

## Knowing Ahead of Time

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#### *Striving for better work-zone management and communications through ITS*

*Roadway work zones are not going away. Yet what can change is how we manage work-zone traffic and how and what we communicate to the public about roadwork. Electronic messages can make a major difference in how work zones affect road users and how roadwork is perceived.*

- Tracy Scriba

"Road work. Next 10 miles."

We have all seen those orange signs and probably groaned when we did. Roadway work zones are necessary to maintain our transportation network for mobility, safety and productivity. So the roadwork is not going away. Yet what can change is how we manage work-zone traffic and how and what we communicate to the public about roadwork.

Electronic messages can make a major difference in how work zones affect road users and how roadwork is perceived. Imagine commuting to work and seeing an electronic message saying, "15 minute delay ahead. Use exit 25 for alternative route." This can make the difference in whether you get to work on time by taking the other route, and also can reduce road rage by telling travelers what to expect. A message that says, "Speed ahead 35 mph. Be prepared to stop." can make all the difference in giving a motorist or truck driver the time to slow down and avoid colliding with the back of a queue approaching a work zone.

In this information age we have many tools at our disposal. There are dynamic message signs (DMS), the Internet, pager alerts, cell-phone text messages, e-mail alerts, highway advisory radio (HAR) and the 5-1-1 traveler information service. All of these tools can be harnessed through a work-zone intelligent transportation system (ITS) to provide commuters, travelers, commercial vehicle operators, transportation agencies, emergency services units, the media and others with the information necessary to make decisions. The information can help a commuter decide to take another route home. A transportation agency can use the information to adjust contractor work hours based on observed congestion. Emergency services units can identify incidents in the work zone and determine the most appropriate response.

Gearing the number and type of vehicles sent to the scene to the severity of an incident observed on ITS cameras in a work zone can both save money and limit congestion.

## The way it's done

ITS technology can be applied in many ways in work zones:

- \* Traffic monitoring and management;
- \* Traveler information;
- \* Incident management;

- \* Tracking and evaluation of contract incentives;
- \* Worker protection; and
- \* Speed management and enforcement.

The most common applications of ITS in work zones are for traffic monitoring and management and traveler information. While these applications are the most common, some of the other uses of ITS in work zones are only beginning to be applied.

Every work zone needs to have some communication to drivers about what to expect, however not every work zone is the right place for a full-scale work-zone ITS application. There should be a congestion concern or a safety concern that work-zone ITS can help address. Work-zone ITS applications need to be designed to the site-specific conditions. In areas with congestion or limited sight distances, a system that tells drivers of queues ahead may be useful. In a short-term work zone or a work zone that moves frequently it may not be practical to deploy a system, although a DMS could prove useful.

Below are examples of states that have used ITS to address a work-zone congestion or safety concern for a particular project.

### **Traffic monitoring and management/traveler information**

Using ITS for work-zone traffic monitoring and management can increase traveler mobility and safety by:

- \* Providing delay information on DMS messages or other devices at strategic locations such as before possible turnoffs, thus enabling drivers to select other routes that may be faster;
- \* Using DMS or other devices to suggest the use of other routes, perhaps even particular routes;
- \* Providing pre-trip information via the media, the Internet or other communication media so drivers can make informed decisions about when to travel and what route to take;
- \* Enabling smoother traffic flow at merge points for work-zone lane closures; and
- \* Alerting drivers to stopped traffic ahead via DMS messages so they know to be prepared to stop.

The use of ITS technology in work zones also can lessen driver frustration by giving the driver a better idea of what to expect.

In May 2002, the North Carolina Department of Transportation (NCDOT) deployed its first smart work zone on I-95 just north of Fayetteville. A series of sensors collected traffic data and analyzed the data to estimate delay. When delay surpassed a pre-set threshold, the system automatically displayed alternate route information on the DMS units. Traffic condition

information also was displayed on a website. Cameras were installed to allow NCDOT personnel to verify, without having to travel to the site, that the system messages truly reflected current road conditions.

Before the system, whenever there were lane closures, queues approaching the work zone were often several miles long and sometimes exceeded five miles. After the system began operating, the queues decreased to generally two miles or less. Steve Kite, P.E., of NCDOT noted that there were no fatalities associated with this work zone and fewer crashes as compared to previous I-95 projects without this technology. Since that time NCDOT has deployed ITS in several additional work zones.

Georgia DOT is one of the agencies that have deployed speed advisory systems to alert drivers to slowed or stopped traffic ahead when they are approaching work zones. The state deployed the speed advisory system on I-75 in Tifton and is experimenting with four other smart work zone systems on interstate construction projects within the state. Rear-end collisions are the most common type of collision in work zones. Alerting approaching traffic to slowed or stopped traffic ahead has the potential to noticeably reduce work-zones crashes, especially where congestion may be unexpected or sight distance is limited.

## **Incident management**

Several states have used ITS to improve incident management in work zones. Work zones often reduce the effective road capacity, whether through lanes closures, lane shifts, narrower lanes or the presence of barriers or distractions. When an incident such as a crash occurs in a work zone, capacity can be further reduced, causing greater congestion and increasing the likelihood of crashes from secondary incidents.

The New Mexico State Highway and Transportation Department (NMSHTD) decided to use ITS when it reconstructed the Big I interchange, where I-40 and I-20 intersect in Albuquerque. NMSHTD determined that any incidents in the roadway (e.g., crashes, cars out of gas) would cause major problems with keeping the large number of vehicles (300,000) moving through the extensive, complex and frequently changing work zone. Efficient incident management was the primary goal of the Big I ITS, with additional goals of providing traffic management capabilities and traveler information. Through the system of cameras, DMS, portable traffic management systems, HAR and motorist assistance vehicles NMSHTD was able to quickly identify incidents, determine an appropriate response and reduce the average time to respond and clear an incident from 45 minutes to 25 minutes. This deployment was one of four sites the Federal Highway Administration included in an ITS in work zones study.

In July 2003, the Florida DOT deployed an interim traffic management system to provide effective traffic and incident management during the eight-year reconstruction of I-95 in Palm Beach County. The system covers the 45-mile length of I-95 in the county as well as neighboring arterials. It provides real-time information about incidents to motorists and helps with coordination among incident response and traffic management agencies. Information is provided to the public through a series of DMS, a website ([www.palmbeachcotraffic.org](http://www.palmbeachcotraffic.org)), radio and regional 5-1-1 service.

## **Tracking and evaluation of contract incentives**

The use of ITS to assess performance-based contracting conditions is relatively new in the U.S. However, a few transportation agencies are applying these systems to improve mobility through areas affected by work zones.

In the reconstruction of S.R. 68, the Arizona DOT (ADOT) turned to ITS to minimize delays through the work zone. S.R. 68 is in northwest Arizona and connects Kingman with Bullhead City, which is across the river from Laughlin, Nev. The rural corridor is a major route for workers commuting to jobs in those cities and also carries many recreational users and trucks. A past project in the area caused lengthy delays. Since the rural area did not offer viable alternative routes, ADOT focused on reducing travel time through the work zone. Travel time through the 13-mile construction zone area averaged 17 minutes before construction. The contract for the project included a provision that during construction the travel time could not exceed an average of 27 minutes, which factored in the reduced speed limit in the work zone. The contract included a \$400,000 travel time budget item that was drawn against when the average travel time exceeded the 27-minute target; the contractor received the remaining balance at the end of the project as an incentive to keep traffic moving.

Cameras were placed at the beginning and end of the work zone to take pictures of license plates. Each license plate image was encrypted and then sent to a central computer. The computer would find matching plate images from the beginning and end of the work zone and use their time stamps to determine individual travel times that were then used to calculate average travel time.

Only \$14,857 was deducted from the \$400,000 incentive pool, indicating the contractor generally kept traffic flowing without major delays. ADOT cited increased contractor accountability and commitment to keeping the traffic moving as benefits. The contractor made efforts such as limiting the number of flagging stations and scheduling work so as to reduce impacts to people traveling through the corridor.

## **Speed management**

Several states, including Michigan, have used ITS to establish variable speed limits (VSL) in work zones. Using a VSL system in a work zone enables an agency to adjust the speed limit based on the changing conditions in a work zone. Varying the posted speed limit as the conditions in the work zone change may result in increased credibility of speed limits, greater speed compliance, improved safety and improved traffic flow.

For example, when workers are present a reduced speed limit could be imposed. This reduced speed limit should result in traffic moving past the work zone at a lower speed, which may increase worker safety and potentially increase the safety of travelers as they are more prepared for construction vehicles entering and leaving the work zone and any distractions from work activities. When traffic volumes are heavy or weather conditions poor, lowering a work-zone speed limit may be appropriate. A VSL system can be linked to traffic sensors or weather information stations to monitor real-time conditions. When certain pre-set congestion or weather conditions are detected, the VSL system can calculate and automatically change the speed limit

to a safer speed for the current conditions. Speed limits posted by VSL systems are enforceable in many states, provided appropriate regulatory signage is used. In some states a regulation change may be necessary.

## **The effect**

Even for the most common work-zone ITS applications, their use and effectiveness has not yet been extensively documented. Like any ITS application, work-zone ITS deployments generate a large amount of data that can be archived. These data can later be used to help evaluate how well the system operated and how well it accomplished its work-zone management objectives. A handful of states have conducted small-scale evaluations of recent work-zone ITS deployments in their states, and this practice is beginning to grow. Since these efforts have been limited to date, the Federal Highway Administration (FHWA) has undertaken an effort to support further documentation of quantifiable results of the effectiveness of ITS applications in work zones. This effort includes the results of state data collection and evaluation efforts, as well as gathering additional data.

FHWA has developed some mechanisms to help new practitioners tap into the knowledge of those experienced with work-zone ITS use. FHWA conducted a study looking at four applications of ITS in work zones. The results of that research are available in a brochure and a study report. FHWA also is in the process of publishing an implementation guide and four short case studies on work-zone ITS applications. The implementation guide is intended to provide guidance for implementing ITS in work zones and share knowledge and lessons learned from those who are experienced using work-zone ITS. It will cover the system concept, planning and system development, procurement, deployment, operations and maintenance, and system evaluation. Available documents can be obtained via the FHWA Work Zone Program website ([www.fhwa.dot.gov/workzones](http://www.fhwa.dot.gov/workzones)).

FHWA has an ITS Peer-to-Peer Program that provides public-sector transportation stakeholders with a way to receive short-term assistance from peers experienced with ITS ([www.its.dot.gov/peer/peer.htm](http://www.its.dot.gov/peer/peer.htm)). The Maintenance and Construction Operations User Service in the National ITS Architecture is intended to facilitate the inclusion of work zones in regional ITS architectures ([www.its.dot.gov/arch/arch.htm](http://www.its.dot.gov/arch/arch.htm)). The American Association of State Highway & Transportation Officials (AASHTO) selected ITS technologies in work zones as one of its focus technologies ([www.aashtotig.org/focus\\_technologies](http://www.aashtotig.org/focus_technologies)). As a focus technology, AASHTO identified work-zone ITS as a technology that is likely to yield significant economic or qualitative benefits to users and aims to champion its implementation through information sharing and outreach.