WORK ZONE MANAGEMENT PROGRAM

U.S. Department of Transportation
Federal Highway Administration

CASE STUDY

UTILIZING WORK ZONE EVENT DATA IN CONNECTED AND SMARTER WORK ZONE APPLICATIONS—MARICOPA COUNTY, ARIZONA

As the nation develops an increasing reliance on technology and next generation transportation management, ensuring the availability of consistent, reliable data describing work zone events is critical to enabling agency management of highway operations. The FHWA is leading the Work Zone Data Initiative (WZDI) to improve the availability of information on work zone events—the "when, where, and how" of highway construction activity—by promoting standards and processes that enhance agency capabilities to manage transportation operations around work zones and enable sharing this valuable information with other transportation operations stakeholders.

This case study focuses on efforts by the Maricopa County Department of Transportation (MCDOT) to utilize the USDOT's Work Zone Data Exchange (WZDx) specification to manage Work Zone Event Data (WZED) within a long-term, connected, and smart work zone on an arterial roadway.

Regional Work Zone Management and Operations Overview

MCDOT is a large regional transportation agency responsible for operating and maintaining over 5,000 miles of roadways within the Phoenix metropolitan area (figure 1). It supports a population of more than four million residents in the fourth most populous county in the United States.[1] MCDOT co-leads, with the Arizona Department of Transportation (ADOT), the AZTech regional traffic management partnership. The partnership, which includes the Maricopa Association of Governments, is a permanent, regionally integrated traffic data-sharing entity, serving as a central data-sharing system across the region's traffic and emergency management agencies.

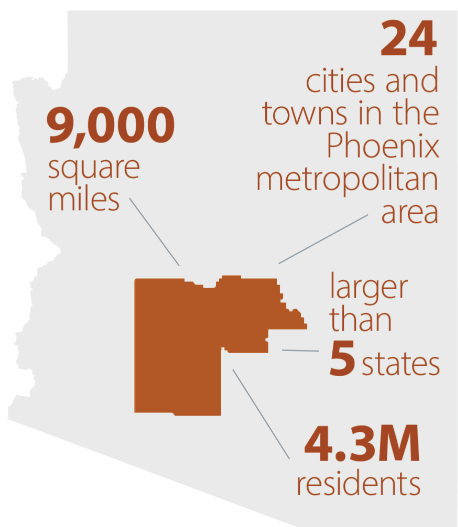

Figure 1. Maricopa County
(Source: Maricopa County Department of Transportation)

Over the past several years, MCDOT, in conjunction with other agencies in the AZTech partnership, has led several initiatives to enhance regional work zone data management practices (figure 2). To supplement ADOT's event data system used to track work zone data, MCDOT built the Traffic Information for Road Closures (TIRC) application to collect and disseminate construction and maintenance, as well as road and lane closure information. The TIRC provides a rich arterial information system for use by neighboring agencies.

[1] Maricopa County Department of Transportation. Accessed 8 Aug 2019. https://www.maricopa.gov/816/About-Us.

Figure 2. AZTech Work Zone Data Initiatives *(Source: Maricopa County Department of Transportation)*

However, understanding that some local agencies wanted to use their own data management methods to collect and share data, MCDOT recognized the need for a central repository for data inputs. In 2014, a 2-year Regional Construction Maintenance Information (RCMI) integration effort was launched. This effort resulted in 10 local agencies integrating their local agency arterial roadway construction and maintenance related closure and restriction data into the Regional Archive Data System (RADS). The agencies used a variety of delivery methods, including RSS, GIS, spreadsheets, and TIRC, which facilitates the provision of this information on the Arizona 511 website.

In 2016, following the data integration effort, MCDOT deployed an arterial Smarter Work Zone (SWZ) Pilot along MC-85, a major freight corridor. The pilot included in-vehicle messaging along with detection and dynamic message signs (DMS) to provide travel times and encourage travelers to consider alternate routes when possible. The pilot also integrated information from RADS into a WZDx-compliant data feed. In 2017, based on the need for SWZs to support Connected and Automated Vehicles (CAVs) on the roadways, ADOT and MCDOT collaboratively deployed a Connected Vehicle (CV) Work Zone pilot focused on freight movements along MC-85. All of these efforts led to the initiation of a **WZDI Pilot** in 2019, utilizing RADS data and focusing on expanding the **WZDx common core specification** to include Traffic Management Data Dictionary (TMDD) data. The focus of this case study is the MC-85 arterial connected SWZ Pilot.

MC-85 Arterial Work Zone Pilot Overview

Route MC-85 is a major freight arterial corridor that parallels I-10 through a large industrial area. Efforts began in January 2019 to widen MC-85, leading to reconstruction of the entire existing roadway. The size and requirements of this 1.5-year, two-phase construction project, warranted mitigation strategies, including SWZ technologies. The project also provided a testbed for deploying CV technologies, complementing a similar effort to test CV technologies in a nearby work zone on I-10. The location of the two-phase MC-85 construction project is shown in figure 3, as well as the alternate routes and SWZ types and locations.

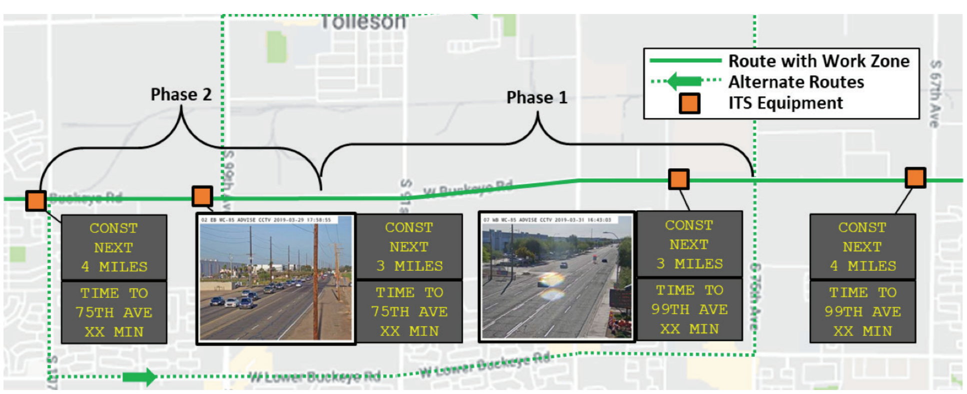

Figure 3. View of the long-term MC-85 project area, a major freight corridor and industrial area
(Source: Maricopa County Department of Transportation)

The CV component of this effort was supported through a Federal Motor Carrier Safety Administration (FMCSA) grant to ADOT and MCDOT, formerly called the Commercial Vehicle Information Systems and Networks (CVISN) grant and now known as the Innovative Technology Deployment (ITD) Program. Additionally, executive orders from Arizona's governor justified the need for SWZs that support CAVs on the roadways.

For the CV elements, ADOT and MCDOT worked with the University of Arizona and Swift Trucking to assist in the development and testing of the connected work zone application.

SWZ and CAV Technology along MC-85

The MC-85 project successfully demonstrated SWZ technology in an arterial setting. During project planning, a concept of operations (ConOps) was developed by MCDOT for the technology systems deployed on both MC-85 and I-10 (figure 4), with dual goals of improving safety and traffic flow through the work zone. The SWZ system included a series of detectors to collect data. Readers were deployed by MCDOT to calculate and display travel times on four portable DMS, (two in each direction) to encourage travelers to consider alternate routes, based on current conditions. closed circuit television (CCTV) cameras and excessive speed feedback signs were also deployed.

Figure 4. Smart Work Zone equipment with CCTV camera and Roadside Unit

(Source: Maricopa County Department of Transportation)

Additionally, MCDOT used information within RADS to generate an open application programming interface (API) feed for this work zone based on the USDOT's WZDx specification. A primary user of the RADS WZDx API was a trucking company and the vendor of their in-vehicle, pre-clearance system, following outreach by ADOT and MCDOT to initiate a partnership. This pre-clearance system is typically used when trucks approach ports of entry. For the MC-85 corridor, the system vendor applied geofencing at points upstream of the work zone, as geofencing would typically be applied at ports of entry. This allowed for the provision of work zone information to truck drivers based on geofenced locations. Specifically, this included a series of messages to inform, advise, alert, and warn truck drivers as they drove through the work zone, based on information the vehicle received at the beginning of the work zone and the vehicle trajectory.

Solar-powered roadside units (RSUs) were installed by MCDOT throughout the corridor to broadcast information using dedicated short-range communications (DSRC). The solar power is required due to the location of the RSU and a lack of nearby power sources. Information was provided via DSRC through three standard message sets: mapData (MAP) message, Roadside Alert Message (RAM), and Roadside Safety Message (RSM). Information for MAP messages are generated by using the Crash Avoidance Metrics Partnership (CAMP) MAP Tool. The information is used to provide drivers with messages about lane closures, worker presence, and the speed limit, as well as vehicle-specific alerts and warnings about hazardous conditions and excessive driver speeds, as shown in figure 5 and detailed in table 1.

Figure 5. In-vehicle messages provided about the work zone

(Source: Maricopa County Department of Transportation)

Table 1. Connected Vehicle Work Zone Messages
(Source: Maricopa County Department of Transportation)

System Message	Description
Aware	Driver is notified of a work zone in the roadway, information includes: lane closures, workers present, and speed limits
Alert	Driver is alerted to hazardous conditions based on traffic data and vehicle decisions
Warn	Warning is provided when a vehicle in the work zone has a heading that intersects the current lane.

Conclusions and Lessons Learned

This project provided a variety of lessons learned for deploying connected SWZs. Per MCDOT, the key to success in resolving challenges as they arose was coordination. Major challenges included FCC licensing on mobile equipment and power supply issues for various high-demand hardware components that are not typically used in a portable environment. Compatibility issues were also encountered by MCDOT with RSUs using new messaging standards. MCDOT stated that antenna placement was important for successful message exchange.

At the conclusion of the MC-85 connected SWZ project, an evaluation was conducted by MCDOT that identified the following benefits:

- Reduced travel times in peak period directions.
- Increased speed compliance/reductions in speed due to SWZ.
- No fatalities or worker safety issues during SWZ deployment.
- No crashes caused by the SWZ equipment.
- Additional SWZ equipment was not a distraction to drivers.

The MC-85 project allowed MCDOT to successfully demonstrate SWZ technologies on an arterial, including an arterial travel time system to encourage the use of alternate routes based on current conditions, as well as innovative CAV technologies. These experiences can be leveraged to facilitate future SWZ and CAV deployments in work zones. Through a WZDI Pilot effort, MCDOT is currently considering expansion of the RADS WZDx API feed to incorporate all work zones in the area.

Resources

Several FHWA reference documents relating to planning and deploying standardized WZED are available at FHWA's Work Zone Management Program website: **https://ops.fhwa.dot.gov/wz/**.

For More Information www.fhwa.dot.gov

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