EDC Exchange for Local and Tribal Agencies

Smarter Work Zones

June 23, 2016
2:00 – 3:45 PM EDT

Efficiency through technology and collaboration
## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Presenters</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00-2:20</td>
<td>Overview of the Smarter Work Zones (SWZ) Initiative</td>
<td>Work Zone Management Team</td>
</tr>
</tbody>
</table>
| 2:20-2:40  | Local Agency Example #1                                                | Murdo M. Nicolson, Jr.  
Associate Engineer  
City of Palo Alto, California |
| 2:40-3:00  | Local Agency Example #2                                                | Faisal Saleem  
ITS Branch Manager  
Maricopa County DoT, Arizona |
| 3:00-3:20  | Local Discussion:                                                      | Facilitated local discussions                                             |
|            | • Which of the SWZ strategies do you believe has the most potential for application in your area? |                                                                            |
|            | • What does it take to get started on an Implementation Plan?          |                                                                            |
|            | • What type of assistance do you need to move forward?                 |                                                                            |
| 3:20-3:40  | National Q&A Forum                                                     | Work Zone Management Team & Presenters                                    |
| 3:40-3:45  | Closing                                                                | Work Zone Management Team                                                 |
Overview of the Smarter Work Zones (SWZ) Initiative
SWZ Overview Speakers

Jawad Paracha, P.E., PTOE
Work Zone Program Manager
FHWA Office of Operations

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

Martha C. Kapitanov
Transportation Specialist
FHWA Office of Operations
EDC-3 Smarter Work Zone Initiative

Innovative strategies designed to optimize work zone safety and mobility

**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
**SWZ Project Coordination Goals**

**Goal 1**
By December 2016, 25 State DOTs have incorporated work zone project coordination strategies into agency documentation and business processes.

**Goal 2**
By December 2016, 5 State DOTs have volunteered to pilot the Work Zone Implementation Strategies Estimator (WISE) software.
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.

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.
Smarter Work Zones
Project Coordination
Project Coordination – What is it?

Coordination within a single project and/or among multiple projects within a corridor, network, or region, and possibly across agency jurisdictions to minimize work zone traffic impacts.

Benefits:

- **For transportation agencies include:**
  - Ability to reduce and manage traffic disruptions from road work
  - Earlier identification of project impacts
  - Dynamic adjustments to schedule
  - Improved communications within and cross agencies
  - Cost savings

- **From the driver’s perspective:**
  - Fewer numbers of work zones and street cuts
  - Better quality road surfaces
  - Increased customer satisfaction

Source: FHWA
Work Zone Project Coordination Guide


Steps for Achieving Project Coordination
1. Establish the PC Vision
2. Develop Details of How PC with Occur
3. Educate Personnel and Stakeholders
4. Implement the PC Process
5. Refine the Process

To learn more check out:
https://www.workzonesafety.org/swz/webinars/

Webinar #7: Work Zone Project Coordination Guide and Examples
Project Coordination Example #1
Software to coordinate right-of-way construction activities

Washington, DC: WZ Project Management System

- System includes:
  - DDOT, Developer, Utility WZ Projects
  - Work Zone Tracking Tool
  - Traffic Analysis Tool
- Used to develop annual citywide TMP
- Tracks performance measurement
- Assists in transportation demand management strategies

Source: DDOT
Project Coordination Example #2
Corridor-level TMPs to address traffic-related construction impacts

Michigan DOT I-94 Corridor
- Significant construction
- Three corridors identified
- Corridor-Level TMPs
  - Assess corridor traffic impacts
  - Define corridor/segment delay thresholds
  - Suggest traffic mgmt. strategies
  - Discuss implementation plan

Source: Michigan DOT
Project Coordination Example #3
Multi-agency construction traffic management activities

Washington State DOT

- Collaborative, multi-agency construction traffic planning effort
- Long-term, mid-term, and short-term information sharing
- Construction Impact Analysis Tool, Maps, Gantt Charts
- Hot Spots, Watch Lists

Source: WSDOT
Project Coordination Tool (1 of 2)
Work Zone Implementation Strategies Estimator (WISE)

• Developed under the SHRP2 R11 project

• Proactively reduces WZ impacts:
  o Effective project coordination upfront in planning/programming
  o Carrying coordination through to project planning/design decisions

• Made up of two modules:
  o Planning Module
  o Operation Module
Four organizations awarded grants to pilot the WISE tool:

- California – Assoc. of Monterey Bay Area Governments MPO
- Florida – MetroPlan Orlando MPO
- Maryland DOT
- Tennessee DOT

Tool and documentation available at
http://www.trb.org/Main/Blurbs/168143.aspx
Smarter Work Zones
Technology Application
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
# Example Work Zone ITS Applications

<table>
<thead>
<tr>
<th>Type</th>
<th>Queue Warning System</th>
<th>Dynamic Lane Merge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Signs provide warnings to drivers about stopped or slow traffic ahead</td>
<td>Signs encourage drivers to merge at a specified point based on current conditions</td>
</tr>
<tr>
<td><strong>Component</strong></td>
<td>Traffic data, CMS, and Communications</td>
<td>Traffic data, CMS, and Communications</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>I-35 Waco - TxDOT using to warn drivers of slowed or stopped traffic downstream</td>
<td>I-95 Florida – FDOT using to enhance safety and operations</td>
</tr>
</tbody>
</table>

For a full listing of examples see the WZ ITS Implementation Guide, Table 1 - [http://ops.fhwa.dot.gov/publications/fhwahop14008/fhwahop14008.pdf](http://ops.fhwa.dot.gov/publications/fhwahop14008/fhwahop14008.pdf)
Real-Time Traveler Information

• **Purpose:**
  - Encourages diversion away from the work zone when congestion exists

• **How it works:**
  - Provides drivers with current travel condition information prior to and within a work zone
  - May provide travel time information on alternative routes in the corridor
Queue Warning System

Zone of advanced work zone awareness provided by Queue Warning System

Warning Signs installed per TCP

Work Zone

Queue Detection Zone

DATA

Queue Warning Controller

DYNAMIC WARNING

PCMS

STOPPED TRAFFIC 2 MILES

Queue Warning System

Zone of advanced work zone awareness provided by Queue Warning System

Warning Signs installed per TCP

Work Zone

Queue Detection Zone

DATA

Queue Warning Controller

DYNAMIC WARNING

PCMS

STOPPED TRAFFIC 2 MILES
Dynamic Lane Merge

**Early Lane Merge:**

In low-volume conditions, reduces occurrence of high-speed merging at the point of lane closure.

Source: [https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging](https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging)

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**Late Lane Merge:**

In high-volume conditions, reduces the length of the queue.

Source: [https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging](https://www.workzonesafety.org/fhwa_wz_grant/atssa/atssa_dynamic_lane_merging)
Variable Speed Limits

• **Purpose:**
  - Reduces potential crashes as drivers approach back of queue
  - Reduces congestion and eases traffic through work zone depending on current conditions
  - Reduces travel time through uniformity in traffic speeds

• **How it works:**
  - Sensors, PCMS, and a processing system
  - Calculates speeds limits for PCMS based on measured speed and/or volume data
  - Provides safe speed limit through a work zone and minimizes braking as approach queue

**Considerations**

- Advisory versus Enforceable
  - Legislative Policy
  - Law Enforcement involvement
- Pre-determined vs. fully automated
  - Active work zone
  - Changing conditions

Source: Virginia DOT
Automated Enforcement

• **Purpose:**
  o Increases worker and motorist safety by reducing speeds in and around work zones

• **How it works:**
  o Detects vehicles traveling above determined speed threshold
  o Captures images (with date/time/location) of speeding vehicles to be used for enforcement purposes

workzonesafety.org
Step 1: Assessment of Needs
Step 2: Concept of Operations
Step 3: Detailed System Planning
Step 4: Procurement
Step 5: System Deployment
Step 6: System Ops, Maintenance, and Evaluation

To learn more check out https://www.workzonesafety.org/swz/webinars/:
- Webinar #2: SWZ and the Work Zone ITS Implementation Guide
- Webinar #10: Designing ITS Systems Based on Identified Needs (SWZ ITS Imp. Guide Steps 1-3)
- Webinar #13: Implementing Work Zone ITS Applications: Procurement
MassDOT’s SWZ 7-Step Process

- 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

Process developed using FHWA’s 6-step Work Zone ITS Implementation Guidelines
Step 2: Project Scoring Criteria

<table>
<thead>
<tr>
<th>MassDOT Project Location:</th>
<th>Project #</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Criteria – Existing Conditions</strong></td>
<td>N/A</td>
</tr>
<tr>
<td>• AM Peak Hour Congestion [ Yes - No ] (*if yes estimated duration)</td>
<td></td>
</tr>
<tr>
<td>• PM Peak Hour Congestion [ Yes - No ] (*if yes estimated duration)</td>
<td></td>
</tr>
<tr>
<td>• Congestion in both AM &amp; PM [ Yes - No ] (*if yes estimated duration)</td>
<td></td>
</tr>
<tr>
<td><strong>Factor 1 – Impacts on Roadway Geometry: Permanent Setup or Recurring Short Duration</strong></td>
<td>Score</td>
</tr>
<tr>
<td>• Maintain existing cross-section (0 points)</td>
<td></td>
</tr>
<tr>
<td>• Loss of full shoulder (1 point)</td>
<td></td>
</tr>
<tr>
<td>• Narrowed travel lanes (3 points)</td>
<td></td>
</tr>
<tr>
<td>• Loss of travel lane (6 points)</td>
<td></td>
</tr>
<tr>
<td>• Loss of multiple travel lanes (10 points)</td>
<td></td>
</tr>
</tbody>
</table>
Local Agency Example #1 – Project Coordination

CITY OF PALO ALTO WORK ZONE PROJECT COORDINATION
SWZ Project Coordination Speaker

Murdo M. Nicolson, Jr.
Project Manager
City of Palo Alto, California
City of Palo Alto – Project Coordination Tool

Palo Alto Background

- Located in Silicon Valley south of San Francisco
- ~66,000 residents with a daytime population of >100,000
- 198.4 miles of streets in 2,158 pavement sections
- Geographic Information System (GIS) based project coordination first used in 1996
GIS as the Authoritative Database (1 of 2)

• Started in 1987
• Based on high-resolution orthophotos tied to a survey network, this data used to be hand drawn for tracking changes
• Parcels entered using Coordinate Geometry (COGO)
• Encompass GIS is used to display, analyze, and edit
• Easy to configure
• See www.geodesy.net for more information
GIS as the Authoritative Database (2 of 2)

- 673 feature classes supporting 1,400 data layers with unlimited fields of data
- Utilities and Public Works Engineering and Operations, Planning, etc.
Goals

- Regional goal: have the best Pavement Condition Index (PCI)
- Local goal: PCI average of 85 with no section under 60 by 2019
- Minimize waste and reduce citizen inconvenience
- Avoid trenches in new pavement during a 5 year moratorium
- Palo Alto rates everything below 60 as POOR
Approach

• Survey and inspect city infrastructure, analyze, and prioritize maintenance via pavement management software (GIS and StreetSaver)

• Use Project Coordinator to find potential conflicts and hold monthly meetings to resolve them

• Toughen regulations: no trench fee if project is coordinated. Otherwise, charge higher fees to meet increased restoration standards

• Triple the funding through 2021

• Trench fees are based on existing PCI scores

• Coordinate during construction

Pavement Predators
Stakeholders

• Internal
  o Sidewalks (Public Works Engineering Department)
  o Storm Drain (Public Works Engineering Department)
  o Pavement (Public Works Engineering Department)
  o PW Ops (Public Works Operations Department)
  o Transport (Transportation/Planning Department)
  o Gas (Water, Gas, Wastewater Engineering Department)
  o Water (Water, Gas, Wastewater Engineering Department)
  o Wastewater (Water, Gas, Wastewater Engineering Department)
  o WGW Ops (Water, Gas, Wastewater Operations Department)
  o Electric (Electrical Engineering/Operations Department)
  o Parks/Open Spaces (Associated Services Department)

• External
  o Pacific Gas and Electric (PG&E)
  o Santa Clara County Roads Division
  o Caltrans (State of California highway, bridge, and rail)
  o Caltrain (commuter rail between San Francisco and San Mateo and Santa Clara counties.)
  o Private Tech Companies(Google: fiber optic to all homes)
Project Coordinator’s Foundational Concepts

• A pavement section is based on a single-block road centerline

• A project represents all the centerline segments acted on for a single discipline in a single year

• Data entry is kept as simple as possible

• A broad conflict definition: any work planned on a road centerline segment (a block) within a given number of years of a paving project is considered a potential conflict

• Data is stored in a Relational Database Management System (RDBMS) and Structured Query Language (SQL) is used for analysis

• Feature class definitions, user authorizations, and app capabilities are all metadata driven
Street Project Data Entry

• App configuration set at startup based on user: discipline and project year are set, optional start and end dates may be set

• Click on road centerline segments to add or remove them from the project
Street Project Review

- Check for potential conflicts
- 5-year Pavement Capital Improvement Projects (CIP)
- 5-year Pavement CIP with Utility projects
Street Project Review

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• 5-year Pavement Capital Improvement Projects (CIP)
• 5-year Pavement CIP with Utility projects
Street Project Review

• Check for potential conflicts
• 5-year Pavement Capital Improvement Projects (CIP)
• 5-year Pavement CIP with Utility projects
Street Project Data Model

• A single authoritative database is used to store all data
• Projects are stored in a single table and related to road centerlines in another table
• Every edit is logged and the changed records are stored in a history table
• User authorities are managed through sub-classed views
Other Internal Uses of Data for Coordination

- Pavement data
- Traffic signal loops vs 2015 overlay
Other Internal Uses of Data for Coordination

- Pavement data
- Traffic signal loops vs 2015 overlay
Coordination During Construction

Contract Special Provisions:

• Contractor shall coordinate his activities with the WGW Engineer, prior to beginning pavement work
• Contractor shall provide a weekly rolling 3-week look ahead schedules that are tied to the baseline schedule

I. These dates are entered into Project Coordinator for the web based map, and

II. For Contractors to coordinate their construction activities via the Engineers involved such that the pavement restoration appears to be seamless even though more than one CIP project is under way...i.e., paving immediately after trenching is complete on Utility projects
Citizen Involvement

- Web map of active street projects
- PaloAlto311
Citizen Involvement

- Web map of active street projects
- PaloAlto311
Project Coordination = Success

- Improved citizen’s quality of life
- All infrastructure is targeted, not just pavement
- Supports Targeted Work Zones
- Provides routine communications and buy-in between stakeholders
- Provides a working examples to neighboring cities
- Easy to get started: simple approach only needs road centerlines
About the Software

- The Encompass GIS suite, including Project Coordinator, is provided by Geodesy [www.geodesy.net](http://www.geodesy.net)

- StreetSaver is provided by Metropolitan Transportation Commission [www.streetsaveronline.com](http://www.streetsaveronline.com)

- PaloAlto311 was created by PublicStuff [www.publicstuff.com](http://www.publicstuff.com)
For More Information:

Murdo Nicolson, Jr.
Project Manager
City of Palo Alto, California
Murdo.Nicolson@CityofPaloAlto.org
Local Agency Example #2 – Technology Application

MCDOT SMART WORK ZONE CONCEPT
SWZ Technology Application Speaker

Faisal Saleem
ITS Branch Manager and Maricopa County
DOT SMARTDrive Program Manager
Maricopa County Dept. of Transportation
Maricopa County, Arizona

- Approximately 9,226 sq. miles
- 4th largest County in United States
- Greater in population than 24 States (about 4 million)
- County Seat: Phoenix
- 24 cities and towns
- 5 Indian Communities
Developing SWZ Vision

• MCDOT Director’s Commitment to Safety and Leadership in SWZ

• MCDOT’s Commitment to Every Day Counts (EDC)

• Serve as model in SWZ Innovation on Arterials
Arterial Challenges

- Lack of Speed Limit Compliance
- Access challenges (local businesses and residential areas)
- Intersections
- Obstructions of sidewalks, traffic lanes
- Treatments for trucks
- Vandalism
- Night time issues
MCDOT SWZ Concept Project

• **Smart Work Zone** – the use of intelligent transportation systems (ITS) technologies/devices and systems to improve the safety and efficiency of work zones for workers and travelers.
  - Improve collection and dissemination of information about conditions in the work zone.

• To be deployed as part of the MC-85 construction project
  - 107th Ave to 75th Ave in two phases
  - Concept will need to be applicable for other types of MCDOT work zones
Developing the Concept

1. Identify measureable SWZ GOAL(S)
2. Identify DATA that needs to be collected to measure progress towards the goals
3. Identify appropriate DEVICES that can collect the identified data
4. Identify additional DEVICES that are needed to support the goal(s)
5. Identify the device LAYOUT/CONFIGURATION within the work zone to support the data needs and goal(s)
Project Goals

• Improve speed limit compliance through the work zone
• Increase travel time reliability through the work zone
• Reduce queues resulting from the work zone
• Reduce crashes in the work zone
### Example: SWZ Goal Option 1

<table>
<thead>
<tr>
<th>SWZ Goal</th>
<th>Data to Collect</th>
<th>Devices for Data</th>
<th>Other Equipment</th>
</tr>
</thead>
</table>
| Improve speed limit compliance through work zone | Speed | Detector  
Radar | DMS  
Variable speed limit trailer  
Speed feedback sign |

![Traffic sign](image1.png)  
![Speed limit](image2.png)  
![Other equipment](image3.png)
Smart Work Zone Concepts

4 possible locations to put equipment:

1. In advance of work zone where people can still re-route
2. In advance of work zone with no detour
3. At beginning of work zone
4. Within the work zone
MCDOT SWZ Core Components

• After analyzing the necessary data, devices and device placement for each goal, a SWZ core concept was developed

• Core components are those that should be deployed at every work zone
  - Portable message sign(s)
  - CCTV camera(s)
  - Detectors
  - Speed feedback sign(s)
# Summary of Core SWZ Components

**LENGTH OF WORK ZONE**

<table>
<thead>
<tr>
<th>DISTANCE BETWEEN INFORM LOCATION AND WORK ZONE</th>
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</tr>
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<tbody>
<tr>
<td>&gt; 2 MILES</td>
<td>&lt; 1 MILE</td>
</tr>
<tr>
<td>INFORM - message sign, detector</td>
<td>INFORM - message sign, detector</td>
</tr>
<tr>
<td>ADVISE (multiple locations may be necessary) - message sign, detector</td>
<td>ADVISE - message sign, detector</td>
</tr>
<tr>
<td>WARN - CCTV, speed assignment, detector CHECK (may not be needed) - speed feedback, detector</td>
<td>WARN - CCTV, speed assignment, detector CHECK - CCTV, speed feedback, detector</td>
</tr>
<tr>
<td>ADDITIONAL INFORM (may not be needed) - message sign</td>
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<tr>
<td>&gt; 2 MILES</td>
<td>1-2 MILES (WITHOUT INTERSECTION IN WORK ZONE)</td>
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**Smart Work Zone Concept**

60
# Summary of Core SWZ Components

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<tr>
<td></td>
<td>WARN - CCTV, speed assignment, detector</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHECK (one per mile between intersections within work zone will be necessary) - message sign, CCTV, speed assignment and/or speed feedback, detector</td>
<td></td>
</tr>
<tr>
<td>&gt; 2 MILES</td>
<td>1-2 MILES (WITHOUT INTERSECTION IN WORK ZONE)</td>
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Core SWZ System Components
Core SWZ System Components
Operational Components

- MCDOT Smart Work Zone Equipment
  - Wireless Cellular Connection
  - Wireless Cellular Link (As Required)

- Web-Based WZ System

- Internet Connection

- MCDOT TMC
  - ADOT TOC or Local TMCs
    - Email, Phone, or Text Coordination (As Required)

- Public Information Office
  - PIO Coordination (As Required)

- MCDOT or Project Website
  - Updates on Conditions and Real-Time Information (As Required)

Smart Work Zone Concept
Next Steps

• Translate concept into requirements that will be included in a template for a construction contract

• Develop SWZ design for MC-85 Phase 1 application
For More Information

**Faisal Saleem**  
ITS Branch Manager & MCDOT SMARTDrive Program Manager  
Maricopa County Department of Transportation  
[faisal.saleem@maricopa.gov](mailto:faisal.saleem@maricopa.gov)
Local Discussion
National Q&A Forum
SWZ Resources
SWZ Interactive Toolkit

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

Source: FHWA
SWZ Webinar Series
https://www.workzonesafety.org/swz/webinars/

1. A Comprehensive Overview of the SWZ Initiative (Sep 9, 2015)
2. SWZ and the Work Zone ITS Implementation Guide (Sep 29, 2015)
3. SWZ Corridor-Based Project Coordination (Oct 15, 2015)
5. SWZ Program-Based Project Coordination (Nov 2, 2015)
6. SWZ Case Study: Variable Speed Limit and Dynamic Lane Merge (Nov 12, 2015)
7. Work Zone Project Coordination Guide and Examples (Dec 2, 2015)
8. Integrating Project Coordination & Technology Applications – Iowa DOT (Dec 15, 2015)
9. SWZ Performance Measurement & System Health Monitoring (Jan 21, 2016)
10. Designing ITS Systems Based on Identified Needs (ITS Guide Steps 1-3) (Feb 24, 2016)
11. SWZ Lane Closure and Permitting Systems (Mar 23, 2016)
12. Integrating Technology Applications – Massachusetts DOT (Apr 26, 2016)
13. Implementing Work Zone ITS Applications: Procurement (May 11, 2016)
14. Leveraging TMC Resources for Work Zone Management (June 16, 2016)

More coming soon!
Learning Opportunities

- In-Person Workshops
- Virtual Peer Exchanges
- In-Person Peer Exchanges
- Demonstration Site Visits

Free educational opportunities are available!

Contact Jawad Paracha for more information
jawad.paracha@dot.gov
Educational Materials

Project Coordination

Case Studies
• Michigan DOT Project Coordination on the I-94 Corridor
• Washington State DOT Regional Project Coordination
• DC DOT Integrated District-Wide Project Coordination Tool

Fact Sheets
• Importance of Stakeholder Engagement to Project Coordination Efforts

Technology Applications

Case Studies
• Massachusetts DOT Technology Applications on the Callahan Tunnel Project
• Iowa DOT Intelligent Work Zone Deployments
• Indiana DOT Use of Third-Party Data for Work Zone Management

Fact Sheets
• North Carolina DOT Collecting and Using Data from Manual Flagging Operations
• Indiana DOT Use of Archived Work Zone Data to Adjust Project Schedules for Reduced Costs and Improved Mobility

More coming soon!
# Project Coordination Resources

| **FHWA** | • FHWA Work Zone Management Program – Project Coordination  
• FHWA Work Zone Management Program – Peer-to-Peer Program  
• Guide to Project Coordination for Minimizing Work Zone Mobility Impacts  
| **TRB SHRP2** | • WISE Software Users Guide  
| **NCHRP** | • NCHRP Synthesis 413: Techniques for Effective Highway Construction Projects in Congested Urban Areas  
| **Others** | • Highway Construction Coordination to Minimize Traffic Impacts  
| **WSDOT Example Documents** | • Data Sharing Agreement between Washington State DOT and Seattle DOT  
• Washington State DOT Memorandum of Understanding – Construction Traffic Coordination and Mitigation  
## Technology Application Resources

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