Work Zone Safety Systems

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Description: Work zone safety systems deploy intelligent transportation system (ITS) devices to increase safety and implement traffic management both in and around a work zone. Examples of work zone safety systems include cameras, dynamic late lane merge systems, Bluetooth detectors to monitor traffic, queue detection systems, and speed compliance systems. Work zone safety systems are typically portable or temporary. Integrated traveler information systems (see #TTI4) and dynamic message signs (see #TTI3) can be used in conjunction with these applications to notify drivers of a change in speed limit, changes in lane configuration, upstream events that may have caused traffic back-ups, delays or alternative routes. Vehicle detection devices (see #TM5) can be used as a warning system to alert construction workers if a driver gets too close to where they are working.

Rural Transportation Critical Needs

- ☑ Crash Countermeasures
- ☐ Emergency Services
- ☑ Operations & Maintenance
- ☐ Rural Transit & Mobility
- ☐ Surface Transportation & Weather
- ☐ Tourism & Travel Information
- ☑ Traffic Management

Issues Addressed

- ☑ Road Geometry Warning
- ☐ Highway-Rail Crossing Warning
- ☐ Intersection Collision Warning
- ☐ Pedestrian Safety
- ☐ Bicycle Warning
- ☐ Animal Warning
- ☑ Collision Avoidance
- ☐ Collision Notification
- ☐ Weather Warning

Strategies Achieved

- ☑ Road User
- ☑ Road
- ☐ Vehicle
- ☐ Safety Culture
- ☑ Engineering
- ☑ Emergency Response
- ☑ Enforcement
- ☑ Education

Applicability	Partnerships	Key Components
• Work zone safety systems are applicable for increasing safety for both the public and the on-site personnel, improving real-time traveler information to reduce motorist frustration and stress, and reducing congestion. Queue detection systems, in particular, may even be more imperative in rural areas as the build-up of a queue is often unexpected and can result in high-speed rear-end crashes.	• Applications benefit from collaboration among numerous agencies, which may include: • Departments of transportation (local, state, federal) • Construction contractors • Emergency services • Media outlets	• One or more of the following: • Dynamic Message Signs (DMS) • Traffic Management Center • Traveler Information Systems • Highway Advisory Radio • Variable Speed Limit Signs • Flashing Lights • Sensors (speed, traffic, queue, bluetooth) • Cameras (for verification of warning activation)

Examples of Implementation

- **Michigan Department of Transportation (MDOT)**

MDOT tested variable speed limit systems in a work zone on I-96. This system used high visibility variable speed signs, traffic sensors, and weather sensors to monitor traffic flow and speed through the work zone. This system displayed accurate speed information to motorists by changing the display signs depending on traffic and work zone activities, resulting in positive effects on speeds and travel times through the work zone.

- **New Hampshire Department of Transportation (NHDOT)**

The NHDOT deployed ITS during the widening of a 20-mile portion of I-93 from Salem to Manchester. This project used traffic cameras, detectors, weather monitoring systems, and DMS. The NHDOT could broadcast real-time information to the public through their Traffic Management System.

- **Illinois Department of Transportation (IDOT)**

IDOT deployed 12 DMS and 10 roadside vehicle sensors, along a 7.7-mile construction project on I-64, to collect real time information on traffic conditions. This information was posted to the DMS and a project website to alert the public to congestion throughout the work zone.

- **Pennsylvania Department of Transportation (PennDOT)**

PennDOT deployed an ITS-based emergency vehicle conflict warning system during replacement of the Brighton Road Bridge on I-376. The system consisted of emergency turnarounds, six DMS, sensors, and siren-activated systems. When activated (43 times during construction), the vehicle's sirens would activate the system and display a message on the DMS so that motorists would slow down to allow access for the emergency vehicle.

- **Texas Department of Transportation (TXDOT)**

During widening of 96 miles of I-35, TXDOT implemented an end-of-queue warning system, which was reported to reduce rear-end crashes by up to 45%.

- **Mandated Use of Queue Warning Systems on Interstate Projects in Illinois**

IDOT and Illinois Governor mandated use of queue warning systems on interstate projects that were expected to result in queued traffic, reducing queue-related crashes by 14%.

- **Safe Work Zones in Arkansas**

The Arkansas Highway and Transportation Department deployed numerous safe work zones in 2014/2015 with reported success.

Implementation Considerations (General)	Implementation Considerations (Pro)	Implementation Considerations (Con)
•There are many variations in the systems that are used. What is ultimately chosen for a construction site should be driven by the construction itself: how long is it occurring, what type of construction is being done, what types of safety improvements are needed (e.g. if personnel are protected by concrete barriers).	•Systems improve safety for on-site personnel. •Reduce traffic delays at work zones. •Reduce collisions at work zones. •Provide real-time information to the public as they approach or travel through a work zone. •Improve emergency response time. •Decrease variability of speed through a work zone. •Motorists give more attention to dynamic warnings as compared with static warnings. •Systems increase worker safety.	•The system may have to be repositioned each time the work zone activities change. •Rural areas may not have convenient access to power for these systems. •Rural areas may have communication limitations. •Potential for false warnings.

Opportunities for Future Expansion

- Vehicle-to-infrastructure (V2I) technology can be used to monitor the movement of a vehicle through a work zone. This information can be used to determine drive time through a work zone.
- V2I technology can be used to warn drivers that they are approaching a work zone.
- These systems could be used to locate personnel to automatically stop/slow a vehicle if it is on the trajectory to hit the worker.
- In the future, there will not be a need for dynamic message signs to notify drivers of an impending queue in front of them (which requires the driver to respond). Instead, as recently demonstrated by a Tesla driver in the Netherlands, the notification, and adjustment will be made by the vehicle.

Useful Tip

Adding work zone information to an existing integrated traveler information system is a great way to warn travelers about work zones and that traffic may be slow/congested in these areas.

Additional Resources

- *Minnesota Intelligent Work Zone Toolbox*, found here: http://www.dot.state.mn.us/trafficeng/workzone/iwz/MN-IWZToolbox.pdf
- *Work Zone Intelligent Transportation Systems Implementation Guide: Use of Technology and Data for Effective Work Zone Management*, found here: http://www.ops.fhwa.dot.gov/publications/fhwahop14008/
- *National Work Zone Safety Information Clearinghouse*, found here: https://www.workzonesafety.org/
- Federal Highway Administration, *Work Zone Management Program*, found here: http://www.ops.fhwa.dot.gov/Wz/index.asp
- *Every Day Counts Smarter Work Zone Initiative*, found here: https://workzonesafety.org/topics-of-interest/smart-work-zones/

Cost Range

(Cost/financial information, where noted, is based on 2016 dollars (unless otherwise specified). Cost/financial information is estimated, and will vary based on size and scope of project, number of units, etc. In general, capital costs include initial purchase costs of hardware, software, and other required equipment. Maintenance and operations costs include staff time to operate, monitor and maintain systems; data collection; system upgrades; evaluation; etc.)

Capital Costs: The total capital costs for this tool range from low (less than to $50,000) to higher (above $250,000). For example, the Ohio Department of Transportation (DOT) installed eight web cameras along the I-70 work zone areas to monitor traffic conditions and provide traveler information at a cost of $23,200[1]. The Utah DOT installed 10 Bluetooth detectors along the Bangerter Highway to monitor traffic conditions for 9 months at a cost of $40,800[2]. Michigan tested dynamic late lane merge systems (microwave traffic sensors, master controller with wirless communications, and DMS) at 3 work zones on I-94 and I-64 with a total system cost $66,579 for 11 weeks of operation[3]. North Carolina DOT implemented a work zone safety system (6 speed sensors, 8 dynamic message signs, 6 cameras, a command center, laptop, and a project website) along I-95 that was leased for a period not to exceed 10 months for $309,000[4]. The University of Minnesota reported deploying a low-cost portable video-based queue detection for work-zone safety, with identified costs as $4,700 for communication and $31 for a micro-computer[5]. The Minnesota DOT used wireless communication to send warning messages to a DMS at a cost of $83,000 for each node[5]. A similar system implemented in Arkansas cost $281,000[5].

Operations Costs: The operations and maintenance costs for this tool are expected to range from low (less than $50,000) to medium ($50,000 to $100,000), depending on the type of work zone safety system deployed. Power, communications, and staff time are all anticipated to be part of the expenses. The Utah DOT reported operations and maintenance costs for ten Bluetooth readers at $33,700[1].

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