Innovative Traffic Control Practices in Europe

by H. Gene Hawkins Jr., W. Scott Wainwright, and Samuel C. Tignor

Vehicular travel is increasing throughout the world, particularly in large urban areas. Accommodating the increased demand, while improving traffic safety, has led transportation officials to use a variety of innovative traffic control practices.

These practices are used to control traffic movement and to provide road users with better information upon which to base travel decisions. By using these practices, transportation professionals can operate the transportation system more efficiently and safely.

In recent years, traffic engineers in the United States have implemented a number of practices to improve the overall quality of traffic flow. However, the need for improved traffic control is a worldwide need, and many other countries have also implemented innovative traffic control practices. Recognizing the benefits that could result from an examination of international practices, a team of traffic engineers was formed to observe and document practices that might have value to U.S. practitioners.

The zig-zag markings on the street mark the approach to a pedestrian crossing in England.

This “scan team” effort was jointly sponsored by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials, and the Transportation Research Board.

In May 1998, the team of 10 U.S. traffic engineers traveled to Europe to observe innovative traffic control practices and identify those practices that could be implemented in the United States. The team members represented several different perspectives, including federal, state, and local governments and two research organizations. The team members were Linda L. Brown (FHWA), J. Lynwood Butner (Virginia Department of Transportation [DOT]), Richard Cunard (Transportation Research Board), Sterling C. Davis (Utah DOT), Edward L. Fischer (Oregon DOT), H. Gene Hawkins Jr. (Texas Transportation Institute), Mark R. Kehrli (FHWA), Peter F. Rusch (Wisconsin DOT), Samuel C. Tignor (FHWA), and W. Scott Wainwright (Montgomery County [Md.] Division of Traffic and Parking Services).

During a two-week period, the team visited with transportation officials in Gothenburg, Sweden; Frankfurt, Cologne, and Bonn, Germany; Paris, France; and London and Birmingham, England. These host officials presented information on a wide variety of traffic engineering and traffic control topics, and the team observed many other interesting practices during the travel between visits.

At the start, midpoint, and end of the trip, the team members met to discuss their observations and to identify those practices that might be worthwhile in the United States. The team identified many noteworthy practices, several of which may have current or future value to transportation agencies in the United States.

This article summarizes the findings and recommendations resulting from the scan trip. The information is organized into five major categories:

- Traffic control devices.
- Freeway control.
- Operational practices.
- Information management.
- Administrative practices.

An FHWA report describes the findings, observations, and recommendations of the scan trip in greater detail.

Traffic Control Devices

As the team traveled between and within each country, they had an opportunity to observe various European practices for traffic control devices. Many of these practices are significantly different from the corresponding U.S. practice — if one exists. The two practices that the team members believe would have the greatest potential value in the United States are the tiger-tail marking used on freeway entrance and exit ramps and the all-white system of pavement markings used throughout Europe.

The tiger-tail marking is an innovative pavement marking pattern that is used on multilane freeway entrance and exit ramps in England. The marking separates multiple lanes by using a wide, painted buffer. The buffer separates the merge/diverge points of each lane, reducing turbulence and improving operations as traffic enters or leaves the mainline.

As the team traveled through Europe, they were very impressed by the quality of the pavement marking systems and by the ability to communicate information to drivers through the use of white markings only. The Europeans use a wide variety of pavement marking patterns (line width, number of lines, line/gap ratio, etc.) to convey the necessary information to road users. They also use significantly more marking material than is commonly used in the United States. The team members feel that the European system of all-white markings could provide some benefits and deserves close examination to determine its potential here.

Members of the Innovative traffic control scan team are (from left): Ed Fischer, Lynwood Butner, Scott Wainwright, Pete Rusch, Linda Brown, Mark Kehril, Rich Cunard, Sam Tignor, Sterling Davis, and Gene Hawkins.

The team also observed many other European practices related to traffic control devices. These practices include: countdown markers for exit ramps, arrowhead-shaped destination signs, internal sign illumination in urban areas, use of a dotted sign border for trailblazing, variations in alphabet stroke width, horizontal signing, chevrons for vehicle spacing, colored pavements, raised crosswalks, flashing yellow on pedestrian clearance, audible pedestrian signals, worker-visibility enhancements, vehicle-visibility enhancements, work-zone traffic control, freeway exit signs, and rotary intersections.

Freeway Control

Many of the freeways (or motorways as they are known in Europe) in urban areas experience high levels of congestion. Practitioners in all four countries have implemented many different strategies for controlling traffic on these congested freeways. The three freeway control practices that the team members feel should be implemented in the United States are variable speed control, lane control signals, and incident and queue detection and protection.

One of the most interesting observations of the trip was the extent to which the host countries use dynamic signs to present variable speed limits to drivers. Operating agencies were able to achieve considerable benefits in traffic flow and safety on freeways by dynamically changing the speed limit based on real-time traffic speed and flow data. The high level of compliance with these signs was attributed to the correlation of the speeds to actual freeway conditions in real time and to the use of cameras and photographs to identify speeders on some freeways.

Lane control signals were also widely used on European freeways — most commonly in conjunction with dynamic message signs and variable speed limits. A signal is mounted above each lane to indicate traffic conditions downstream. These signals use a red X, yellow diagonal down arrow, or green down arrow to indicate that a lane is closed, closed ahead, or open, respectively.

Freeway queue detection and protection were observed in all four countries. Sensors (primarily loops) are placed in freeway mainlanes (and sometimes in the shoulder lanes) to identify when a line of backed-up traffic forms and where the back of the queue is located. The operating agency uses this information to provide advance notice of the presence of a queue. The information presented to drivers may be an advisory speed, a speed limit, or a congestion warning message (symbol or words). Some of the response systems are fully automated. In some locations, another or additional form of queue protection is provided by placing incident response vehicles with flashing lights and/or dynamic message signs on the shoulder at the end of the queue. These vehicles back up as the queue proceeds upstream.

Operational Practices

Our European hosts use many unique and interesting operational practices to control traffic. The scan team recommends two practices for possible implementation in the United States: intelligent speed adaption and self-optimized traffic signal control.

Intelligent speed adaption (ISA) consists of processes that monitor the current speed of a vehicle and can instigate a corrective action if that speed is not appropriate. Sweden has tested a system of intelligent speed adaption in which a “road beacon” transmits a signal to a receiver in the vehicle; the driver is alerted by a sound or light signal if he is exceeding the posted or safe speed.

These photos show a road in England before and after it was painted with a wide striped buffer, called tiger-tail markings, to seperate the merge/diverge points of each lane. (Used with the permission of the Highway Agency, UK)

An automatic ISA system that directly limits the vehicle's speed was also tested in Sweden. The test vehicles were equipped with a device that could be turned on and off by radio signals. When turned on, the speed of the vehicle was limited to 50 kilometers per hour. The driver experienced resistance in the accelerator, and it was not possible to increase speed even if the accelerator was depressed further.

An interesting traffic signal operational practice was presented by the Swedish officials. At isolated intersections, they are testing self-optimized signal control (SOS) as a means to improve safety. SOS is a sophisticated system of detection and traffic signal controller logic that enables the change in right-of-way between opposing traffic movements to be made based on assessing and minimizing the safety risks for traffic that will be stopped on the approaches. It is a dilemma-zone enhancement that translates stopping risks and cross-street queue development to a cost algorithm.

The team also observed many other European operational practices related to traffic control. These include: use of historical loop data during loop-failure conditions, innovative coordinated signal-preemption strategies, automated speed enforcement, emergency telephones, and elevated police patrol bays. The use of automated enforcement was particularly evident throughout the four countries.

Information Management

The team members were impressed by the amount of information that European agencies provide to road users. The Europeans have placed a strong emphasis on presenting easy-to-understand information to drivers.

This road in France shows the effectiveness of all-white markings.

Even though the team members expected to see the extensive use of symbols, they were nonetheless impressed by the extent and success of symbols. Symbols (or pictograms as they are more commonly called in Europe) are widely used in variable message signs. Typical symbols that are presented in these signs include congestion, snow, danger, workers, and slippery pavement.

Symbols in the form of geometric shapes are also widely used to indicate diversion routes. When it is necessary to divert traffic from the freeway, variable message signs indicate the diversion symbol to follow. That symbol is presented at all decision points along the diversion route.

The team learned that dynamic message signs along the freeway are also used to provide drivers with travel-time information. One of the most impressive examples of this practice was found in Paris where more than 200 dynamic message signs on the outer ring freeway, its entrance ramps, and the inner ring provide real-time travel times to upcoming junctions. An evaluation of this system in 1994 found that 65 percent of the motorists preferred travel-time information over congestion information.

The team also observed many other European practices related to information management. These practices include: consistency in variable message signs, real-time parking information, traffic information on FM radio, and private-sector collection of traffic data for traveler information.

European transport agencies are actively pursuing partnerships with the private sector to collect traffic data. In several countries, commercial firms are allowed to install, operate, and maintain supplemental traffic detectors to enhance their own for-profit traffic information databases.

Administrative Practices

In addition to the benefits derived from discussing and observing traffic control practices, the team gained valuable insight into the administrative issues associated with operating a transportation system. The team found that European transportation officials place a significant emphasis on "marketing" traffic engineering practices and improvements.

One of the key observations of the team is that when justifying transportation programs to policy-makers and elected officials, several of the countries emphasize safety benefits and improved incident response times by emergency services instead of improved operations or congestion reduction. This is particularly true for the heavily congested freeways and highways.

Several countries in Europe have been able to achieve considerable benefits in traffic flow and safety by changing the freeway speed limit based on real-time traffic speed and flow data. (Used with the permission of the Highway Agency, UK)

The most prominent examples of the safety emphasis were found in Sweden. The Swedish government has adopted a safety strategy known as "Vision Zero." The objective of this strategy is to eliminate fatalities on Swedish highways.

An example of the emphasis on business practices was found in England where transportation improvements are evaluated using a "Value for Money" concept. Each improvement is carefully assessed with respect to expenditures and expected benefits.

The use of cameras and photographs on some freeways to identify speeders is one factor that adds to the high level of compliance with traffic signs in Europe.

Several of the interesting concepts identified by the team related to the effort to reintegrate telematics, intelligent transportation systems, into the existing organizational structure and transportation system. This effort was initiated to ensure that the use of technology is inherent within the traditional organizational components and more readily assimilated within the political, customer, and organizational arenas as a critical component of long-term transportation solutions.

The European emphasis on customer service was best exemplified in a French private-sector toll facility. The high-quality facility demonstrated that standards in construction, operation, and maintenance were actually being exceeded to promote the future acceptance and expansion of these types of facilities.

The team was also very impressed with the administrative commitment to transportation research in several countries and with the safe and efficient management of high-speed freeways.

Recommendations

The members of the scan team were privileged to travel to four European countries to see firsthand many outstanding traffic control and traffic engineering practices. Following the meetings with the host countries, the team members met to review the findings from the trip and to identify those practices that have the greatest potential for successful implementation in the United States.

The resulting recommendations are divided into primary recommendations and additional recommendations. The primary recommendations, which have been briefly described in this article, represent the team's recommendations for practices that should receive strong consideration for implementation in the United States. The scan team report provides more detail on the additional recommendations. Table 1 summarizes the team's recommendations.

Table 1. Summary of Recommendations

Category	Primary Recommendations	Additional Recommendations
Traffic Control Devices	Tiger-Tail Marking All-White Pavement Markings	Countdown Markers for Exit Ramps Sign Colors More Intense Arrowhead-Shaped Destination Signs Internal Sign Illumination in Urban Areas Use of Dotted Border for Trailblazing Guide Sign Sheeting Types Variations in Alphabet Stroke Width Horizontal Signing

		Chevrons for Vehicle Spacing Colored Pavements Raised Crosswalks Flashing Yellow on Pedestrian Clearance Audible Pedestrian Signals Worker-Visibility Enhancements Vehicle-Visibility Enhancements Work-Zone Traffic Control Freeway Exit Signs Rotary Intersections
Freeway Control	Variable Speed Control Lane Control Signals Incident and Queue Detection and Protection	Rolling Freeway Block Should Detection
Operational Practices	Intelligent Speed Adaption Self-Optimizing Signal Intersection Control	Use of Historical Loop Data During Loop Failure Conditions Coordinated Signal=Preempiton Strategies Automated Speed Enforcement Emergency Telephones Elevated Police Patrol Bays
Information Management	Symbolics Display of Travel-Time Information	Consistency in Variable Message Signs Real-Time Parking Information Traffic Information on FM Radio Radio Data System -- Traffic Messaging Channel MATTISSE, Travel Information Exchange System Private Sector Collection of Traffic Data for Traveler Information

In some cases, the practices can be implemented with little or no change in current U.S. practices or standards. In other cases, implementation must be preceded by research that addresses U.S. aspects of a topic. The implementation of the recommended traffic control practices will ensure that our citizens receive the maximum benefit of innovative traffic controls to save lives, enhance operational efficiency, and improve the movement of traffic in the United States.

Also widely used on European freeways are lane control signals that are mounted above each lane to indicate traffic conditions ahead. These signals use a red X to indicate a closed lane, a yellow diagonal downward arrow to indicate a lane closed ahead, and a green downward arrow to indicate that the lane is open.

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