U.S. Department of Transportation
Federal Highway Administration

ATDM Brief: ATM Implementation and Operations Guide

OVERVIEW

Active Traffic Management (ATM) encompasses a broad array of advanced technological solutions that agencies can deploy to increase the efficiency of their transportation facilities and move from static approaches to more actively and dynamically managed traffic operations which work to match fluctuating demand and varying conditions. As transportation agencies grapple with increasing congestion and fewer available funds to add capacity, ATM applications and systems have been increasingly deployed in the United States within the last decade as an alternative to expanding roadway capacity. These applications vary in approach, scale, and purpose, and many more agencies throughout the country are considering various aspects of these strategies to improve the efficiency of their existing roadway systems.

In response to this growing interest, FHWA developed an ATM Implementation and Operations Guide that provides lessons learned, best practices, and general guidance on critical issues of implementing and operating ATM. The Guide provides an overview of ATM strategies and provides information on their characteristics and when they might be appropriate to address regional goals and objectives. It uses a combination of relevant existing resources and documents, along with best practices and lessons learned gleaned from early adopters to offer practical guidance. It also emphasizes the value of ATM and what these strategies can offer to operating agencies as part of their broader transportation systems management and operations (TSMO) program.

WHAT IS ACTIVE TRAFFIC MANAGEMENT (ATM)?

ATM strategies work to maximize the effectiveness and efficiency of a facility or network while increasing throughput and safety. Characteristics of these strategies include integrated systems, advanced technology, real-time data collection and analysis, and automated dynamic and/or proactive deployment. Whether implemented individually or as a combination of applications, ATM works to optimize the existing infrastructure. The ATM strategies included in this Guide include adaptive ramp metering (ARM), adaptive traffic signal control (ATSC), dynamic junction control (DJC), dynamic lane reversal (DLR), dynamic lane use control (DLUC), dynamic shoulder lanes (DShL), queue warning (QW), dynamic speed limits (DSpL), and dynamic merge control (DMC).

What is Active Transportation and Demand Management (ATDM)?

ATDM is the dynamic management, control, and influence of travel demand, traffic demand, and traffic flow of transportation facilities. By using available tools and assets, traffic flow is managed, and traveler behavior is influenced in real-time to achieve operational objectives, such as preventing or delaying breakdown conditions, improving safety, promoting sustainable travel modes, reducing emissions, or maximizing system efficiency. Under an ATDM approach, the transportation system is continuously monitored. Using archived data and or/predictive methods, actions are performed in real-time to achieve or maintain system performance. The ATDM concept is based on the Active Management cycle shown below.

Active management cycle.

WHAT ARE SOME EXAMPLES OF ATM APPLICATIONS?

The Washington State Department of Transportation (WSDOT) implemented "Smarter Highways" on several corridors in Seattle, which include ATM signage used for incident management, and automatically posts regulatory variable speed limits to smooth traffic flow. The first corridor to begin ATM operations in Seattle was a 7-mile segment of Interstate 5 (I-5) northbound from the Boeing Access Road to Interstate 90 (I-90) in downtown Seattle. With significant construction on the parallel State Route 99 (SR 99)-Alaskan Way Viaduct, ATM signage was implemented to help alleviate increased traffic on the I-5 corridor. Prior to deployment, this corridor averaged 434 crashes per year, 296 of which were congestion related. A 6-year before-after study on the I-5 implementation showed a decrease in overall crashes by 4.1 percent.

ATM on I-5, Seattle, WA (Source: TTI).

DJC, Los Angeles, CA (Source: Caltrans).

Caltrans deployed DJC in Los Angeles, which involved opening the right shoulder on the connector ramp during the peak period to provide additional capacity to improve safety and mobility on the connector and stop drivers traveling on the connector shoulder during peak periods. Crashes at the end of the queue decreased because of the deployment and overall the delay on the network dropped by 7 percent.

The Wyoming Department of Transportation (WYDOT) first implemented ATM in the form of a variable speed limit system along I-80 between Laramie and Rawlins in 2009. This system was implemented to address weather-related closures and to reduce speeds during severe weather and wind conditions. The rural application incorporated technology to monitor road and weather conditions and visibility with cameras, road and wind sensors, surface and atmospheric conditions, and speeds. Operators in the traffic management center (TMC) are responsible for speed selection using all available road and weather data and the notifications of any incidents in the corridor.

VSL on I-80, WY (Source: WYDOT).

The Texas Department of Transportation (TxDOT) developed an end-of-queue warning system to use in work zones on a nightly basis. The system consists of a highly-portable work zone ITS of easily-deployable radar speed sensors linked to one of eight more portable changeable message signs, and highly-portable transverse rumble strips. The system is deployed upstream of nighttime lane closures where queues are expected to develop. Overall, the QW system is estimated to have reduced crashes 13 percent from what they would have otherwise been if the system had not been used. The crashes that did occur were less severe, most likely because fewer of them were of the high-speed rear-end collision variety.

OVERVIEW OF GUIDE

The intended audience(s) of the Guide includes agencies interested in obtaining guidance on operating their ATM systems and strategies more effectively. The guide is divided into five technical chapters, along with a summary and references. The titles of each technical chapter and the major topics covered are highlighted below.

Planning and Organizational Considerations

Planning for an ATM implementation is a multifaceted and complex process. Since ATM still represents an emerging strategy, with it comes new approaches needed to effectively plan for ATM and integrate ATM into current plans and planning processes. This chapter provides an overview of planning-level and organizational approaches that agencies need to consider when developing ATM for a corridor or across a region. Key guidance across the five planning topics includes:

- **Planning for ATM Operations.** Essential elements of successful ATM planning include scenario planning and the use of data, planning based on subareas and corridors, and engaging stakeholders. These elements can assist an agency with addressing project planning, life-cycle costing, operations, and maintenance, and institutional collaboration necessary for ATM implementation.
- **Organizational Capability for ATM Operations.** The six dimensions of agency capability (business processes, systems and technology, performance measurement, culture, organization and workforce, and collaboration) serve as a good organizing framework for an agency implementing ATM and can aid in determining areas of improvement that will help to assure successful ATM operations.
- **Setting Objectives and Performance Measures for ATM.** Performance measures for ATM strategies will be SMART (specific, measurable, attainable, realistic, and time-bound), should clearly relate to agency goals and objectives, and shall be driven by the capability to collect the data and conduct analyses. Key groups of measures include travel time reliability, congestion management, safety, and sustainability and livability.
- **Analysis, Modeling, and Simulation.** Simulation and modeling help agencies evaluate various ATM strategies at the planning, design, or operational stages. Microscopic, mesoscopic, and macroscopic tools all serve different purposes in analyzing ATM strategies for impacts on mobility, safety, benefit-cost, and the environment.
- **Programming and Budgeting.** ATM strategies can be included within an improvement or long-range plan once an agency or project sponsor determines that it can complement or improve upon statewide, regional, or local goals, though ATM strategies will have to compete with other projects to gain approval for funding.

Design Considerations

Designing an ATM system can be a complex endeavor. An agency needs to consider the various features and processes of design when moving forward with ATM projects. These features and processes include the concept of operations; requirements development; physical design; performance-based practical design; technology, procurement, and testing; and the impact of connected and automated vehicles on ATM. Key guidance in this chapter includes:

- **Concept of Operations.** Broad stakeholder input is essential to the ConOPs process because ATM likely affects multiple stakeholders. Critical elements of the ConOps help address key decisions that need to be made, such as enforcement, coordination across modes (freeway, arterial, and transit), long-term funding needs, and the ability to leverage existing systems.
- **Requirements.** The requirements of an ATM system will need to be clearly defined and included in procurement documents to ensure that the system deployed meets the intended goals, objectives, and operational performance.
- **Design Elements.** Design elements of an ATM system should map to defined functional requirements established in the ConOps. Software is always a required element and is critical to effectively delivery the defined solution.
- **Performance-Based Practical Design.** The performance-based practical design process is a

logical fit for ATM; it allows an agency to analyze each element of a project in terms of value, need, and urgency to help maximize the return on investment.
- **Technology, Procurement, and Testing.** ATM systems require more precision and skill to implement than conventional traffic management systems, and enhanced education on technologies and operational needs increases the potential for success.

Implementation and Deployment

This chapter provides a review of the approach to implementing and deploying ATM strategies in a region. Particular topics include legal issues, stakeholder engagement, and public outreach and involvement. Key guidance includes:

- **Construction and Scheduling.** ATM projects lend themselves to various project delivery methods, including design-build, design-bid-build, construction management at risk, and public-private partnerships, all of which have advantages and disadvantages for implementation.
- **Legal Issues.** ATM deployments may have legal implications related to operations. Agencies should assess legal authority to operate and enforce strategies, and gain buy-in from agency stakeholders and officials to help facilitate successful implementation.
- **Stakeholder Engagement, Public Outreach, and Involvement.** A comprehensive outreach program can provide stakeholders and the public with information on the purpose, benefits, operation, and performance outcomes of ATM strategies, and can help garner support to ensure a successful ATM deployment.

Operations and Maintenance

This chapter provides guidance on operations and maintenance issues agencies will face once ATM strategies go online. Key takeaways include:

- **Activation Thresholds and Performance Monitoring.** Detection and monitoring systems are critical to supporting the active management of ATM systems. Performance reporting supports real-time operations and allows an agency to evaluate performance measures against the ATM strategy's operational objectives.
- **Performance Evaluation.** Dashboards are an effective tool for assessing ATM strategies, documenting trends in performance over time, and fine-tuning the deployment of ATM strategies to better meet operational targets.
- **Maintenance.** An agency's ATM system maintenance strategy can dictate its design, including locating maintenance resources, institutional responsibilities, staffing levels and requirements, and using contract services to maintain agency assets.
- **Incident Management.** Incident management on facilities with ATM operational deployments can be enhanced with such efforts as a unified response approach, stationed tow trucks in the corridor, and emergency refuge areas.
- **Enforcement.** Law enforcement should be engaged early in ATM project's implementation stage to ensure they understand the strategy's rationale and can work to identify enforcement approaches that are best for the region.
- **Costs.** Costs for ATM projects include infrastructure, technology, longer-term operations, maintenance, and system upgrades. Various funding and financing sources might be available at the state and local level while some Federal funding program categories can also support ATM.

For More Information

The FHWA ATDM Program website contains more information about ATDM approaches and strategies, all the ATDM briefs, guidance documents, and resources and links to external stakeholder resources: https://ops.fhwa.dot.gov/atdm/index.htm.

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