Smarter Work Zones Webinar Series

Webinar #15: Work Zone Impacts and Strategies
Estimator (WISE) Software Pilot Sites

John Corbin, Subrat Mahapatra, Thomas Jacobs, Eric Hill, Bhupendra Patel, Paul Ricotta, Brad Freeze, and Sabya Mishra

October 11, 2016  1:00-2:30pm EDT

Efficiency through technology and collaboration

Every Day Counts
Smarter Work Zones

INTRODUCTION AND TODAY’S SPEAKERS
Today’s Speakers

John Corbin
SHRP2 Reliability Specialist, R11 Product Co-Lead
FHWA Resource Center

Subrat Mahapatra
Transportation Manager
Maryland SHA

Thomas Jacobs
Director, CATT
University of Maryland

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Director of Transportation System Management and Operations
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Director of Modeling
AMBAG

Paul Ricotta, P.E.
Principal Transportation Engineer
Caliper Corporation

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Traffic Operations Division, Director
Tennessee DOT

Sabya Mishra, Ph.D., P.E.
Assistant Professor
University of Memphis
Webinar Overview

• Work Zone Traffic Analysis
• SHRP2 Summary
• Origins of the WISE Tool
• Status of WISE Implementation

Source: Georgia DOT
How Travelers Experience Work Zones

Source: Washington State DOT

Source: Michigan DOT
The Work Zone Management Program Context

• Increasing number & impacts of work zones
• Need for corridor or network-level planning
• Work Zone Safety & Mobility Rule (2004)
• State-level work zone safety and mobility
  – Work Zone Delay Policy
  – Processes & Procedures
  – Work Zone Impacts Assessment & Management
    …Project-specific Work Zone Transportation Management Plans
• Transportation Management Planning
FHWA Work Zone Traffic Analysis Tools Guidance

- **Vol. VIII for Decision-Makers**
  - Guidance for engineers & reviewers
  - “Decision-Making Engine”
  - Selecting correct tools
- **Vol. IX for Analysts**
  - Guidance for analysts
  - Case studies
- **Vol. XII “Decision Framework”**
  - Maintenance of Traffic Alternatives Analysis (MOTAA)
  - Modeling tool selection framework
  - Model development and application process
  - Detailed case studies


Source: FHWA
Work Zone Management Decision-Making Engine

Scheduling Decisions

Application Decisions
(Construction Techniques)

TMP Decisions
(Traffic Accommodation)
Strategic Highway Research Program Focus Areas

**Safety**: fostering safer driving through analysis of driver, roadway, and vehicle factors in crashes, near crashes, and ordinary driving

**Reliability**: reducing congestion and creating more predictable travel times through better operations

**Capacity**: planning and designing a highway system that offers minimum disruption and meets the environmental and economic needs of the community

**Renewal**: rapid maintenance and repair of the deteriorating infrastructure using already-available resources, innovations, and technologies
The Seven Causes of Unreliability

The Reliability Focus Area research has attributed variability in travel time to seven primary causes:

1. Incidents
2. Weather
3. Work zones
4. Fluctuations in demand
5. Special events
6. Traffic devices (Signals)
7. Inadequate base capacity

Source: FHWA
Reliability Product “Bundles”

TSMO Organizational Capabilities

Advanced Operations Strategies

National TSMO Community

Reliability Analysis Tools (TSMO Decision Support)

Source: All images from Google
R11: Strategic Approaches at the Corridor and Network Levels to Minimize Disruption from the Renewal Process

- Multiple roadwork projects.
- How can they be coordinated to reduce the combined traffic impacts?
- What strategies can help?

Source: FHWA
WISE: Work Zone Impacts and Strategies Estimator Software

**Solution**

- A decision support system for use by planners and engineers.
- Helps them:
  - Evaluate traffic impacts of combinations of work zones
  - Identify best sequencing to manage impacts

**Benefits**

- Better coordinated and planned work zones.
- Reduced mobility, safety, and economic impacts of highway renewal activities.
- Increased public satisfaction.

Source: FHWA
WISE Implementation Plan

Implementation Plan Goals

1. Software enhancement & readiness
2. Software validation, demonstration, & application
3. Transportation community awareness & use
4. Institutionalization

R11 Implementation Assistance Opportunity

• Identify, assess, address software needs for refinements to address readiness
• Enable and expand software demonstration and application
• Build national work zone traffic analysis knowledge base
WISE SHRP Implementation Assistance Sites

Source: FHWA
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

**Smarter Work Zone Initiatives**

- Project Coordination
- Technology Applications
Project Coordination Definition and Goals

- 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

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 Impacts and Strategies Estimator (WISE) software.
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Smarter Work Zones
WISE Software Proof-of-Concept (R11) in Maryland

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Thomas Jacobs
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Today’s Agenda

• **Background - Maryland/ MATOC Work Zone Planning**

• **MD R11 Scope of Work & Status**

• **MD R11 WISE Testing Overview/ Next Steps**
Maryland Work Zone Planning Motivation

MDOT State Highway Administration (SHA) TSM&O Plan recognizes “Work Zone Management” as a key implementation strategy

- Safety is #1 driver for WZ management with various tools like Lane Closure Permitting System, WZ Performance Dashboard etc. supporting agency operations

- Solid data, analytical and institutional foundation in place for Smarter Work Zone Initiatives at a System/Program level

- WISE Tool Implementation hopes to build a data driven WZ Planning framework

Source: Maryland SHA
Maryland/MATOC WZ Planning

- Partnership of MDOT, VDOT, DDOT, WMATA
- Began in 2009
- Comprised of:
  - Steering Committee
  - Information Systems Committee
  - Operations Subcommittee
  - Severe Weather WG
  - Regional Construction Coordination WG

www.matoc.org

Source: MATOC
MATOC RCC WG Purpose

• Purpose:
  – Within NCR, the MATOC Regional Construction Coordination Working Group will Work to:

  • Reduce potential for conflicting lane/road closures and special events

  • Schedule regular meetings for key personnel to discuss construction related lane closures and special events

  • Develop Enhanced Public Information Resources as well as Internal/External WZ Information Dissemination Capabilities

  • Share Agency Best Practices (e.g. WZ lane closure permitting systems)
### MATOC List of Agency Planned Construction/Work Zone Projects by Year

**List of Agency Projects 2015 - 2020: List of Projects Presented on March 31, 2015.**

<table>
<thead>
<tr>
<th>Date</th>
<th>Agency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/1/2015</td>
<td>MDOT</td>
<td>US-50 Asphalt Overlay of L手套fford Vista Rd to Anne Arundel County Line</td>
</tr>
<tr>
<td>2/2/2016</td>
<td>VDOT</td>
<td>US-1 &amp; VA-123 Interchange Prince William County</td>
</tr>
<tr>
<td>3/1/2016</td>
<td>MDOT</td>
<td>MD-373 and Brandywine Road Relocated - Phase 2</td>
</tr>
<tr>
<td>3/1/2016</td>
<td>VDOT</td>
<td>VA-27 over VA-110 Arlington County Modify and repair the VA-27 Bridge over VA-110.</td>
</tr>
<tr>
<td>3/2/2016</td>
<td>VDOT</td>
<td>I-95 and US-15 Interchange Reconstruction Prince William County</td>
</tr>
<tr>
<td>4/1/2015</td>
<td>NPG</td>
<td>National Mall and Kutz Bridge Repair and Sidewalk Widening</td>
</tr>
<tr>
<td>4/12/2015</td>
<td>NPG</td>
<td>Memorial Park - Kutz Bridge Repair and Sidewalk Widening</td>
</tr>
<tr>
<td>5/1/2015</td>
<td>MDOT</td>
<td>MD-193 Safety and Resurfacing Safety and Resurfacing with daytime and nighttime lane closures</td>
</tr>
<tr>
<td>6/1/2015</td>
<td>MDOT</td>
<td>MD-210 Grade Separated Interchange Key Bridge over Potomac River Richardson Bridge</td>
</tr>
</tbody>
</table>

**Source:** MATOC
Lane Closure Permit Program

Source: Maryland SHA
MARYLAND R11 SOW Status

• Task 1 – Develop a calibration/re-calibration module for WISE (underway)

• Task 2 – Prepare list of long term planned work zone projects in the NCR (complete)

• Task 3 – Enhance the user demand and behavior inputs (underway)

• Task 4 – Validation

• Task 5 – Final Report
MARYLAND R11 – WISE Testing Overview

Source: Maryland SHA
MARYLAND R11 Next Steps

» Technical
  • Model Calibration
  • Interface Development
  • Scenario/ Sensitivity Testing

» Institutional
  • Making a business case for WISE Tool
    • Programmatic (across agencies/ asset/ funding categories)
    • Area wide/ Corridor Specific
  • Coordination and Communication

» Performance Management
  • TSM&O
  • FAST Act/ MAP-21/ MDOT Excellerator
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Smarter Work Zones
**METROPLAN ORLANDO: SHRP2 WISE IMPLEMENTATION**

**ERIC T. HILL**  **METROPLAN ORLANDO**
MetroPlan Orlando
MetroPlan Orlando Planning Area
MetroPlan Orlando Role in the Project

• Project Management
  – University of Central Florida
  – Caliper Corporation

• Liaison

• Technical assistance
Two million people… and by 2040, ONE MILLION MORE
66.1 million visitors in 2015

Source: Visit Orlando
How Freight Moves

95%

4%

1%

<0.1%
Transportation Improvement Program (TIP)

Federal & State Funds  
2016/17 to 2020/21

<table>
<thead>
<tr>
<th>Category</th>
<th>Totals ($000s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>1,653,981</td>
</tr>
<tr>
<td>TSMO</td>
<td>43,563</td>
</tr>
<tr>
<td>Bike/Ped</td>
<td>90,009</td>
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<tr>
<td>Transit</td>
<td>1,001,068</td>
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<tr>
<td>SunRail</td>
<td>83,708</td>
</tr>
<tr>
<td>Aviation</td>
<td>225,556</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,097,885</strong></td>
</tr>
</tbody>
</table>

More details on website
Transportation Systems Management and Operations

• TSMO Advisory Committee
• Traffic Incident Management (TIM)
• Safety
• Active Transportation Demand Management (ATDM)
• TIP
Challenges and Solutions

• Operating WISE; rewriting code
• Functionality of DTA; reformulation
• Traffic counts; coordination with FDOT
For More Information:

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Director, Transportation Systems Management and Operations
MetroPlan Orlando
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Smarter Work Zones
DATA COLLECTION AND DYNAMIC TRAFFIC ASSIGNMENT ON MONTEREY REGION

BHUPENDRA PATEL, PH.D.       AMBAG
PAUL RICOTTA, P.E.            CALIPER CORPORATION
Project Outline

- Evaluation of the WISE and propose potential remedies to improve WISE
- Network coding for DTA in TransModeler
- Data collection for sub-area DTA
- WISE modifications
- DTA Model calibration and validation
- Coding of Construction Projects for WISE applications
- WISE applications (Planning and Operation)
- Webinar/training to increase awareness and use of WISE
AMBAG Region and Interests in WISE Pilot Testing

- Regional Challenges
- Evaluate impact of construction on travel time reliability
- Minimize travel delay
- Enhance safety
- Increase coordination and communication among agencies

Source: AMBAG
Evaluation of WISE Software

• Current implementation is cumbersome and difficult to use for most MPO or DOT staff.
• Extensive manipulation of network data is required to make it usable in WISE.
• Present traffic re-assignment calculation makes little sense for larger projects that impact route choices at the origin-destination level.
• Integration with travel models should allow user to input delay and/or diversion calculations directly without the need for ad hoc detour calculations in WISE.
• WISE not capable of properly handling complex sequencing of projects.
• No support for project phasing or for defining projects that span more than one link.
Potential Remedies to Improve WISE

• Streamline input process, bypass network importer, editor, and redefine how projects are defined.
• Provide additional guidance to WISE evaluation by including critical parameters such as seasonal traffic variation, work zone hours, project priority, and possible mitigation strategies.
• Allow modeling platform to define detours through static OR dynamic assignment.
• Completely bypass ad-hoc detour building in WISE which presently uses a myopic k-shortest path and buffering methodology.
• Inclusion of time of day-based input parameters to better capture travel behavior.
• Improve WISE reporting mechanisms so output is more easily understood.
Data Collection

• Meso-Scopic Network in AMBAG Region: 100 Miles
  – Including California State Route (SR) 68, US HWY 1, and Local arterials
• 17 BlueMAC devices installed
  – Data Collection period: 2/18/2016 ~ 4/22/2016
• 11 video recorders installed for turning movement counts
  – Data Collection period: 2 weeks
• 17 Additional intersections for signal timing/turn movement
  – Data is provided by Caltrans and 3 Local Municipalities
Data Collection Sites and Devices

- **Turning Movement Videos (11)**

- **BlueMAC Readers (17)**

Source: AMBAG
**BlueMAC device data (1 of 2)**

### Projects > Monterey Deployment

#### Overview

**Status:** Complete  
**No of Locations/Devices:** 17  
**Start Date/Time:** 2/18/2016 12:00 AM (UTC-8)  
**End Date/Time:** 4/22/2016 11:59 PM (UTC-8)

**Description**  
Created by PRW 2/24/16

![Map of Monterey Deployment](image)

#### Overview Table

<table>
<thead>
<tr>
<th>Status</th>
<th>Location</th>
<th>Last Checkin</th>
<th>Total Devices (Last 7 days)</th>
<th>Weekly Trend (Last 7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanco @ S Davis (130)</td>
<td>4/22/2016 11:53 PM</td>
<td>9,536</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWY 68 @ Laureles Grade (3)</td>
<td>4/22/2016 11:53 PM</td>
<td>11,326</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWY 68 @ Olmsted (96)</td>
<td>4/22/2016 11:59 PM</td>
<td>8,159</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWY 68 @ Portola (127)</td>
<td>4/17/2016 3:50 AM</td>
<td>7,650</td>
<td></td>
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<tr>
<td>HWY 68 @ Reservation (77)</td>
<td>4/22/2016 11:50 PM</td>
<td>10,067</td>
<td></td>
<td></td>
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<tr>
<td>HWY 68 @ San Benancio (112)</td>
<td>4/22/2016 11:56 PM</td>
<td>9,766</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** AMBAG
BlueMAC device data (2 of 2)

- **Provides average travel times:** by 5min/15min/Hourly/Daily on a specific route between two installed detectors with link information

Source: AMBAG
Turning Movement data

- Data selected on
  - Feb 23~24, 2016
  - 4:00~6:00 PM

![Diagram of Turning Movement data]

Source: AMBAG
Additional Turning Movement & Signal Schedules

- 17 additional intersections for signal time/turning movements
- Data is provided by
  - Caltrans
  - 3 Local Municipalities
For More Information:

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Smarter Work Zones
PROJECT COORDINATION USING WISE:
TN PILOT PROJECT

BRAD FREEZE, P.E.
SABYA MISHRA, PH.D., P.E.

TENNESSEE DOT
UNIVERSITY OF MEMPHIS
Overview

• Motivation
• Goals and Tasks
• Rationale
• Pilot Project Experience
• Challenges and Limitations
• Initial Recommendations
Motivation to WISE (1 of 2)

• Significant projects which are anticipated to cause sustained work zone impacts

• Currently revising the TDOT Work Zone Safety Mobility Manual and reformatting the Transportation Management Plan Process (TMPs)

• Optimal multiple project coordination helps to reduce work zone related crashes

• Obtain three pillars of benefit
  – Social
  – Economic
  – Environmental

Source: TDOT
Motivation to WISE (2 of 2)

• Need in Tennessee for coordinating work zone (WZ) projects
  – Type: construction, maintenance, utility, etc.
  – Pass through state
• TDOT selected EDC-3 Smarter Work Zones as an initiative to help stimulate and support the improvement of work zone planning.
• TDOT has an existing lane closure decision support system software that is underutilized and is in need of revitalization.
• In TN
  – Approximately 500 WZ/year on interstates/state routes
  – Highest type of WZ are construction.
Goals and Tasks

- Goals of the pilot project
  - Assessment of WISE to identify limitations
  - Recommendations to improve WISE
- Tasks of pilot project include
  - Collect network and WZ data,
  - Build
    - Planning and operational strategies for WZ sequencing
  - Model calibration and validation
  - Use WISE to optimize sequence of WZ projects
Rationale Work Zone Sequencing

1. Decision Maker Objective: e.g. Minimize Congestion

2. Users Objective: Minimum cost path choice

3. Input: # of WZs, and their characteristics, Budget and other constraints

4. Input: Network, Origin-Destination, and other supply demand features

5. Output: Sequence of WZ activities

6. Output: Link flow and path choices

Planning

Operations

Every Day Counts
Pilot Project – Shelby County, Memphis, Tennessee

Shelby county: Located in Memphis Metropolitan Area

Source: Memphis Metropolitan Planning Organization (Interactive Map)
## Pilot Project Network Overview

### Total Length of Roadway Segments (miles)

<table>
<thead>
<tr>
<th>Category</th>
<th>Length (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Interstates</td>
<td>2.1</td>
</tr>
<tr>
<td>Urban Interstates</td>
<td>60.3</td>
</tr>
<tr>
<td>Rural Principle Arterials</td>
<td>28.6</td>
</tr>
<tr>
<td>Urban Principle Arterials</td>
<td>232.7</td>
</tr>
<tr>
<td>Urban Freeways/Expressways</td>
<td>35.5</td>
</tr>
<tr>
<td>Rural Minor Arterials</td>
<td>13.6</td>
</tr>
<tr>
<td>Urban Minor Arterials</td>
<td>513.2</td>
</tr>
<tr>
<td>Rural Major collectors</td>
<td>7.7</td>
</tr>
<tr>
<td>Urban Collectors</td>
<td>383.3</td>
</tr>
<tr>
<td>Rural Minor Collector</td>
<td>81.7</td>
</tr>
<tr>
<td>Local Roads</td>
<td>3183.5</td>
</tr>
</tbody>
</table>

Source: TDOT
NeXTA – Study Area Network

Network Properties
# Nodes: 26,348
# Links: 38,606
# O/D pairs: 1,267

Limitation:
23,000 nodes

Source: TDOT
NeXTA – Simplified Study Area Network

Network Properties

# Nodes: 3,649
# Links: 3,696
# O/D pairs: 1,267

Source: TDOT
Pilot Project Work Zones

<table>
<thead>
<tr>
<th>Work Zone Type</th>
<th>Frequency (1992-2016)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed/Ongoing</td>
<td>511</td>
</tr>
<tr>
<td>Proposed/Not Started</td>
<td>51</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>562</strong></td>
</tr>
</tbody>
</table>

Source: TDOT
Pilot Project Work Zone Characteristics (1 of 2)

Source: TDOT
Pilot Project Work Zone Characteristics (2 of 2)

Frequency of Work Zones in Tennessee

Year

Work Zone Frequency

Source: TDOT
Work Zone Crashes

- Anticipated decrease in WZs because of informed rerouting and better planning

Source: TDOT
Challenges and Limitations

• Data Preparation
  – Identify work zones to be analyzed
    • State, MPO, and City (all have different databases!)
    – Sub-area selection if the network is bigger
• WISE uses DynusT for DTA
  – Provide flexibility to include other software
• Significant effort needed mesoscopic model calibration
• Detail construction cost components not defined as input in WISE
  – Labor, materials, tools, schedule conflict, and other components
Initial Recommendations

- Enhance GUI
  - (for wider use make it practitioner friendly)
- Data input/output
  - (provide example data structure)
- Analyze larger number of WZ projects
  - (test other sequencing algorithms)
- Capacity to analyze larger network
  - (for planning enhance traffic assignment algorithm)
- Support other DTA platforms
  - (direct WISE to other DTA platforms)
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Smarter Work Zones

FHWA RESOURCES
SWZ Interactive Toolkit Available!

https://www.workzonesafety.org/SWZ/

Source: FHWA
## Other Resources – Project Coordination

| --- | --- |
Thanks for joining us!

• Questions or Comments?

**Smarter Work Zones**
- Jawad Paracha (FHWA Operations, WZ Management Team)
  jawad.paracha@dot.gov
- Visit The National Work Zone Safety Information Clearinghouse website for more information https://www.workzonesafety.org/swz

**SHRP 2/WISE Software**
- Tracy Scriba (FHWA SHRP Reliability Program Coordinator & R11 Product Lead)
  tracy.scriba@dot.gov
- Visit the TRB SHRP2 R11 website for more information http://www.trb.org/Main/Blurbs/168143.aspx