ACTIVE TRANSPORTATION AND DEMAND MANAGEMENT

ATDM PROGRAM BRIEF: DATA NEEDS FOR ATDM

U.S. Department of Transportation
Federal Highway Administration

WHY IS DATA NEEDED FOR PLANNING, OPERATING, AND EVALUATING ATDM?

Data needs increase as an agency evolves toward more active management. A successful ATDM initiative requires a variety of quality data in each stage:

- **Planning** for ATDM needs data to identify the areas in the region that would most benefit from ATDM approaches.
- **Operating** ATDM systems generally requires more reliable and sophisticated real-time data than typical ITS deployments.
- **Evaluating** ATDM requires more data than simple traffic counts to show benefits in improved mobility and safety and the effectiveness of deployed strategies.

This brief will inform practitioners about data considerations for ATDM initiatives at each stage of deployment: Planning Data Needs, Data for Day-to-Day Operations, and Data Needs for Monitoring and Evaluation.

PLANNING DATA NEEDS

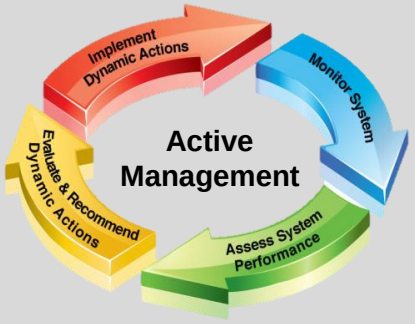
Data needs for planning are driven by monitoring needs to define the extent and duration of congestion and system performance, and modeling needs to estimate the performance of potential ATDM strategies on the transportation network. Model outputs generally include an estimated benefit/cost ratio and can help establish performance targets.

Goals and Objectives. Transportation agencies must consider ATDM solutions within the context of regional goals, which may relate to safety, mobility, reliability, the environment and climate change, and/or livability and accessibility. These goals can be translated to objectives with performance measures and targets for an ATDM deployment that will drive data needs. Consider the "SMART" objectives framework—specific, measurable, attainable, realistic, and time-bound—to determine and periodically assess performance measure targets.

During the planning phase, agency coordination to facilitate data sharing may aid in determining and prioritizing corridors and areas where specific ATDM approaches will be most effective by providing a more comprehensive picture of overall system performance. Inter-agency coordination may also facilitate a common understanding and agreement of problem areas, needed improvements, and the identification and prioritization of performance measures.

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. Through the use of 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.



Based on regional needs and goals, a preliminary list of initiatives should be identified that would receive the greatest benefit. During a regional assessment, agencies should keep the following key questions in mind, which will drive ATDM data needs:

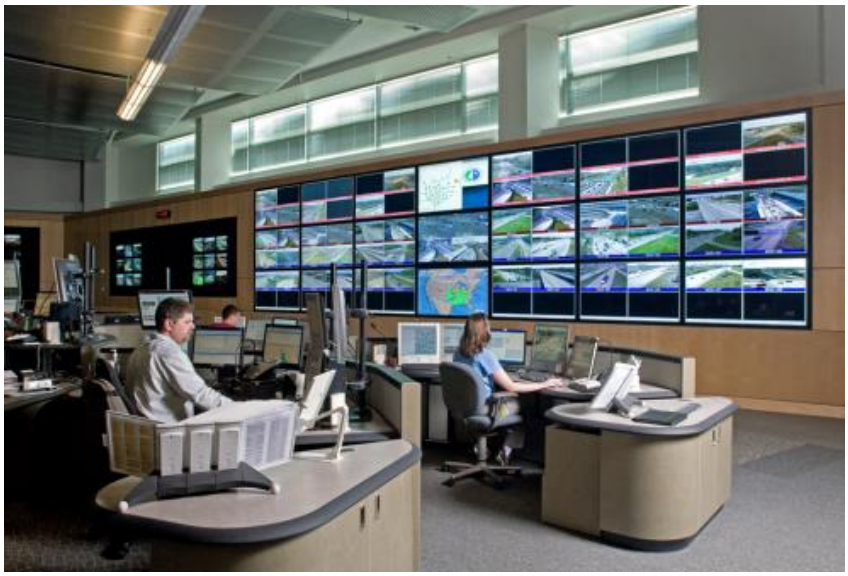
- What specific approach or combination of approaches would work best?
- What multimodal networks and facilities would be best suited for ATDM?
- What would be the range of expected benefits?
- What would be the expected costs (capital and ongoing)?

Performance Measures for Planning. Agencies should leverage all available, relevant archived and forecasted data during the planning phase to identify potential deployment areas, and also for day-to-day operations. Similarly, agencies should cast a wide net to use comprehensive data sources for system evaluation to measure the effectiveness of ATDM approaches. Agencies should consider data from sources that may traditionally be overlooked, including data from other agencies. Relevant data are available from a variety of sources, such as:

> An agency must obtain the right data to measure performance. If available data are not sufficient, the agency should not simply compromise, but should collect or purchase data to provide the required measures.

- Travel Demand Models. These models, developed by regional metropolitan planning organizations (MPOs) provide outputs identifying and monitoring the severity of current and future bottlenecks, areas of congestion, and air quality problem areas.
- Transportation Management Center (TMC) Data. Local and state agency TMCs typically collect data from traffic detectors, road weather information systems (RWIS), and maintain incident data.
- Transit Ridership Records. Transit agencies often maintain records of ridership that can identify available capacity and transit travel times; on-time performance records may provide a measure of transit reliability, as well as for the larger arterial network.
- Crash Records. Law enforcement agencies maintain detailed crash records that may be used to identify unsafe intersections and segments, and examine the specific causal factors of those crashes to confirm that an ATDM initiative would be effective.
- Third-party mobility data. Historical third-party data (i.e., probe or private-sector vendor data) on traffic congestion may be available to identify trends, monitor progress toward performance targets, and help evaluate effectiveness of the ATDM solution.
- Citation data. Citations issued by law enforcement for parking violations, including double parking, may highlight areas where active parking management (APM) would be beneficial. Similarly, citations issued for speeding or other minor offenses, as well as qualitative information from law enforcement officers may be useful in identifying areas that would benefit from ATDM. Citation data could also be reviewed to determine if there is an underlying need for better public awareness of new operations management strategies such as managed lanes/pricing, variable speed limits, part time shoulder lanes, or overhead lane control signals. This could influence a need for a public outreach campaign.

The key is for an agency to obtain the right data to measure performance. An agency can leverage these available data sources and resources to quantify the potential and actual benefits of ATDM deployments. If available data are not sufficient to measure performance, the agency should not simply compromise, but rather should collect or purchase data to provide the required measures. Utilizing these resources, ATDM solutions can be prioritized by evaluating regional conditions that support ATDM deployments and producing a benefit-cost ratio by ATDM initiative and area. Additional considerations should be made for the facility characteristics, existing ITS infrastructure, and institutional issues to ascertain the appropriateness of various ATDM solutions.



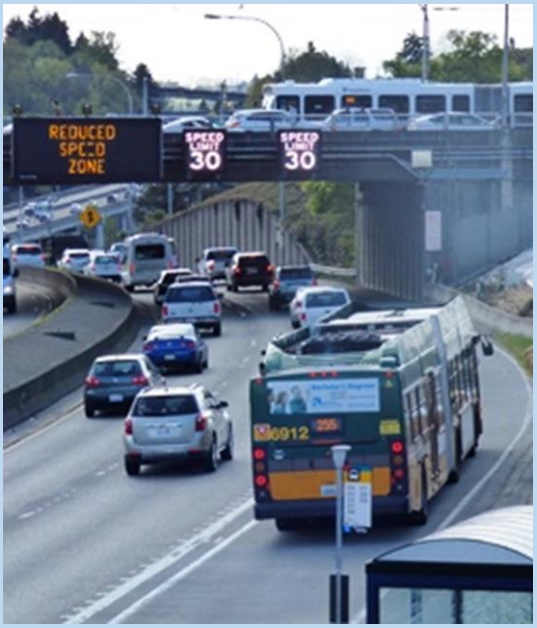
Source: MnDOT

DATA NEEDS FOR DAY-TO-DAY OPERATIONS

Data identified during the planning phases may be useful for day-to-day operations. However, operations may require a different, higher quality dataset than was needed for planning. Operations data needs to be current, and usually real-time, in order to allow for more active management. By comparison, planning data can have a higher latency or can be collected over a shorter time period. Archived data can also be used to inform the development of algorithms that determine an appropriate response for a given current condition to achieve the desired result.

ATDM initiatives may require the integration of and additional data from arterials, freeways, and/or transit operations systems in an entire corridor or region for effective, reliable, and proactive management. To be more proactive, additional real-time data feeds with reduced latencies, increased accuracy, and better geographic coverage are needed. Regions should leverage inter-agency data coordination and warehousing, when available, in order to receive and provide seamless, real-time traveler information as well as utilize that comprehensive data set to better manage the dynamic transportation network and conduct evaluations. This increased data may also require better data fusion, data processing and communications systems in the field and TMC that link data sources to calculate system performance measures in real time. Proactive management requires increased real-time situational awareness and therefore increased data processing capabilities, such as data mining tools, data fusion systems, prediction systems, and decision support systems to analyze and proactively respond to real-time conditions, due to the increased complexity associated with real-time data capture and response beyond traditional ITS. Consider the following ATDM operations data examples:

Even agencies that are "data rich" will likely need to deploy new infrastructure to collect additional data to fill in gaps. The Washington State DOT deployed ATM signage every half-mile on three corridors and found that variable speed limits required additional detectors for geographic coverage from one-mile spacing to one-quarter mile spacing, and improved resolution from five-minute to 20-second aggregated data.



Source: WSDOT

Active Traffic Management (ATM)

Dynamic signage with variable speed limits and lane control guidance requires detailed volume, density, occupancy, travel time, and/or speed data for very short-distance segments for incident detection and as inputs about incident location and lane closures for an algorithm to generate automated responses. This data may also drive the system requirements during the planning stages. Although manual input may be required, sufficiently robust data and processing systems may be able to automatically detect incidents and/or changes in vehicle speeds.

Active Demand Management (ADM)

Automated variable pricing algorithms require real-time data on volume, vehicle occupancy, density, and speed, possibly in conjunction with historical data, to calculate appropriate prices at any given time for the current demand, and potentially activate incentive programs during peak periods of congestion. For example, the number of free high-occupancy vehicles (HOVs) that will not be impacted by pricing changes needs to be known to calculate the appropriate price for tolled vehicles in order to sufficiently manage volumes to maintain speeds above the designated threshold.

Active Parking Management (APM)

Dynamic parking pricing requires real-time parking occupancy data, in conjunction with historic parking demand data, for an automated algorithm to calculate appropriate parking prices at any given time for the current demand to maintain a specific threshold of available parking while reducing congestion related to motorists looking for parking.

Higher quality data can enable a higher quality, more dynamic response. It reduces the risk and uncertainty of both the current and future conditions on the transportation network. Higher quality data enables agencies to more closely monitor the result of the public's response to an ATDM solution (or group of solutions) and then modify the deployment if the initial response did not have the desired impact.

Deploying ATDM concepts often requires a high-level output that may involve different amounts and types of data. ATDM may mean that an agency must upgrade displayed outputs from a color-coded traffic speed map to precise speeds on short segments for operator verification, as well as inputs for an automated algorithm, when variable speed limits or managed lane pricing systems are deployed. Even agencies that are already data rich may need to deploy new infrastructure to collect additional data to fill in gaps. The scale of this additional investment to collect necessary data will depend on the complexity of the ATDM deployment, as well as the availability of current geographic coverage and data resolution. While deploying additional sensors and detectors may be expensive, doing so is critical for successful operations and is likely to result in long-term cost savings.

The Urban Partnership Agreement (UPA) and Congestion Reduction Demonstration (CRD) programs implemented congestion pricing for parking and managed lanes, as well as transportation demand management and advanced technology solutions in six U.S. cities. A comprehensive before-after evaluation effort examined numerous performance measures, such as average parking occupancy and mean parking search time for APM; travel time, travel time reliability, and throughput measures for mobility, comparing managed lanes performance with the general purpose lanes; change in number and severity of crashes for safety. Exogenous factors considered included fuel price, unemployment rate, and road work. For more information on the UPA/CRD programs, see: *http://ops.fhwa.dot.gov/congestionpricing/urb_partner_agree.htm*.

Source: SFMTA

Maintenance as it pertains to the resilience of the data is also an important consideration. A certain level of redundancy or planning for outages is important for continuing operations. For example, both SF*park* and Los Angeles Express Park™ experienced hardware issues with the parking sensors within two years of deploying Active Parking Management. Los Angeles Express Park™ had a maintenance contract that included replacement of faulty sensors. Conversely, SF*park* chose to remove the sensors from the agency's decisionmaking and instead decided to adapt a variable parking pricing algorithm based on payment data. This approach was developed using the rich dataset of payment and occupancy data from the time that the sensors were active, and was found to be reasonably accurate.

DATA NEEDS FOR MONITORING AND EVALUATION

As discussed previously, an agency's identified ATDM needs should be associated with SMART objectives that have a corresponding means of measurement. The data associated with these objectives are critical for tracking ATDM deployment progress by assessing day-to-day performance targets, as well as driving management decisions for future expansion and deployment within a region. This data is also key in providing performance measures to inform the public about how the system is performing over time. While the concept of linking ATDM solutions to existing operations objectives is simple, limitations in the data needed for monitoring, evaluating, and enhancing performance and difficulty in agreeing upon the appropriate target or timeframe for achievement may hinder agency efforts. Developing ATDM operations objectives requires data on baseline conditions and often requires forecasts of future conditions.

ATDM operations objectives are inextricably tied to performance measures. Performance measures should be developed based on the individual needs and resources of each agency. Performance measurement is an iterative process, as operations objectives may be refined once performance measures are developed and baseline data is collected. Some performance measures may be project-specific and determined based on project objectives. Reported performance measures may initially be limited by available data. However, ATDM deployment evaluations often have an advantage over traditional ITS or operations analyses in that the additional and higher-resolution data required for ATDM operations makes for a more comprehensive evaluation. That said, it is important that agencies ensure these data are archived for evaluation. Agencies should also make the effort to collect data, which is typically identified in the ATDM planning stage,

to effectively assess outcomes against the regional goals and objectives. Generally, performance measures for ATDM will employ similar data and techniques that are used for analyzing traditional ITS and operations. As more data becomes available, performance trends should be calculated to provide a comprehensive picture of system and ATDM performance over time. The following includes a list of potential measures which may be used to evaluate system performance and ATDM deployments:

• Average Travel Time	• Travel Delay	• Bike/Ped Accessibility
• Travel Time Reliability	• Non-Recurring Delay	• Transit Use
• Travel Time Buffer Index	• Average System Speed	• Transit vs Auto Travel Time
• Travel Time x^{th} Percentile	• Incident Info. Dissemination	• Transit On-Time Performance
• Planning Time Index	• Incident Severity	• Mode Share
• Vehicle Miles Traveled	• Incident Clearance Time	• Parking Occupancy
• Congestion Level	• Road Weather Clearance Time	• Number of Citations
• Traffic Density	• Queue Length	• Customer Satisfaction
• Traffic Volume	• Occupancy	• Reduced Trips

Supplementary data should also be collected in order to understand and separate the impacts of exogenous factors, particularly since the impacts of an ATDM deployment may be much smaller by comparison. For instance, the price of fuel, unemployment rates, other highway improvements, and work zones can all affect traveler behavior and cause significant mobility and safety impacts that result in anomalies in baseline and post-deployment data, and potentially diminish the impact of the ATDM initiative. Carefully selected data and performance measures are key to a successful evaluation since not all performance measures are always easily calculated due to exogenous factors, data availability, or data quality issues. This is especially important for an evaluation of ATDM deployments, where the measured improvement may be more subtle.

For additional information on performance measures, refer to FHWA's "Guide for Highway Capacity and Operations Analysis of ATDM Strategies: Analysis of Operational Strategies under Varying Demand and Capacity Conditions" (FHWA-HOP-13-042) on FHWA's Office of Operations website: *http://www.ops.fhwa.dot.gov/publications/fhwahop13042/fhwahop13042.pdf.*

In summary, the tools and approaches of active management can help agencies take advantage of the big data environment to transform transportation operations, resulting in the realization of ATDM goals: *increased system productivity, efficiency, and safety.*

HOW CAN I FIND OUT MORE?

The ATDM Program is intended to support agencies and regions considering moving towards an active management approach. Through workshops, tools, guidance documents, resources, and peer exchanges, the program can assist with the technical support needed to implement ATDM. Importantly, ATDM is not an exclusive program restricted to specific agencies. Every agency that is considering moving towards active and dynamic capabilities can benefit from the ATDM program's efforts.

The FHWA's ATDM Website has additional information on ATDM concepts and tactics, current research, future events, and available resources, including resources to help agencies prioritize potential ATDM deployments: *http://ops.fhwa.dot.gov/atdm/about/program.htm.*

ATDM Informational Briefs

This informational brief is one in a suite of outreach materials. Other available briefs include:

- ATDM Program Overview
- ATDM Program Brief: ATM
- ATDM Program Brief: ADM
- ATDM Program Brief: APM
- ATDM Program Brief: ATDM and Work Zones
- International Influence on ATDM in the US

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