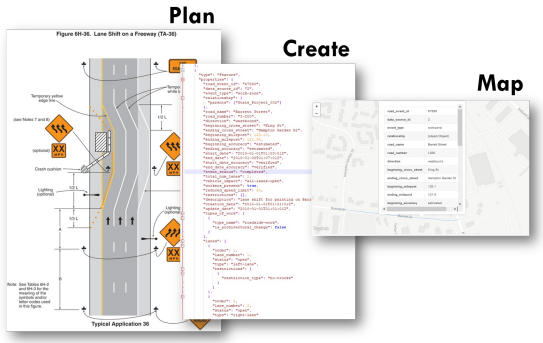
WZDx WORK ZONE DATA EXCHANGE

Early Adopters' Guide



The Technical Assistance Subgroup Co-chairs conducted interviews with early adopters of the Work Zone Data Exchange (WZDx) specification (spec) to identify processes taken to implement the spec, as well as challenges faced and lessons learned throughout the process. This guide is a compilation of the information gathered with the intention of assisting IOOs interested in adopting the spec.

You are not alone!

Common challenges experienced when implementing a WZDx data feed include:

- Project seems intimidating
- Budgetary restrictions
- The benefit to consumers of the data is unclear
- The benefit to my agency is unclear
- Not certain whether JSON elements within data feed are correct
- Not certain how to provide data for recurring work zones
- Work zone examples within WZDx GitHub repository don't align perfectly

Institutional Awareness & Advocacy

Injuries and fatalities of vulnerable workers and motorists in construction zones is a significant and ongoing problem across the U.S. If work zone information is available and consistent with the WZDx specification, data consumers can use this information to provide real-time alerts to warn drivers of lane closures, reduced speed limits, uneven road surfaces, or the presence of workers on the roadway.

Some important beneficiaries of this information are North American automakers and their technology suppliers. Vehicles are becoming increasingly connected and aware of their driving environments in real-time. SAE International has outlined levels of vehicle automation[1] ranging from Level 0 – No Automation to Level 5 – Full Automation. Advanced active safety features, such as Level 2+ hands-free driving, are quickly becoming available in new vehicle models. These increasingly automated vehicles would benefit from information about work zone events to support safe navigation.

Basic detection of work zones exists already in consumer vehicles, but the quality of driver alerts can be significantly improved by allowing these systems to access a standardized data feed of work zone information for the motorist's local area. The immediate goal is NOT to fully automate driverless vehicles through these complex work sites, but rather to notify the driver of hazards and provide ample opportunity for the driver to resume manual control.

In the short term, highway safety can be substantially improved simply by making this data available to consumers through a standardized API on a state-by-state basis. This data will be used to trigger in-vehicle alerts to warn of road hazards. In the longer term, as vehicle technology becomes more advanced, this information can eventually be used to automate vehicle functions such as steering and braking—but it's important to start now with limited data versus waiting for perfect data.

Crashes in work zones lead to approximately 1000 fatalities annually[2]. Additionally, the portion of crashes in work zones has accounted for a larger overall percentage of fatal crashes year over year. Another important consideration for cities and states is the impact that work zones can have on traffic and the downstream economic impacts of lost productivity. Clear, verifiable data about the existence of work zones could help mapping companies provide more efficient routing of traffic, potentially leading to an overall reduction of fatal crashes and decreased traffic due to a more intelligent use of the underlying transportation network.

1 https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-%E2%80%9Clevels-of-driving-automation%E2%80%9D-standard-for-self-driving-vehicles

2 https://www.workzonesafety.org/crash-information/work-zone-fatal-crashes-fatalities/#national

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For more information visit: https://github.com/usdot-jpo-ode/jpo-wzdx

Hints and Tips from Interviewees

Based on early adopter feedback, recurring work zone definitions are being prioritized for inclusion in the spec. Interviewees also provided some hints and tips, including:

- Start small. Focus on specific and clear work zone parameters that are already available, potentially from another project.
- Start with manual data entry. Don't attempt to immediately automate every aspect of your agency's work zone information. Get a few elements working successfully first.
- Use contract resources when available.
- Solicit inputs from data consumers. Ask automakers, mapping companies, etc. why the data is important! Ask other state agencies how their data is being used.
- Take advantage of connected field devices deployed at active work sites.
- Leverage JSON validation tools available through the WZDx GitHub repository.
- Request technical assistance from the WZDx Help Desk or GitHub.
- Request technical assistance from WZDx subgroup or helpdesk.

Foundational Infrastructure

The foundational infrastructure used to build out the WZDx feeds varied (sometimes greatly) between the interviewed DOTs. These infrastructures did have some commonalities on the technical side. Some details from the foundation infrastructures used to build out the WZDx feed for the interviewees are included below:

- Texas Department of Transportation (TxDOT) relied on an existing advanced traffic management system (ATMS) application that identified work zones and times. Data from this system was then pulled and transformed into the WZDx compliant feed.
- TxDOT used a C# REST service to stand up their WZDx feed.
- Massachusetts Department of Transportation (MassDOT) limited their WZDx feed to smart work zones. These smart work zone devices (i.e., sensors, radar, smart arrow boards etc.) provided data to be aggregated into a WZDx feed.
- Maricopa County Department of Transportation (MCDOT) used longer term work zone projects (6 or more months in duration) for their WZDx feeds along with manual data entry into their work zone projects.
- MCDOT used a containerized Microsoft IIS Server to serve up the WZDx feed.

Third Party Development

All of the departments of transportation (DOTs) interviewed used third-party contractors to help develop or maintain their work zone data feeds to varying degrees. This seems to be due to a combination of contractors' knowledge of the overall specification as well as convenience for a DOT to hand off development work.

Contractors were not the sole resources and were used with varying degrees of involvement in spec development. For instance one DOT essentially handed the project off to the contractors to design, build and deploy the WZDx feed; another oversaw the design, build, and deployment of the feed; while a third DOT used in-house resources to facilitate the distribution of information and relied on the contractor to build out the technical data feed.

DOTs will differ from state to state on the development of their data feeds, but, so far, contractor involvement in existing data feeds has been a large part in existing deployments, depending on the level of in-house technical expertise. DOTs reported spending a range of $30K to $1.2M to develop their feeds.

Case Studies

MassDOT

MassDOT was working on a smart work zone data manager tool prior to becoming involved with the WZDx project. After reorganizing and receiving data in various formats from different reporting tools, the state decided it needed a universal platform to interface with vendors.

Prior to WZDx, the state had two ways of reporting events—a legacy Massachusetts Highway system and a separate reporting entity. There was a desire to move to one universal process using a roadwork notification form, which is submitted electronically. This data feed would be made available to mapping service providers like WAZE. The state is trying to replace the two legacy systems with a stopgap measure until a new system comes online. MassDOT's concept is to ensure all data entry for planned construction or maintenance events will be made available through the MassDOT tool, to then be made available to third parties.

MassDOT brought on IBI Group as a consultant to build an API interface that works with different smart work zone providers. While the team experienced various levels of enthusiasm from vendors, Vermac was able to standardize their API with WZDx. MassDOT had to engage with Vermac to resolve differences in terminology between the legacy specification and the new WZDx specification. Correctly using terminology and definitions was important, but, reconfiguring Vermac's legacy work to adapt the new WZDx API required effort.

When interviewed, MassDOT requested a way to express recurring work zones. Additionally, the team mentioned that defined performance metrics would help determine if the state is on track.

TxDOT

TxDOT employed Southwest Research Institute (SwRI) to develop the state's WZDx feed. The state already collected work zone data through its existing center to center (C2C) feed, third parties that manage highway construction, and the Texas Transportation Institute (TTI). SwRI was able to align the existing C2C data to the WZDx specification within a short time frame of several weeks.

In Texas, work zone data is entered into the state's ATMS system before being converted to a C2C feed and finally to a WZDx feed. SwRI used XLST to convert C2C data into GeoJSON format. XSLT (Extensible Stylesheet Language Transformations) is a language for transforming XML documents into other formats. The C2C data is updated in real-time and this conversion is performed each time the WZDx data is requested. Data is entered by different operational units which leads to varying levels of accuracy since some areas use cameras to confirm construction activity while others rely on construction schedules.

Since TxDOT was a very early adopter, the team expressed some challenges with early versions of the spec but noted that most of these challenges had been addressed in v3.0. The largest outstanding issue was the lack of recurring events (which TxDOT addressed by creating 14 days of events at a time). The team also expressed a desire for more documentation for new version releases, as well as an up-to-date JSON schema and data dictionary. SwRI posed questions of whether a feed should include data for other purposes and what jurisdictional level should be responsible for the feed (e.g., city, county, state, etc.).

MCDOT (Maricopa County, AZ)

MCDOT had been working on their own smart work zone project before the advent of WZDx. The goal of its project was to provide work zone information to the freight operator Swift, through the Drivewyze interface.

MCDOT used a contractor for the technical development of their feed. A containerized Microsoft IIS is used to host the MCDOT WZDx API. Additionally, GeoJSON.io API is used to render the map for construction projects. In-house work was used for facilitation and distribution. The county collects data from 10-12 smaller jurisdictions and originally had them enter the data, but this became a burden on the jurisdictions and MCDOT took over the data entry task. MCDOT noted that the manual approach to data entry helped train staff on how to convert construction plans into the WZDx specification.

MCDOT expressed a desire for a better representation of recurring construction events within the spec, as well as clearer definitions of work zone artwork. The team mentioned that the tools and resources on the WZDx GitHub page were very helpful, especially the tools for validating a schema and drawing line art in GeoJSON format.

MCDOT staff believe that resources outlining the key messages of WZDx and the benefits of implementing a feed could improve buy-in from senior leadership.