Smarter Work Zones Webinar Series

Webinar #2: Implementing Technology Application Solutions

Todd Peterson and Gerald (Jerry) Ullman

September 29, 2015
1:00-2:30pm EDT

Efficiency through technology and collaboration

innovation ingenuity imagination invention
Every Day Counts

U.S. Department of Transportation
Federal Highway Administration

Smarter Work Zones

Introduction and Today's Speakers

Today's Speakers

Todd Peterson, P.E., PTOE
Transportation Specialist
FHWA Office of Operations

Gerald (Jerry) Ullman, Ph.D., P.E.
Senior Research Engineer
Texas A&M Transportation Institute

Smarter Work Zones Webinar Series

- This is the second in a series of bi-weekly SWZ webinars
- Topics based on **what matters most to you!**
- Webinars include:
  - Previously Recorded:
    - Webinar #1: A Comprehensive Overview of the SWZ Initiative (9/9/2015)
      - https://www.workzonesafety.org/swz/webinar1
  - Coming Up:

October	10/15	Webinar #3: SWZ Corridor-Based Coordination
	10/26	Webinar #4: TA Technology Showcase: Queue Warning Systems
November	11/2	Webinar #5: SWZ Program-Based Coordination
	11/12	Webinar #6: TA Case Studies: VSL and Dynamic Merge
December	12/2	Webinar #7: Work Zone Project Coordination Guide and Examples
	12/15	Webinar #8: TA/PC Showcase: Corridor Traffic Management

For additional information go to:
https://www.workzonesafety.org/SWZ/main

Purpose of Today's Webinar

Provide a comprehensive overview of the Work Zone Intelligent Transportation Systems (ITS) Implementation Guide and associated case studies as they relate to the SWZ initiative.

Topics include:

1. SWZ Technology Application Initiative
   - Show how the SWZ Technology Application initiative can be used by agencies to enhance their current work zone management practices
2. Work Zone ITS Implementation Guide
   - Explain the systematic approach to implementing work zone ITS via the 6-step Work Zone ITS Implementation process
3. SWZ Case Studies
   - Provide real-world examples of Work Zone ITS implementation via the 6-step process and the associated benefits

Smarter Work Zones

TECHNOLOGY APPLICATION INITIATIVE

What are Smarter Work Zones (SWZ)?

Innovative strategies designed to optimize work zone safety and mobility

- Policies and practices used to incrementally and continuously improve WZ operations
- Tools to reduce WZ crashes and delays
- Tools to enhance WZ management strategies

Two Identified SWZ Initiatives:

Project Coordination

Coordination within a single project and/or among multiple projects within a corridor, network, or region, and possibly across agency jurisdictions

Technology Application

Deployment of Intelligent Transportation Systems (ITS) for dynamic management of work zone traffic impacts, such as queue and speed management

Today's Focus of Discussion

Technology Application – What is it?

Deployment of ITS for dynamic management of work zone traffic impacts, such as queue and speed management to **provide actionable information** to drivers and traffic managers.

Capabilities include:

- Improving driver awareness
- Providing dynamic and actionable guidance to drivers
- Enhancing tools for on-site traffic management

Source: FHWA

SWZ Technology Application Goals:

Goal 1A

By December 2016, 35 State DOTs have implemented business processes for work zone ITS technologies as identified in the Work Zone ITS Implementation Guide

- **What does this mean?**
  - Well-documented agency policies and processes to streamline consideration and use of work zone ITS technologies to minimize traffic impacts

SWZ Technology Application Goals:

Goal 1B

By December 2016, 35 State DOTs have utilized at least one work zone ITS technology application for dynamic management of work zone impacts

- **What does this mean?**
  - Consideration of the six step process explained in the WZ ITS implementation guide to plan and implement ITS strategies
  - Identify and use ITS strategies such as speed and/or queue management on at least one project for dynamic management of work zone impacts

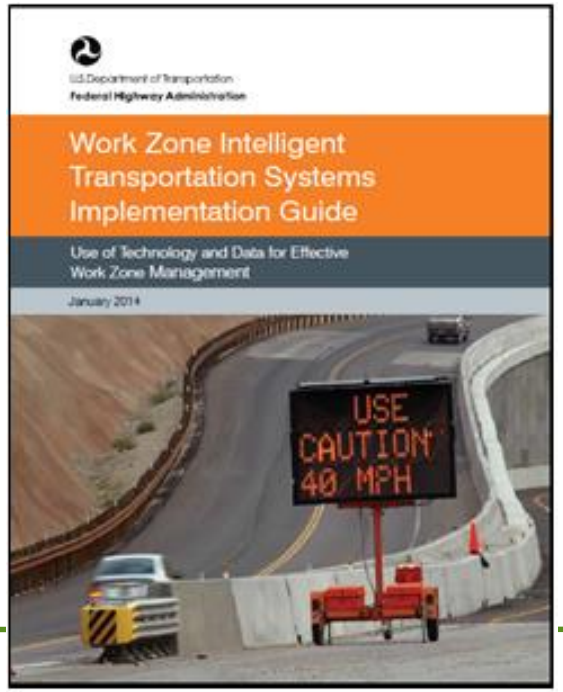
Smarter Work Zones

Work Zone ITS Implementation Guide

Focus of the Guide

- Provide guidance on implementing ITS in work zones to assist public agencies, design and construction firms, and industry stakeholders

- Presented through a 6-Step Systems Engineering Approach to WZ ITS implementation



http://ops.fhwa.dot.gov/publications/fhwahop14008/index.htm

Work Zone ITS Implementation Guide Steps

Assessment of Needs

Concept Development & Feasibility

Detailed System Planning & Design

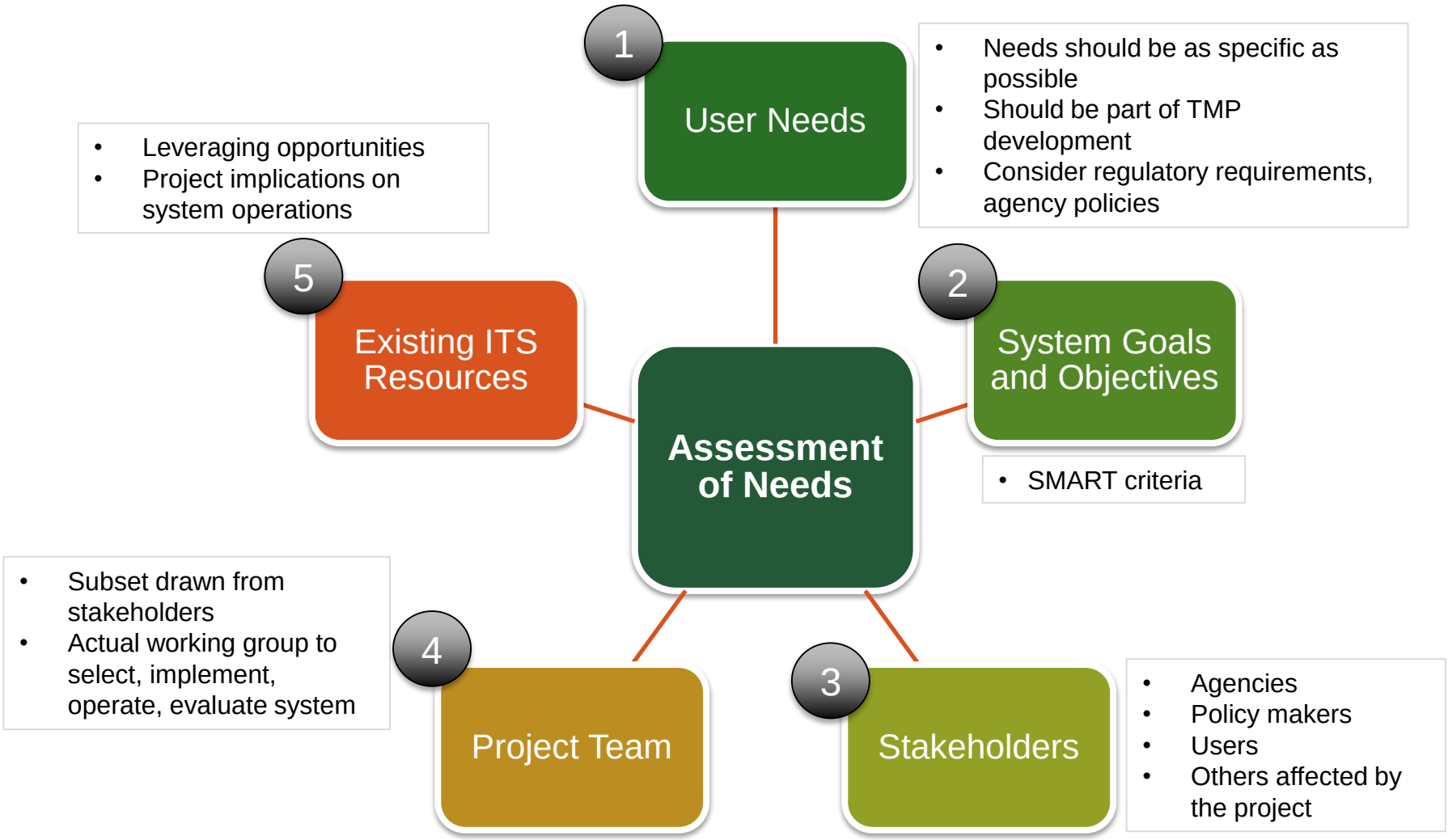
Procurement

System Deployment

System Operation, Maintenance, and Evaluation

Applies to any WZ ITS deployment regardless of scale

Step 1. Needs Assessment Considerations



Step 1: Key Takeaways

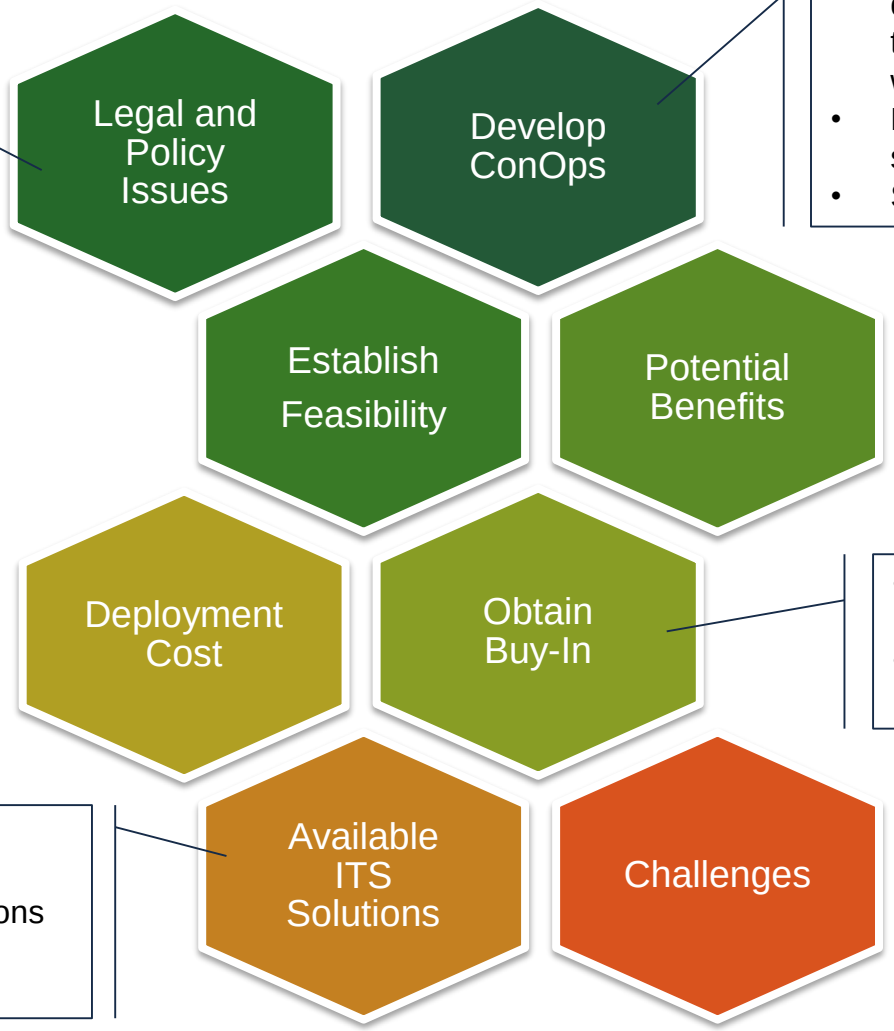
- Plan with the end in mind
- Use a coordinated approach – consider issues in the context of impacts assessment and TMP development
- Stakeholders and project team have been identified

Step 1 Outcome

- Preliminary framework of user needs, goals and objectives, and existing ITS resources

Step 2. Considerations for Concept Development and Feasibility

- Is the system permitted in the current laws and regulations?
- What is the potential increased liability for placing ITS equipment in the work zone?
- What are possible liability issues regarding how warnings and messages are given?



- Answers the question - "How does the agency envision that the system will operate within WZ?"
- May include multiple sub-systems
- Solution-agnostic

- Peer-to-peer contact
  Cross-training
- "What's in it for me?"

Three main categories of ITS
- Stand-alone, COTS
- Customized WZ ITS solutions
- Services or data only (no equipment)

Examples of Benefits for Various WZ ITS

Work Zone ITS	Issue(s) being Addressed	States with Studies of Example Deployments[1]	Example of Benefits
Real-time Traveler Information	• Congestion • Delay • Safety	CA, DC, NE, OR	16-19% reduced traffic volumes (diversion) on affected route (CA)
Queue Warning	• Safety (crashes)	IL	Significantly reduced speed variance; reduced vehicle conflicts; queuing crashes reduced 14% despite an increase in both lane closures and vehicle exposure.
Dynamic Lane Merge (early merge, late merge)	• Delay • Aggressive driving behavior • Travel speed • Safety • Queue length	FL, MI, MN	Reduced forced and dangerous merges by factors of 7 and 3, respectively (MI)
Incident Management	• Incident clearance time • Delay	NM	Reduced average time to respond and clear incident from 45 minutes to 25 minutes (NM)
Variable Speed Limits (VSL)	• Speed management • Safety	VA, UT	Greater speed compliance vs. static signs; reduced average speed and variation (UT)
Automated Enforcement	• Speed management	MD, IA, IL, OR	Significantly reduced speeds by 3-8 mph (IL)
Entering/Exiting Vehicle Notification	• Safety	MN, PA	Signs warn drivers of a slow-moving construction or emergency vehicle entering or exiting the roadway to reduce crash risk.

Step 2: Key Takeaways

- Engage ITS staff as a source of expertise
- Achieving a broad level of consensus in this step is a prerequisite to moving to Step 3
- Presenting results of Step 2 to stakeholders is essential

Step 2 Outcome

- Concept of Operations Report

Step 3: Detailed System Planning and Design

Develop system requirements and specifications, develop performance measures for the system objectives, and prepare plans for deployment and subsequent operations and maintenance.

Steps include:

- Determining system requirements and specifications
- Developing the system design
- Developing a testing strategy
- Planning for operations and maintenance
- Determining staff training needs for those using and operating the WZ ITS
- Planning for public outreach
- Investigating system security
- Planning for evaluation
- Estimating system benefits and costs

System Requirements

- Effective requirements define performance requirements and targets rather than design features
- Requirements should link to a user need
- Requirements should be verifiable and monitored for compliance

Planning for Evaluation

The primary purpose of evaluation is to:

- Identify changes needed to optimize operation and improve performance
- Understand and quantify benefits of the system
- Document lessons learned

Example Evaluation Criteria

Evaluation Objective	Hypothesis	Measures of Effectiveness	Required Data
Mobility – Reduce delay and optimize travel times through the construction corridor by providing advanced traveler information**.**	The ITS will reduce travel time through the corridor during construction.	• Change in travel time over baseline conditions in the primary direction during construction. • Change in the overall corridor-wide travel time reliability • Change in travel time on recommended or viable alternate routes	• Observed corridor travel time during construction • Observed travel time variability • Observed alternate route travel times during construction • Observed queue lengths before and after ITS on mainline routes
Safety – Improve traveler safety in the construction corridor	The ITS implementation will reduce crash risks during construction.	• Changes in the number of crashes or crash severity occurring in the corridor • Changes in speed variability along the corridor during construction • Change in the number of conflicts that occur in the corridor during construction	• Historical crash data • Real-time crash data • Observed speed variability during construction • Observed number of conflict situations occurring during construction
Customer Satisfaction – Improve travel satisfaction for corridor users during construction	The ITS will result in improved satisfaction among corridor users.	• Corridor traveler perceptions • Corridor traveler behavioral response to system components • Update frequency and perceived accuracy of provided information	• Opinions of corridor travelers serving on a panel survey • Traffic volumes on alternate routes and mainline • Wide distribution of customer satisfaction surveys
Institutional – Improve coordination among implementing agencies.	The ITS will result in improved coordination among implementing agencies.	• Number of institutional issues	• Documented institutional issues

Step 3: Key Takeaways

- Documentation should include plans for system testing, operation, staffing, public outreach, security, and evaluation throughout duration
- Must plan for each of these aspects to avoid issues with system deployment and ensure data will be available for system evaluation
- Most effective evaluations occur when the goals and objectives are explicitly stated, measurable, and agreed to by all stakeholders

Step 3 Outcome

- Detailed Systems Plan (built off of ConOps)

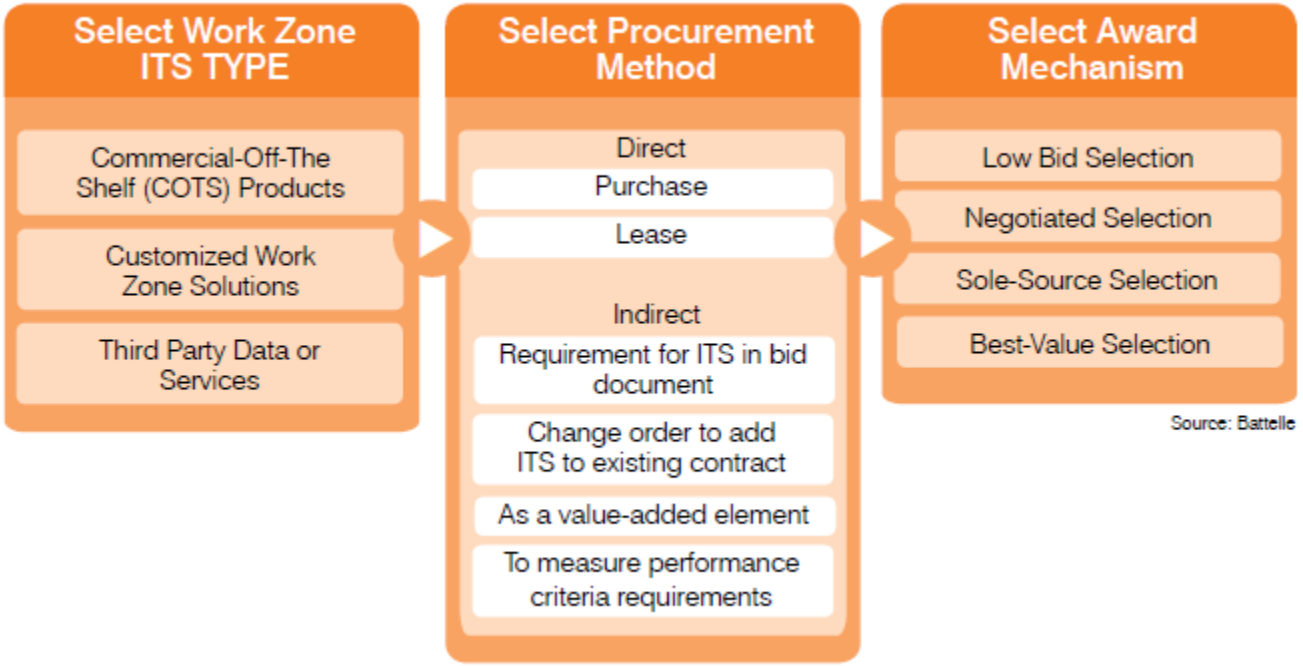
Step 4: Procurement

Procure the work zone ITS by first considering a number of options, based on the type of deployment being procured.

Steps include:

- Assessing procurement options
- Deciding direct or indirect procurement
- Determining the procurement award mechanism
- Issuing a request for proposals
- Selecting the preferred vendor, consultant, or contractor

Procurement Approaches



- Procurement options depend on the characteristics of the ITS
- Traditionally, WZ ITS procurement has primarily been for COTS or customized ITS solutions
- Potential now exists for agencies and contractors to purchase data collected by private-sector data providers for similar purposes

Step 4: Key Takeaways

- In procuring work zone ITS, there are three different perspectives:
  - Contracting agency that desires work zone ITS
  - Contractor responsible for the overall construction project
  - Vendor who supplies work zone ITS

Step 4 Outcome

- Procurement Type and Mechanism Determined
- RFP Issued
- Proposal Selected

Step 5. System Deployment

Implementing System Plans

Role of agency depends on
- System size and complexity
- Independent operation versus integrated into other ITS operations

Scheduling Decisions

- Plan for sufficient lead time to deploy
- Plan for sufficient calibration time and effort
- Expect the unexpected

System Acceptance Testing

- Conduct system acceptance testing before field activation
- Ensure all system requirements are met

Handing Deployment Issues

- Communications, power, and sensors
- Experienced/qualified contractor is beneficial
- Have frequent communication

Step 5: Key Takeaways

- Coordination of the deployment with other aspects of the project, including other TMP strategies, is important.
- Deployment of the ITS must be considered a process while it should follow the implementation plan it must be flexible to deal with:
  - Changes in overall work zone scope and scheduling
  - Unanticipated driver needs and responses
  - Wide range of field conditions and actions which could influence system operations

Step 5 Outcome

- System plans, schedule, and acceptance test plans completed
- Work Zone ITS deployed

Step 6: System Operation, Maintenance, and Evaluation

- This step covers system operation and maintenance and includes sections on:
  - Dealing with changing work zone conditions
  - Using and sharing ITS information
  - Maintaining adequate staffing
  - Modifying the strategy and plan based on operational results
  - Leveraging public support

Step 6: Key Takeaways

- Flexibility is important. Staff need to be available to make adjustments, as necessary, due to changing work zone conditions and findings from ongoing system monitoring and evaluation

- Final evaluation should be conducted to include findings from available data and detail benefits and lessons learned

Step 6 Outcome

- Work Zone ITS operational in field with appropriate staff operating and monitoring deployment as necessary

Smarter Work Zones

Work Zone ITS Implementation Examples

Real-World Work Zone ITS Examples

1. Callahan Tunnel Rehabilitation Project (Boston, MA)
   - Accelerated construction project resulting in full tunnel closure
   - December 2013 – March 2014

2. Reconstruction and Widening of I-57/I-64 Interchange (Mount Vernon, IL)
   - Interchange lane closures, reduced lane widths, and reduced shoulder widths
   - Multi-phase construction from 2011-2013

3. I-35 Widening (Central TX)
   - 96-mile expansion project to widen the highway from and change two-way frontage roads into one-way lanes
   - May 2013 – current

4. Bangerter Highway (SH 154) Improvement (Salt Lake City, UT)
   - Design-build contract to build three continuous flow intersections and one interchange
   - August 2011 – April 2012

Step 1 – Assessment of Needs

Project	Step Description
Callahan Tunnel Rehab	Key concerns: 1. Congestion 2. Safety 3. Management and Monitoring
I-57/I-64 Interchange	Key concerns: 1. Unpredictable queues leading to severe rear-end crashes 2. Lengthy delays when queues form (up to 3-4 miles)
I-35 Widening	Key concerns: 1. Queues during nighttime lane closures creating rear-end crashes 2. Lane closures and incidents creating localized delays 3. Multiple lane closures on same night creating large cumulative delays 4. Ramp, frontage road, and cross-street lane closures hindering access
Bangerter Highway	Key concerns: 1. Overall delays 2. Specific delays to turning and cross-street traffic

Step 2 – Concept Development and Feasibility

Project	Step Description
Callahan Tunnel Rehab	SWZ system concept of operations involved a self-monitored system to provide current travel information and information on alternate routes
I-57/I-64 Interchange	Developed Concept of a SWZ Traffic Monitoring System for: 1. Automatic detection of slow/queued traffic 2. Ability to warn approaching motorists of slow/queued traffic 3. Encourage diversion by informing motorists of current delays
I-35 Widening	Developed a construction traveler information system concept: 1. Direct travel time monitoring throughout the corridor 2. Dissemination of travel times en route and pre-trip 3. Collation of all lane, ramp, and cross-street closures for dissemination 4. Deployment of highly portable end-of-queue warning technology only when and where queues were expected
Bangerter Highway	Operational concept: 1. Directly measure travel times for specific origin-destination pairs through the project 2. Alert contractor/agency if delay thresholds exceeded

Step 3 – Detailed System Planning and Design

Project	Step Description
Callahan Tunnel Rehab	COTS Design: • Portable Cameras • Portable Camera/Message Sign combo units • Portable Changeable Message Signs (PCMS) • Probe Sensor Data
I-57/I-64 Interchange	COTS Design: • Radar-based traffic sensors on all interchange approaches • PCMS providing slow speed, delay, and diversion recommendation messages • Website portal for contractor and agency access (no public access)
I-35 Widening	Hybrid System Design: • Bluetooth technology to measure travel times in 5-10 mi segments • Volume sensors at critical locations • PCMS integrated with TxDOT Lonestar software to disseminate travel times • Email alert system for lane, ramp, cross-street closures • Public website providing all available traffic information in the corridor • Automated lane closure analyses to assess queue potential • Contractor-based COTS end-of-queue and portable rumble strip deployment where queues anticipated
Bangerter Highway	System Design: • Bluetooth technology to monitor various movements through project • Early warning of increased delays to contractor and agency.

Step 4 - Procurement

Project	Step Description
Callahan Tunnel Rehab	Jobs either bid as “Lump Sum” or have deployment cost and per month rental cost • Lump Sum: Cost procurement jobs range from $125K to $950K, with an average ~$400k • Monthly Rental: PCMS ($500-750), Queue Sensor Trailer ($400 - $700), Portable Camera Trailer ($1,000 - $3,000), System Ops ($2,500 - $3,500)
I-57/I-64 Interchange	Developed description and specifications for contract bid documents for a “turn-key” system involving COTS technology • Contractor responsible for identify the vendor they wanted to use • Contractors, in turn, conducted their own informal assessment of the systems available, and made a choice of system
I-35 Widening	Hybrid solution • Interagency agreement with university agency to develop and operate the overall system • Change ordered end-of-queue warning system deployment on initial contracts • Included end-of-queue requirements in subsequent contracts • End-of-queue bid as mobilization cost plus a per night deployment charge
Bangerter Highway	Direct purchase with on-call contract support for operations: • Bluetooth sensors purchased by department • Consultant provided installation, operation, and evaluation support

Steps 5 and 6 – System Deployment, Operation, Maintenance, and Evaluation

Project	Step Description
Callahan Tunnel Rehab	• SWZ system continuously evaluated traffic conditions along alternate routes and based on predefined thresholds, PCMS directed motorists to best route • MassDOT received very few negative comments • SWZ system managed public's expectations which allowed MassDOT to concentrate on addressing construction activities • Sharing access to the SWZ System allowed better network management and created a sense of partnership
I-57/I-64 Interchange	• Underestimated equipment needs, required a change order to increase system coverage • Activated messages 28 to 68 times per month for extended queues • Camera coverage was useful, but not necessarily essential, for successful system • Calibrated to slightly overestimate delays
I-35 Widening	• Equipment health status and operations monitored continuously • Periodic adjustments to equipment location occurs as construction progresses • Post-mortem assessments of traffic impacts are provided to TxDOT at regular intervals • Plan underway to transition to permanent ITS operations in corridor
Bangerter Highway	• System was a test of potential performance-based specification contracting for mobility impacts on design-build projects. • Some calibration challenges arose, but were resolved. System was deemed to provide valuable data and alerted agency and contractor if delays started to develop. • Contractor initially skeptical, but benefited from system when agency agreed to lengthen work windows

Smarter Work Zones

FHWA Resources

SWZ Interactive Toolkit Available!

https://www.workzonesafety.org/swz/main

Other FHWA Resources

- Work Zone ITS Implementation Guide
  http://www.ops.fhwa.dot.gov/publications/fhwahop14008/fhwahop14008.pdf

- Work Zone ITS Case Studies
  http://www.ops.fhwa.dot.gov/publications/fhwahop14007/

- FHWA Work Zone Mobility and Safety program website
  http://www.ops.fhwa.dot.gov/Wz/its/index.htm

- Work Zone ITS Overview Webinar
  http://www.ops.fhwa.dot.gov/wz/webinars/itsoverview013014/ullman/index.htm

Thanks for joining us!

- **Upcoming Events**
  - Webinar #3: Smarter Work Zones Corridor-Based Coordination
    - Thursday, October 15, 2015 Time: TBA
  - Webinar #4: Technology Application Showcase: Queue Warning Systems
    - Monday, October 26, 2015 Time: 1:00-2:30pm EDT
  - Regional Peer Exchanges

FHWA DFS Region	Location	Dates
Mid-America	Des Moines, Iowa	October 22-23
North	Springfield, Massachusetts	October 28-29
South	Raleigh, North Carolina	November 5-6
West	Denver, Colorado	Week of November 16th

  - Check The National Work Zone Safety Information Clearinghouse website for updates
    - https://www.workzonesafety.org/SWZ/main
- **Questions or Comments?**
  - Jawad Paracha (FHWA Operations, WZ Team)
    - Jawad.Paracha@dot.gov