Real-Time Monitoring with ITS in Work Zones / Developing Partnerships with Tech Companies

Work Zone Safety Conference
Springfield, VA

September 20, 2016
Overview of Presentation

1) Overview of Work Zone ITS
2) Why do we use ITS in the Work Zone?
3) Application of SWZ Technologies
   a) Explanation of systems
   b) Selling Use of Work Zone ITS
4) Steps of Work Flow Process
5) Use of the Real-Time Data
6) Next steps to improve data dissemination
7) Future with Connected Vehicles
What is Work Zone ITS?

- Portable combinations of ITS equipment designed for flexible deployment in work zone environments and used to monitor and report out on traffic operations (*Smart Work Zones*)

- SWZs typically consist of four components:
  - Detection and surveillance equipment
  - Central processing systems
  - Dissemination outlets (message boards, website)
  - Ancillary systems (power and communications)
Characteristics of Smart Work Zones

- **Real-Time:** The system obtains and analyzes traffic flow data in real-time in order to provide updated information to motorists on a frequent basis.

- **Portable:** The equipment is portable which allows for it to be deployed along the roadside as needed and can be adjusted as the construction project advances.

- **Automated:** The system operates in an automated manner to collect data and disseminate information with minimal interaction by human operators.

- **Reliable:** The system must provide accurate and reliable information to avoid misinforming motorists in work zones.
Smart Work Zone Design
Smart Work Zone ITS Equipment

- Portable Changeable Message Signs (PCMS)
- Portable Camera Trailers

- SWZ Operating System
- Speed Feedback Boards
- Radar/Doppler Sensors
- Bluetooth Sensors
- Probe Data
Why are we using SWZ’s?

- As part of FHWA’s “Work Zone Safety and Mobility” Rule DOTs are required to gather work zone traffic operations and safety data to monitor performance.

- SWZs are a tool that can be used as part of the Traffic Management Plan to provide real-time feedback to the DOT and the road user.

- Involves the dynamic management of work zone traffic impacts to improve motorist and worker safety and mitigate work zone-related congestion.
How does Work Zone ITS Help?

Historical Data vs Opportunity

Credibility
Benefits of Real-Time Data

- Ability to better inform motorists of traffic conditions and reduce their frustrations
- Encourage alternate route selection through informed travel time decisions
- Reduce lane-drop congestion to promote free flowing traffic merges
- Detect and clear incidents more quickly which helps to prevent/reduce secondary incidents
- Address speed limits to help make work zones safer for highway workers and motorists
Applications of SWZ Technology

- Dynamic Travel Time Systems
- Work Zone Delay Systems
- Back-of-Queue/Speed Reduction Warning Systems
- Dynamic Lane Merge Systems
  - Early Merge
  - Late Merge
- Variable Speed Limit Technologies
- Automated Work Zone Speed Enforcement
Dynamic Travel Time Systems

Tip: When providing travel time point-to-point, use current time to show last update.
Work Zone Delay Systems

In some cases, you cannot provide travel times between point-to-point locations, but you can offer the motorists details on the travel time through the work zone to provide them an opportunity to seek an alternate route.

Tip: Requires less detection equipment which brings cost of system down – but still provides Real-Time information.
Variable Speed Limit Systems

**Issue:** many states struggle with how to get motorists to reduce speeds through the work zone

- Need statutory authority to reduce limits
- Need to define time to when workers are present requiring reduction

**Solution:** Variable Speed Limit systems can be deployed to allow DOTs to dynamically reduce speed during active construction

**Tip:** When using VSL system, it is helpful to use beacons to signify there is active work
Back of Queue Warning System

- Used to alert motorists of slow or stopped traffic before they reach the back of queue
- Helps to prevent rear-end crashes before they happen

**Tip**: When using BOQ systems, it is recommended that you estimate the potential queue to determine sensor equipment needs.
Speed Reduction Warning System

- Utilizes similar algorithms as a Back-of-Queue system to alert motorists of travel speed reductions due to the presence of slow moving traffic ahead
- Helps to prevent unsafe lane changes or side-swipe/rear-end crashes

Tip: Speed Reduction System is better suited when volumes are lower and reduced speeds are likely
Dynamic Merge System: Early Merge

- Effective for longer passing zones and lower traffic volumes
- The early merge is intended to encourage aggressive drivers to merge into the open lane sooner than they would with traditional static lane closures

Tip: Works well for light, free-flowing traffic
Dynamic Merge System: Late Merge

- Effective for higher volumes of traffic where the demand exceeds the capacity of the open lane and there is the potential for extensive queuing
- Encourages all drivers to remain in their lanes until they reach the defined merge point

Tip: Works well for heavy, stop & go or slow moving traffic
Automated Enforcement

- Excessive speed, speed variability and driver distraction are major issues for work zone safety
- Use of law enforcement is one of the effective means at increasing speed limit compliance

Tip: Automated Enforcement helps to deter speeding when workers are present but also mitigate the lack of available details
Speed Feedback Signs

Tip: Flashers used only if workers present
How to sell Smart Work Zones

SWZs provide **Real-Time Traffic Management** and video coverage of the work area/key traffic decision points

**Mobility Applications**: capability to ensure an efficient flow of traffic through the work zone, minimizing the congestion through traffic diversion and providing travel/delay times

**Safety**: capability to minimize the number and severity of traffic-related incidents, injuries and fatalities, and asset damage in the work zone

**Planning and Monitoring**: capability to collect work zone data in order to develop performance reports, allocate enforcement patrols, refine guidance for allowable working hours, and evaluate throughput capacity
So who has experience with SWZs?

- Have not yet tried a SWZ system
- Some past experience / not currently using SWZ technology
- Tried SWZ system but had bad experience
- Actively using SWZ systems and successful
FHWA’s Work Flow Process

FHWA Work Zone Intelligent Transportation Systems Implementation Guide: Six-Step Process

**STEP 1**
Assessment of Needs

**STEP 2**
Concept Development and Feasibility

**STEP 3**
Detailed System Planning and Design

**STEP 4**
Procurement

**STEP 5**
System Deployment

**STEP 6**
System Operation, Maintenance, and Evaluation

Figure 4. Overview of the implementation process.

Source: Battelle
MassDOT’s SWZ 7-Step Process

Separate out the Operation and Maintenance of the SWZ System from the Evaluation of the data collected

- **Step 1**: Assessment of SWZ Needs
- **Step 2**: Planning SWZ Applications
- **Step 3**: Layout and Design SWZ
- **Step 4**: Define SWZ Specifications
- **Step 5**: Deploy, Calibrate and Test SWZ
- **Step 6**: Operate and Maintain SWZ
- **Step 7**: Evaluate SWZ Data
Step 1: Assessment of Need

- Evaluate need as part of the Transportation Management Plan (TMP) development
- Ensure that you have an end goal in mind
- Establish realistic project expectations
- Engage stakeholders early in the process
Step 2: Planning WZ Applications

**Key Points:**

- Investigate the possible SWZ technology applications available to mitigate the conditions of your project
- Identify any jurisdictional or institutional challenges that might limit the use of a SWZ and engage appropriate stakeholders
- Engage the vendors - they have the experience and legitimately want to help you develop the concept of operations and succeed
- Successful implementations help drive the desire for continued use of ITS technology in the work zone
Step 3: Layout and Design SWZ

- Layout Guidelines – Identify the following key locations:
  - Start and end points
  - Merge points for lane drop(s)
  - Approaches to project site
  - Upstream decision points
  - Stable points upstream and downstream of the bottleneck

- Locate required detection and surveillance equipment
- Add PCMS to disseminate messages at key locations

Tip: Engage SWZ Vendors
Step 4: Define SWZ Specifications

- Include detailed descriptions of the required equipment and expected functions
- Define expectations for system operations
- Document placement, calibration and testing expectations
- Define expected performance/deliverables

**Key Points:**

- Include detailed descriptions of the required equipment and expected functions
- Define expectations for system operations
- Document placement, calibration and testing expectations
- Define expected performance/deliverables
Step 5: Deploy, Calibrate & Test SWZ

Key Points:

- Safe deployment that follows the Roadside Design Guide (clear zone)
- Capture the GPS coordinates for equipment locations in the field for reporting
- All devices must be calibrated to field conditions
- Develop testing plan to execute the functionality of the system

Maintain Communication Flow

DOT

Contractor

Vendor
Step 6: Step 6: Operate & Maintain SWZ

Successful Implementation

Proactive Maintenance

Training & Support

Reliable Operation
Step 7: Evaluate SWZ Data

- On-going evaluation of operations to support construction work hours
- Ability to calculate work zone throughput capacity
- Work zone mobility performance measures
- Develop public-facing work zone dashboard
- Planning for future traffic management plans

Key Points:

Need a wrap up evaluation that identifies and documents key findings and lessons learned. Provides a valuable learning tool for future efforts.
What is the data good for?

Lane Speed Graph
What is the data good for?

The measured capacity for the 4-2 lane closure is close to the MassDOT standard of 1480 vphpl used to determine WZ capacity.

The 24-hour speed profile is helpful in identifying precipitous drops in speed that indicate where queuing exists at the sensor location.
So what is next?

- Need to continue spreading the word about the benefits of using ITS in the work zone to improve safety and mobility
- Foster peer-to-peer support to help guide state and local agencies with the preparation of a SWZ project plan
- Engage the industry partners for help improving information dissemination
- Collect data during project, evaluate and report out on the benefits
Improve Information Dissemination

- Work with Traffic Services to ensure that real-time data collected for Smart Work Zones is getting out for the public benefit
- The “Industry” needs to start the conversation as the use of probe data alone may not produce the most accurate results
- States can help start the process by requiring that SWZ data become publically available to the providers
Who has the most accurate data?

Garmin

TomTom

HERE

Google

INRIX

Waze
What does the future hold?

How can Smart Work Zones be leveraged to support Connected Vehicle Technology?

- Majority of SWZ devices utilize cellular modems to send data back to the CPU
- The communication medium could be updated to DSRC or other means such that the data could be sent directly back to the vehicle
- Providing information directly to the driver inside of the vehicle should be effective for improving safety & mobility
Key Takeaways…

- Make use of ITS in work zones part of your traffic management mitigation strategies
- Start planning your Concept of Operations early in project development
- Be sure to engage stakeholders to get them invested in the project and support the scope of work
- Set realistic expectations for the system operations
- Maintain flexibility as field conditions may differ significantly from what was expected during system planning and design
- Verify the quality of the information being disseminated to the public to build credibility
- Evaluate the data results post-project and document results
Thank you!

Contact Information:
Neil Boudreau, State Traffic Engineer
Phone: (857) 368-9655
Email: neil.boudreau@state.ma.us