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ADOT

Intelligent Transportation Systems (ITS) MASTER PLAN

EXECUTIVE SUMMARY



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Introduction

The Arizona Department of Transportation (ADOT) Transportation Systems Management and Operations (TSMO) Division has developed an Intelligent Transportation Systems (ITS) Master Plan to guide activities and investments that relieve congestion, optimize infrastructure operations, and promote a safe and reliable transportation system. This Executive Summary provides an overview of the process, evaluation, and recommendations. Additional documentation is provided in the Inventory and Existing Conditions Report and the ten System Layer Plans developed as part of the study.

Existing TSMO Organization

The ADOT TSMO Division was launched in October 2015 to consolidate operational-focused resources under a single vision and management at the same organizational level as Infrastructure Delivery and Operations (IDO) and Multimodal Planning Division (MPD). The Division currently oversees a wide range of ITS assets and applications through the efforts of approximately 290 staff. The following graphic shows the major groups within the organization as of 2022, all of which are supported by the TSMO Business Administration group.

<p>Traffic Management</p> <p>Oversees traffic along interstates and highways through the Traffic Operations Center (TOC), the Incident Response Unit (IRU), Emergency Management systems, and Road Weather Information Systems (RWIS).</p>	<p>Traffic Maintenance</p> <p>Oversees maintenance of statewide signing, striping, and pavement marking. The group consists of three regional hubs (Northern, Central, and Southern) and a centralized sign factory.</p>	<p>Systems Maintenance</p> <p>Oversees maintenance of ITS (CCTV, DMS, ramp meters, signals/lighting) and other electrical/mechanical systems across the state including the Deck Park Tunnel and pump houses.</p>
<p>Systems Management</p> <p>Oversees administrative efforts that support TSMO and IDO divisions such as Feature Inventory System (FIS), Level of Service (LOS), Maintenance Management Services (MMS), Performance Control System (PeCoS), maintenance procurement, and statewide permits.</p>	<p>Systems Technology</p> <p>Oversees the research, planning, and implementation of new ITS technologies and applications such as travel times, Wrong-Way Detection (WWD), and Integrated Corridor Management (ICM). The group also manages data and assesses performance of the ITS systems and assets.</p>	<p>Operational Traffic & Safety</p> <p>Oversees statewide traffic operations, access management, traffic maintenance, safety analysis, and crash records. The group is partially organized around three Regional Traffic Engineers in Phoenix, Tucson, and Flagstaff/Prescott; each with signal maintenance groups.</p>

Existing ITS Assets and Applications

ADOT has installed a wide range of ITS infrastructure on state highways, roadways, and freeways throughout Arizona. These assets and applications form the basis for a significant amount of TSMO data collection, traffic management, situational awareness, and messaging to the public. The following is a brief list of the primary assets and applications as of 2022; additional information is available in the *Inventory and Existing Conditions Report*.

- **Traffic Operations Center** – This center is the hub for traffic management – the majority of ADOT-owned ITS field devices (detection, CCTV, DMS, etc) are connected to the center and allow operators to dispatch resources and coordinate with ADOT Districts and Department of Public Safety (DPS).

- **ITS Field Devices and Systems** – Individual ITS field devices are the basis for providing ADOT with real-time data collection and allow for decision making relative to operations and sharing public information. While new installations are always occurring, the following are the approximate number of devices deployed for the various ITS systems underway in 2022.
- **Other Assets:**
 - » Pumps – Hydraulic pumps and associated equipment are needed to remove water from depressed roadway sections. ADOT currently maintains and operates more than 250 pumps systemwide.
 - » Regional Archive Data System (RADS) – Within the Phoenix Region, information from ITS field devices is sent to a central system to provide archived data for ADOT and regional partners.

Ramp Meter	Dust Det System	WWD	Traffic Signal	RWIS	SWZ	Animal Crossing	Comms	ATMS	Total Devices
	Speed Feedback Sign			Sensors:				CAMELEON	CCTV (525)
Detectors (575)	Visibility Sensors (13)	Thermal Camera (300)	Detector	Weather	Supplied by Project Contractor	Thermal Camera (2)	Fiber Network (1000 miles)	DMS	DMS (300)
Signals (275)	VSL (32)	Radar (5)	Signal (600)	Wind Speed		Warning Flasher (2)	Node Building (28)	CCTV	Traffic Signal (600)
Flashers	DMS (5)	Flashing Wrong Way Sign (58)	CCTV (300)	Precipitation			Cellular Modem (215)	WWD	Thermal WWD Camera (300)
Controllers	CCTV (5)	DSS		Humidity			Radio	DDS	VSL (32)
	Detector (6)			Temperature				MAXVIEW	Ramp Meter Detection (575)
	X-Band Radar (1)			Visibility				Traffic Signal	Visibility Sensor (13)
				Grip Sensor				Ramp Meter	Wrong-way sign (59)
				CCTV					Speed Feedback Sign (28)
									Truck Escape Ramp (3)
									RWIS (21)
									Cell Modem (215)

Stakeholder Input

This project held a number of coordination efforts to collect data and discuss needs and issues directly with stakeholders. Feedback from ADOT staff from TSMO and other Divisions helped identify and prioritize gaps and recommendations. These stakeholder efforts included:

- **Vision workshop** – An in-person workshop was held with the ADOT Project Management Team (PMT) and additional stakeholders to set the direction and goals for the ITS Master Plan.
- **PublicCoordinate online platform** – This online platform allowed input to be collected geographically on a map and categorized by type of need or issue.
- **In-person workshops** – Seven in-person workshops were held with TSMO and IDO District staff to discuss opportunities to improve ADOT processes around ITS implementation.

- **Interviews with each TSMO group** – Eight individual interviews were conducted with the various TSMO groups, MPD and IDO staff, to discuss needs and issues from a programmatic, people, and process perspective that could assist in the future direction.
- **Individual meetings** – Numerous individual meetings occurred throughout the project to discuss various aspects of the evaluation and proposed recommendations.

The graphic below summarizes the coordination efforts, associated tasks, and timeline.

Challenges and Gaps

Through a variety of meetings, workshops, and review of existing conditions and applications utilized by the state, a number of challenges and gaps were uncovered that provide insight into the direction that ADOT should focus on addressing. These are documented in a separate document.



System Layer Plans

The ITS Master Plan synthesizes a large number of efforts to address different issues spread across the various TSMO groups and functions through the aid of ITS. While there is significant interaction and some overlap, System Layer Plans (SLP) were developed focusing on particular areas of need and the ITS strategies that could support them. The evaluation of the ITS needs and the development of recommendations were organized into individual System Layer Plans (SLP). Eight SLPs focused on primary functional areas while two SLPs served as support areas common to the other eight areas.

Challenges and gaps identified in each SLP provided a basis for the development of future implementation steps. Each SLP includes specific, purpose-driven recommendations, organized as process and infrastructure improvements, to progress the associated function independent of the other functions. The ten SLPs are standalone reports but are summarized in the *System Layer Plan Executive Summary*.



Traffic Management

Traffic management of freeways and highways including infrastructure, daily and near/long-term operations, and agency coordination.



Work Zone Management

Work zone management includes planned activities occurring on the state network and how those activities impact the traveling public.



Road Weather Management

Road weather management includes the operation and management of the transportation network through flooding, fires, snow, ice, dust, and rain conditions.



Safety Applications

Safety applications include projects, initiatives, and infrastructure directly related to preventing incidents.



Active Transportation Demand Management

ATDM is used to analyze, predict, and manage congestion issues. Active management optimizes the performance of TSMO/ITS strategies by monitoring the strategies, assessing their performance, generating and selecting ways to improve performance, and then implementing the performance.



Connected/Autonomous Vehicles and Smart Cities

C/AV and Smart Cities are emerging fields within the transportation realm that utilize technology and communication platforms to communicate and interact with public infrastructure. Connected vehicles exchange data and information to increase efficiency and safety while autonomous vehicles utilize sensors and other means to automate driving tasks.



Traffic Incident Management

Traffic incident management includes unplanned events occurring on the transportation network that causes safety risk, capacity restriction, rerouting, and coordination between transportation and public safety agencies.



Traveler Information Message Systems

Traveler information message systems include the utilization and management of a dynamic network consisting of software and hardware to alert the traveling public in a real-time manner to affect driver routing decisions.



ITS Communication Structure

A structure for communications statewide that is needed to support any device/system installed throughout the state.



Data and Performance Management

Systems to support data feeds from various systems to allow evaluation and assessment of program and operational performance.

Future Direction

The future for ADOT TSMO is bright. There is a solid foundation of ITS infrastructure, data use cases, and a variety of staff working in many different areas within the ITS field on demonstrating and deploying technology that has broad uses both for ADOT personnel and for the constituents in the state. While there are many successes to note, there are opportunities to improve ADOT's capabilities in some specific areas to further enhance collaboration and capabilities to support a future environment. In particular, there is a desire for more active management and operations of the transportation network; a transition from a reactive and incident management perspective to a proactive and mobility management perspective.

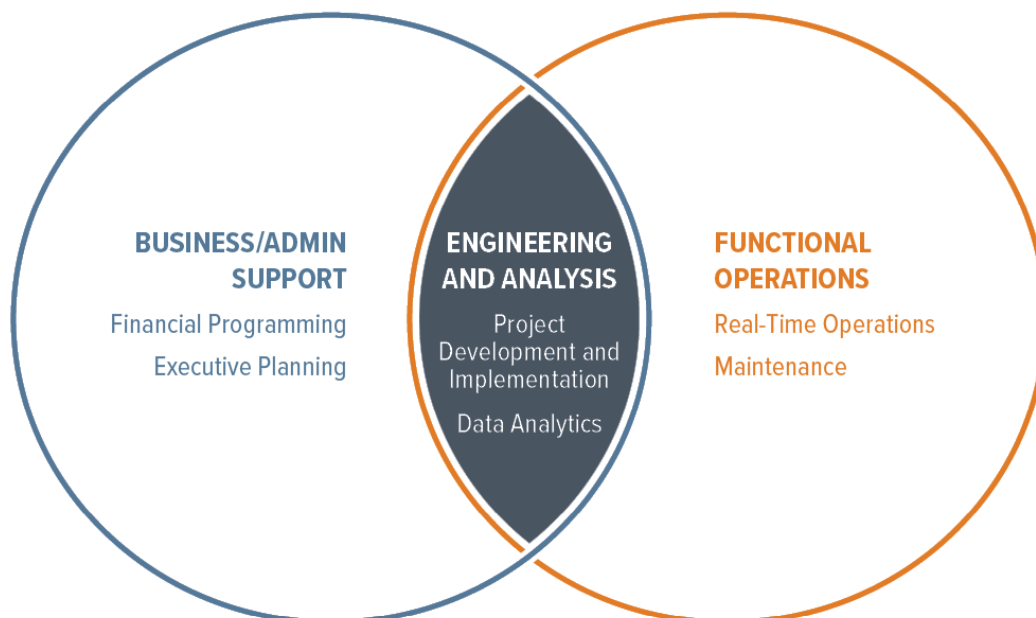
ADOT strives to provide enhanced services. Providing broadband infrastructure statewide and piloting technologies for potential application are great first steps in broadening ADOT's capabilities. There are fundamental activities needed to support ADOT's technology future including asset management, staffing to support operations and maintenance, and programmatic funding for technology.

The future includes ADOT providing robust infrastructure in strategic ways to support data collection and information dissemination that matters to the users of the network.

The future includes ADOT having staff dedicated to maintaining assets at appropriate levels of functionality, staff to provide active transportation operations as well as reactive operations, and staff to support not only data collection and management but also analysis and future decision-making for investments. The future also includes data collection and analysis, partnerships with private sector for deployment, and accountability on activities outlined in the ITS Master Plan.

The implementation of future improvements will require coordination and interaction among all the TSMO functions regardless of where the champion is located within the organization.

The graphic below illustrates the three primary categories of TSMO staff (business/administration, engineering, and functional operations) and the application of high-level activities that lie within the junctions between the categories.



At a high-level, the focus for ADOT TSMO should be on the following major categories:

- Formalize ADOT ITS Committee Across TSMO Division
- GIS-Based Asset and Work Order Management
- Develop Data Governance and Management Plan
- Establish ITS Program Funding Pools
- Establish Connection to all ADOT ITS Devices and Traffic Signal Statewide
- Dedicated Traffic Management Staffing

SPECIFIC RECOMMENDATIONS

The individual SLP reports contain numerous recommendations within each functional area based on the challenges and gaps uncovered through the extensive stakeholder coordination. Areas of concern included roadway coverage, congestion, crash history, weather events, system improvements, utilization of resources, and others. Recommendations are generally categorized between process and infrastructure improvements with further subdivision based on the nature of the improvement.

Stakeholder input resulted in over 100 recommendations, so an initial screening was conducted to identify the more manageable solutions based on funding, resources, and timelines. A prioritization process was developed with ADOT leadership to rank each recommendation as “high”, “medium”, or “low” based on the relative merit taking into account the following factors:

- Effectiveness of the ITS strategy/technology
- Incident hot spots
- Compatibility with existing systems/projects
- Rate of return on investment
- Staffing levels of support

The most applicable and feasible recommendations, along with those already underway, across all SLPs with a “high” priority rating are shown in the tables on the following pages.

Specific device/system locations were prioritized and mapped on ArcGIS Portal. A link to the detailed plan is provided on the TSMO website. The detailed plan will be updated periodically, as project and needs change.





COSTS

Each recommendation has been evaluated against ADOT TSMO internal resources to assess if implementation is better suited as an “in-house” or “outsourced” activity. In-house actions may be accomplished by ADOT staff at minimal cost beyond staff time. Several of the in-house activities are currently in development and require dedicated time to complete. Most “outsourced” activities will require significant time and manpower to accomplish, along with ample funding support. Funding of these larger efforts should be considered when future grant opportunities become available.

Initial capital costs are included in the tables below, but sustained funding for operations, maintenance, and subscriptions will be needed as initiatives and assets are deployed.

SLP Summaries

PROCESS IMPROVEMENTS

	= Likely done In-House		= Likely Out-Sourced		= In-House/Out-Sourced
	= Efforts that are Underway				

System Layer Plan	Near-Term (1-3 yr) Priority Recommendation	Cost
A. Traffic Management	Institute a GIS-Based Asset and Work Order Management System	\$2,000,000
A. Traffic Management	Develop ITS Upgrade/Maintenance Plan	\$920,000
A. Traffic Management	Evaluate Traffic Management Staffing & Workforce	\$900,000
A. Traffic Management	Establish ITS Program Funding Pools	\$0
A. Traffic Management	Formalize ADOT ITS Committee Across TSMO Division	\$0
A. Traffic Management	Automation to Assess Detector Health	\$0
B. Active Transport Demand Management	Enhance Real-Time Data Repository	\$400,000
B. Active Transport Demand Management /DPM	Develop & Utilize a TSMO Performance Measure Platform	\$400,000
B Active Transport Demand Management /DPM	Develop TSMO Data Governance and Management Plan	\$250,000
B. Active Transport Demand Management	Develop ATSPM Dashboard	\$200,000
C. Safety Application	Setup Predictive Crash Data Analysis Tool	\$500,000
C. Safety Application	Improve Crash Data Platform	\$40,000
C. Safety Application	Track TSMO Safety Goals to Align with Statewide Traffic Safety Plans	\$0
D. Work Zone	Complete WZ Performance Measures Dashboard	\$400,000
E. RWIS	Develop Statewide RWIS Management Plan	\$150,000
E. RWIS	Evaluate RWIS Inventory for Modernization	\$100,000
F. Traffic Incident Management	Enhance Data Sharing between AZDPS and ADOT TOC	\$500,000
F. Traffic Incident Management	Improve and Automate TOC TIM Performance Tracking	\$0
F. Traffic Incident Management	Complete IRU Expansion Feasibility Study & Implement Recommendations	\$100,000

System Layer Plan	Near-Term (1-3 yr) Priority Recommendation	Cost
G. Traveler Info System	Establish DMS Message Automation	\$50,000
G. Traveler Info System	Administer AZ511 Public Awareness Campaign	\$150,000
I. Data Performance & Management	Maintain and Enhance AZ511 Public Data Feed to External Users	\$200,000
J. Communication	Establish Funding Pool for Middle Mile /Last Mile Connections	\$0

Total Cost = \$7.3 M

INFRASTRUCTURE IMPROVEMENTS

= Likely done In-House
 = Likely Out-Sourced
 = In-House/ Out-Sourced
 = Efforts that are Underway

System Layer Plan	Near-Term (1-3 yr) Priority Recommendation	Cost
B. Active Transport Demand Management	Fix Detection Locations	\$210,200
B. Active Transport Demand Management /TIM	Enhance CCTV Coverage for Monitoring (30 devices)	\$1,020,000
C. Safety Application	Expand Installation of Wrong Way Counter Measure/WWD Detection	\$300,000
D. Work Zone	Establish Smart Work Zone Data Connection to TOC/ATMS	\$100,000
D. Work Zone	Retrofit Equipment	\$100,000
E. RWIS	RWIS Modernization	\$2,000,000
E. RWIS	Expand RWIS Locations	\$12,760,000
J. Communication	Construct Middle Mile/Last Mile Connections	\$19,875,000

Total Cost = \$36.4 M

Assumptions:

CCTV Coverage = \$34,000 per location X 30 locations

Fiber = \$265,000 per mile X 75 mile corridor

Fix Detection Locations cost based on current \$87,000 contract and need for 1,100 detector cards at ~\$112 per card

