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Enhancement and Outreach for the Active Management Screening Tool

Final Report

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16. Abstract

Active traffic management—widely deployed for decades in Europe but in its infancy in the United States—maximizes the effectiveness and efficiency of the facility, and increases throughput and safety through integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly. In a previous UTCM project (TRID Online Accession #01364063) the principal investigator completed a beta version of an Active Management Screening Tool (AMST) for use by agencies in their congestion management process. The purpose of the AMST is to help agencies better assess the potential of active management strategies for their region. It is structured to provide beneficial information and guidance related to active management strategies in all areas and levels of transportation planning. Active management strategies included in the tool are: HOV lanes, HOT lanes; express toll lanes; non-tolled express lanes; exclusive/dedicated truck lanes; exclusive transitways; temporary shoulder use; speed harmonization; queue warning; dynamic rerouting and traveler information; ramp metering; dynamic merge control; and automated enforcement. This project enhanced the AMST with recent and emerging research and domestic experiences to make it a more robust product. The project also enhanced the website developed in the previous UTCM project to incorporate recent development and changes in the newly formed Active Transportation and Demand Management program within the Federal Highway Administration. Furthermore, by reaching out to practitioners across the country regarding the availability of the AMST, this project can have a positive impact on transportation networks by providing a tool to assess appropriate active management strategies for a region.

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ENHANCEMENT AND OUTREACH FOR THE ACTIVE MANAGEMENT SCREENING TOOL

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Disclaimer

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Executive Summary

Active traffic management—widely deployed for decades in Europe but in its infancy in the United States—maximizes the effectiveness and efficiency of the facility, and increases throughput and safety through integrated systems with new technology, including the automation of dynamic deployment to optimize performance quickly. Agencies that are challenged with finding good guidance on deployment alternatives can use the Active Management Screening Tool (AMST), developed in a previous project, for their congestion management process. Potential transportation improvements can include an increase in average throughput for congested periods, an increase in overall capacity, a decrease in primary accidents, a decrease in secondary accidents, a decrease in accident severity, an overall harmonization of speeds during congested periods, an increase in trip reliability, and the ability to delay the onset of freeway breakdown.

AMST is an online tool that provides beneficial information and guidance related to active management strategies in all areas and levels of transportation planning. Active management strategies included in the tool are:

- HOV lanes.
- HOT lanes.
- Express toll lanes.
- Non-tolled express lanes.
- Exclusive/dedicated truck lanes.
- Exclusive transitways.
- Temporary shoulder use.
- Speed harmonization.
- Queue warning.
- Dynamic rerouting and traveler information.
- Ramp metering.
- Dynamic merge control.
- Automated enforcement.

This project enhanced the AMST with recent and emerging research and domestic experiences to make it a more robust product. The project also enhanced the website to incorporate recent development and changes in the newly formed Active Transportation and Demand Management program within the Federal Highway Administration.

AMST shows which operational strategies an agency might include in the regional transportation plan that have the potential to provide the most benefit to the regional transportation network. The AMST ascertains, at the appropriate screening level, major attributes about candidate corridors that help determine if any active management strategy is suitable, and in successive steps which strategy and program needs best respond to the mobility, safety, and environmental needs of the corridor. By reaching out to practitioners across the country regarding the availability of the AMST, this project can have a positive impact on transportation networks by providing a tool to assess appropriate active management strategies for a region.

Chapter 1: Background

Document Overview

In response to the growing pressure for agencies to do more with less and address congestion challenges from all aspects of the network, the FHWA sponsored two International Technology Scanning studies of Europe in 2005 and 2006 to examine the congestion management programs, policies, and experiences of other countries that are either in the planning stages, have been implemented, or are operating on freeway facilities. The 2005 scan focused on European approaches to demand management, including operational strategies. It primarily addressed travel demand reduction strategies such as the use of traveler information to influence travel before and while it is occurring. One main conclusion of this scan was the need to integrate the approach of managing demand into the daily management and operations of the highway system (*1*). The 2006 scan examined the congestion management programs, policies, and experiences of other countries that are either in the planning stages, have been implemented, or are operating on freeway facilities. This scan sought information on how agencies approach highway congestion and revealed a complete package of strategies that make up the broad concept of active traffic management. This approach to congestion management is more holistic and is considered the next step in congestion management of freeway corridors. The scan tour defined active traffic management as the ability to dynamically manage recurrent and non-recurrent congestion based on prevailing traffic conditions (*2*). Active traffic management (ATM) strategies can be automated, combined, and integrated to fully optimize the existing infrastructure and provide measurable benefits to the transportation network and the motoring public. These strategies include but are not limited to speed harmonization, temporary shoulder use, junction control, queue warning, ramp metering, lane restrictions, and dynamic rerouting and traveler information.

It is clear that the concepts of ATM and travel demand management (TDM) are very closely linked. TDM works to reduce overall demand on the already overburdened system while ATM works to manage system demand to optimize capacity and improve reliability. As a result of the increasing interest in these congestion management approaches and their complementary objectives and measures, the FHWA Office of Operations sees a new vision that blends ATM and TDM into the broader and holistic approach to management and operations of active transportation and demand management (ATDM). Many urban corridors in most large cities have been expanded to the extent feasible from subsequent widening projects, leaving few options to improving performance and efficiency other than the combined efforts of TDM and ATM. Limited resources will require investments in strategies that generate greater efficiencies without requisite environmental or safety impacts. The current fiscal and physical environment lends itself to greater reliance on the holistic approach of ATDM.

ATDM is in the early deployment phase in the United States when compared to Europe. Only a handful of states have deployed some type of ATDM approach, and agencies are challenged with finding good guidance on deployment alternatives.

Scope and Purpose

The primary intent of this project was to enhance the Active Management Screening Tool (AMST) with recent and emerging research and domestic experiences related to ATDM to make it a more robust product. The purpose of the AMST, a beta version of which was developed for the FHWA Office of Planning, is to help agencies better assess the potential of active management strategies for their region. The AMST is structured to provide beneficial information and guidance related to active management strategies. It directly links the transportation planning process with operations by providing regions with information on which operational strategies they might include in the regional transportation plan that have the potential to provide the most benefit to the regional transportation network. The AMST ascertains at the appropriate screening level, major attributes about candidate corridors that help determine if any active management strategy is suitable and appropriate, and in successive steps which strategy and its companion support facility and program needs best respond to the mobility, safety, and environmental needs of the corridor. Active management strategies included in the tool are:

- dynamic pricing, dynamic ridesharing,
- on-demand transit,
- predictive traveler information,
- adaptive ramp metering,
- dynamic lane use control,
- dynamic merge control,
- dynamic speed limits,
- dynamic traveler information and rerouting,
- dynamic truck restrictions,
- queue warning,
- dynamic parking capacity,
- dynamic parking reservation,
- dynamically priced parking,
- dynamic wayfinding,
- high occupancy vehicle lanes,
- high occupancy toll lanes,
- express tolled and non-tolled lanes,
- exclusive/dedicated truck lanes, and
- exclusive transitways.

The project also enhanced the website developed in a previous UTCM project to incorporate recent development and changes in the newly formed Active Transportation and Demand Management program within FHWA.

Intended Audiences and Uses

It is envisioned that state departments of transportation and their partnering agencies—including metropolitan planning organizations, transit authorities, commuter organizations, toll authorities, and regional mobility authorities—will have an interest in the results for assessing the best approach for ATDM approaches in their region. This project may also identify research gaps that can be pursued in other avenues and with sponsoring agencies that have a vested interest in the subject.

Chapter Summary

The following chapters are included in this report:

- **Chapter 1—Background**: Provides the background, scope, and purpose of the project; identifies the intended audiences and uses for the project results; and gives a summary of the report components.

- **Chapter 2—A Review of Active Transportation and Demand Management Strategies**: Details a comprehensive review of operational approaches that comprise active transportation and demand management, including active demand management, active parking management, and active traffic management.

- **Chapter 3—Updating the Active Management Screening Tool:** Describes the process for updating the AMST to incorporate the new elements covered in the project.

- **Chapter 4—Updating the ATDM Website:** Provides the philosophy and process for updating the ATDM website and an overview of the information contained therein.

- **Chapter 5—Final Remarks:** Provides a final comment on the project and highlights the overall benefits of the study.

Chapter 2: A Review of Active Transportation and Demand Management

Active Transportation Demand Management is a newly formed program within the Federal Highway Administration. 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. ATDM is in the early deployment phase in the United States when compared to Europe. Only a handful of states have deployed some type of ATM strategy, and agencies are challenged with finding good guidance on deployment alternatives.

When examining the strategies and concepts it is clear that ATM and TDM are very closely linked. TDM works to reduce overall demand on the already overburdened system, while ATM works to manage system demand to optimize capacity and improve reliability. As a result of the increasing interest in these congestion management approaches and their complementary objectives and measures, the FHWA Office of Operations sees a new vision that blends ATM and MTD into the broader and holistic approach to management and operations of ATDM. Many urban corridors in most large cities have been expanded to the extent feasible from subsequent widening projects, leaving few options to improving performance and efficiency other than the combined efforts of TDM and ATM. Limited resources will require investments in strategies that generate greater efficiencies without requisite environmental or safety impacts. The current fiscal and physical environment lends itself to greater reliance on the holistic approach of Active Transportation and Demand Management.

Active Demand Management Strategies

The continuing growth of both the population and the number of vehicles worldwide have affected travel demand in many countries around the world through increases of traffic congestion and demand on infrastructure. One attempt to address this problem is the advent of travel demand management. Some TDM strategies can be traced back to the 1940s and World War II when company buses, carpools , and staggered work shifts were introduced to attract employees and manage worksite congestion problems caused by increased production demand (*3*). Active demand management strategies, i.e., active and dynamic approaches to TDM, work to influence traveler behavior before a trip begins. Active parking management approaches work to influence traveler behavior based on the availability and cost of parking at the termination of the trip. Both of these approaches can complement ATM approaches as part of the overall ATDM movement. The following sections discuss several active demand and active parking management strategies that can play a significant and relational role in the development of ATDM approaches to enhance mobility on and efficiency of the transportation system. The following sections provide brief descriptions of active demand strategies that fall with the overall concept of ATDM.

Dynamic Ridesharing

Carpooling was one of the earliest TDM strategies introduced in the 1940s. Over the years, two types of carpooling have emerged as separate strategies, formal carpooling, and informal carpooling. Benefits derived from carpooling include time savings through access to high occupancy vehicle (HOV) lane facilities, savings through shared cost of commuting, and improvement of air quality.

Formal carpooling is described as a formal arrangement where several participants regularly commute together in one vehicle. The participants share commuting costs and often take turns driving (*4*). Carpooling is often encouraged by employers and authorities in areas where congestion and parking pressures are prevalent. Some employers provide incentives for carpooling by providing employees: ride-matching, priority parking, and financial incentives to off-set fuel costs of carpool operation (*5*).

Informal or casual carpools have formed with the introduction of HOV lanes and tolls. Casual car pools also known as “slugging” in some areas are formed when drivers and passengers who do not know each other meet at designated locations. This form of carpooling, a form of dynamic ridesharing, is prevalent in various metropolitan areas, such as Washington, D.C., northern Virginia, Houston, Pittsburg, and California (*6, 7*). A definition of real-time or dynamic ridesharing is a single or recurring rideshare trip with no fixed schedule, organized on a one-time basis, with matching participants occurring as little as a few minutes before departure or as far in advance as the evening before a trip is scheduled to take place (*8*). It often emerges in corridors with HOV lanes that have a 3+ requirements, which are often more difficult to form on a formal and reliable basis than 2+ carpools. The East Bay area and San Francisco have over 26 locations for dynamic ridesharing pickups and have existed for more than 30 years (*9*). The carpools, which are not run by any organization, are often organized through the internet and have rules and etiquette for both drivers and passengers. New technologies offer the prospect of improving the practice of dynamic ridesharing with safety, efficient payment, and service on both managed lanes and traditional freeways.

The success of casual carpools have spawned another type of dynamic ridesharing: ride credit ridesharing. Entrepreneurial groups such as the Raspberry Express (*10*) in New Zealand have organized a ridesharing route based system that eliminates some of the hesitation from casual carpooling. The Raspberry Express screens all participants, once participants are screened they receive a membership card, this provides a sense of safety for participants. Participants receive ride credits for driving and taking passengers, while passengers spend or give credits for riding. If a passenger needs a ride because of late work, a ride is provided by the Raspberry Express back to their car at no charge. Costs to utilize the system include an application fee, ride credits, and a service fee. Ride credits may be purchased, if a person does not wish to drive (*9*).

On-Demand Transit

On-demand transit is an evolution of traditional fixed-route transit that utilizes technology to optimize service in a dedicated area that might otherwise not have transit operations, which may not be receptive to transit, or which have built environments configured such that higher forms of transit are ineffective and costly (*11*).

Key features within the service area that can contribute to highly effective on-demand type services include:

- A major transfer point (i.e., rail station);
- Numerous mid-day activities (grocer, department stores, medical facilities); and
- A desire on the part of the transit agency to “right-size” rolling stock (*11*).

Furthermore, higher on-demand transit productivity is associated with specific market characteristics:

- A mix of land uses;
- Moderate population and employment density;
- A small-to-moderate service area size;
- Moderate income of residents in the area; and
- Elements of community setting are important determinants of successful service (*11*).

Higher on-demand transit productivity is also associated with such service characteristics as route deviation (flex route), operators that tend to limit route deviations (< 15%) through fare surcharges and allocating less flex time, feeder services with scheduled connections and spontaneous boarding, as well as integration with fixed-route services (*11*). Figure 1 through Figure 6 provide examples of different types of on-demand services that capitalize on these features and market characteristics to provide optimal service for the area.

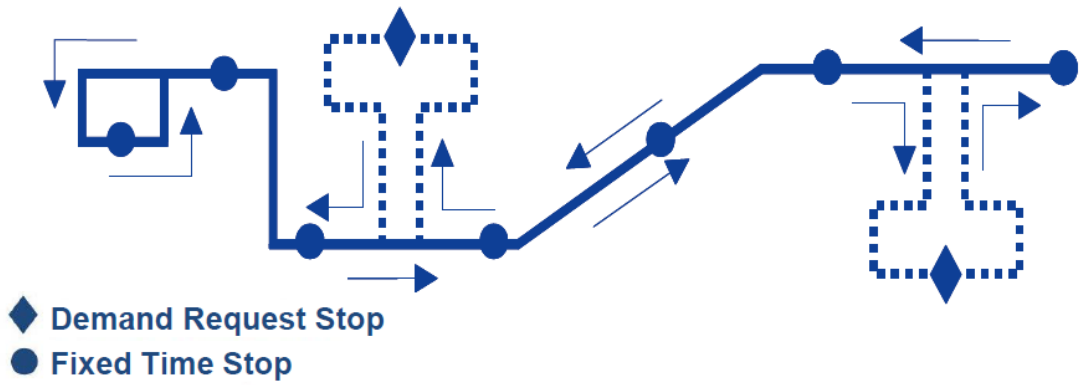

Figure 1. Deviated-Route Service (*11*).

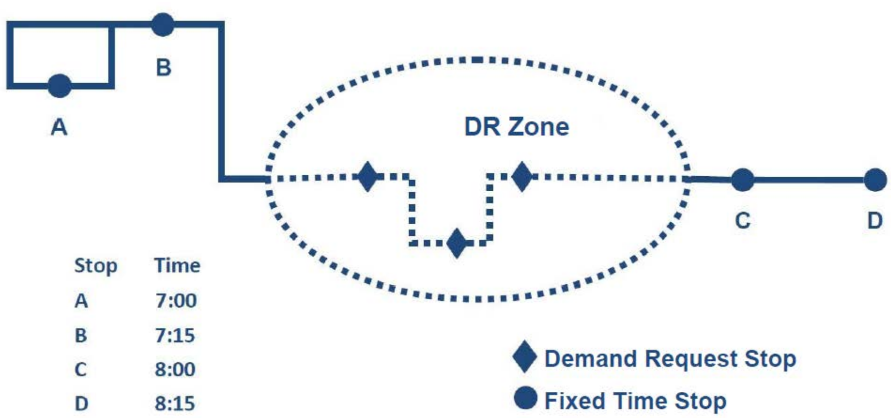

Figure 2. Flexible-Route Segment Service (*11*).

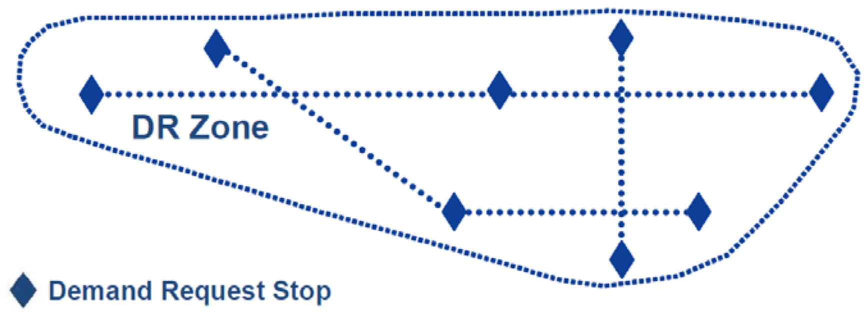

Figure 3. Demand Response Service (*11*).

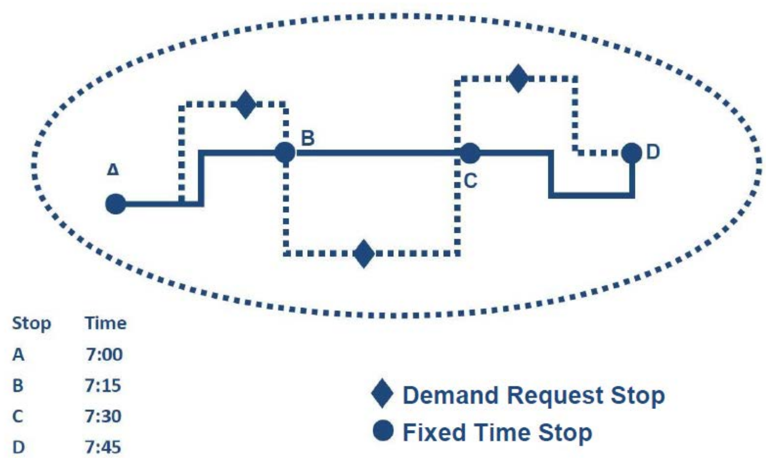

Figure 4. Point Deviation Service (*11*).

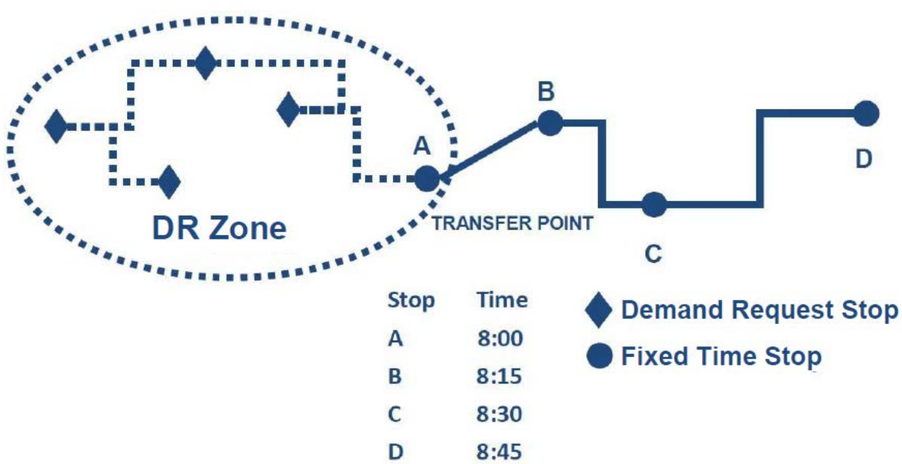

Figure 5. Demand Response Connector Service (*11*).

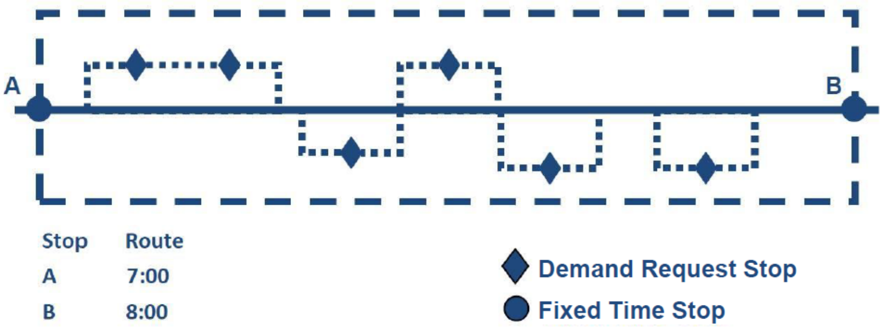

Figure 6. Zone Route Service (*11*).

Technology plays a key role in the success and flexibility of on-demand transit. Technology facilitates the connectivity between riders, drivers, and transit management. Key facilitating technologies include automatic vehicle location (AVL); mobile data terminals/tablets (MDTs); communications (cellular, click-to-talk, radio); and routing, scheduling, and trip-request software. Regions that have implemented on-demand transit with success include Denver, Dallas, San Diego, and Chicago (*12*).

Dynamic Pricing

Road pricing is the imposition of a fee for the use of a roadway facility (*13*). Within this context, two primary types of road pricing exist: tolling and pricing. Tolling is the form of road pricing that is the collection of a fixed fee from motorists for using a facility, used to generate to revenue. Pricing is the use of tolls that vary by demand and are used to generate revenue in addition to managing congestion. Road pricing in the form of congestion pricing can act as a tool for demand management. Through the implementation of priced lanes (one or more lanes on a roadway facility that offer a reliable alternative in congested corridors) or priced highways (pricing on all lanes on a roadway facility that encourages off-peak trips or mode shift), agencies can work to influence driver behavior via pricing (*13*). They key component that makes road pricing fall within the purview of active demand management is the dynamic aspect of the pricing, which is the real-time and proactive adjustment of pricing to optimize facility performance. An agency adjusts tolling rates in response to changing conditions (*13*). One caveat is that electronic toll collection is essential to effective dynamic pricing.

The I-15 Express Lanes in San Diego are an excellent example of dynamic pricing. The 20-mile facility on I-15 between SR 163 and SR 78 is an expressway within a freeway. Operating 24 hours a day, 7 days a week, the I-15 Express Lanes offer a reliable alternative to users. Carpools, vanpools, motorcycles, and some clean are vehicles have free access to the facility while all other users may pay for the privilege of using the facility using electronic toll collection (*14*). On the dynamic front, tolls are based on travel distance and express lane congestion. The price for access can be adjusted every 6 minutes and ranges from $0.50 to $8.00 in the peak of the peak. The California Highway Patrol verifies vehicle occupancy at each tolling zone (*14*).

Predictive Traveler Information

Traveler information has been a key component of urban traffic management for several decades. As technology and the availability of real-time data have advanced in recent years, agencies have the ability to be more proactive in providing traveler information to reduce the impact of recurring and non-recurring congestion. Dynamic rerouting and traveler information is the practice of redirecting traffic to avoid unequal levels on service on parallel routes. The intent is to provide users with viable route alternatives, and the approach can be especially beneficial in helping reduce the impact of noncurrent congestion (*15*). A new direction can be suggested while the standard routing remains, or if the hardware allows it, the standard routing may be substituted by the recommended one.

Providing rerouting and traveler information in a dynamic manner is a critical component of a successful ATDM approach (*2*). An approach that can complement and enhance dynamic traveler information is prediction. Agencies can utilize real-time data and historical data along with information related to planned events to predict congested conditions and convey that information to travelers and also to provide relevant rerouting information. Also, for unplanned events, the system can use the same data to predict the impacts of the event and determine alternate route information and/or convey predicted delay information to system users. This approach is a more robust method of providing dynamic traveler information and can be applied in rural and urban settings for both recurring congestion and non-recurring congestion as a result of incidents or construction activities.

Active Parking Management Strategies

Active parking management is the dynamic management of parking facilities in a region to optimize performance and utilization of those facilities while influencing travel behavior at various stages along the trip making process. Dynamically managing parking can affect travel demand by influencing trip timing choices, mode choice, as well as parking facility choice at the end of the trip. This ATDM approach can also have a positive impact on localized traffic flow by providing real-time parking information to users and ensuring the availability of spaces to reduce circling around parking facilities. The overall goal is to help maximize the nation's transportation infrastructure investments, reduce congestion, and improve safety (*16*). The following sections provide brief descriptions of active parking management strategies that fall within the larger concept of ATDM. Typically, regions will implement a combination of these approaches to maximize the utilization of their parking facilities.

Dynamic Parking Reservation

Reservation systems deployment is a relatively new concept of TDM for congested metropolitan areas (*17*). Reservations systems in TDM require a user to follow a booking procedure prior to traveling. This booking procedure would then allow the traveler access to a specific facility or resource such as travel slots in a congested downtown area. The authors envision that the system could be applied to congested area such as a central business district. This strategy is still in the conceptual phase as a stand-alone ATM strategy; however the reservation system concept is employed in other strategies such as parking management (*17*).

Numerous cities and airports have also implemented advanced parking management systems also known as parking reservations systems for areas that have limited parking availability or are subject to traffic congestion. In the U.S., advanced parking management systems have seen the widest application in airports including Baltimore-Washington International (BWI) Airport, Orlando International Airport, and Detroit's Wayne County International Airport. More limited applications include systems in Pittsburgh, St. Paul, Minnesota; Seattle, Washington; and Norfolk, Virginia. In 2005, transit park-and-ride applications were initiated in Chicago, Illinois; and San Francisco, California (*18*, *19*).

Parking reservation systems may encompass lot parking, on street parking, or a combination of both in the designated area. The Pittsburgh Downtown Partnership has implemented ParkPGH for the downtown Cultural District (*18*). ParkPGH allows patrons to make reservations for parking at any of 11 participating garages. The parking reservations require 24-hour advance notice and are for the hours of 10 a.m. to 2 p.m. ParkPGH also provides real time parking information for the area. Parking updates are provided every 30 seconds and designate the available capacity through both a color system (green/yellow/red) and the number of spaces available. The real time parking information may be accessed through iPhone application, website, mobile website, text messaging, and telephone (*18*).

Dynamic Wayfinding

Searching for a parking spot, especially in congested downtown areas where curbside parking may be underpriced increases traffic congestion, wastes fuel, and may increase traffic collisions (*20*). A report by Donald Shoup of the University of California at Los Angeles estimated that between 8 and 74 percent of traffic in congested downtown areas may be caused by people cruising looking for parking spots.

A United Kingdom (UK) study by Cairns, Newson, and Davis (*21*) found that parking management was the single most important factor in determining the degree of success achieved through travel work plans. Successful corporation travel plans that addressed parking management included strategies that restricted parking for employees, introduced charges for parking, or provided incentive payments for joint commuting by employees or employees who chose other modes of transportation (*21*).

One solution for relieving this congestion is utilizing a smart parking system that provides dynamic wayfinding information. Such smart parking management systems have been implemented in numerous European, British, and Japanese cities to more efficiently use parking capacity at transit stations. The smart parking systems typically provide real-time dynamic information via changeable message signs (CMSs) to motorists about the number of available parking spaces in park-and-ride lots, departure time of the next train, and downstream roadway traffic conditions (e.g., accidents and delays) (*22*).

A smart parking system employs a series of installed sensors that monitor the availability of spaces for parking. This type of system can be used for both parking lots as well as curbside parking. In 2004, the California Partners for Advanced Transit (PATH) conducted a field test utilizing smart parking for Bay Area Rapid Transit (BART) (*23*). The test was conducted at the Rockridge Station in Oakland, California. The field test utilized 50 parking spaces and employed two real-time user interfaces:

- Two CMSs that displayed parking availability information to motorists on an adjacent commute corridor into downtown Oakland and San Francisco (Highway 24) and
- A centralized intelligent reservation system that permitted commuters to check parking availability and reserve a space via telephone, mobile phone, Internet, or PDA.

Those who used the system for en-route reservations called in their license plate number via mobile phone when they parked in the smart parking lot. BART enforcement personnel ensured that those parking in the smart parking lot either had: an advanced reservation parking permit or a license plate number, which matched one of the numbers provided real-time to enforcement personnel via PDA for en-route reservations (*20*). The results of the field test suggested that smart parking applications may be an effective way to expand transit ridership. However, the capital, operation, and maintenance costs presented in this paper do suggest that the system has to operate at a scale that is significantly larger than the field test (50 spaces at one station) to recover system costs (*20*, *21*).

Chicago and Seattle implemented advanced parking management systems that offer lot specific parking information. This information is transmitted to drivers through signs that provide both active and passive components. The passive component provides simple directions to facilities utilizing arrows and parking lot names, while the active component provides information on space availability in specific lots (*19*). The BWI Airport has a similar signing system. The BWI system also has active signage on each floor, which provides information on the availability of parking spaces at the floor, aisle, and parking space level (*19*).

There are numerous other cities and venues that offer a combination of dynamic and static message signs, reservations for parking, and other low-cost parking options. Some of the venues use reservation systems specifically for special events such as festivals and sporting events. In Lincoln, Nebraska, for example, an online system allows University of Nebraska football fans to reserve their downtown parking spaces in advance (*19*). Minute Maid Park is a baseball stadium located in downtown Houston, Texas. Although there are an estimated 25,000 parking spaces available within walking distance, finding a lot or place to park can be challenging to the casual sporting event visitor. Several parking lots have partnered with Minute Maid Park to allow parking reservations (*24*).

Dynamically Priced Parking

Pricing can play a key role in the utilization of parking facilities. As with other dynamic pricing strategies, parking prices can be adjusted based on demand to optimize utilization during peak periods and encourage travelers to adjust their trips and/or parking destination based on price and availability. When combined with real-time dynamic parking information and wayfinding, travelers circle less looking for spaces and otherwise empty spaces are filled.

The demonstration project in San Francisco, SF*park,* uses this demand-responsive approach to optimize parking in pilot neighborhoods. Using wireless parking sensors embedded in the pavement of parking spaces, the city monitors parking space availability and provides information to travelers as to where they can park. Parking rates vary by block, time of day, and day of week depending on demand (*25*). In areas where parking is difficult to find at specific times of the day, rates are increased incrementally until at least one space is available on each block most of the time. In areas where parking is readily available, prices are decreased until some of the empty spaces fill (*25*). Price adjustments can be made no more than once a month and can decrease no more than 50 cents per hour or increase on more than 25 cents per hour. The system combines the pricing and sensors with state-of-the-art parking meters and alternative payment methods to optimize parking in the region.

Dynamic Parking Capacity

A lesser-known approach to managing parking is the concept of dynamic parking capacity. Using innovative facilities and technology, parking facilities can expand to accommodate additional parkers in case of limited space. Elevated platforms can be used to add spaces above existing ones to create more stalls in existing facilities. New facilities can incorporate automated parking systems that maximize utilization and ensure security and ready access to vehicles.

Active Traffic Management Strategies

Traffic congestion is a problem found in industrialized countries worldwide, and every year the congestion problems grow. Since the 1980s, European countries, including Germany and the Netherlands, have started to evaluate the effectiveness of measures designed to increase capacity and safety on motorways without having to widen them. These measures include shoulder use, speed harmonization, queue warning, dynamic merge control, dynamic rerouting, and dynamic truck restrictions. All of these measures are grouped under one general name: Active Traffic Management.

ATM has proven effective in reducing congestion while requiring little to no geometric changes in the facilities. As explained later in detail, these measures can prove very efficient in managing congestion and safety on highways in the United States.

An inventory of active traffic management practices was constructed to capture how the different agencies in Europe and in the United States managed to implement the different ATM strategies. For each of the different strategies, specific points of interest were determined to describe what choices the different agencies had made and what their reasons were. The inventory was completed using information from a comprehensive literature review and email correspondence with the people who participated in the different applications of the strategies.

Dynamic Lane Use Control

Shoulder use, also known as hard shoulder running (HSR), is a measure designed to temporarily increase the capacity of a facility by opening one or sometimes both shoulders to traffic. In some instances, only transit buses are allowed to use the shoulder lane.

Dynamic Speed Limits

The concept of speed harmonization, also called variable speed limits or dynamic speed limits, is already in place in many countries and several states in the United States. Agencies choose speed harmonization to solve very different problems. The two most cited purposes for deploying speed harmonization are for weather-related conditions and congestion management. Depending on the goals of the agency, the speed can either be mandatory or advisory.

Queue Warning

The basic principle of queue warning is to inform travelers of the presence of upstream queues, based on utilizing dynamic traffic detection and using warning signs and flashing lights. This strategy allows the traveler to anticipate a situation of emergency braking and limit the extent of speed differentials, erratic behavior, and queuing-related collisions.

Dynamic Merge Control

Dynamic merge control, also termed junction control, is used when the sum of both freeway general purpose lanes and merging lanes at an interchange is higher than the number of downstream general purpose lanes. A combination of ramp metering and lane control at ramps, dynamic merge control is used to dynamically meter or close specific lanes upstream of the interchange to manage access based on traffic demand.

Dynamic Rerouting and Traveler Information

When the main road is congested, rerouting traffic on a parallel road to relieve further congestion can be an efficient strategy. Providing rerouting and traveler information in a dynamic manner is a critical component of a successful ATM system. The intent is to provide users with viable route alternatives, and the approach can be especially beneficial in helping reduce the impact of noncurrent congestion.

Dynamic Truck Restrictions

Restricting trucks to the right lane has several benefits. The treatment can increase capacity by up to 3 percent, the speed of the left lane can be higher, and safety is improved since no trucks are changing lanes.

Chapter 3: Updating the Active Management Screening Tool

The purpose of the AMST, a beta version of which was developed for FHWA, is to help agencies better assess the potential of active management strategies for their region. The AMST is structured to provide beneficial information and guidance related to active management strategies. It directly links the transportation planning process with operations by providing regions with information on which operational strategies they might include in the regional transportation plan that have the potential to provide the most benefit to the regional transportation network (*26*). The AMST ascertains at the appropriate screening level, major attributes about candidate corridors that help determine if any active management strategy is suitable and appropriate. It also determines in successive steps which strategy and its companion support facility and program needs best respond to the mobility, safety, and environmental needs of the corridor. Active management strategies included in the tool are: high occupancy vehicle lanes; high occupancy toll lanes; express tolled and non-tolled lanes; exclusive/dedicated truck lanes; exclusive transitways; temporary shoulder use; speed harmonization; queue warning; dynamic rerouting and traveler information; ramp metering; dynamic merge control; and automated enforcement. The project team incorporated additional information related to ADM and active parking management (APM) into the AMST to expand the strategies included that an agency can consider for deployment. With the online update of the tool, the team ensures that users of the tool have the latest information available via online access.

Screening Tool Goal and Objectives

The overall goal of the AMST is to assist in improving an existing congestion management process (CMP) by correlating the planning goals and objectives of the CMP to the particular active management strategies that can help attain those objectives. As a broad concept, the process of strategy selection is customizable by the depth of the screening mechanism as well as local priorities assigned to various objectives. Upon completion of the selection process, the tool presents information related to each strategy.

The specific objectives of the AMST are:

- To query users for a mode of tool operation based on the screening level (i.e., suitability screening, detailed screening, or prioritization of strategies).
- Based on the screening level, to query users for desired goals and objectives.
- Based on the screening level, to dynamically match goal and objective information to appropriate strategies.
- To narrow the initial screening results with user input constraint information.
- To report information to the user on the top strategy selections by the tool, including guidance, implementation considerations, data collection needs, and applicable performance measures.

Additionally, the AMST has certain functions to address usability, including specific objectives of:

- A robust user interface allowing for the storage, retrieval, and change of previously entered information, for a limited time period.
- A seamless update capability for the core database containing active management strategy information.
- Operation in a web-based environment supporting commonly used browsers.

AMST Framework

The overview of the framework for the AMST is shown in Figure 7. This is a high-level component diagram showcasing each main block of the application. Each section of the framework is numbered (1 through 8) for easier reference to Figure 7. Each application block is discussed in general below. Some application blocks where additional detail is necessary will be expanded upon, later in this section.

The tool starts with an introduction block (labeled as 1) that provides an overview of its purpose and instructions for use, and allows the user to save the results. After the introduction, the user is presented with a selection box (labeled as 2) for what type of analysis will be completed. This is a user-selectable process and will affect the path the user takes through the application by the application blocks, or components, that are presented. There are three types of users, or paths, for this application. The first is essentially a planning- or educational-level path, focusing primarily on learning the broad overview of active traffic management and what strategies are appropriate based on the broad goal areas. The second level is a path that utilizes more detail and focuses on refining the broad goals to specific objectives. The third path is for users that actually want to rank the most appropriate strategies based on specific information such as constraints and their relative weighting of the objectives.

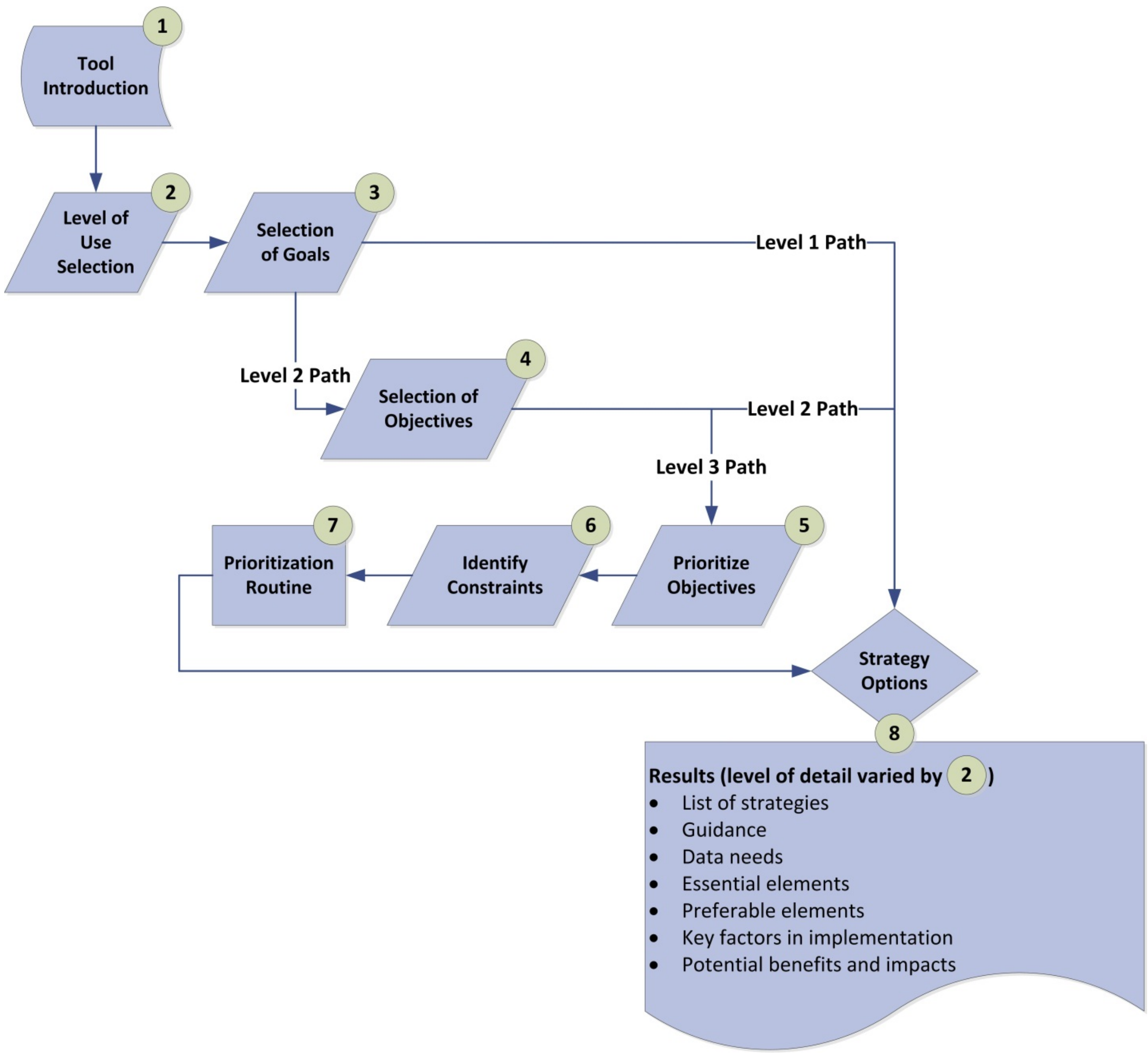

Figure 7. Overview of AMST framework.

The user then proceeds to select specific goals for utilizing or investigating active traffic management. The goals of active management strategies are varied and consist of items such as providing reliable alternatives, increasing mobility, optimizing existing capacity, and more. Within this application block (labeled as 3), the user is able to select goals that are specific to their potential uses, which is the first step in refining the strategy list.

As this juncture in the application, the first branch point is encountered. If the user entered a level 1 analysis in application block 2, the user is routed to application block 8 at the conclusion of selecting the appropriate goals. In application block 8, the user is presented with the applicable strategy options as well as broad information on each strategy matching the user's selected goals, including items to consider for implementation, data collection needs, applicable performance measures, and more.

If the user entered a level 2 analysis, the user continues to the next application block (labeled as 4). In application block 4, the user selects specific objectives. Objectives are really a refinement of the goal area. While goals are broad, objectives are narrow, precise, and measurable. The listing of objectives that are presented to the user is stored in a database, along with the goals from application block 3.

At this point in the application, the next branch point is encountered. If the level of use that was selected (refer to application block 1) was level 2, the application branches the user to application block 8 and presents strategy options as well as detailed information about each strategy option. If the level of use that was selected was 3, the user is routed to application block 5.

In application block 5, the user has the ability to weight the selected objectives in order to prioritize their importance. This prioritization can have a profound impact on the strategy selection and is therefore included as an integral component of the most detailed path.

The user then progresses to the identification of constraints, labeled as application block 6. Within this block, the application presents, for user selection, a listing of constraints (e.g., limited shoulder width, limited right-of-way) that are typically faced in these types of projects. Here again, the concept is to refine the wide range of strategy options to a ranked scale of applicability based on the user input information.

The actual weighting and ranking is done as a prioritization routine in application block 7. This routine weighs the relative importance of the objectives, in conjunction with the constraints, to determine the strategies that should be considered first. At the conclusion of the prioritization routine, the user is routed to application block 8, where the ranked list of strategy options are presented along with complete information on each option.

Application Database

As discussed briefly in the previous section, the application database utilizes the high-performance open-source solution MySQL®. While the strengths of that choice were discussed, the crucial component of the database solution is the information store. As a result of the different levels of users, multiple tables—each of which maps information differently—will be created, internal to the database. The main mappings are discussed below.

Mappings of Goals and Objectives to Strategies

The level 1 analysis depends on a mapping of goals versus strategies. This information is contained in the overall application database. An example of this database table is shown in Figure 8.

Active Management Operational Strategies		Provide a Reliable Alternative	Provide a Transportation System that Can Handle Current and Future Demand	Increase Mobility and Accessibility by Offering Travel Options	Provide Additional Facility Capacity	Optimize Existing Capacity	Optimi Existin Managed L Capaci
Pricing (P)	Value Priced Express Toll Lanes	•	•	•	•		•
	Express Toll Lanes Non-Value Priced	•	•	•	•		•
Vehicle Eligibility (V)	HOV Lanes	•	•	•	•		•
	Truck Restricted Lanes	•	•	•	•		•
Access Control (A)	Non-tolled Express Lanes	•	•	•	•		•
P + V	HOT Lanes	•	•	•	•		•
V + A	Exclusive Transitways	•	•	•	•		•
	Exclusive or Dedicated Truck Lanes	•	•	•	•		•
P + V + A	Multifaceted Managed Lanes	•	•	•		•	•
Active Traffic Management	Speed Harmonization	•		•		•	
	Temporary Shoulder Use	•	•	•	•	•	
	Queue Warning	•		•		•	
	Ramp Metering	•		•		•	
	Dynamic Merge Control	•	•	•	•	•	
	Dynamic Truck Restrictions	•		•	•	•	
	Dynamic Rerouting and Traveler Information	•	•	•		•	
	Automated Enforcement	•		•		•	

Figure 8. Example mapping of goals versus strategies for level 1 user.

In a similar manner, the level 2 analysis depends primarily on the mapping of objectives versus strategies. This mapping is also a table structure within the application database. A sample is shown in Figure 9.

Active Management Operational Strategies		Active Management Objectives																	
		Increase Vehicle-Carrying Capacity	Increase Person-Carrying Capacity	Increase Goods-Carrying Capacity	Maintain Free Flow Speed	Maintain or Improve Level of Service	Reduce Travel Time	Increase Trip Reliability	Provide Travel Alternatives	Reduce Peak Period Vehicle Trips	Improve Express Bus Service	Provide Transmodal Connectivity and Accessibility	Minimize Traffic Crashes Involving Large Trucks	Minimize Primary Traffic Crashes	Reduce Incident Severity	Minimize Secondary Crashes	Improve Air Quality from Mobile Sources	Reduction in Fuel Consumption	Address Environmental Justice Concerns
Pricing (P)	Value Priced Express Toll Lanes	*			*		*	*	*					*					
	Express Toll Lanes Non-Value Priced	*			*		*	*	*					*					
Vehicle Eligibility (V)	HOV Lanes	*	*		*	*	*	*	*	*	*			*			*	*	*
	Truck Restricted Lanes	*		*	*	*	*	*	*	*	*		*	*					*
Access Control (A)	Non-tolled Express Lanes	*					*	*						*					
P + V	HOT Lanes	*	*		*		*	*	*		*			*			*	*	*
V + A	Exclusive Transitways	*	*		*		*	*	*	*	*	*		*			*	*	*
	Exclusive or Dedicated Truck Lanes	*		*	*		*	*	*	*	*	*	*	*			*	*	*
P + V + A	Multifaceted Managed Lanes	*	*	*	*		*	*	*	*	*	*	*	*			*	*	*

Figure 9. Example mapping of objectives versus strategies for level 2 user.

Mappings to Display Strategy Information

In addition to the mappings of strategies versus goals and objectives, the database contains numerous additional tables to facilitate the presentation of information in application block 8. An example is shown in Figure 10, which details the relationships between various active management objectives and typical active management performance measures.

Active Management Objectives	Active Management Performance Measures																								
	Average Daily Traffic	Peak Hour Vehicle Traffic	Persons/Hour During Peak	Vehicle Occupancy Rate	Formation of HOV Groups	Bus Ridership	Persons/Hour of Total Freeway	Freight Travel	Change in Operating Speed	Density for an Improved LOS	Travel Time	Standard Deviation or Change in Travel Speed	Standard Deviation or Change in Travel Time	Shift Travel Behaviors to Off-Peak Traveling Times	Bus Efficiency	Bus Safety	Impacts to Neighborhood Acces s and Circulation	Traffic Accidents Involving Trucks	Traffic Accidents and Data	Emissions	Consumption of Fossil Fuels	Noise Levels	Impacts to Residences and Businesses	Revenue Generated by Tolling	Accelerated Construction and Implementation
Produce Enough Revenue to Cover Debt Service																								*	*
Private Investment Profit																								*	*
Generate More Uniform Speeds in Travel Lanes									*		*	*													
Decrease Headways between Vehicles										*															
Promote More Uniform Driver Behavior										*		*	*												
Delay Onset of Freeway Breakdown		*							*	*	*			*											
Reduce Traffic Noise																						*			

Figure 10. Example mapping of objectives versus performance measures.

User Information Database Components

In addition to the mappings discussed above, the database contains information relating to the user of the AMST. Primarily, this component of the database records user-specific information, such as the person's name and agency, and the associated level of use selection. This information, along with the strategy options, is preserved for a time period in the user information database. An example of the flow of information into the user information database is shown in Figure 11. The intention of this aspect of the application is to enable a user to return to the AMST at a later date/time and retrieve the information without having to re-enter and reselect items.

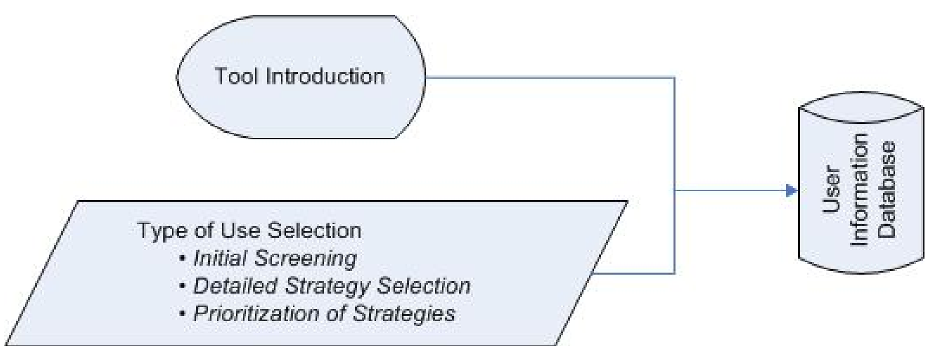

Figure 11. Diagram. User information database.

Chapter 4: Updating the ATDM Website

The project team updated the website previously developed for information dissemination regarding the subject of ATM. The new website is devoted to ATDM and expands the information provided on the subject. The following sections describe the update process undertaken during the project.

Graphic Design

The first step in the update of the site was the generation of a modified graphic design for the site. It was the desire of the project team was to rebrand the site with the ATDM concept while continuing to provide a site that is easy to navigate and reflective of the dynamic approach of ATDM. With the assistance of the graphic design experts at TTI, the project team developed a modified banner for the website that incorporates a logo, a photograph of a dynamic speed display implementation, a search box, and links to the various sections for the website. The banner is shown in Figure 12.

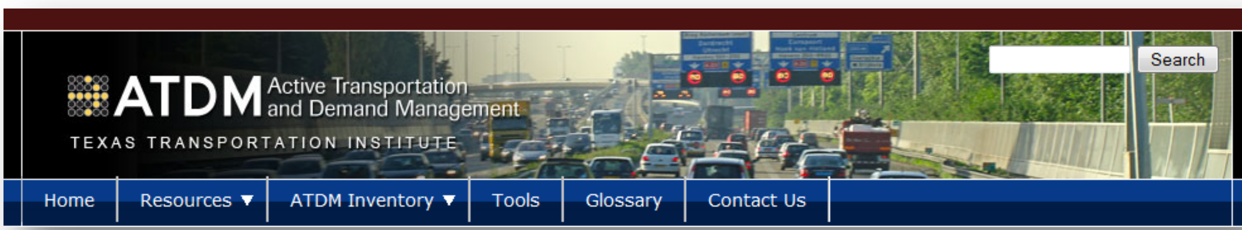

Figure 12. ATM website banner.

Database Update

The ATDM website is database driven to facilitate easy updating by staff when related documents, links, and information are available. The project team used Drupal® to update the content portion of the website to include additional resources and ATDM approaches, including ADM and APM strategies previously discussed. Drupal® is an open-source content management platform that is a powerful tool for website development (*27*). It allowed the developers to create modules that provide various website features and also facilitate easy management of the large number of resource documents and components that are included in the ATM website. Figure 13 is a screenshot of one of the Drupal® input screens used by the project team to import data.

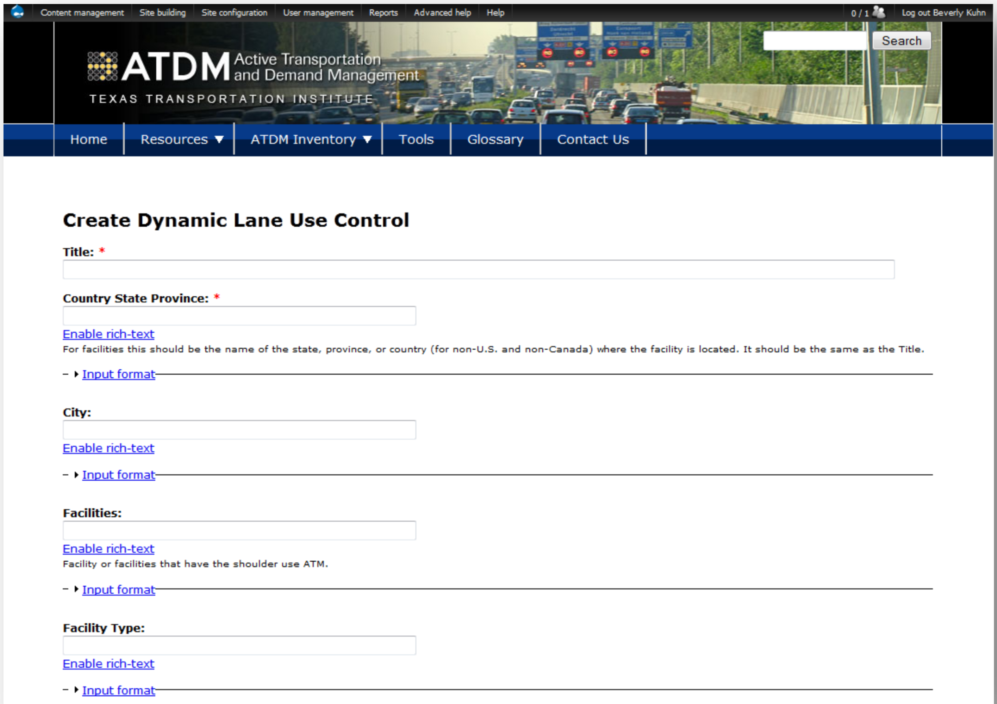

Figure 13. Website development input screen.

Website Sections

The ATDM website includes several key sections to provide key information for users. The first section is a main page that provides a brief overview of Active Transportation and Demand Management. It also provides the links to the main sections and a request for feedback from users if appropriate. A screenshot of the main page is shown in Figure 14. This page was updated to reflect the ATDM concept.

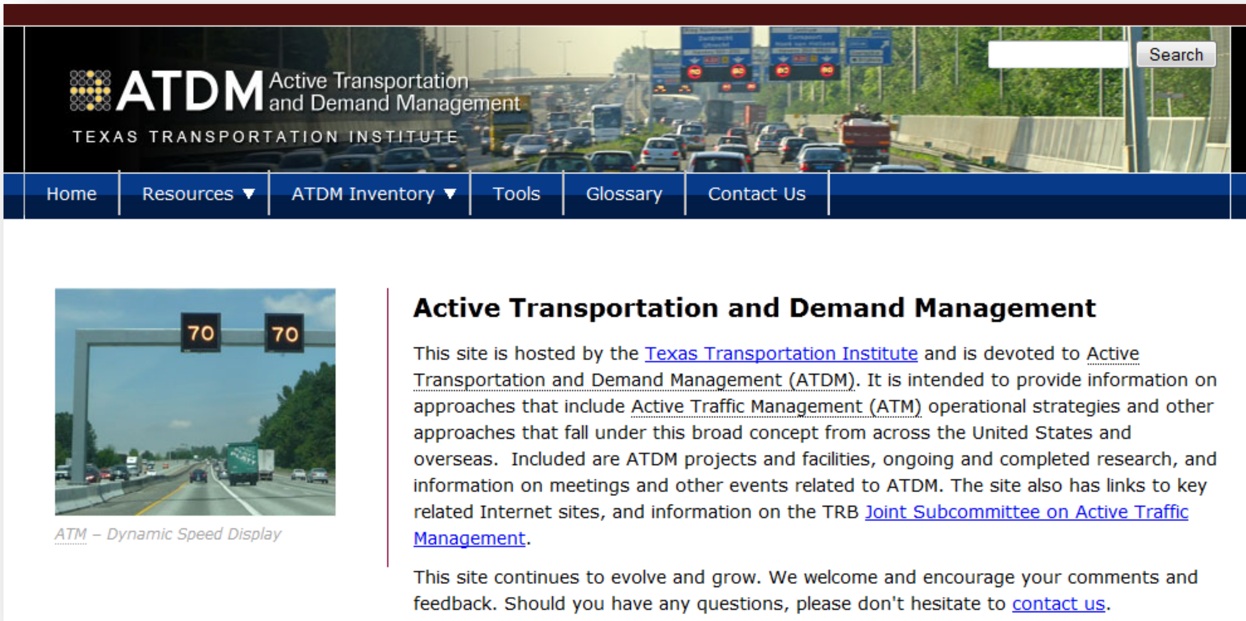

Figure 14. ATDM website main page.

A major section of the website is the ATDM inventory page. This page provides an inventory of ATDM operational facilities in the United States and overseas. These facilities are organized into three primary categories of active demand management, active traffic management, and active parking management. The specific strategies are accessible on the main inventory page and also accessible via a pull-down menu on the banner. These are organized in several subsections to make navigating this section logical and easy. A screenshot of the main inventory page, with links to the various subpages, is shown in Figure 15.

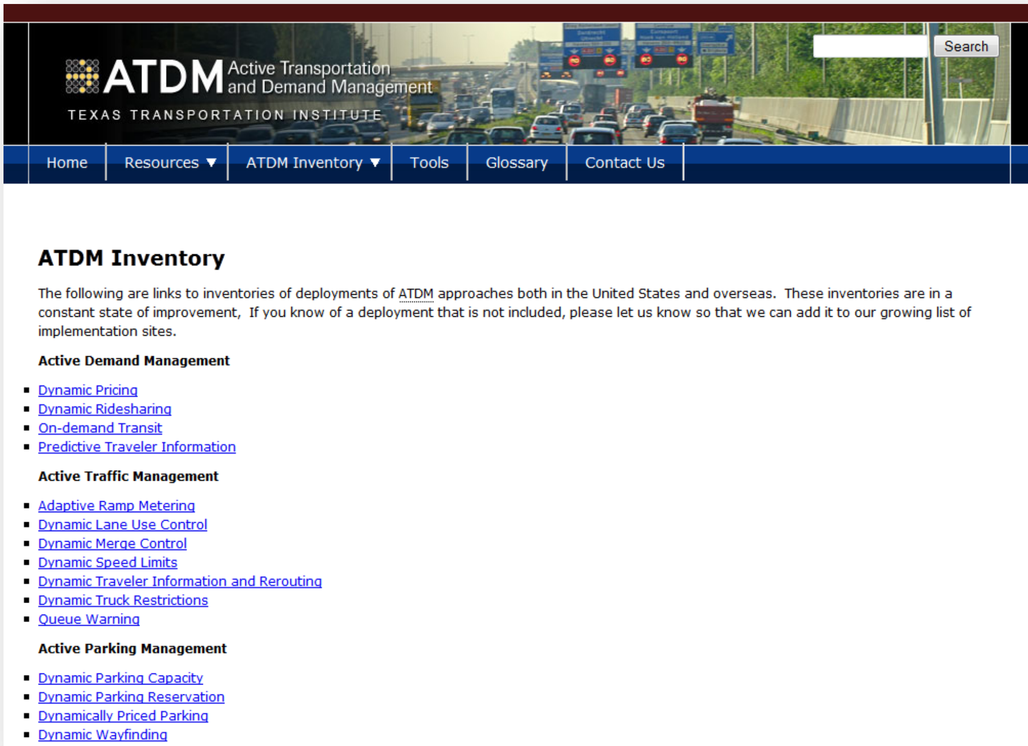

Figure 15. ATDM website ATDM Inventory page.

Another key section on the website is the ATDM glossary. This page provides a list of commonly used terms related to ATDM along with brief definitions for each. Additional terms related to ADM and APM were added to the glossary to expand the information contained in the glossary. A shot of the Glossary page is shown in Figure 16.

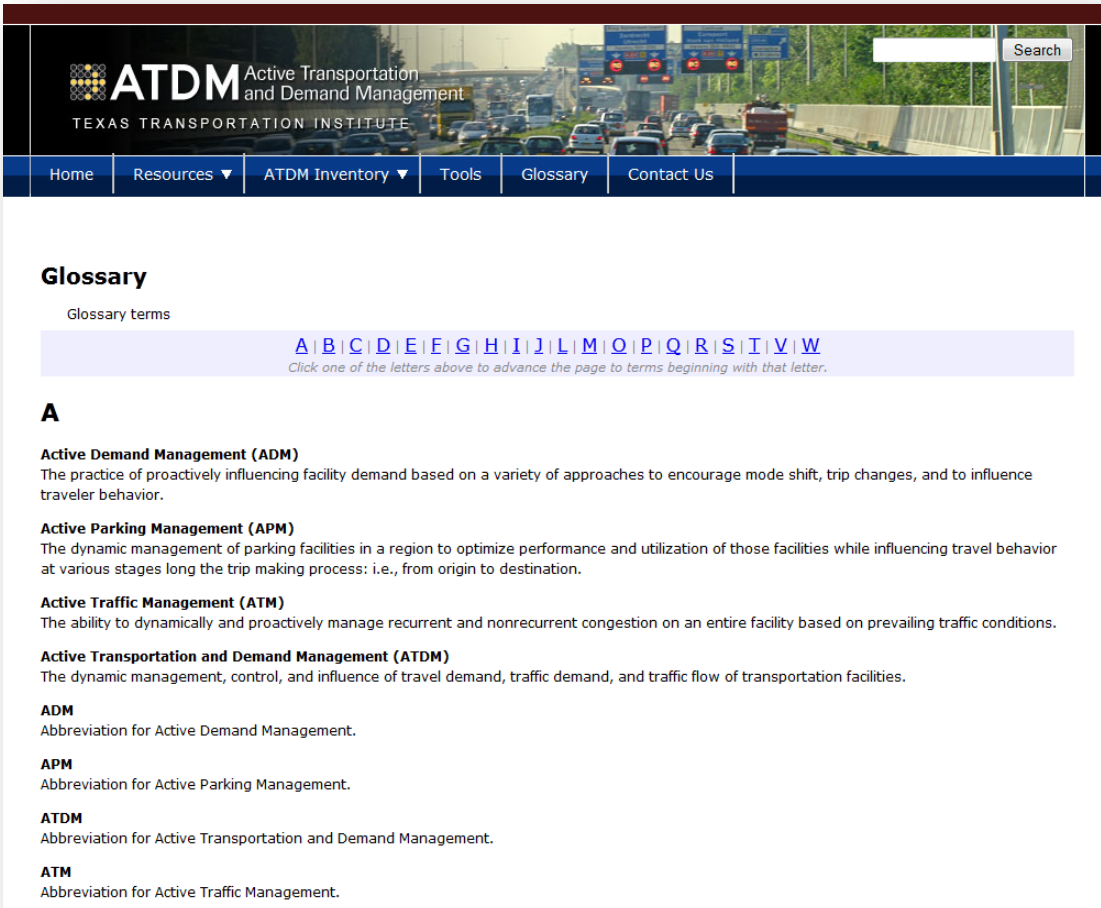

Figure 16. ATDM website Glossary page.

The final section of the website is the Contact page. On this page, as shown in Figure 17, users can provide feedback to the team regarding any aspect of the site. The intent of this page is to provide users with an opportunity to alert the project team of problems, suggestions for improvements, or any other issue that might need addressing.

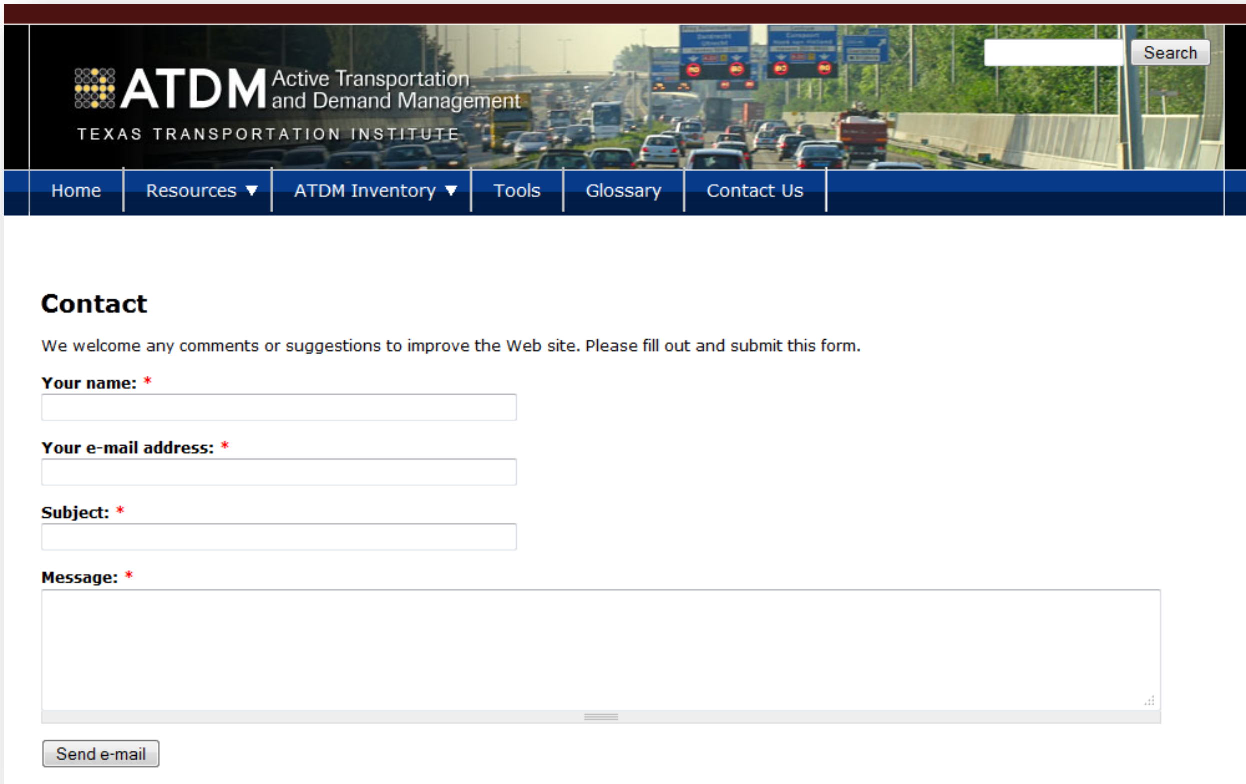

Figure 17. ATDM website Contact page.

Chapter 5: Final Remarks

It is the hope of the authors that by providing transportation agencies with information on practices for deployment and operation of ATDM strategies as well as updating the AMST and the ATDM website, this project can have a positive impact on transportation networks where ATDM is feasible. Potential transportation improvements can include an increase in average throughput for congested periods, an increase in overall capacity, a decrease in primary accidents, a decrease in secondary accidents, a decrease in accident severity, an overall harmonization of speeds during congested periods, an increase in trip reliability, and the ability to delay the onset of freeway breakdown. ATDM has the potential to help transportation agencies address the ever-increasing challenge of doing more with less and operating existing facilities in the most efficient manner possible.

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