Benefits of the Different Types of Smart Work Zone Systems

TxDOT Transportation Short Course

October 11, 2017
What are Smart Work Zone Systems?

- Sensors for real time data collection
- Data/information communications capabilities
- Software to process/analyze data
- Equipment to use information
  - Provide real time information to road users
  - Implement work zone management decisions

*Smart work zones are designed to provide benefits to the traveling public, to the work crews on-site, and/or to the agency.*
Types of Smart Work Zone Benefits

• Reduced safety impacts to travelers, workers
  – Fewer crashes
  – Less severe crashes
• Reduced traveler mobility impacts
• Reduced customer dissatisfaction/complaints
• Reduced impacts to work crew productivity

Different smart work zone system functions deliver different types of benefits
Common Smart Work Zone Functions

• Queue warning
• Travel time information/diversion advice
• Variable speed limits (VSL)/speed harmonization
• Dynamic late merge management ("zipper merge")
• Construction access point warning
• Maintenance/enhancement of traffic surveillance and incident management functions
Queue Warning Benefits

Primary:
• Fewer crashes (primarily rear-end collisions)
• Less severe crashes

Secondary:
• Reduced delays
• Reduced impact on contractor productivity
Travel Time Information Benefits

Primary:
- Reduced customer dissatisfaction
- Reduced delay

Secondary:
- Fewer crashes
- Reduced impact on contractor productivity
VSL/Speed Harmonization Benefits

Primary:
- Fewer, less severe crashes
- Reduced delay

Secondary:
- Reduced impact on contractor productivity
Dynamic (Zipper) Merge Benefits

Primary:
• Reduced customer dissatisfaction
• Fewer crashes

Secondary:
• Reduced delay
• Reduced impact on contractor productivity
Construction Access Point Warning

Benefits

Primary:
• Fewer crashes

Secondary:
• Reduced delay
• Reduced impact on contractor productivity
Maintenance/Enhancement of TMC Functionality Benefits

Primary:
• Fewer, less severe crashes
• Reduced delays
• Reduced customer dissatisfaction

Secondary:
• Reduced impact on contractor productivity
## Evidence of Smart Work Zone Effects

<table>
<thead>
<tr>
<th>Smart Work Zone Functionality</th>
<th>Examples of Benefits Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue Warning</td>
<td>14-55% reduction in crashes; % of crashes involving injuries cut by up to 2/3</td>
</tr>
<tr>
<td>Travel Time Information/Diversion Advice</td>
<td>16-19% diversion observed in some cases</td>
</tr>
<tr>
<td>VSL/Speed Harmonization</td>
<td>Reductions in speed variance and average speed.</td>
</tr>
<tr>
<td>Dynamic (Zipper) Late Merge Management</td>
<td>Queue lengths cut by 40%; forced/aggressive merges decreased by 85%</td>
</tr>
<tr>
<td>Construction Access Point Warning</td>
<td>unknown</td>
</tr>
<tr>
<td>Maintenance/Enhancement of TMC Functions</td>
<td>45% reduction in response time to incidents</td>
</tr>
</tbody>
</table>
Quantifying Expected Smart Work Zone System Benefits

• $\sum \text{Benefits}_{\text{deployment}} > \sum \text{Costs}_{\text{deployment}}$

• Benefits depend on:
  – Frequency of system activation
  – Benefits achieved per activation

• Costs depend on:
  – Amount and type of equipment desired
  – Procurement approach used
Estimating Queue Warning Benefits:

Example

• What conditions will create queues?
  – Lane closures
  – Crashes, stalls (especially if shoulders closed)

• How many crashes are expected if a queue occurs?

• How much will a queue warning system reduce crashes?

• What is the economic value of the crash reductions?
Effect of Queues...

Bar chart showing the increase in crashes during lane closures:
- With Queuing: 471%
- Without Queuing: 28%

Bar chart showing the percentage of crashes involving fatalities or injuries:
- With Queuing: 51%
- Without Queuing: 31%
Estimating Additional Crashes Due to Queuing
Estimated Effect of Queue Warning Systems

-55% reduction in expected crashes.

50% of crashes involving fatalities or injuries vs. 16% with queue warning.
## Economic Costs of Crashes

<table>
<thead>
<tr>
<th>Crash Severity Level</th>
<th>Crash Costs (Highway Safety Manual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>$4,509,991</td>
</tr>
<tr>
<td>Disabling Injury (A)</td>
<td>$242,999</td>
</tr>
<tr>
<td>Evident Injury (B)</td>
<td>$88,875</td>
</tr>
<tr>
<td>Possible Injury (C)</td>
<td>$50,512</td>
</tr>
<tr>
<td>Property Damage Only</td>
<td>$8,325</td>
</tr>
</tbody>
</table>

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<tr>
<th>Crash Severity Level</th>
<th>Crash Costs (FHWA-HRT-05-051)</th>
</tr>
</thead>
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<tr>
<td>Fatality + Injury</td>
<td>$254,789</td>
</tr>
<tr>
<td>Property Damage Only</td>
<td>$9.642</td>
</tr>
</tbody>
</table>
Crash Cost Savings Per 11-hr Nighttime Lane Closure

![Graph showing the relationship between Crash Cost Savings and AADT for queueing for 2 hours and 6 hours.](chart)
Questions?

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