The Use of the 85 Percentile Speed Data as a Measure of Winter Maintenance Performance

S5: ITS In Storm Response

Jennifer Foley
Willard Thompson P.E.
Robert Warren
Michigan Department of Transportation
Expand and enhance our focus to provide products, programs, and services that meet our customers’ most important current and future needs.

- Increase staff awareness of the potential impacts of their actions and decisions on customers, stakeholders, and partners.
- Develop and document a tool box of processes (best practices) that facilitate communication with and participation by customers and stakeholders to ensure reasonable consistency throughout the department.
- Report annually on the customer engagement processes used, input received, and how these impacted MDOT investment.
- Expand outreach initiatives to enhance MDOT’s image and our understanding of our customers’ wants and needs.
- Develop a process for ongoing measurement of external customer satisfaction and needs, and use the data to make better decisions.
Background

- I-96 is a 6 lane freeway near Brighton (14 miles), and a 4 lane rural freeway near Lansing (35 miles)
- 80,000 ADT, 70 mph, 8% Commercial Traffic
- Very important link between the state capital, Lansing, and the state’s largest city, Detroit
67 Counties provide maintenance

28 Direct MDOT Forces provide maintenance
Maintenance Facilities

- MDOT has 3 maintenance garages which service the I-96 freeway from Brighton to Lansing
  - Easy for data collection

- Service Level Definition
  - Priority 1-Orange Routes
  - Priority 2-Blue Routes
Priority 1-Orange Route

- Goal is to achieve full width pavement “generally bare of ice and snow”
- Operations should be continuous during and after the storm until goal is met
2008 snow fall for Ingham County: 40-60 inches

2008 snow fall for Livingston County: 20-40 inches

Generally snowfall events are less than 4 inches
Overview

- Speed used to quantify performance
- Three rural counties
- Results will be used to help mitigate impacts of future winter storm events:
  - maintenance cost
  - customer service/satisfaction
Measures of Performance

- **Regain Time**
  - End of the storm until the roadway reaches a speed that is stable and comparable to speed before the storm began
  - During the storms there are many variables that can make it difficult to get repeatable results
  - In general, shorter regain time is better

- **Consistency of Operations**
  - Comparison of regain times between the three maintenance garages
  - More uniformity is better – indicates similar road condition therefore, there are no surprises to motorists
Variables

- Storm start and stop time
- Temperature
- Precipitation
- Wind
- Treatment of roadway
- 85th% speed
- Volume
- Crashes
Benefits of Speed Data

- Highly automated
- Very little user input
- Not subjective
  - No visual condition to be recorded
- Easy to compare contract agencies with MDOT forces
Data Collection PVDS

- To measure the speed and volume, we used three Portable Vehicle Detection System (PVDS) trailers
- These trailers collected the volume, speed and classification 24 hrs/7 days a week
- Accessed wirelessly from office
- Used Wavetronix HD sensor
Data Collection - Storm Logs

- Each garage was required to fill out storm logs

- Storm logs included:
  - Storm start and storm end time, date
  - Precipitation (Total inches of snow fall)
  - Temperature
  - Driving surface
  - Weather conditions
<table>
<thead>
<tr>
<th>DATE</th>
<th>Event Start Time</th>
<th>Crew Start Time</th>
<th>Air Temp</th>
<th>INITIAL Weather Conditions</th>
<th>INITIAL Driving Surface Condition</th>
<th>Material Used (Check all that apply)</th>
<th>Change in Weather Time</th>
<th>New Weather Conditions</th>
<th>End of Precip or Blowing</th>
<th>Total Inches of Snow/Rain</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-30-08</td>
<td>9:00 am</td>
<td>9:00 am</td>
<td>?</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Salt</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>2 from nights were in road patrolling they called in the rest of nights around 9:00 pm. Called in days around 2:00am to help out nights, around 6:00 am called in more of day shift to help out. Very windy all night could not keep the roads open.</td>
</tr>
<tr>
<td>1:04-09</td>
<td>7:00 am</td>
<td>7:00 am</td>
<td>32</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Freezing rain started around 7:00 am, never really warmed up roads where a sheet of ice.</td>
</tr>
<tr>
<td>1:08-09</td>
<td>8:00 am</td>
<td>7:00 am</td>
<td>28</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Freezing drizzle started at 8:30 pm, 2 from nights were in road patrolling they called in the rest of nights around 8:30. The roads iced up instantly.</td>
</tr>
<tr>
<td>1:07-09</td>
<td>6:00 am</td>
<td>7:00 am</td>
<td>27</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Light snow started at 6:30 am.</td>
</tr>
<tr>
<td>1:08-09</td>
<td>8:00 am</td>
<td>9:00 am</td>
<td>25</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Light snow and drifting approximately 2 inches. Called in had them report at 3:00 am.</td>
</tr>
<tr>
<td>1:08-09</td>
<td>12:00 am</td>
<td>12:00 am</td>
<td>24</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Started to snow around 8:00 pm, called in night around 8:30 pm they reported around 9:00 pm approximately 2&quot; of snow.</td>
</tr>
<tr>
<td>1:08-09</td>
<td>9:00 am</td>
<td>9:00 am</td>
<td>23/25</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Started to snow around 12:00 pm crews out and ready. Third lane of I-96 started to cover over around 12:40 along with some freezing on and under some of the overpasses.</td>
</tr>
<tr>
<td>1:08-09</td>
<td>7:00 am</td>
<td>7:00 am</td>
<td>?</td>
<td>Frost</td>
<td>Slippery In Spots</td>
<td>Sand</td>
<td>0.00 pm</td>
<td></td>
<td></td>
<td></td>
<td>Severe weather warning issued Light snow all day picked up around 12:30 pm. Sill snowing at 6:00 pm.</td>
</tr>
</tbody>
</table>
Data Analysis

- Graphs created using sensor data
- Relevant information
  - Normal (non-storm) travel speed
  - Time when storm ended
  - Time when normal speed regained
- Regain Time =
  The time the storm ends until the time speed is back to normal
Slow Lane Speed during Winter Storm Event for three areas
Friday 12.26.2008, 2:00 AM to 2:00 PM

Storm Info
Ice storm, about 1/4 inch precipitation
Temperatures 20-22 °F
Garage Locations

Grand Ledge

Williamston

Brighton
Slow Lane Speed during Winter Storm Event for three areas
Friday 12.26.2008, 2:00 AM to 2:00 PM

Storm Info
- Ice storm, about 1/4 inch precipitation
- Temperatures 20-22 °F

Regain times
- Grand Ledge: 5 hr
- Williamston: 4.5 hr
- Brighton: 5 hr

- Original Speed Regained

Graph shows data on speed in MPH for Grand Ledge, Williamston, and Brighton over time.
Slow Lane Speed during Winter Storm Event for three areas

Friday 12.26.2008, 2:00 AM to 2:00 PM

Storms Begin

Storms End

Storm Info
Ice storm, about 1/4 inch precipitation
Temperatures 20-22 °F

Regain times
Williamston: 4.5 hr
Slow Lane Speed during Winter Storm Event for three areas
Friday 12.26.2008, 2:00 AM to 2:00 PM

Storm Info
Ice storm, about 1/4 inch precipitation
Temperatures 20-22 °F

Regain times
Brighton: 5 hr

Grand Ledge
Williamston
Brighton
Slow Lane Speed during Winter Storm Event for three areas
Friday 12.26.2008, 2:00 AM to 2:00 PM

Storm Info
Ice storm, about 1/4 inch precipitation
Temperatures 20-22 °F

Regain times
Grand Ledge: 5 hr
Brighton: 5 hr
Williamston: 4.5 hr
Slow Lane Speed during Winter Storm Event for three areas
Sunday 12.21.2008 9:00 PM to Monday 12.22.2008 4:00 PM

Storms Begin

Storms End

Speed Stability Regained
Williamston
Grand Ledge & Brighton

Regain times
Grand Ledge: 8 hr
Williamston: 5 hr
Brighton: 7.5 hr

Storm Info
30+ MPH winds
1+ inch snow
Lots of blowing snow

Speed MPH

90
80
70
60
50
40
30
20
10
0

9:00 PM
10:00 PM
11:00 PM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM

Grand Ledge
Williamston
Brighton

Grand Ledge: 8 hr
Williamston: 5 hr
Brighton: 7.5 hr

Lots of blowing snow

30+ MPH winds
1+ inch snow

Graph showing speed stability regaining times for each area and storm information.
Slow Lane Speed for Winter Storm Event in Grand Ledge and Brighton
Friday 12.19.2009 at 12:00 AM to Saturday 12.20.2009 at 2:00 AM

- Storm Begins
- Storm Ends
- Original speeds regained

Grand Ledge
- Storm Info: 6-8 inch snow in Grand Ledge
- Regain Times: 8.5 hr

Brighton
- Storm Info: 10 inch snow in Brighton
- Regain Times: 10 hr
Results

- 32 total storms (Dec-Feb), 13 storms had useful data

- Regain Time
  - Storm < 4 inches averaged 5.6 hours
  - Storm > 4 inches averaged 11.5 hours

- Variations in regain time
  - Ice storm regain time of 8.5 hours

- Consistency of Operations
  - Fairly good, most storms had less than a 1 hour difference in regain times between garages
Sources of Error

- Storm logs are subjective
  - Not completely filled out
  - Different perception of when the storm started or stopped
  - Road condition difficult to quantify

- Low volume
  - When the volumes were low due to holidays or no driving during heavy snow fall, the speed was averaged over smaller number of vehicles

- PVDS
  - Had difficulty with maintaining power to the trailers
Customer Survey

- **68%** rated plowing and salting of MDOT roadways “Good” or better
- **83%** believed that freeways should be in better condition than non-freeways
- **42%** willing to pay more taxes if MDOT could improve performance during winter storm events
- Most surveyed chose to use visual data as a performance measure
Future Considerations

- MDOT obtaining statewide vehicle probe data
  - Probe data tracks GPS signals along all major MDOT trunklines
  - Travel time delivered to message boards
Future Considerations

- Installing permanent ITS infrastructure along the I-96 corridor

- The permanent DMS signs will allow us to:
  - Respond quicker to incidents
  - Give travelers up to date travel time and weather information
Conclusions

- A shorter regain time is better
- Consistency
- Customer satisfaction
- Investigating cost of maintenance tied to performance
Lessons Learned

- Choose a location for data collection with a power source
- Storm start and end documentation
- Visualization vs. speed
- Non-linear relationship between snowfall (inches) and regain time
Questions?