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TRAQ Technical Overview

Transportation Air Quality Center

Transportation Control Measures: Intelligent Transportation Systems

EPA's main strategy for addressing the contributions of motor vehicles to our air quality problems has been to cut the tailpipe emissions for every mile a vehicle travels. Air quality can also be improved by changing the way motor vehicles are used—reducing total vehicle miles traveled at the critical times and places, and reducing the use of highly polluting operating modes. These alternative approaches, usually termed Transportation Control Measures (TCMs), have an important role as both mandatory and optional elements of state plans for attaining the air quality goals specified in the Clean Air Act. TCMs encompass a wide variety of goals and methods, from incentives for increasing vehicle occupancy to shifts in the timing of commuting trips. This document is one of a series that provides overviews of individual TCM types, discussing their advantages, disadvantages, and the issues involved in their implementation.

Getting There with Clean Air

Intelligent Transportation Systems

Contents

Intelligent transportation systems (ITS), provide a technological solution to the problem of growing congestion on U.S. roadways. The U.S. Department of Transportation (DOT) has defined an ITS infrastructure consisting of traffic detection and monitoring, communications, and control systems required to support a variety of ITS products and services in metropolitan and rural areas. Whether infrastructure is deployed by the public sector, the private sector, or a combination of the two, depends on the locality. The following are types of systems that can be employed as part of an ITS:

- **Traffic signal control systems**, which have the capability to adjust the amount of green light time for each street and coordinate operation between each signal to maximize the person and vehicular throughput

- **Freeway management systems**, which provide for control of traffic entering the freeway, as well as coordination of response to emergency and special-event situations

- **Transit management systems**, which include hardware/software components on buses, dispatching centers, radio communications, operator training, and maintenance to increase mass transit ridership and productivity

- **Incident management programs**, which help to quickly identify and remove incidents (e.g., accidents and stalled vehicles) that occur on area freeways and major arterials

- **Electronic toll collection systems**, which include hardware and software for roadside and in-vehicle use and driver payment cards to allow drivers to pay tolls without stopping, thus decreasing delays and improving toll collection productivity

- **Multimodal traveler information systems**, which serve as a repository for current, comprehensive, and accurate traffic flow data and disseminate this information to travelers through a variety of methods

- **Highway/railroad crossings and interface systems**, where traffic signals are coordinated with train movements and drivers are notified of approaching trains through in-vehicle warning systems

➥ **Emergency management systems**, where response personnel are linked to incident management centers to ensure that the closest available applicable emergency response unit can respond to an incident

The rationale for installing technological solutions rather than traditional highway expansion varies with location and project type. Freeway management systems are a cost-effective way to increase throughput where additional lanes requiring expanded right-of-way would be very expensive or politically impossible. Some transit operations are implementing ITS as the best way to improve passenger convenience and security. The way an area chooses to use ITS technologies in meeting transportation needs can either increase or decrease its air quality.

In the short run, using ITS technologies to increase speeds and capacity on severely congested highways can reduce emissions of some pollutants. This beneficial effect results from more efficient engine operation at steady speeds rather than stop-and-go traffic at very low speeds. However, there is a point at which higher speeds cause pollutant emissions to increase again. Moreover, as the increased capacity encourages more driving, the impact of increased road capacity and higher traffic volumes on air quality is clearly negative.

Sustainable uses of ITS technologies can reduce congestion without encouraging more traffic for example, by electronic tolling and better management of traffic flow. Beginning to implement sustainable ITS strategies now can give a locality a head start in achieving and maintaining healthy air. Sustainable ITS involve environmental design goals which both increase the flow of traffic and decrease the number of single occupancy vehicles. Localities that implement sustainable ITS may find conformity demonstrations easier or may take credit for sustainable ITS measures in their air quality plans. Choosing “win-win” ITS measures that both improve transportation system efficiency and air quality can maximize return on transportation investments. In areas where operating costs are affected, life-cycle cost comparisons by the operating authority can justify ITS.

1. Background

ITS computerized traffic signal systems have been in place since the

ITS user services have been developing over the past three decades. Transportation authorities have been installing progressively more flexible traffic signal systems since the first computerized systems were commissioned in the early 1960s. Isolated ramp meters have developed into freeway management systems in metropolitan areas such as Los Angeles, Houston, San Antonio, and Seattle. Other cities such as Detroit and Atlanta are building or expanding traffic management centers that include freeway management components. Incident management programs that began as courtesy patrols and CB monitoring have incorporated new technologies and are increasingly being integrated into transportation management centers. Technologies incorporated include motorist call boxes, cellular phone call-in, loop detectors, live video, and, more recently, microwave, ultrasonic, and image processing techniques.

Transit fleet management has also evolved from managers with radios and clipboards to dispatch centers receiving real-time Automatic Vehicle Location information derived from sign-post or Global Positioning System equipment. Electronic fare payment is expanding from magnetic strip farecards in use in the Washington, D.C. METRO and San Francisco BART rail systems to systems that accept multi-purpose magnetic strip cards, commercial credit cards, and remote electronic transaction devices. Electronic toll collection systems are being installed both in urban areas and on rural tollways.

2. Costs and Benefits

The benefits of ITS are derived from a smoother traffic flow with less delay from signals, incidents, and traffic queues. Most aspects of the ITS infrastructure contribute to time savings. Other benefits include emissions reduction, accident reduction, improved transit customer service, increased roadway capacity and speed, and decreased fuel consumption. [1] The total costs are dependent on the size of the system and the types of technology used. ITS systems could be implemented independently, but concurrent implementation is expected to significantly increase overall benefits and decrease incremental costs.

ITS Costs Include:

- **System design**
- **Procurement**
- **Deployment of the system**
- **System operation and maintenance**
- **Evaluation and support**
- **Public outreach**

3. Implementation

An ITS requires a substantial investment of government resources. The measure is typically implemented by the public sector, but private sector participation is highly encouraged, particularly in the collection and dissemination of traveler information. ITS systems can be readily deployed in the near term and are typically eligible for federal funding.

4. Keys to Success

To be effective, the implementation of all features of an ITS must be carefully coordinated. Key components needed for the success of the system include the following:

- ➥ Capability to distribute multimodal traveler information to the general traveling public
- ➥ Surveillance and detection capability, resulting in timely, comprehensive, and accurate information on traffic and transit system performance
- ➥ Infrastructure-based communications systems linking field equipment with central software/database systems
- ➥ Communications (routine information sharing) among jurisdictions, between traffic and transit agencies, and between the public and private sectors, without necessarily relinquishing control responsibility
- ➥ Information sharing/coordination with emergency medical services, hazardous materials programs, and other appropriate participants
- ➥ Proactive management of roadway and transit resources to achieve metropolitan transportation objectives
- ➥ Sufficient resources for continuing support of system operations and maintenance needs, including personnel and training requirements

Many ITS services require wide-scale coordination across jurisdictional boundaries.

5. Summary of Recent Examples

ITS are being implemented widely across the nation. Transit management systems are currently operating in 24 U.S. metropolitan areas, with another 31 areas in various stages of procurement. Twelve authorities are currently using electronic toll collection. Recent studies have shown these programs to be successful at reducing emissions, as well as providing other benefits. [1]

The City of Abilene, for example, installed a synchronized traffic signal system. A portion of the funding for the Abilene upgrade came from a bond issue that specifically included the upgrade and the remainder came through a state-funded program. The system upgrade was partly to move traffic better and partly to replace an antiquated system that was causing difficulty in locating replacement parts. The portion of funding on the bond issue competed with other projects in the public works budget for priority. The City of Abilene reported the overall impacts shown in Table 1.

Table 1 - Results from Abilene Signal System Upgrade

Travel time	-14%
Travel speed	+22%
Number of stops	+0.3%
Delay	-37%
Fuel consumption	-6%
CO Emissions	-13%
HC Emissions	-10%
NO_x Emissions	+4%

6. Sources

[1] Federal Highway Administration. *Intelligent Transportation Infrastructure Benefits: Expected and Experienced*. Prepared by The MITRE Corporation. Washington, D.C. (January 1996).

7. An On-line Resource

The Environmental Protection Agency's Office of Mobile Sources has established the Transportation Control Measure (TCM) Program Information Directory to provide commuters, the transportation industry, state and local governments, and the public with information about TCM programs that are now operating across the country. This document and additional information on other TCMs and TCM programs implemented can be found at:

http://www.epa.gov/omswww/transp/traqtcms.htm