# Evaluation of Work Zone ITS Deployments

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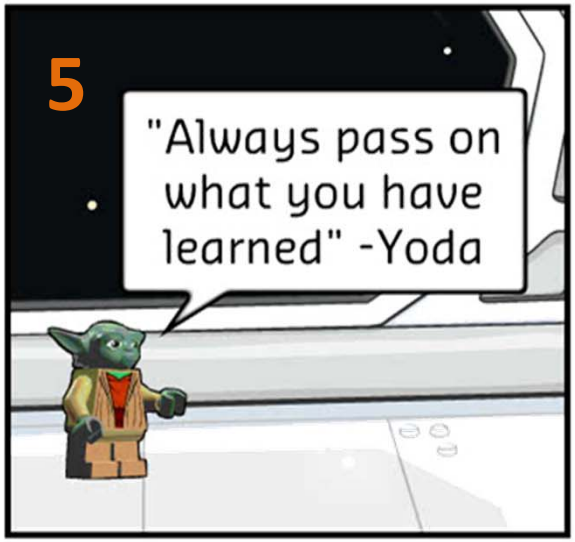
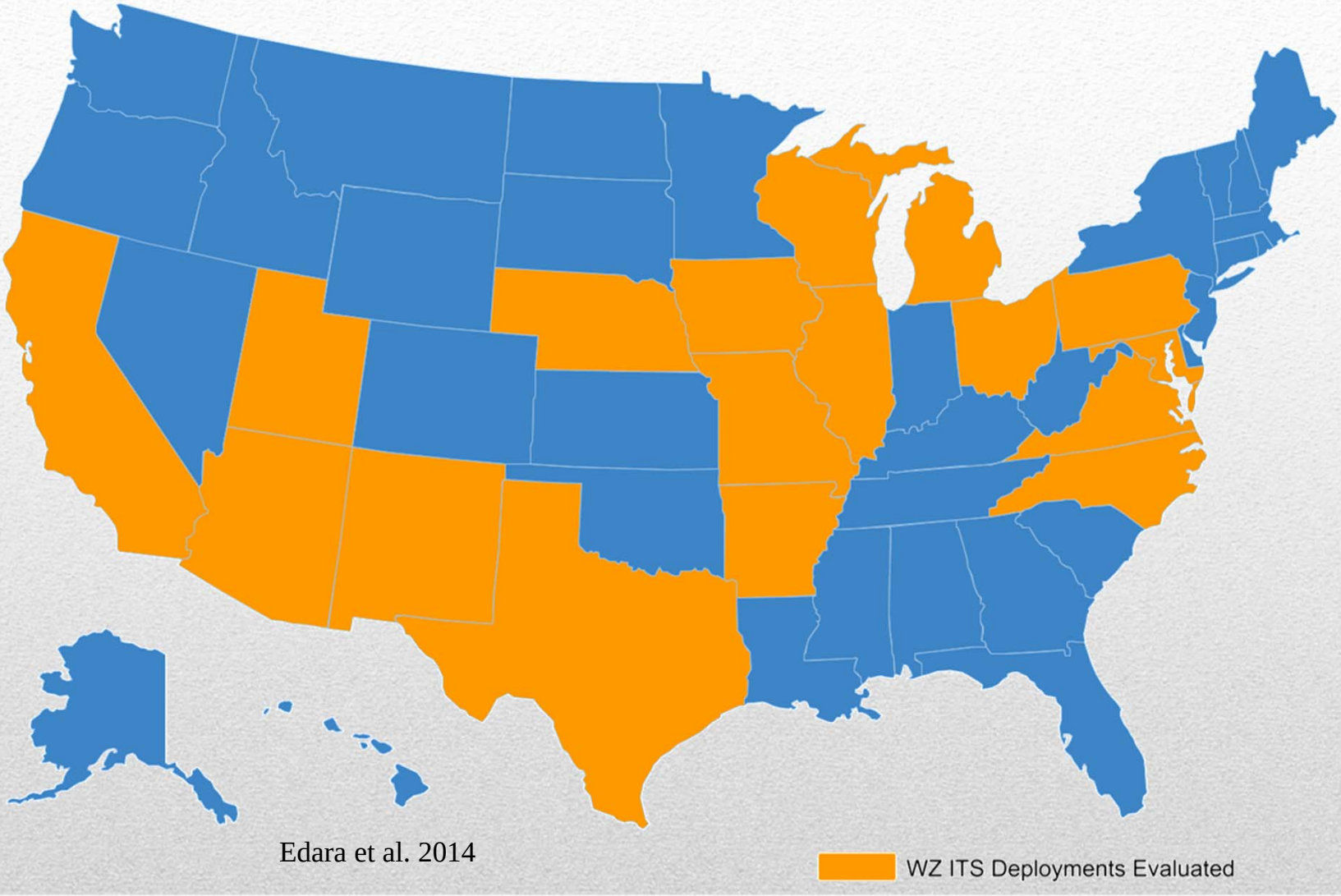
# Presentation Outline










Edara et al. 2014

# WZ ITS Evaluation Literature

| Work Zone ITS | Study Findings |
|---|---|
| Delay and alternate routes | 86.4 % diverted |
| | 5 to 9 % diverted. Travel time savings of ~ 4 minutes |
| | Up to 28 % diverted |
| | 4% diverted |
| | |
| Alternate routes | 8 to 10 % diverted |
| | |
| Delay and Travel time information | 5 to 10 % diverted |
| | |
| Queue information | Diversion rate doubled when queue exceeded 5 mi. |
| | |
| Travel times | 71.6 % diverted |
| | 8 to 10 % diverted |

# Past WZ ITS Deployments

| Work Zone ITS | Study Findings |
| --- | --- |
| Speed advisory | 66 % of drivers slowed down with overall speed reduction of 7 mph near work activity area. Speed variance also decreased. |
| Travel times | Crash rates declined and number of citations for moving violations also declined. |
| Queue information | Fatal crash rate was 50% lower than at control sites |
| Dynamic lane merge | Significant reduction in number of forced merges and dangerous merges |

# Past WZ ITS Deployments

# Site Characteristics

- Congestion is frequent at the location
- Work zone results in high delays or crashes
- Alternative routes are available
- Demand is frequently at or above road capacity

**Performance measures selection**

Operational measures
-Delay, Diversion, Queue length, Energy consumption, Emissions

Safety measures
-Crashes, Speed-based measures

**Data collection**

Traffic sensors
CCTV feeds
Probe data
Surveys
Crash database
Energy consumption
Emissions data

**Benefit-cost analysis**

Quantify benefits
- Reduction in delay, crash, emissions, energy
- Simulation or analytical methods
- AASHTO Red book guidance

Quantify costs
- Equipment, setup, operation, removal
- Unit cost estimates when project costs not available

# Evaluation Framework

# Missouri Case Studies

- I-70 Blanchette Bridge Work Zone
  - Permanent Dynamic Message Signs
  - Traveler information and divert traffic to alternate routes
- I-44 Antire Road Work Zone
  - Permanent + Portable DMS, Bluetooth, Queue Warning
  - Traveler information and queue warning (safety)


# Case Study Locations

- $63 million rehab. of a 54-year old bridge
- AADT ~121,000, ~12% trucks
- WB bridge over Missouri river closed for a year
- Lane reduction from 5 lanes to 3 lanes in both directions
- Two designated alternate routes – Rt. 364, Rt. 370
- Gateway Guide TMC

# I-70 Blanchette Bridge WZ


# I-70 Blanchette Bridge WZ

# Evaluation of I-70 WZ ITS

- Diversion rates
  - Traffic counts for mainline from permanent sensors
  - Ramp counts using portable sensors
- Diversion rate attributable to DMS
  - ITS was always on during work zone (no “Without ITS” data)
  - Traveler surveys
- Delay reduction benefits
  - Simulation model to simulate traffic flows

| | Time | Before WZ, Day 1 (10/24/12) | During WZ, Day 2 (11/7/12) | Diversion |
|---|---|---|---|---|
| EB I-70 to EB I-370 | AM peak, 7-9am | 30.6% | 36.1% | +5.5% |
| EB I-70 to NB Rte 94 | | 7.7% | 10.0% | +2.3% |
| EB I-70 to SB Rte 94 | | 3.5% | 4.9% | +1.4% |
| WB I-70 to NB Earth City Expy | Off-peak, 1-2pm | 11.9% | 13.8% | +1.9% |
| WB I-70 to NB I-270 | PM peak, 4-6pm | 9.2% | 11.9% | +2.7% |
| WB I-70 to SB I-270 | | 22.2% | 28.7% | +6.5% |
| NB I-270 to WB I-370 | | 19.8% | 24.5% | +4.7% |
| NB I-270 to Missouri Bottom Rd | | 5.0% | 5.1% | +0.1% |
| SB I-270 to WB Rte 364 | | 17.7% | 21.9% | +4.2% |

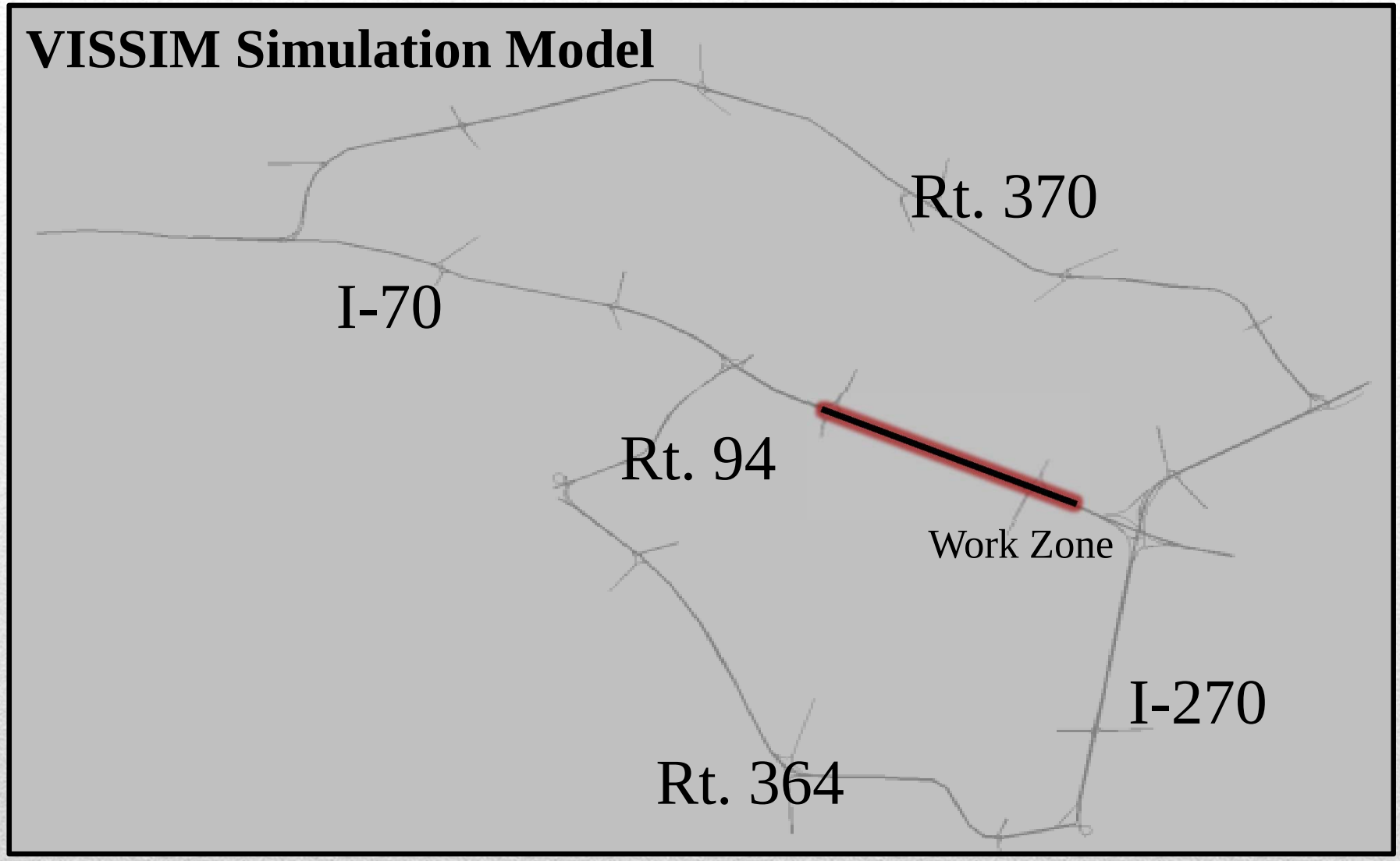
# Traffic Diversion Rates

# Traveler Survey

- 19-question web-based survey
- Questions focused on:
  - Commuter route choice before and during closure
  - Traveler information sources
  - Perceived delay
  - Value of travel time/incident messages on DMS
- Disseminated via MoDOT social media, newsletters, email
- 496 respondents in one month

- Two questions cross-referenced to find:

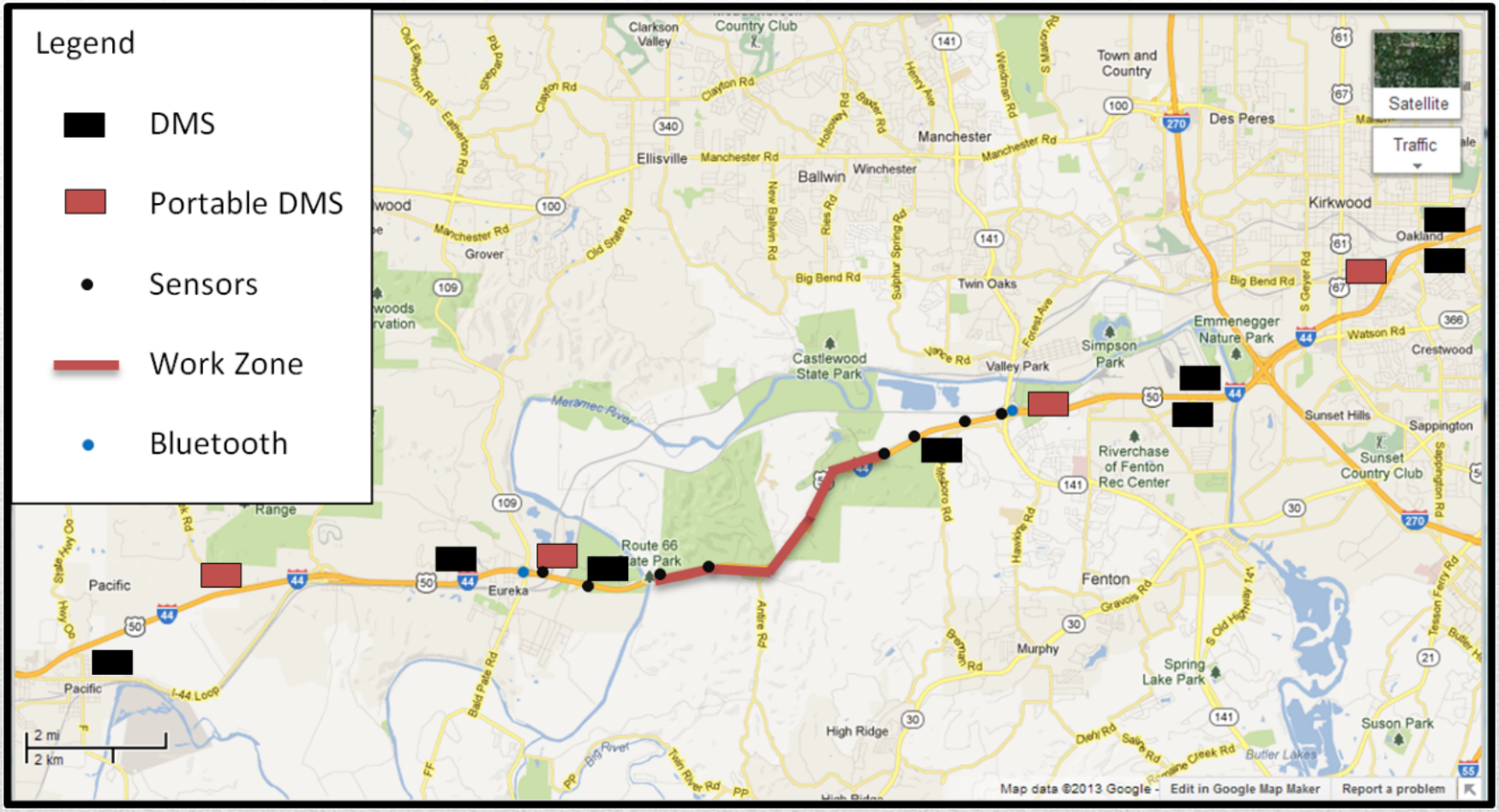
***"What percent of drivers that diverted to an alternate route did that due to ITS?"***




# Assessing Delay Reduction

- Road resurfacing for 140 days
- AADT ~69,000, ~12% trucks
- No alternate routes due to rural setting
- Lane reduction
  - 3 lanes to 2 lanes in both directions
  - Exception: 3pm to 7pm all 3 lanes available for WB

# I-44 Antire Road WZ




# I-44 Antire Road WZ

# Evaluation of I-44 WZ ITS

- Reduction in crashes
  - Crash data from MoDOT database
  - Again, “Without ITS” data not available
  - One study showed a 13.8% reduction in queue related crashes due to WZ ITS
- Crash reduction benefits
  - Benefits quantified using AASHTO Redbook values

- Total costs include: cost of equipment, cost of operation, and cost of set up
- Total benefits include: delay reduction benefits and crash reduction benefits.

| Case Study | Benefits | Costs | B/C Ratio |
|---|---|---|---|
| I-70 | $407,694 | $198,530 | 2.1:1 |
| I-44 | $345,900 | $106,700 | 3.2:1 |

# Benefit-Cost Analysis

# Lessons Learned

- Performance “without ITS” is required to quantify WZ ITS benefits
  - Has been the missing component or less accurate part
- Obtaining “without ITS” data
  - Control site (s)
  - Not use ITS for a few days when WZ is active
  - Traveler surveys

# Challenges and Opportunities

- Evaluations are data intensive
  - Private sector data to supplement other data
- Emissions and fuel consumption data challenges
- Evaluation tools, information accessible to practitioners
  - Unit costs, rates, parameters, etc
- How to leverage and evaluate newer ITS technology to improve WZ operations and safety?
  - Connected Vehicle Technology
  - Autonomous Vehicles

# Summary

- Synthesis of past WZ ITS deployments
  - Collectively, what does existing research tell us about effectiveness of WZ ITS
- A framework for future WZ ITS evaluations
- Case studies illustrating framework use
- Lessons learned and future opportunities

# Acknowledgments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  - Dan Smith, , Jon Nelson, Linda Wilson, Tom Blair, Gateway Guide Staff, Ryan Pierce
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- Mid-America Transportation Center

# Final Report and Other Resources

- Edara, P., Sun, C., Robertson, A. *Effectiveness of Work Zone Intelligent Transportation Systems*. Smart Work Zone Deployment Initiative. Final Report. InTrans Project 06-277. December 2013. http://publications.iowa.gov/15989/1/IADOT_InTrans_TPF-5(081)_work-zone_ITS_effectiveness.pdf

- FHWA WZ Mobility and Safety Program
  - ITS and Technology - http://www.ops.fhwa.dot.gov/Wz/its/index.htm#its

- The National WZ Safety Information Clearinghouse

http://wzsafety.tamu.edu/