Automating Variable Speeds with Real Time Traffic and Weather

Presentation for 2014 TexITE Fall Meeting

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(co-authored by Jim Peters, PE, PTOE)
1. Project Background
2. Planning
3. Variable Speed System
4. Other Integrated Systems
5. Planned Variable Speed Systems
1. Project Background

2. Plan
Suburban freeway
2-3 lanes
7.52 miles
12 interchanges
122,000 ADT
<5% heavy vehicles
High crash frequency

Crash hotspots

200 crashes per year
70% rear-end crashes
Most during peak periods
Exceeds capacity during peak periods, near capacity throughout the day.
2. Planning

**Planned solution (2004)**
- More capacity: add lanes and braid ramps
- $1 billion for 7.5 miles

**Actual improvements implemented: 2004 to 2013**
- Added auxiliary lane (1 mile)

**ITS Solutions**
- Automatic enforcement per gantry today, with residual evasive Brakes
  - Variable advisory speed
  - Crash warning system
  - Queue warning system
  - Travel lane indication
  - Updated adaptive ramp metering
  - Total cost: 1% of $1 Billion

**Targeted safety improvements**
1. Decrease primary factors contributing to collisions
   - Fast lane change maneuvers
   - Panic braking
2. Reduce secondary collisions
3. Improve system reliability and allow the Highway to operate better

**New planning goals (Let's be realistic)**
1. Find a lower cost strategy to improve conditions now
2. Be consistent with the long-term corridor plan
Planned solution (2004)
More capacity: add lanes and braid ramps

$1 billion for 7.5 miles
Actual Improvements Implemented: 2004 to 2013

- Added auxiliary lane (1 mile)
New planning goals (Let's be realistic)

1) Find a lower cost strategy to improve conditions now.

2) Be consistent with the long-term corridor plan.
Targeted Safety Improvements

1) Decrease primary factors contributing to collisions:
   - last second avoidance maneuvers
   - panic braking

2) Reduce secondary collisions

3) Improve system reliability and allow the highway to operate better
ITS Solutions

Affordable improvements we can build today, with immediate traveler benefit:

- Variable advisory speeds
- Curve warning system
- Queue warning system
- Travel time information
- Updated adaptive ramp metering

Total cost: 1% of $1 Billion
3. Variable Speed System

Three subsystems choose the speeds

- **Congestion Responsive Subsystem**
  - Uses fixed percentiles speeds calculated on demand, as low as 20 seconds.

- **Statewide Variable Speed System**
  - Uses real-time traffic and weather data for adaptive control.

- **Operator Control Subsystem**
  - Allows control and monitoring by operators.
Three subsystems choose the speeds

Statewide Variable Speed System

- Congestion Responsive Subsystem
  - Uses 85th percentile speeds calculated on intervals as low as 20 seconds

- Weather Responsive Subsystem
  - Uses grip factor, visibility, roadway condition, classification, and chain requirements

- Operator Control Subsystem
Congestion Responsive Subsystem

Uses 85th percentile speeds calculated on intervals as low as 20 seconds
Weather Responsive Subsystem

Uses grip factor, visibility, roadway condition, classification, and chain requirements
## Weather Responsive Speed Message Selection

<table>
<thead>
<tr>
<th>Visibility</th>
<th>Grip Factor</th>
<th>&gt; 0.70 (Dry to Wet)</th>
<th>0.70 &gt; X &gt; 0.30 (Very Wet)</th>
<th>&lt; 0.30 (Snow or Ice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 500'</td>
<td></td>
<td>Speed Limit</td>
<td>Speed Limit - 10 MPH</td>
<td>Speed Limit - 20 MPH</td>
</tr>
<tr>
<td>&lt; 500'</td>
<td></td>
<td>Speed Limit - 10 MPH</td>
<td>Speed Limit - 20 MPH</td>
<td>Minimum Speed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Visibility</th>
<th>Chain Condition</th>
<th>B or B1 (Towing or &gt; 10,000 lbs)</th>
<th>C (Chains Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 500'</td>
<td></td>
<td>45 MPH</td>
<td>35 MPH</td>
</tr>
<tr>
<td>&lt; 500'</td>
<td></td>
<td>35 MPH</td>
<td>Minimum Speed</td>
</tr>
</tbody>
</table>

* The lowest generated speed from the two tables is used
## Weather Responsive VMS Message Selection

<table>
<thead>
<tr>
<th>Weather VMS Message Lookup Table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grip Factor</strong></td>
</tr>
<tr>
<td><strong>Visibility</strong></td>
</tr>
<tr>
<td>Moist or Wet</td>
</tr>
<tr>
<td>&gt; 500'</td>
</tr>
<tr>
<td>Frosty, Snowy, Icy, or Slushy</td>
</tr>
<tr>
<td>Moist or Wet</td>
</tr>
<tr>
<td>&lt; 500'</td>
</tr>
<tr>
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</tr>
</tbody>
</table>

*Snow zone chain requirement messages for VMS will come from ATMS/TOCS*
Humans optional
all systems fully automated

Why?
- Only Engineers can alter traffic control devices
- Operators at ODOT's Traffic Management Center are not Engineers
- Engineers are not staffed 24/7

Benefits
- Reacts quickly to changing conditions
- Automated systems not easily distracted, and continue operating during high workloads
- Will not forget to turn off when no longer needed
Systems are fully automated but we can still control them

- ODOT Traffic Management Center Operators can disable systems
- Engineers can alter system decisions on the fly
  - Guidance has been developed for different scenarios and conditions
4. Other Integrated Systems

- Curve Warning
- Queue Warning
- Travel Times
- Adaptive Ramp Metering
Curve Warning
Queue Warning
Travel Times
Adaptive Ramp Metering
5. Planned Variable Speed Systems

Three Oregon Variable Speed Systems Are Active in 2014

More Variable Speed Systems Are Being Planned
Three Oregon Variable Speed Systems Are Active in 2014

- Staley's Junction
- OR 217 Active Traffic Management
- I-5/I-405 Active Traffic Incident Management
ODOT RealTime signs give you up-to-the-minute traffic information and advisories so you can get where you’re going safely and efficiently. The video below shows how you can stay on top of traffic conditions in real time - without ever taking your eyes off the road.

**SEE THE SIGNS**

**KNOW THE LOCATIONS**

**FIND OUT MORE**