Work Zone Management

The intent of System Layers is to define in further detail recommendations that would serve toward the goals of how ADOT should be operating and managing their network. It has been evaluated that eight of the original System Layer Plan topics focus on the operations and management of the network, and two served to provide the functionality and connection necessary to carry out those eight main management topics. This System Layer Plan is focused on:

- **Work Zone Management** – Work zone management includes planned activities occurring on the state network and how those activities impact the traveling public.

Context of Existing Capabilities

ADOT has been implementing Smart Work Zones (SWZ) in construction zones in the last five to seven years. The SWZ system is a broad range of portable communications-based information and electronic technologies placed in and around work zones to enhance transportation and improve safety and mobility. ADOT has utilized Traffic Data Collection Systems, Queue Warning, Dynamic Lane Merge, Travel Times, Variable Speed Limits, Traffic Monitoring Cameras, and Truck Entry/Exit systems. SWZ systems are being tested and deployed more and more on construction sites and the benefits of technology deployed are proving valuable to safety and mobility.

As ADOT looks to implement and incorporate additional types of technologies, it will be important to coordinate the standardization and processes to make sure that SWZ technologies are being used effectively. The amount of data that SWZ provides offers ADOT a strong foundation of situational awareness that is not standardized today. Performance measures will provide real-time feedback to make decisions from the TOC, the District maintenance crews, and the construction crews in the field that drive the recommendations outlined in this System Layer Plan.

Current Issues

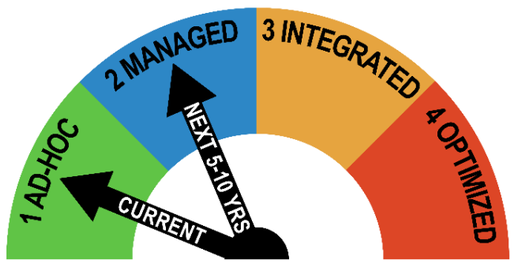
Through a variety of meetings, workshops, and review of existing conditions and applications utilized by the state, current issues were uncovered that provide insight into the direction that ADOT should focus on addressing. The following are some of the current issues identified as related to Work Zone Management:

- Lack of real time metrics to evaluate work zone performance.
- Need to update smart work zone standards as technology changes to improve work zone situational awareness efficiently and effectively.
- Need ability to know real time work zone conditions by TOC to manage and adjust upstream traffic flows.
- Limited application of SWZ standards.

Future Direction

The project team conducted a series of individual workshops with ADOT for each System Layer Plan to identify the perceived existing readiness and future direction within the functional areas. The workshop included an interactive, online (JamBoard) activity in which ADOT staff provided specific feedback following a similar structure to the TSMO Capability Maturity Model (CMM) Framework. For Work Zone Management, the workshop was held on April 7, 2022.

CMM levels for consideration of ADOT staff for their current capabilities, where they see progress in the next 5 years, and where there is desire to move toward in the next 10 years.



- **Level 1 – Ad-Hoc** – Activities are ad-hoc, informal, champion-driven
- **Level 2 – Managed** – Basic strategy application is understood with limited internal accountability or coordination
- **Level 3 – Integrated** – Standardized strategy applications that are managed for performance and aligned
- **Level 4 – Optimized** – Full and sustainable program based on prioritized data-driven process of continuous improvement

A summary of the feedback for the state is that the current capabilities are at the ad-hoc Level 1 state and in the future can be moved toward the Level 2 managed state. Because of the ad-hoc nature of work zones in general, it is recommended to not pursue reaching Level 4 optimized, only because the variations of work zone management will continue to differ across the state and types of work zones and thorough management and potentially at a later date integrated work zones are the goal that ADOT should strive to achieve.

To enhance coordination between Districts, TSMO groups, and the construction Contractor, ADOT should acquire additional staff either in-house or through contracting mechanisms and utilize those staff as liaisons between the above-mentioned groups. This staff would be responsible for collecting and disseminating current and accurate work zone information to necessary stakeholders in a timely manner. ADOT should also focus its resources on developing standard, scalable formats and management practices for the vast amount of work zone data that can be generated with current and future technology. In particular, ADOT should formalize a process to ingest WZDx data from deployed devices, manipulate that data as necessary to then be fed into other systems, and push that data to those systems. This process should be as automated as possible in order to minimize additional work for current ADOT staff. ADOT should look toward a future where there are clearly designated activities that occur in every work zone in the state and there is automation in work zone data collection and sharing that information with users that require that knowledge to make resource and routing decisions.

Recommendations

Each of the ten System Layer Plans developed as part of the ADOT ITS Master Plan has a unique future direction for ADOT to move toward as well as individual recommendations associated with achieving the future direction. This section provides a summary of important steps that be used as building blocks for achieving the ultimate vision that extends to the five- to 10-year horizon. Because ADOT is looking at the three- to five-year horizon for implementation, these recommendations will focus on investments that are foundational technologies needed to support ADOT's future. The remaining gaps between what ADOT has today and where ADOT needs to be in the future becomes the recommended changes/additions that are needed.

ADOT desires to look at potential recommendations in the following areas:

- Dynamic lane merge system
- Intelligent Work Zone (WZ) equipment
- Smart cones, vests, etc.

Table 1 provides a summary of recommendations, with key efforts denoted in bold, that ADOT should undertake to move toward Level 2 capabilities for Work Zone Management on a statewide basis.

Table 1 – Work Zone Management System Layer Plan Recommendation Summary (STIP level information)

PROCESS Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Total Funding Required	Annual Funding Required	Contracting Mechanism
DATA MANAGEMENT								
Update Work Zone Standards	Continue to update standards needed for work zone data.	**Steps:** Continue to evaluate and update standards for work zone data. Maintain connections of WZDx with AZ511 **Outcomes:** Work zone data standards that cover any data related to work zones shared with all entities/agencies that need the information.	ADOT desires to have a more holistic understanding of its work zone performance. Work zone data currently is not available for traveler consumption and therefore not helpful to travelers for routing and decision making. This is challenging especially for freight travelers that require significant advanced notice for rerouting. Providing a WZDx transmission of data will automate the process by which real-time work zone information gets to the traveler faster and is more accurate. Adding data standard management to the workload of current staff will likely not produce acceptable results in a reasonable timeframe because ADOT staff do not have additional capacity for workload. There are manual processes required as well that need establishing, such as better coordination with the contractor when lane restrictions are active. Establishing a more comprehensive and cohesive work zone data standard set will make sure travelers and ADOT alike have real-time work zone information where there had been none prior.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	TSMO Systems Technology Manager, TSMO RTEs, ADOT Contracts and Specifications (C&S)	-	-	In-house – this can be out-sourced as well, although in-house staff should initiate the process
PERFORMANCE MEASURES								
Complete WZ Performance Measures Dashboard	Develop a dashboard to capture work zone data and display performance metrics to internal and external stakeholders. This dashboard should be providing delay and queue information from work zones and accessible by the ADOT TOC for monitoring.	*Steps and Outcomes have been incorporated in the **Develop and Utilize TSMO Performance Measure Platform** action item in the **Data and Performance Management System Layer Plan***	A single platform would offer the ability to incorporate other types of data such as pump stations, tunnels, etc.	ADOT TSMO Director and Operational Traffic & Safety Manager	ADOT ITG to assist in database/software development, all TSMO Group managers to contribute	$400K for developing platform and dashboarding with the various groups that will utilize the platform	$50K per year of maintenance (if any is needed once it is initially established)	Out-source – through RFP or TSMO On-Call
STAFFING STRUCTURE								

PROCESS Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Total Funding Required	Annual Funding Required	Contracting Mechanism
Dedicated WZ Staffing	Increase staffing to support work zone and work zone data management statewide. This would include appropriate staff that have the skillsets and training required to support statewide adoption and consistency in use of WZ standards and data integration.	**Steps:** Identify, allocate, and train a staff person to serve as an extension of staff for WZ management purposes. The staff augmentation may be one person dedicated or a selected firm with a team of staff dedicated to a portion of their time during the year to provide a capped contractual number of resources. **Outcomes:** Dedicated staff to support WZ activities statewide.	It is clear that many of the improvements that ADOT desires to make require additional staff in order to be implemented successfully. To support these new initiatives, ADOT should allocate additional funding to bring on board additional staff specifically to facilitate coordination of work zone closures, management of work zone data, and assist construction staff with the administration of work zones. Currently there is only one FTE allocated to supporting work zone management statewide. Lack of SWZ oversight in the state has contributed to suboptimal results for SWZ deployments which may challenge its desire for use in the future. With the desire for additional data and WZ processes to be established and supported statewide, there is a need to identify additional staff to support adoption and integration into all Districts and Region processes.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	TSMO Systems Technology Manager, TSMO RTEs, ADOT Contracts and Specifications (C&S)	$300K per year for one FTE staff position in a staff augmentation contract	$300K per year for one FTE staff position in a staff augmentation contract	Out-source – either RFP or TSMO On-Call assignment for WZ dedicated staff augmentation for 100% of one FTE staff position to serve as liaison to complete SLP needs
PROCESS STRUCTURE								
Planned Event Routing and Response Procedures	Develop planned event plans to enhance internal and external coordination during work zone detours.	**Steps:** Develop incident management and response procedures with appropriate partner agencies (alternate routing, after-hours response processes) statewide. Implement table-top coordination exercises to foster awareness among partners and evaluate potential needed improvements. Conduct these workshops periodically to improve and refine processes. **Outcomes:** Routing mapping accessible statewide.	There are not great routing options for many corridors in the state. There is also a different response strategy for closures depending on a variety of factors. I-15 Coalition and I-10 Coalition have stated this as a concern as well. Standardizing routes, incident procedures, planned event procedures, communication protocol, and expectations involving closures and routing will keep all parties on the same page in terms of response and management of the closure.	TSMO RTEs	District Maintenance Personnel	$300K	No funding required – although this information should be updated and verified annually for accuracy	Out-source – either RFP or TSMO On-Call assignment

PROCESS Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Total Funding Required	Annual Funding Required	Contracting Mechanism
Work Zone Software Standards	Standard protocol for new software system (entry, training, integration, and time requirements for data entry) for all ADOT (RND Process) groups, subgroups, and districts as related to work zone software and processes.	*Steps and Outcomes outlined in the **Develop and Conduct ITS Technologies and Software Training Program** action item in the **Traffic Management System Layer Plan***	A comprehensive training program needs to be developed and implemented to ensure those utilizing these resources can use them to their full potential. This would also help ensure redundancy in staff's knowledge to combat potential for information loss from staff turnover.	TSMO RTEs	District Maintenance Personnel	-	No funding required – although this information should be updated and verified annually for accuracy	In-house – this can be out-sourced as well, although in-house staff should initiate the process
PROCESS STRUCTURE								
Update Current WZ Standards for Contractors to Incorporate Additional Needs	Update the current standards for smart work zone technology to incorporate additional desired needs. This may require a revision to the smart work zone study that recommends particular smart work zone technologies for specific applications completed in 2020.	**Steps:** Contract to update the current work zone standards and specifications. Incorporate the following new components desired into the documentation required by contractors to utilize on ADOT construction projects: - Smart arrow boards - Variable speed limit - Speed harmonization - Requirement for deployment of remote real-time situational awareness such as CCTV or detection while new systems go into place at intersections Refer to the ADOT Smart Work Zone Technical Concept Study and Quantity Estimation Tool (with associated Queue Length Estimation Tool) completed in 2020 to determine appropriate use of and application of the above smart work zone components. An update to the smart work zone concept may be desired. **Outcomes:** Updated WZ standards and specifications.	The existing WZ standards and specifications that were developed to include the use of smart work zone technologies in 2019 have been well utilized throughout the state. Now that smart work zone technologies are becoming standard during construction, it is time to update them to make sure they are consistent with desired use for better mobility and safety in work zones statewide. Updating the requirements on the contractor to provide these technologies so that ADOT can continue to receive data and stay away from needing to own and manage smart work zone infrastructure that a contractor would need to borrow for work will simplify the process that ADOT needs to manage.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	TSMO Systems Technology Manager, TSMO RTEs, ADOT Contracts and Specifications (C&S)	$100K	No funding required – although updating the standards and specifications every few years is a process to consider	Out-source – either RFP or TSMO On-Call assignment

PROCESS Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Total Funding Required	Annual Funding Required	Contracting Mechanism
PROCESS STRUCTURE								
Construction Procedures for Real-Time Information Updates	Develop SOPs for construction projects for contractors to notify ADOT when construction starts and ends as well as updates during construction to be provided on 511.	**Steps:** This task may be completed by either or both of the following methods: 1. Updating the work zone standards and specifications to require the contractor to perform a specific process (similar to how the as-built or construction record process is already laid out) to inform the TOC of construction activities. This data should include such items as beginning and ending milepost, number of lanes closed, and anticipated duration. This data should be provided in a format that it can be easily input into the AZ511. 2. Establish external user permissions to the ADOT ERS system to give the contractor a unique code related to their project that they would enter (with permission) into the ADOT ERS system to trigger the construction pin on map and alerting and also completing the process when construction is complete as well as provide updates during construction to be populated on 511. **Outcomes:** New process established for the ADOT TOC to collect from the contractor when construction starts and ends.	To alleviate some of the burden currently on ADOT field staff, ADOT should develop standards and procedures that requires the construction contractor to provide information about the construction work activity to support real-time situational awareness. In the future this process could potentially be automated, further reducing the level of effort required by ADOT construction staff. Permitted information is forecasted ahead of construction scheduling. When the actual construction and lane restrictions begin and end needs to be collected to provide real-time traveler information to users of the transportation network. This process will establish a standard by which contractors need to communicate this information upon the start and completion of construction to help create better situational awareness on the roadways.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	TSMO RTEs	-	-	In-house – this can be out-sourced as well, although in-house staff should initiate the process

INFRASTRUCTURE DEPLOYMENT Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Quantity	Cost Per Unit	Total Capital Cost	Total O&M Cost	Contracting Mechanism
LIFECYCLE REPLACEMENT										
None										

INFRASTRUCTURE DEPLOYMENT Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Quantity	Cost Per Unit	Total Capital Cost	Total O&M Cost	Contracting Mechanism
EXPANSION OF ADOT TECHNOLOGY DEPLOYMENT										
Establish Smart Work Zone Data Connection to TOC/ATMS	Establish connections to gather and store SWZ device data into a TOC data lake and create operational and safety performace dashboards that allow for the measurement of SWZ performance.	**Steps:** 1. Define data collection, integration, and dissemination flowchart. 2. Define what data to be integrated, frequency, format and who to integrate the data with. 3. Identify data ingestion API to ingest the data from the field devices to TOC data lake. 4. Make sure data exchange will utilize the WZDx protocols. 5. Automate continuous data acquisition for performance measures and situational awareness. 6. Set up error detection-correction mechanisms and clearly defined consequences when failure rates are excessive. 7. Estimate the cost to rent the devices including connectivity and data ingestion if the data is ingested via intermediary sever. 8. Have the cost be included in project bid. **Outcomes:** Accessible work zone data for TOC and traveler information use.	Real-time and historical work zone data help the agency to better understand and manage the safety and mobility impacts of construction activities by improving the efficiency of incident management and the reliability of highway traffic operations by disseminating real-time alerts to the road users. ADOT continues to deploy SWZ technologies and needs methods to disseminate the real-time data to the TOC and travelers to enhance safety and operations.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	ADOT, MCDOT, MAG and local agencies	-	-	$100K	$10K	In-house/Outsourced

INFRASTRUCTURE DEPLOYMENT Recommendation Title	Description	Steps and Outcomes	Context for Recommendation	Recommended Champion	Recommended Stakeholder Involvement in Implementation	Quantity	Cost Per Unit	Total Capital Cost	Total O&M Cost	Contracting Mechanism
Retrofit Equipment	Update work zone equipment requirements as technology changes to increase SWZ device use and improve work zone situational awareness and management.	**Steps:** 1. Determine which types of devices are currently being used in work zones. 2. Determine which of those devices can be feasibly replaced by a SWZ version. 3. Identify other available SWZ devices that can fulfill a need (queue tracking, dynamic merge, etc.) 4. Prepare the policies/special provisions/standards requiring the devices. **Outcomes:** Increased use of and benefit from SWZ devices.	Safety is a major concern in work zones especially as they alter traffic patterns, management, and monitoring. Devices like smart arrow boards, queue detection devices, and speed monitoring devices help reduce congestion and driver frustration by providing real-time reliable information that can be shared with travelers and the TOC. However, these new devices are not always captures in work zone requirements.	Operational Traffic & Safety Engineer, State Work Zone Operations Engineer	TOC & Districts	-	-	$100K	$100K	In-house – this can be out-sourced as well, although in-house staff should initiate the process
DEMONSTRATED TECHNOLOGIES FOR ADOT DEPLOYMENT										
None										
EMERGING TECHNOLOGY FOR ADOT PILOTING										
None										

Performance Measures

The ADOT TSMO Plan defines performance measures using three categories, safety, mobility, and infrastructure/system health. The following performance measures were recommended as part of the SWZ Technical Concept Study ADOT completed in 2020 that defines valuable metrics for reporting on SWZ goals and objectives.

Performance Measurement Topic	Performance Measure	Measure Applicability
Better inform motorists	Improved traveler information	Work zone related travel times/delay *
Speed compliance	Improved speed compliance in work zone	Measure speed variation and speed compliance when workers are present
Improve safety in and around work zones	Safer for traveling public and workers	Continue to track number of work zone related crashes *

** Metrics specifically cited in ADOT's ENG 07-3 Work Zone Safety and Mobility Policy*