/> No recommendation, but one needed</td><td><input type="radio"/> Recommendation provided, not needed</td></tr><tr><td colspan="2"><input type="radio"/> Recommendation inappropriate for blowing snow conditions</td></tr></table> <p>2. What operational problems did you experience on this route? (check all that apply)</p> <table border="0"><tr><td><input type="checkbox"/> MDC computer did not work</td><td><input type="checkbox"/> Air temp. sensor did not work</td></tr><tr><td><input type="checkbox"/> Road temp. sensor did not work</td><td><input type="checkbox"/> Plow position sensor(s) did not work</td></tr><tr><td><input type="checkbox"/> GPS did not work</td><td><input type="checkbox"/> Other</td></tr></table> <p>3. How well did cellular communication to the MDC work on this route?</p> <p><input type="radio"/> Worked Well <input type="radio"/> Intermittent <input type="radio"/> Not at All</p> <p><input type="button" value="Submit"/> <input type="button" value="Cancel"/></p>			<input type="radio"/> Yes, was within +/-50 lbs	<input type="radio"/> Unable to get recommendations	<input type="radio"/> Recommended rates were light	<input type="radio"/> Recommended rates were excessive	<input type="radio"/> No recommendation, but one needed	<input type="radio"/> Recommendation provided, not needed	<input type="radio"/> Recommendation inappropriate for blowing snow conditions		<input type="checkbox"/> MDC computer did not work	<input type="checkbox"/> Air temp. sensor did not work	<input type="checkbox"/> Road temp. sensor did not work	<input type="checkbox"/> Plow position sensor(s) did not work	<input type="checkbox"/> GPS did not work	<input type="checkbox"/> Other
<input type="radio"/> Yes, was within +/-50 lbs	<input type="radio"/> Unable to get recommendations															
<input type="radio"/> Recommended rates were light	<input type="radio"/> Recommended rates were excessive															
<input type="radio"/> No recommendation, but one needed	<input type="radio"/> Recommendation provided, not needed															
<input type="radio"/> Recommendation inappropriate for blowing snow conditions																
<input type="checkbox"/> MDC computer did not work	<input type="checkbox"/> Air temp. sensor did not work															
<input type="checkbox"/> Road temp. sensor did not work	<input type="checkbox"/> Plow position sensor(s) did not work															
<input type="checkbox"/> GPS did not work	<input type="checkbox"/> Other															

SD Survey 2015 (1481 responses)



DRIVER RESPONSE	NUMBER	PERCENT
NO RESPONSE		7
Answer not provided	66	
Unable to get Recommendation	45	
TOO LIGHT		32.8
No recommendation but one needed	239	16.1
Recommended rates were light	247	16.7
TOO HEAVY		19.6
Recommended rates were excessive	111	7.5
Recommendation provided but not needed	108	7.3
Recommendation inappropriate for blowing snow conditions	71	4.8
APPROPRIATE		40.1
Yes Recommendation was within ± 50 lbs	594	40.1

SD Survey 2014 (894 responses)



DRIVER RESPONSE	NUMBER	PERCENT
NO RESPONSE		(8.3)
Answer not provided	56	
Unable to get Recommendation	18	
TOO LIGHT		33.3
No recommendation but one needed	112	13.7
Recommended rates were light	161	19.6
TOO HEAVY		8.5
Recommended rates were excessive	30	3.7
Recommendation provided but not needed	29	3.5
Recommendation inappropriate for blowing snow conditions	11	1.3
APPROPRIATE		58.2
Yes Recommendation was within ± 50 lbs	477	58.2

An 'Automated' Approach to Assessing Recommendations



❄ [Link to Automated Approach](#)

Plan for 2015/16



❄ Training

- Clarify what recommendations can be evaluated
- Explain value of reruns
- Describe the Assessment procedures
- Solicit additional participation

❄ Select active participants from at least 3 states for detailed study

Contact Information



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