Where Utah is
Where Utah is going

Josh Van Jura
Overview of UDOT

- Centerline Miles by Type
  - 935 miles of Interstate
  - 2,945 miles of Level 1 (AADT>1,000)
  - 1,985 miles of Level 2 (AADT<1,000)
  - 5,865 miles total

- Speed Limits
  - 13% @ 80 mph
  - 35% @ 70 mph or higher
  - 60% @ 60 mph or higher
  - 82% @ 50 mph or higher
Project Goal

Goal: Improve safety within construction work zones through significant reduction in traveler speed within the boundary of Active Work Space.
Slower ≠ Safer

• Motorists:
  o Increase the time available for a motorist to react
  o Reduce stopping distances
  o Allow more significant (recoverable) evasive maneuvers

• Workers:
  o Greater time for workers to move out of the way
  o Reduce the likelihood of severe injury
Operating vs. Posted

Kloeden et al., 1997, 2002

West and Dunn 1971

Speed Harmonization!!!
PVSL Candidate Projects

• 4 lane divided / undivided roads
• High Speed (50mph +)
• Project with simple geometries
• Example
  o Resurfacing
  o Slab Replacement
  o Bridge Work
  o Maintenance Work
Regulatory Enforcement

- Work with Highway Patrol
- System logs speed changes & time of
- Document location of device
- Not tested in court to date
SMRT System

A Marginally Smart Work Zone

- We have done 12+ projects to date with PVSL
- No detection
- Field crew remotely changes speeds per TEO
- There is data collection
- Basically low or high
SMRT- Success Stories

US 40 Deck Replacement
- Original Posted Speed = 65 mph
- Reduced Speed = 45 mph
  - Single drop

Number of data points: 70343
Posted speed: 45
Average speed: 51.4
Percentiles: 85th 58
SMRT - Success Stories
• PVSL: Where we are going?
PVSL: Where we are going

- **PVSL System**
- **Portable, Intelligent and Dynamic**
- **Multiple Devices (PVSL, Detectors, PVMS)**
  - Integrated as one system
  - Dynamically posting speed limits, and
  - Traveler information messages
  - Operated by RE and Roadway Contractor (No TOC)
PVSL System: How we are getting there

• FHWA AID Grant
  o Awarded December 2014

• System Planning & Design
  o NTP June 2015
  o Kimley-Horn and avenue CONSULTANTS

• Turn-key Solution Provider
  o NTP May 2016
  o Ver-Mac and Interstate Barricades
PVSL System: Con Ops

Systems Engineering Process

- Con Ops Phase
  - Goals/Objectives/Performance Metrics
  - Operational Parameters and Limits
  - Stakeholder Roles and Responsibilities Matrix
  - Operational Scenarios
  - User and System Needs
Operational Scenarios

Scenario 1

Scenario 2

Scenario 3
PVSL System: RFP Development

- RFP Development
  - System Requirements
  - High-Level Design
  - System Algorithms

- Turn-key Solution Provider selection
VSL Subsystem Algorithm

VARIABLE SPEED LIMIT ZONE

Start with VSL SL = TEO Low

Calculate Average Speed

Average Speed < 35mph

VSL SL = 45mph

YES

Average Speed > TEO High

NO

Average Speed > (TEO High + 10mph)

VSL SL = TEO High

YES

Average Speed < (TEO Low + 10mph)

NO

VSL SL = TEO Low

VSL SL = Average Speed (rounded down to nearest 5mph) – 10mph

Average Speed < 35mph

YES

VSL SL = Last known VSL SL

NO

Vol < 8 veh/min Vol > 8 veh/min
PVSL System: System Procurement

Systems Engineering Process

- System Development
  - Submittal Reviews
  - Hardware Fabrication
  - Algorithm Refinement
  - Test Plan Development
System Components

- **Portable Variable Speed Limit Signs (PVSL)**
  - Trailer Mounted with variable speed digits
  - White LEDs on black background (Regulatory)

- **Portable Operator Control Device**
  - Cell Service Req’d

- **Speed Detection Trailers**
  - K-Band Doppler – ease of use
  - Trailer Mounted
PVSL Trailers
• Testing & Verification
  o Testbed Deployment
  o Pass/Fail Acceptance Testing
    - Hardware requirements met?
    - Software requirements met?
    - Integration/algorithms working?
## Software (Mobile)

<table>
<thead>
<tr>
<th>Queue</th>
<th>Warning</th>
<th>PVSL</th>
</tr>
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### JamLogic Mobile

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- **01 Q1 PVMS 01 #2360=1**: 13.25 V
- **01A Q1 Radar on PVMS 01 #2360=1**: 13.22 V
- **02 Q2 (Radar) #3565=2**: 13.97 V
- **03 Q3 (Radar) #3566=3**: 13.69 V
- **04 PVSL 01 #3259 =6**: 13.21 V
- **04A S1 on PVSL 01 (Radar) #3259=6**: 13.23 V

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**USE OF VSL IN CONSTRUCTION ZONES**

**L.D.O.T:** Keeping Utah Moving
System Alerts

FRM:jamlogic@jamlogic.com
SUBJ: New Speed Recommendation
MSG: Speed on PVLS2 should be 55
08/17/2016 08:25:42 PM

1 of 3
FRM:jamlogic@jamlogic.com
SUBJ: UT - PVSL QWS SWZ (2016-2017) - 01A Q1 R
Path: 10-SWZ - (Con't 2 of 3)
UT - PVSL QWS SWZ
(2016-2017)
2016-08-04 WZ NB I-15

Device: 01A Q1 Radar on PVMS O1 #2360=1

Alarm: No speed received
Status: In
(Con't 1) 3 of 3
Alarm
Since: 8/16/2016 2:34:07 AM

(End)
Project 1 Preliminary Results

Radar Speed (MPH)
Spot Speed Study

- Same timeframe
- 99% C.I.
- +/- 2mph

- AVG = 45.7 mph
- 85th% = 52 mph
PVSL System: Next Steps

- System Validation
  - Year 1 Project 1 deployment
    - Baseline data collection
  - Full system deployment data
  - Compute & compare with performance measurers
  - Lessons learned workshop

- Refine System Parameters
- Repeat Validation Steps 3 more deployments
Other Important Factors:

- Public Information:
  - Communicate impact and duration
  - 1.5 miles = 52 seconds
  - Real time messages

- Challenges
  - Getting the change made
  - Lag time (Camera)
Contact Information

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