Michigan Department of Transportation

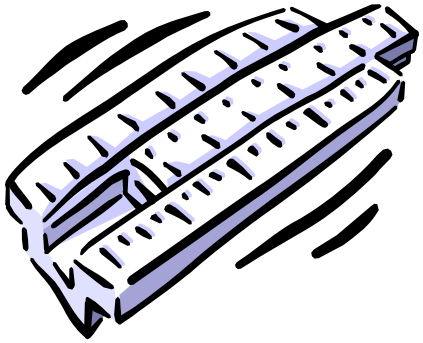
Highway Operations - Performance Measures & Management

Steven J. Cook, P.E.

Engineer of Systems Operations & Maintenance

Overview

- Performance Management vs. Performance Measures
- User Delay Cost (UDC)
- Performance Management Process
- Mobile Data Source
- Outcomes

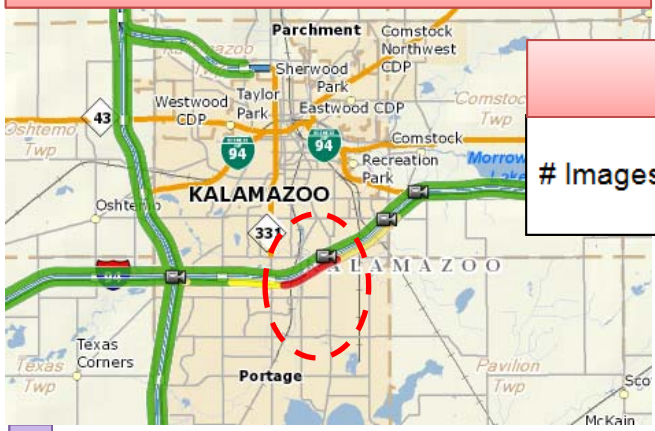


User Delay Cost

- Traditional project level taken to Transportation Systems Management & Operations level
  - Calculation based on travel volumes, speeds (constants: vehicle occupancy, cost per vehicle, segment, etc.)
  - Sensor and probe vehicle data (HERE previous Navteq)
    - Travel Times and Mi Drive website
    - User Delay Cost
- Performance Measurement Tool
  - “Red Images”
  - Regional Integrated Transportation Information System (RITIS)

User Delay Cost Method

1. Capture Delays (red images)

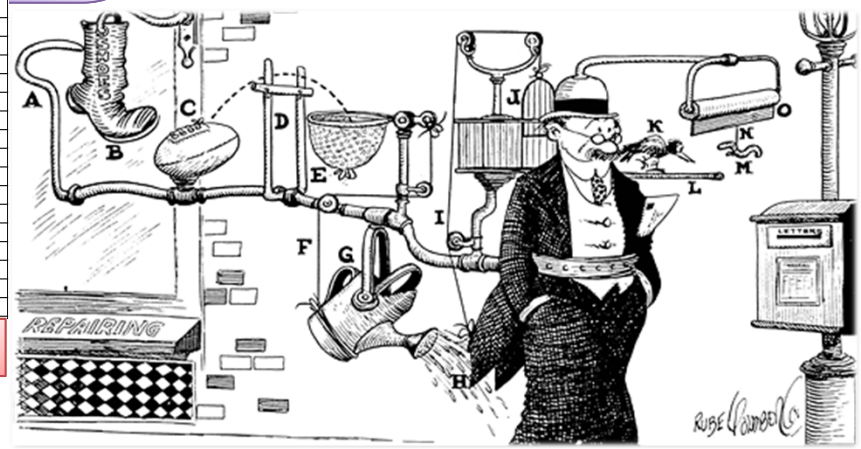


3. Sum the number delays, convert to a user cost

$$\text{\# Images} \times \frac{10\text{ min of delay}}{\text{image}} \times \frac{\text{hour}}{60\text{ min}} \times \frac{\text{Users}}{\text{Day}} \times \frac{1\text{ Day}}{24\text{ hours}} \times \frac{\$19.42}{\text{hour}} = \text{User Delay Cost}$$

	A	B	C	D	E
1	I-94 CORRIDOR RED IMAGE DATA				
2					
3	FILE NAME	DATE	TIME	RED/TSC	WORK ZONE OR INCIDENT ?
4					
5	10 10 02 07 25 AM.JPG	10/02/10	725A	MARSHALL	Unknown - EB Near 66
6	10 10 02 09 00 PM.JPG	10/02/10	900P	KALAMAZOO	Work zone
7					
8	10 10 04 02 00 AM.JPG	10/04/10	200A	COLOMA	Unknown
9	10 10 04 03 00 AM.JPG	10/04/10	300A	COLOMA	Unknown
10	10 10 04 07 33 AM.JPG	10/04/10	733A	KALAMAZOO	Work zone (EB @ Oakland)
11					
12	10 10 05 12 00 AM.JPG	10/05/10	1200A	COLOMA	
13	10 10 05 12 30 AM.JPG	10/05/10	1230A	COLOMA	
14	10 10 05 01 42 AM.JPG	10/05/10	142A	COLOMA	
15					
16	10 10 06 11 23 PM.JPG	10/06/10	1123P	MARSHALL	Unknown (WB past 66)
17					
18	10 10 07 07 13 AM.JPG	10/07/10	713A	KAL/COLO	Incident (WB at I-94BL)
19					
20	10 10 08 08 43 PM.JPG	10/08/10	843A	KALAMAZOO	Incident (WB @ Sprinkle)
21	10 10 08 09 13 AM.JPG	10/08/10	913A	KALAMAZOO	Work zone (EB @ Oakland)
22					
23	10 10 09 08 38 AM.JPG	10/09/10	838A	KALAMAZOO	Work zone (EB @ Oakland)
24	10 10 09 05 31 PM.JPG	10/09/10	531P	MARSHALL	Unknown (EB @ 66)

2. Review images, document delays



User Delay Cost Method

UDC on I-94 Work Zone Incident Example: 09/09/2013

Total Cost

10 AM	11 AM	12 PM	1 PM	2 PM	3 PM	4 PM	5 PM	6 PM	7 PM	8 PM	9 PM	10 PM	11 PM	Daily Totals
$0K	$0.1K	$0K	$0K	$1.2K	$90.3K	$122.6K	$33.6K	$0.3K	$0K	$0K	$0K	$0K	$0K	$298.2K
$0K	$0						$0K	$0K	$0K	$0K	$0K	$0K	$0K	$0.4K
$0K	$0						0K	$0K	$0K	$0K	$0K	$0K	$0K	$0.2K
$0K	$0							$1.3K	$3.1K	$4.4K	$4.2K	$2.2K	$0K	$15.3K
$6.3K	$9.5							$0K	$0K	$0.1K	$0K	$0K	$0K	$75.7K
$0K	$0						$0K	$0.1K	$1.2K	$0.7K	$0K		$0.2K	$2.5K
$0.4K	$0.1						$1.5K	$0K	$0.3K	$1.4K	$ 7K	$0	$0K	$5.1K
$6.7K	$9.8					K	$85.2K	$1.7K	$4.7K	$6.6K	$ K	$2.2K		Grand Total $397,487.4

Mon Sep 09 2013 16:00:00

Delay cost:
- Total: $122,631.56
- Per vehicle: $54.64
- Per person: $45.48

Hours of delay:
- Person-hours: 6,259.41 hours
- Vehicle-hours: 5,209.59 hours
- Per vehicle: 2.32 hours

Volume:
- Passenger: 1060 vph
- Commercial: 312 vph

Data validity: 94.89%

Click the table cell to see links to congestion scans

SHA State Highway Administration

MDOT Michigan Department of Transportation

I-95 Corridor Coalition

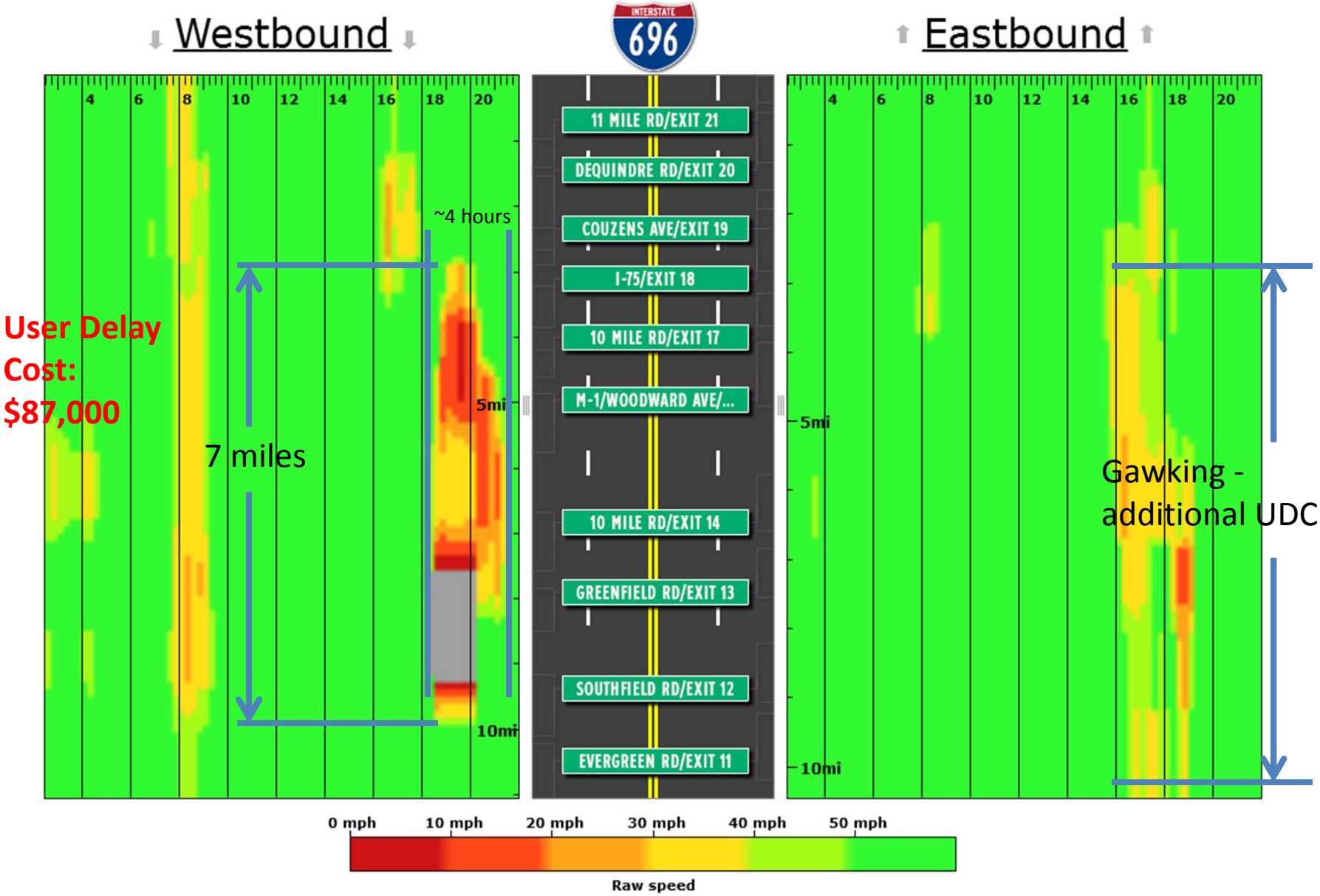
CATT Laboratory

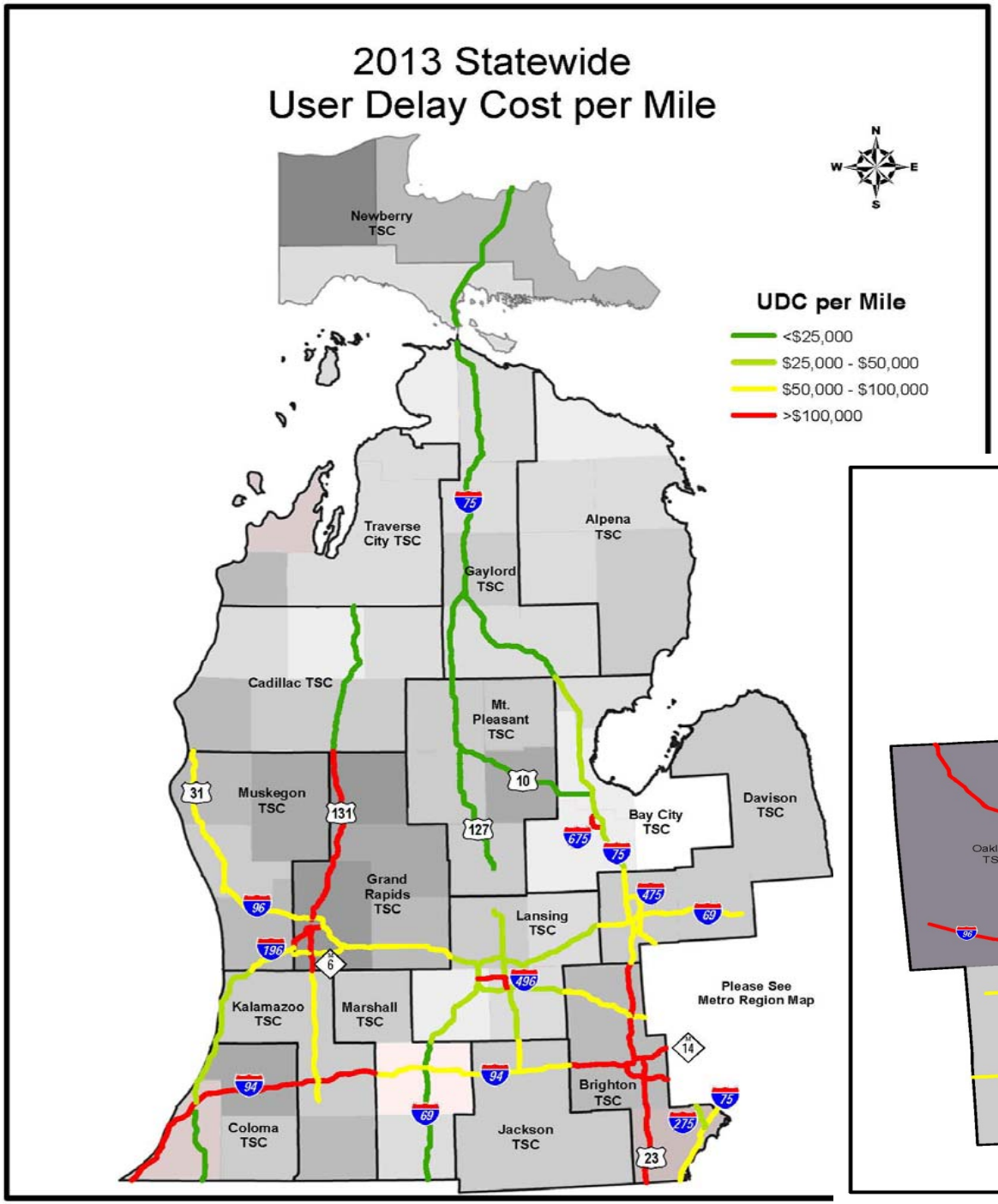
University of Maryland

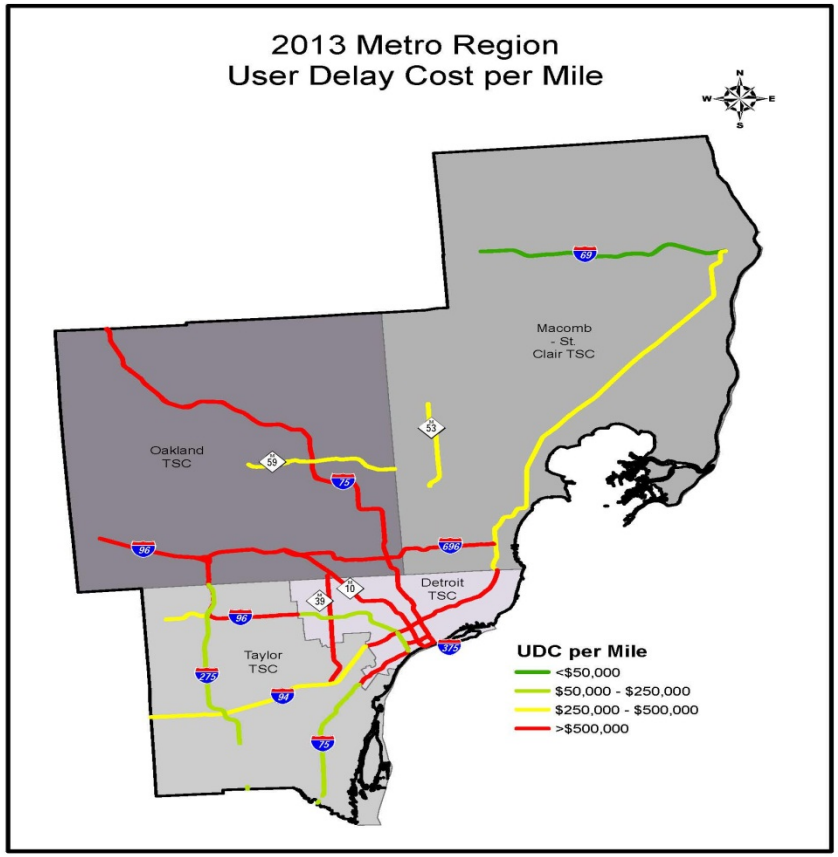
RITIS – Congestion Scan

Speed on I-696 between 11 Mile Rd/Exit 21 and Evergreen Rd/Exit 11

Data shown is averaged on Wednesday Jul 24, 2013 at 15 minute intervals.




2013 Statewide
User Delay Cost per Mile
N
W
E
S
UDC per Mile
<$25,000
$25,000 - $50,000
$50,000 - $100,000
>$100,000
Newberry TSC
Traverse City TSC
Alpena TSC
Gaylord TSC
Cadillac TSC
Mt. Pleasant TSC
Muskegon TSC
Bay City TSC
Davison TSC
Grand Rapids TSC
Lansing TSC
Kalamazoo TSC
Marshall TSC
Brighton TSC
Coloma TSC
Jackson TSC
Please See Metro Region Map


2013 Metro Region
User Delay Cost per Mile
N
W
E
S
Macomb - St Clair TSC
Oakland TSC
Detroit TSC
Taylor TSC
UDC per Mile
<$50,000
$50,000 - $250,000
$250,000 - $500,000
>$500,000

Managing User Delay Cost

Goal: Limit 2013 User Delay Cost to $304.4 Million by 12/31/13

Winter Weather sub-goal:

Regain normal speeds in 2 hours or less 80% of time

Lead Measure 1:

Perform After Storm Huddles 80% of the time

Lead Measure 2:

Compliance with Salting Policies 80% of the time

TIM sub-goal:

Limit the number of traffic incidents closing 1+ lanes lasting longer than 2 hours to 203

Lead Measure 1:

Perform Post Incident Reviews 75% of the time

Work Zone sub-goal:

Limit Non-Recurring Construction UDC to $80.3M

Lead Measure 1:

Perform WZ Reviews 80% of the time

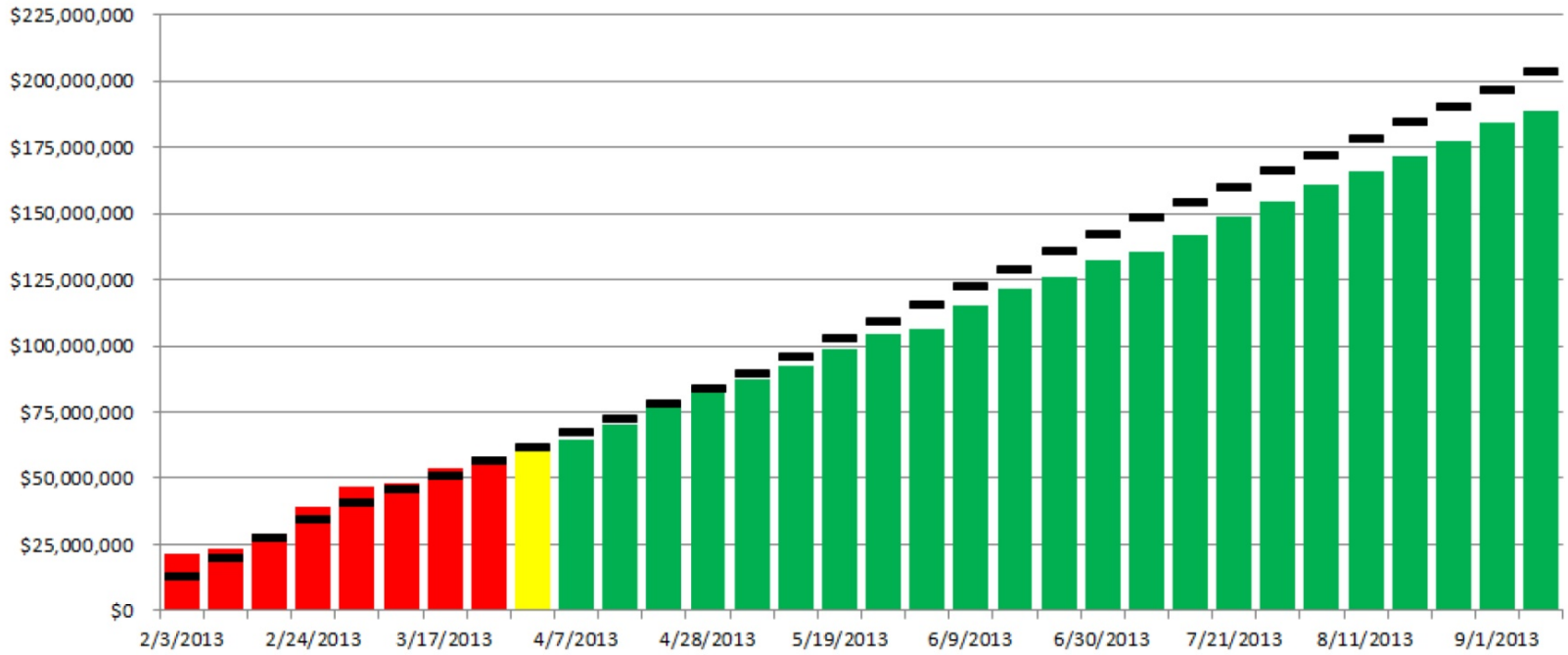
Lead Measure 2:

Compare Predicted vs. actual Capacity & Diversion Rates

Scoreboard for Team: Statewide

UDC Statewide

as of 9/17/2013: Current: $196.49M / Target: $210.57M



Limit the 2013 user delay cost to $304.4 million, between 1/1/13 and 12/31/13.

Green

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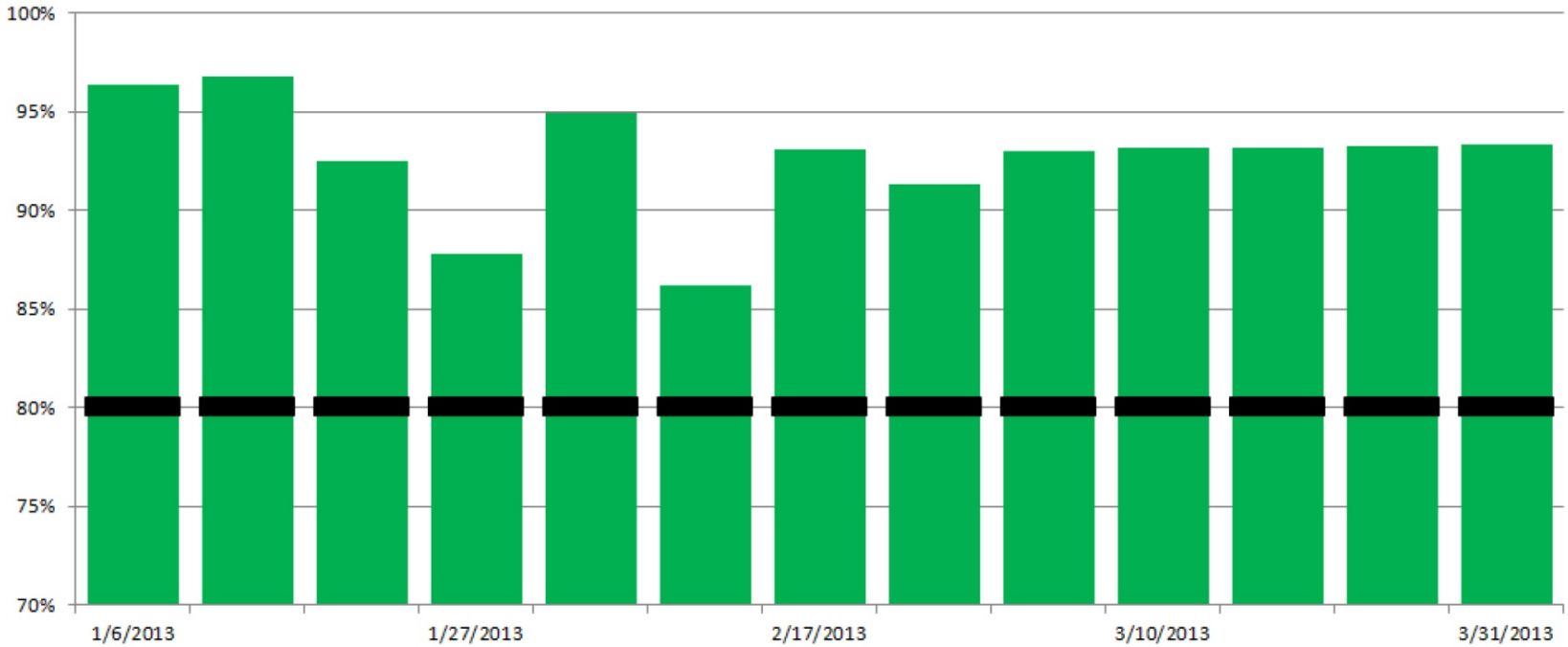
Scoreboard for Team: Statewide

Weather Travel Impacts

as of 9/17/2013: Current: 92.74% / Target: 80%



Regain normal speeds in two hours or less, 80 percent of the time for winter weather events.

Green

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Printed: Tuesday, September 17, 2013 1:57:59 PM UDT

Continuous Improvement

- Previous goal – Regain normal speeds in two hours or less, 80% of the time for winter weather events
- Proposed goal – Maintain traffic speeds within 10 mph of **normal speeds** 80% of the time when a **storm event impacts the AM peak (6am - 9am)**

	% Speeds within 10 mph			
Location	All Day	AM Peak (6-9)	PM Peak (3-7)	6am-6pm
Grand Region	74%	45%	67%	68%
US-127(Isabella Co.)	91%	82%	100%	89%
I-94(Jackson TSC)	79%	75%	80%	80%
I-94(Taylor TSC)	51%	41%	65%	58%
I-94(Marshall TSC)	68%	73%	57%	74%

Managing User Delay Costs

Goal: Limit 2014 User Delay Cost to $300 Million by 12/31/14

Winter Weather sub-goal:

Maintain traffic speed w/in 10 mph of normal speeds 80% of time (6am-9am)

Lead Measure 1:

Perform After Storm Huddles 80% of the time

Lead Measure 2:

Compliance with Salting Policies 80% of the time

Traffic Incident Mgt sub-goal:

Limit the number of traffic incidents closing 1+ lanes lasting longer than 2 hours to 203

Lead Measure 1:

Perform Post Incident Reviews 75% of the time

Work Zone sub-goal:

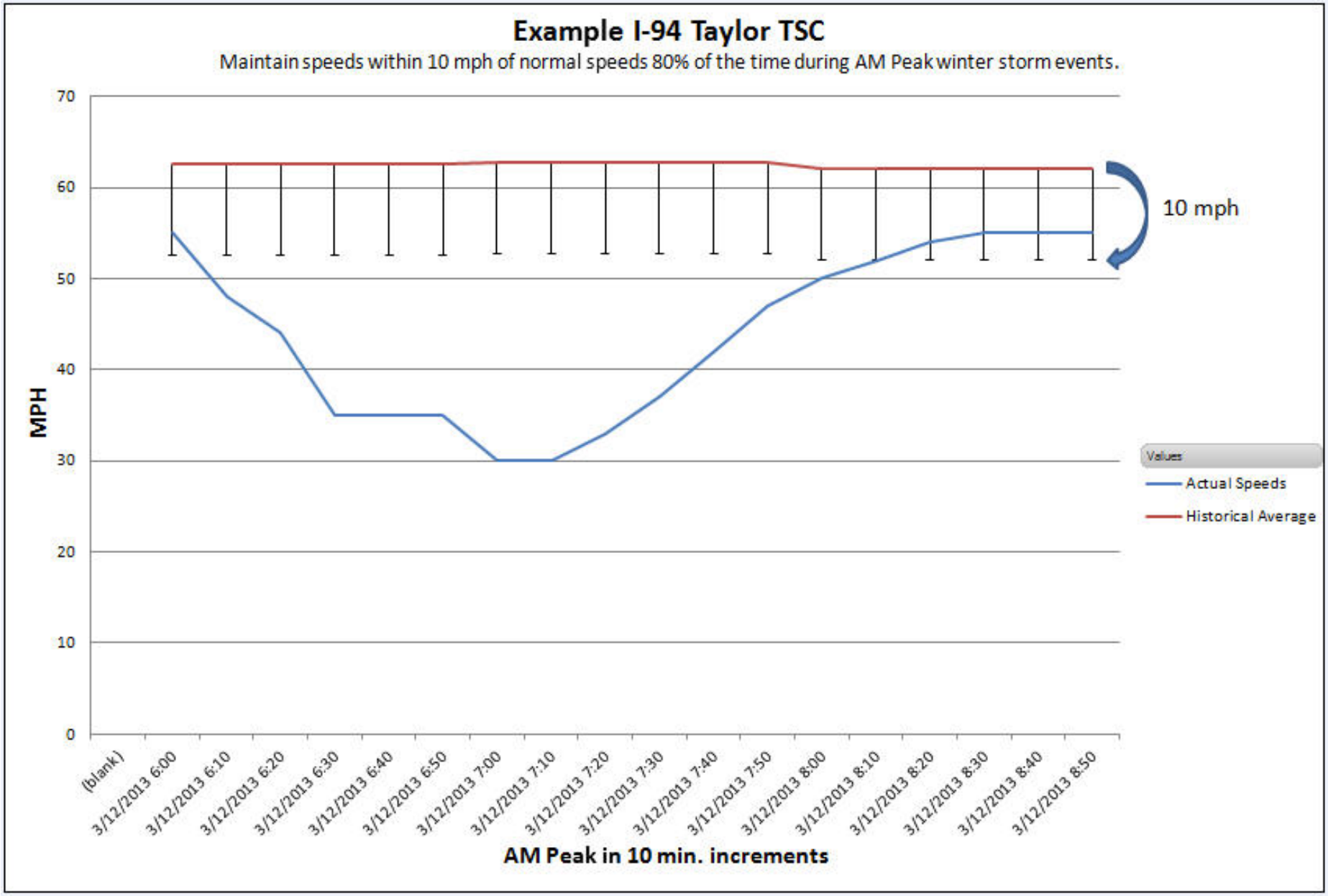
Limit Non-Recurring Construction UDC to $80.3M

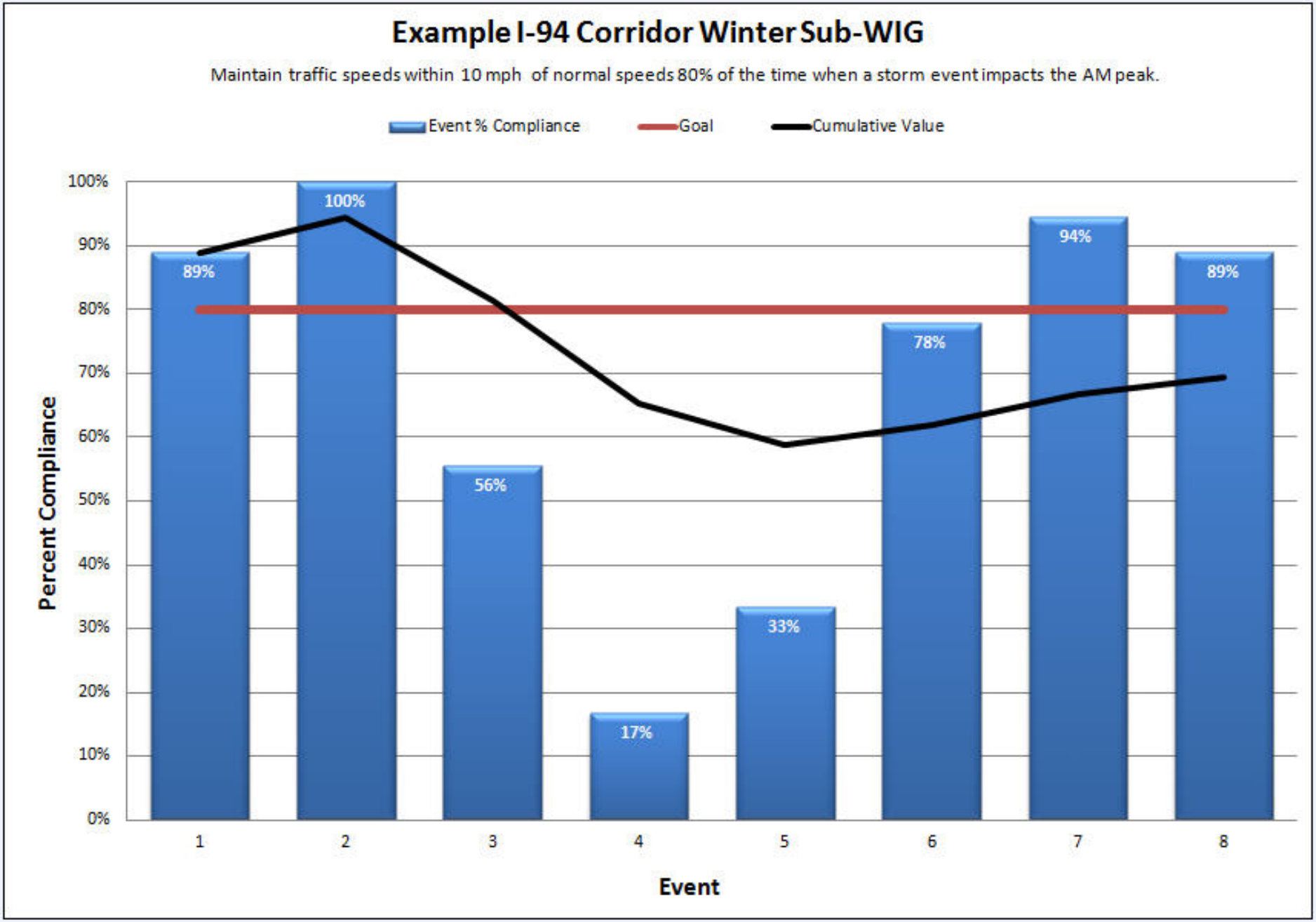
Lead Measure 1:

Perform WZ Reviews 80% of the time

Lead Measure 2:

Compare Predicted vs. actual Capacity & Diversion Rates


Example I-94 Taylor TSC
Maintain speeds within 10 mph of normal speeds 80% of the time during AM Peak winter storm events.
MPH
70
60
50
40
30
20
10
0
10 mph
Values
Actual Speeds
Historical Average
(blank)
3/12/2013 6:00
3/12/2013 6:10
3/12/2013 6:20
3/12/2013 6:30
3/12/2013 6:40
3/12/2013 6:50
3/12/2013 7:00
3/12/2013 7:10
3/12/2013 7:20
3/12/2013 7:30
3/12/2013 7:40
3/12/2013 7:50
3/12/2013 8:00
3/12/2013 8:10
3/12/2013 8:20
3/12/2013 8:30
3/12/2013 8:40
3/12/2013 8:50
AM Peak in 10 min. increments


Example I-94 Corridor Winter Sub-WIG
Maintain traffic speeds within 10 mph of normal speeds 80% of the time when a storm event impacts the AM peak.
Event % Compliance
Goal
Cumulative Value
Percent Compliance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
89%
100%
56%
17%
33%
78%
94%
89%
1
2
3
4
5
6
7
8
Event

MiScorecard Performance Summary

Business Unit: Transportation
Executive/Director Name: Kirk Steudle
Reporting Period: Apr 2014

Green	>90% of target
Yellow	>= 75% - 90% of target
Red	<75% of target

Date Approved: 5/22/2014
Revised By blaxtonv on 05/22/2014 12:44

Metric ID	Metric	Status	Progress	Target	Current	Previous	Frequency	Metric Definition
A Economic Growth								
1	Commercial vehicle traffic miles	Green		Maint/increase	5.81B 2012	5.74B	CY Annually	Maintain or increase the number of commercial traffic miles in billions traveled on Michigan roads.
B Safety								
7	Statewide crash fatality reduction	Red		-3.4%/yr	936 +5.29% 2012	889	CY Annually	Reduce crash fatalities from 889 in 2011 to 750 in 2016.
8	Statewide crash serious injury reduction	Red		-3.4%/yr	5,676 - .53% 2012	5,706	CY Annually	Reduce crash serious injuries from 5,706 in 2011 to 4,800 in 2016.
C Condition								
13a	Sufficiency surface condition	Yellow		90%	78.8% 2012	81.3%	CY Annually	Improve or sustain 90% of trunkline pavements in fair or better condition
E Mobility								
19	Deliver approved projects	Green	=	95%	92.2% 2012		CY Annually	Obligate 95% of projects approved for funding by the State Transportation Commission.
20	Manage traffic incidents timely	Green		75%	93.1% Dec 2013	93.7%	Monthly	75% or greater with less than 120 minute delay.
21	Peak Hour Winter Travel Speed	Green	=	80%	87.2% 11-2013 thru 3-2014		CY Annually	Maintain traffic speeds within 10 mph of normal speeds 80% of the time when a storm event impacts the morning peak.

9 - Categories & 32 – Metrics

- Economic Growth
- Safety
- Condition
- Accountability
- Mobility
- Customers
- Financial Health
- Environmental
- Employees

www.michigan.gov/mdot
"MDOT Performance"
"Transportation Scorecard"

Mobile Data

Vehicle Data Sources

SIGNAL	DAS or Smart Phone	OBD-Key	Surface Monitor
Position - GPS	X		
speed	X		
direction	X		
altitude	X		
distance	X		
vehicle dynamics (accelerometer)	X		
Roughness (accelerometer - vertical)	X		
photo	X		
VIN		X	
RPM		X	
Throttle Position		X	
Anti-lock Braking System (ABS)		X	
Traction Control		X	
Barometer		X	
Air temperature			X
Pavement temperature			X
Humidity			X
Dew point			X

Potential Applications

- Data quality checks (ground truth - RWIS stations, MDSS, third party speed data)
- Targeted individual messages (augments DMS & website)
- Provide travel times and incident updates
- Performance Measure/Management
- In-the-storm performance (how well are you managing the event)
- Maintenance Decision Support System
- Remote imaging and physical monitoring of environment (camera photos)
- Visibility monitoring (i.e.: snow squalls, localized lake effect white outs, fog, rain, etc.)
- Slippery surface notification (ABS lockup & differential wheel speed)
- Pin point icy road conditions (driver & maintenance staff)
- Early notification to First responders, Hospitals, Work place, Schools, Community events, etc.
- Regional and cross jurisdictional alerts (Great Lake Regional Transportation Operations Coalition ties into the Northwest Passage and other regional coalitions)
- Provide in-vehicle alerts
- Vehicle/device health monitoring (are devices installed on vehicles working?)
- Vehicle diagnostics (fleet monitoring and management (miles, hours, routine maintenance, etc.)

Lessons Learned

- Performance Measures w/o Performance Management does not achieve improved system performance
- Process requires full support from top management.
- Need automation to help manage the process. Can't let the process itself overrun other staff daily duties
- Are we measuring the right things? Choosing the right measure (and wording) takes time
- Tracking project performance 24-7 maintains staff focus on mobility and improves decision making toward operations
- Performance Measures - User Delay Cost provides accountability and helps justify Highway Systems Operations for legislators, transportation partners, and the motorists

THANK YOU!

MDOT
Michigan Department of Transportation