MANAGING TRAVEL DEMAND

APPLYING EUROPEAN PERSPECTIVES TO U.S. PRACTICE

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N O T I C E

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16. Abstract
Managing the demand for automobile use is becoming an increasingly important strategy to address the negative consequences of traffic congestion. The Federal Highway Administration, American Association of State Highway and Transportation Officials, and National Cooperative Highway Research Program sponsored a scanning study of programs and policies to manage travel demand in Germany, Italy, the Netherlands, Sweden, and the United Kingdom.

What the scan team observed was a way of thinking that attempts to influence travelers before they get into their cars by promoting alternative travel modes and provides improved options for those who choose to drive, such as faster routes and more reliable travel times. The team learned that travel demand could be affected through a variety of measures, including road pricing to reduce traffic going into city centers, variable message signs, and customized traveler information.

The team's recommendations for U.S. implementation include demonstration projects on congestion and demand management measures observed in Europe, technical support and a training course on congestion and demand management techniques, and a study on the state of the practice in the United States.

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May 2006

International Technology **Scanning Program**

The International Technology Scanning Program, sponsored by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the National Cooperative Highway Research Program (NCHRP), accesses and evaluates innovative foreign technologies and practices that could significantly benefit U.S. highway transportation systems. This approach allows for advanced technology to be adapted and put into practice much more efficiently without spending scarce research funds to re-create advances already developed by other countries.

FHWA and AASHTO, with recommendations from NCHRP, jointly determine priority topics for teams of U.S. experts to study. Teams in the specific areas being investigated are formed and sent to countries where significant advances and innovations have been made in technology, management practices, organizational structure, program delivery, and financing. Scan teams usually include representatives from FHWA, State departments of transportation, local governments, transportation trade and research groups, the private sector, and academia.

After a scan is completed, team members evaluate findings and develop comprehensive reports, including recommendations for further research and pilot projects to verify the value of adapting innovations for U.S. use. Scan reports, as well as the results of pilot programs and research, are circulated throughout the country to State and local transportation officials and the private sector. Since 1990, approximately 70 international scans have been organized on topics such as pavements, bridge construction and maintenance, contracting, intermodal transport, organizational management, winter road maintenance, safety, intelligent transportation systems, planning, and policy.

The International Technology Scanning Program has resulted in significant improvements and savings in road program technologies and practices throughout the United States. In some cases, scan studies have facilitated joint research and technology-sharing projects with international counterparts, further conserving resources and advancing the state of the art. Scan studies have also exposed transportation professionals to remarkable advancements and inspired implementation of hundreds of innovations. The result: large savings of research dollars and time, as well as significant improvements in the Nation's transportation system.

Scan reports can be obtained through FHWA free of charge by e-mailing international@fhwa.dot.gov. Scan reports are also available electronically and can be accessed on the FHWA Office of International Programs Web site at *www.international.fhwa.dot.gov*.

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Abbreviations and Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ACS	Access control system
ANPR	Automated number plate recognition
ATAC	Agency for Bus and Railway Transport in Rome
ATM	Active traffic management
AVV	Transport Research Center in the Netherlands
CO	Carbon monoxide
DfT	Department for Transport
DRIP	Dynamic route information panel
DTM	Dynamic traffic management
EC	European Commission
EU	European Union
FHWA	Federal Highway Administration
GDP	Gross domestic product
GPS	Global Positioning System
HA	Highways Agency
HOT	High occupancy toll
HOV	High occupancy vehicle
ITS	Intelligent transportation systems
km	kilometer
km/h	kilometers per hour
KVB	Transport Company of Cologne
MIDAS	Motorway incident detection and automatic signaling
mi/h	miles per hour
MM	Mobility management
MTM	Motorway traffic management
NHI	National Highway Institute
NOx	Nitrogen oxides
NTI	National Transit Institute
NRW	North Rhine Westphalia
NVVP	National Transport Plan
OBU	Onboard unit
PM	Particulate matter
RDS-TMC	Radio Data System—Traffic Message Channel
RWS	Ministry of Transport, Public Works, and Water Management
SMS	Short message service
SRA	Swedish Road Administration
STA	Mobility Services for Rome
SVV2	Second Transport Structure Plan
SWINGH	Working Together in the Greater Hague Region
TDM	Transportation demand management
TfL	Transport for London
TMC	Traffic or transportation management center
USDOT	U.S. Department of Transportation
VKT	Vehicle kilometers traveled
VMS	Variable message sign
ZTL	Limited traffic zone

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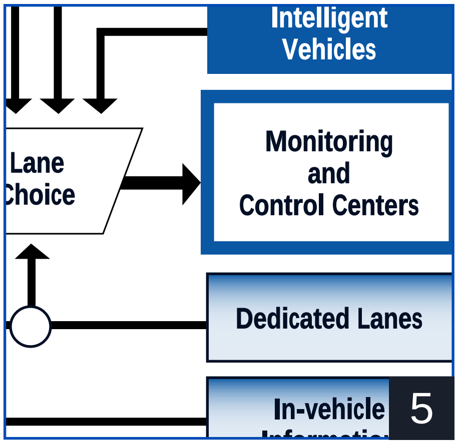
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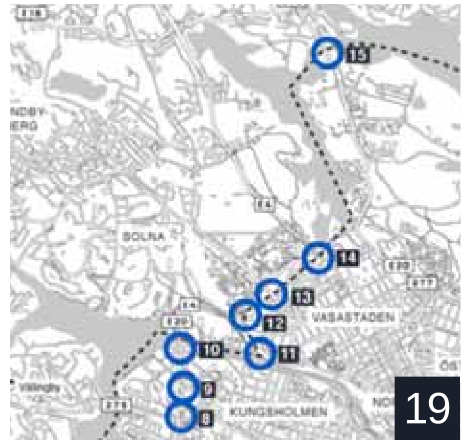
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Executive Summary

Background

This report summarizes the findings of an International Technology Scanning Program scan on managing travel demand. The purpose of the scanning study was to assess European experience in managing the demand for automobile and truck travel through a variety of means, including traveler information, technology, improved modal options, pricing, and new institutional arrangements. The scanning program is sponsored by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board (TRB).

The scan team visited the following cities throughout Europe that have been pursuing programs and policies to reduce automobile demand:

- Rome, Italy
- Stockholm and Lund, Sweden
- Cologne, Germany
- Rotterdam and Delft, Netherlands
- London, United Kingdom

The visit focused on both local efforts to manage demand within a metropolitan area and national research, policies, and programs to integrate demand management into planning, management, and operations of the transport system. While congestion is often the issue driving efforts to manage demand in the United States, European policies tend to also focus on air quality and sustainability objectives.

Demand Management Strategies Examined

To sort through the myriad of strategies to manage demand, the scan team created a loose categorization of techniques, including the following:

Physical Measures—These include access control (Rome), HOV lanes (the United Kingdom), expanded park-and-ride systems (Cologne, Rome, and Stockholm), and use of the hard shoulder during rush hours (the Netherlands). These measures have been designed to modulate use of the automobile via infrastructure changes and physical restrictions.

Operational Measures—These include real-time dynamic information on traffic and parking, traffic management centers, and improved public transport in every city visited. Travel time prediction methods, using recent or archived data, have been developed (the Netherlands, the United Kingdom, and Germany) to provide pretrip and near-trip information. Photo enforcement makes access restrictions (Rome), area pricing (Rome, Stockholm, and London), and highway speed controls (the Netherlands and the United Kingdom) possible. Finally, demand management is being used to mitigate traffic during major highway reconstruction projects (the United Kingdom and the Netherlands) and during large-scale events (the United Kingdom and Germany).

Financial/Pricing Measures—Several cities were selected for their implementation of pricing. In addition to London's Congestion Charging Scheme, the scan team learned about a large-scale area pricing pilot in Stockholm, priced nonresident permits for access into the historic center of Rome, and truck tolls on the German autobahn system. Revenue from these schemes is being used to improve services (public transport) or infrastructure (highways from truck tolls). Financial incentives were also used in many cities to induce travelers to use alternative modes (the Netherlands and Lund), such as free public transport passes to use transit.

Institutional Measures—New institutional arrangements and processes have been developed to integrate demand management into planning, management, and operations. Sustainable travel and demand management have been integrated into, and even become the focus of, long-range transport plans and have been built into the highway deficiency evaluation process (Sweden and the Netherlands). Travel planning for worksites and schools has become institutionalized in many countries (the United Kingdom, the Netherlands, and Italy). Integrated packages of strategies are being tested through European initiatives such as CIVITAS. New organizational arrangements are being formed to manage traffic, operate public transport, and provide traveler information (Rome and London). Finally, new public-private partnerships have been formed to collect, process, and deliver traveler information (the Netherlands).

Performance Measurement—The ability of demand management strategies to address congestion, air quality, energy, efficiency, and quality-of-life objectives is being carefully monitored and evaluated in most of the cities and countries the scan team visited. Large-scale evaluations of the pricing (Rome, Stockholm, and London), traveler information (Cologne and the Netherlands), and traffic management schemes (all countries) have provided critical information on the effectiveness of these strategies. In Lund, Sweden, a comprehensive, integrated package of strategies resulted in a modest absolute reduction in per capita car use at the same time that the area enjoyed growth, effectively decoupling traffic growth from economic growth. Finally, several countries the team visited are building performance measurement, centered on travel time reliability, into their national transport and funding policies (the Netherlands and the United Kingdom).

Conclusions from European Experience: An Evolution in Thinking

The purpose of the managing travel demand scan was to explore European experience with demand-side strategies that contribute to the more efficient use of highway

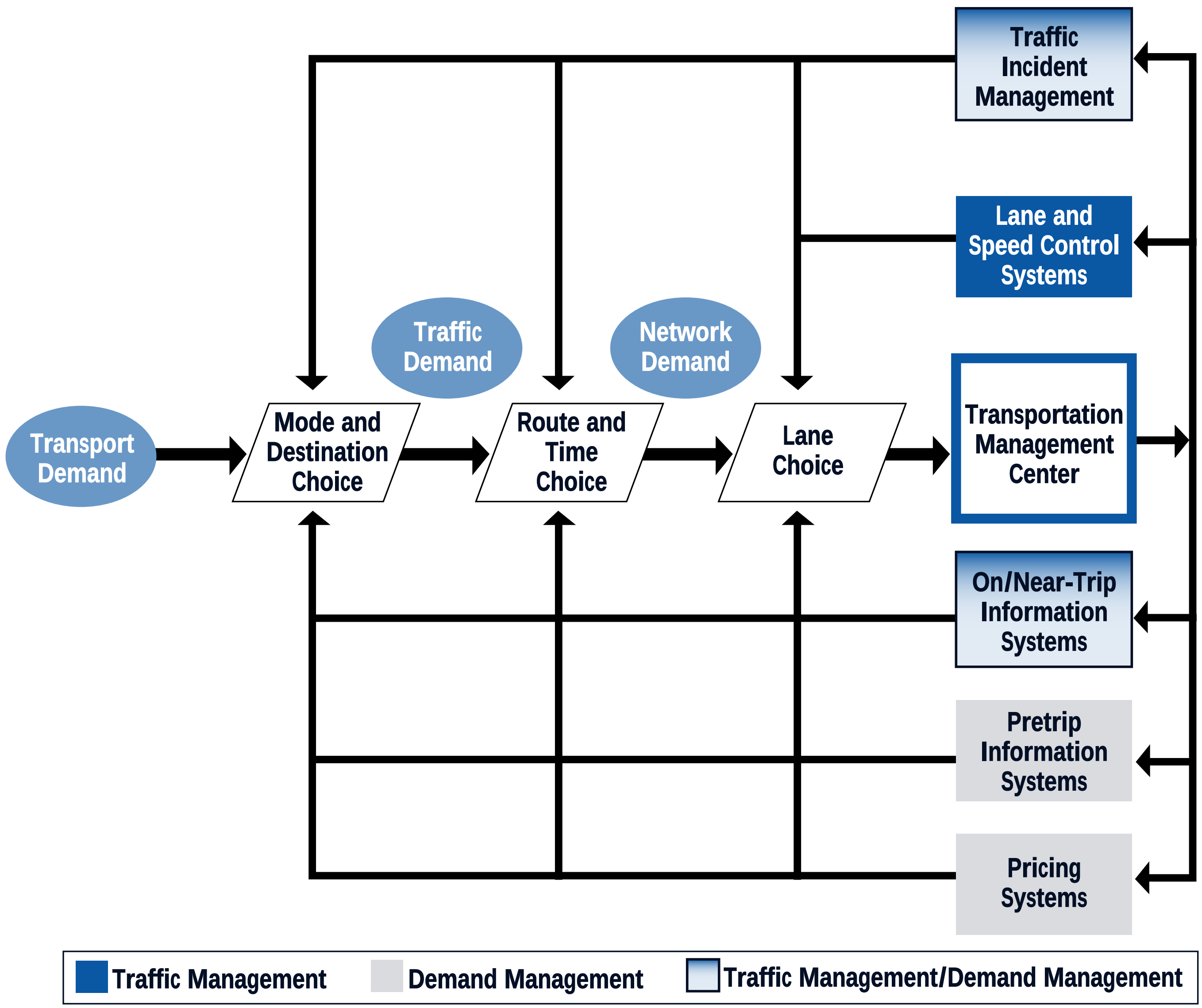


Figure 1. *Conceptual framework for demand management and traffic management: modified Dutch model.*

infrastructure and provide enhanced mobility options and travel choices. What the scan team found was a profound new way of thinking about travel, one that attempts to influence travelers before they get into their cars (promoting nonmotorized modes and alternative destinations of travel) and provides improved options for drivers who choose to use the road system (faster routes and more reliable travel times).

The Dutch model of traffic and demand management (see figure 6) was a key to the scan team's understanding of how demand management fits into the management and operations of the transportation system. A modified version of this model (figure 1) provides a conceptual framework illustrating how many of the management **systems** used to manage travel demand and traffic can affect traveler **choices**, be they the choice of which lane is best, which route or time of departure is fastest, or even which mode of travel or destination is optimal for a given traveler. For example, systems to control the number of directional lanes or maximum speeds might affect only lane choice on a given facility and, therefore, manage only traffic already on the network. But other systems, such as incident management, which traditionally have been believed to influence traffic only on a given facility, might actually influence route choice, time of travel, destination, and even mode, as was the case with the hurricanes in the southeastern United States in 2004 and 2005. In these cases, a much broader view of managing traffic and demand was required.

Other systems can be viewed as influencing traffic demand and transport demand, beyond managing the traffic on the existing network. Pretrip traveler information systems are clearly designed to encourage more efficient travel by suggesting routes and times of the day that are less congested and offer more reliable travel times. Pretrip information can also influence the mode selected (e.g., public transport or carpooling) or even the destination of travel (whether to work from home or shop closer to home). However, as evidenced by European experience, near-trip and even on-trip (en route) information can influence time, route, mode, and destination choice. For example, commuters can be provided with real-time information on travel times to their work location if they continue to drive or shift to a nearby park-and-ride service. Finally, while road pricing can clearly affect mode, time, and route choice, it can even influence lane choice, as is the case with high occupancy toll (HOT) lanes in the United States. Pricing can also include incentives for changing modes or time of travel.

In the center of the management systems is the transportation management center (TMC), which both manages facilities and provides information to travelers. Traditional transportation demand management (TDM), such as rideshare matching, promotion of alternative modes, and vanpool provision, typically works at the other end of the framework to influence mode and destination choice based on the need to travel, but it can also be an integral part of the information systems linked to the TMC. Therefore, this conceptual framework, modified from that presented by the Dutch, provides a new way of looking at the need for and management of transport and traffic demand. It provided scan team members with a new perspective on the systems they manage by helping them understand the difference between managing traffic and managing demand.

Overall, most of the places the scan team visited were striving to create more livable, sustainable cities by creating and implementing integrated packages of transportation measures that combined improved alternatives to driving a car; real-time information on traffic conditions; options providing pretrip, near-trip, and on-trip route information; new partnerships to support these enhanced travel choices; and even pricing to reduce the number of cars entering the city centers or on the entire network during congestion periods. They are doing so by integrating demand management into both their long-range transportation plans and shorter range operating policies. They are carefully monitoring the performance of the system by looking not only at mobility but also at measures such as accessibility, air quality, and livability.

Recommendations and Implementation Strategies

The scan team developed a detailed set of implementation strategies aimed at disseminating the findings, conclusions, and transferable strategies to transportation professionals in the United States, thereby helping to accelerate the evolution of thinking in this country. The recommendations fall into six categories:

Outreach—Pursue presentations at key conferences, articles in transportation journals, and development of Web-based seminars, brochures, and slide shows.

U.S. Practice—Assess the domestic understanding and state of the practice in integrating demand management into plans, programs, and policies.

Training—Develop a revised National Highway Institute or National Transit Institute course on demand management and include demand management in other training and university curricula.

Peer Exchange—Establish additional exchange between professionals involved in demand management in Europe and the United States by facilitating face-to-face or virtual interaction.

Demonstrations—Test some of the observed techniques from Europe in the United States, including use of the hard shoulder during rush hour, travel time prediction using archived data, and road pricing.

Guidance—Develop guidance on how to assess the effectiveness of demand management strategies and how to integrate demand management into plans and programs.

The scan team learned that demand for travel can be managed at a number of points in the planning, management, and operations processes and that managing demand to improve travel time reliability necessarily involves enhanced travel choices, be they other modes, destinations, route, or time of travel. Demand management is clearly not the only solution to congestion, air pollution, or energy problems, but it provides a broad set of tools to use the Nation's transport system and resources more efficiently.

Introduction and **Background**

Introduction

Managing the demand for automobile use is becoming increasingly important as a strategy to address the negative consequences of traffic congestion. Managing peak-period demand has been used successfully in other consumer areas such as electricity, with strategies that are voluntary (such as the "Flex Your Power" media campaign in California) or mandatory (such as rolling blackouts during periods of peak energy demand). Managing demand on roads during congested periods is increasingly vital as the growth in travel far outpaces society's ability or tolerance to add more road capacity.

Scan Context

Managing travel demand was the subject of an international scan designed to explore innovative techniques used in Europe to manage demand. The International Technology Scanning Program is sponsored by the Federal Highway Administration (FHWA), the American Association of State Highway and Transportation Officials (AASHTO), and the National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board (TRB).

Of particular interest to the scan team were the roles and benefits that traveler information, advanced technology applications, and financial mechanisms play in managing traffic congestion and demand for both passenger and freight movements on highway systems, arterial road networks, public transport services, parking facilities, and freight centers.

The lessons learned could assist U.S. planners, engineers, and policymakers in addressing the distinct role that demand management might play in alleviating some of the negative effects of congestion, including air pollution, noise, depletion of energy resources, and travel delay, which can result in lost workforce productivity.

Panel Composition

Traditionally in the United States, efforts to manage demand have been initiated at the regional and local levels, especially when it comes to commuters. However, policies developed at the Federal and State levels, especially resource allocation guidelines, will affect the types of strategies used at the regional and local levels to manage demand and address congestion. The managing travel demand scan involved representatives from FHWA and State transportation agencies in Florida, Minnesota, New Jersey, and Utah. Representatives from a metropolitan planning organization and a private consultancy were also included in the scan.

Scan Itinerary

The scan team visited five countries and several cities (shown in figure 2). The scan originated in Rome, Italy, in part to enable the scan team to learn about automobile

Figure 2. *Map of scan on managing travel demand.*

restrictions in the historic core. The scan team then traveled to Stockholm, Sweden, to investigate the pending cordon charging scheme. Next on the itinerary was Lund, Sweden, a moderate-sized university town, where the team learned about an integrated program to decouple travel growth from economic growth. The scan team then traveled to Cologne, Germany, to examine parking management and traveler information programs. The second week of the trip began in Rotterdam and Delft, Netherlands, where the team learned about Dutch research projects on travel time prediction, traffic management, and mobility management. The scanning trip concluded in London, England, where congestion charging was examined along with national programs to influence travel behavior by promoting smarter choices among travelers. Before the scan trip, the scan team sent the host organizations a set of amplifying questions (see Appendix C) to clarify the types of information and case examples desired.

Purpose and Organization of Report

The purpose of this report is to describe the innovative demand management measures examined in each city, summarize the findings from the scan trip, suggest lessons that might be applicable to the United States, and recommend activities that might increase awareness and knowledge of the need to and means for managing demand in light of this European experience.

The remainder of this chapter provides a conceptual framework for understanding the U.S. and European perspectives on managing demand. It also provides a European policy context to assist U.S. audiences in understanding the reasons that some of these demand management strategies are being undertaken. Chapter 2 presents case studies on the cities (Rome, Stockholm, Lund, and Cologne) and countries (the Netherlands and the United Kingdom) visited both to provide a context for implementation and to reveal the full range of strategies and techniques explored. The key findings from the scan are presented in Chapter 3, organized by four types of demand management measures. Lessons for the United States are enumerated in Chapter 4 and a summary of implementation recommendations is provided in Chapter 5.

This report also serves as a companion to the FHWA report *Mitigating Traffic Congestion—The Role of Demand-Side Strategies* (FHWA-HOP-05-001), which provides an overview and case studies of demand-side measures in the United States. The report is available at *www.ops.fhwa.dot.gov/publications/mitig_traf_cong/index.htm*.

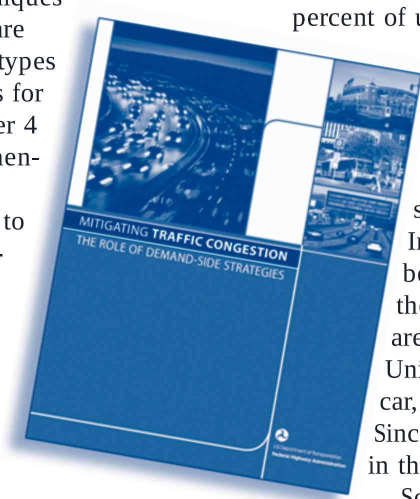


Figure 3. *FHWA report on Mitigating Traffic Congestion—The Role of Demand-Side Strategies.*

Background and Conceptual Framework

The Need for Demand Management

Traffic congestion is often one of the top concerns Americans cite in surveys covering metropolitan issues. Annual rankings of the most congested U.S cities are now headline news. The causes and impacts of congestion are well documented, yet there is no widespread agreement among planners, engineers, and politicians on solutions.

Traffic congestion in the United States has worsened significantly in the past 20 years. Two-thirds of all peak-period travel is in congested conditions, compared with one-third 20 years ago. Sixty percent of the urban freeway system is congested and travelers in the largest U.S. cities spend 3.76 billion hours a year stuck in traffic (compared to 0.72 billion hours in 1982). The average commuter spends 46 hours stuck in traffic each year. This costs the United States more than US$68 billion per year in lost productivity and excess fuel consumption.

Congestion lasts longer as well, with travelers subject to delay for more than 7 hours per day today, compared to 4.5 hours some 20 years ago. Recurring congestion accounts for over half of the delay—too many cars trying to use too few lane miles of highway at the same time.

The capacity of the Nation's road system clearly has not kept pace with this tremendous growth in travel demand. While the amount of vehicular travel in the United States has increased by almost 90 percent since 1980, the supply of roadway capacity has increased by only 5 percent. Vehicle kilometers traveled (VKT) have increased by 4 percent a year, while new road capacity has increased by only 0.2 percent.

Likewise, traffic congestion is a prevalent and growing issue in Europe. A survey of Europeans revealed that 80 percent of urban dwellers believe traffic congestion, crashes, and pollution are very serious problems that need to be addressed urgently. Europe experiences 7,000 to 10,000 kilometers (km) of congestion daily, even though the rate of increase in travel is somewhat less than that in the United States. In Sweden, volumes on the road system have been increasing by 1.5 percent per year for the past several years, and in Stockholm they are increasing by 4 percent annually. In the United Kingdom, 85 percent of all travel is by car, compared to 79 percent some 20 years ago. Since 1980, vehicle use has risen by 80 percent in the United Kingdom.

So why manage demand? If road capacity cannot keep pace with growing demand, we

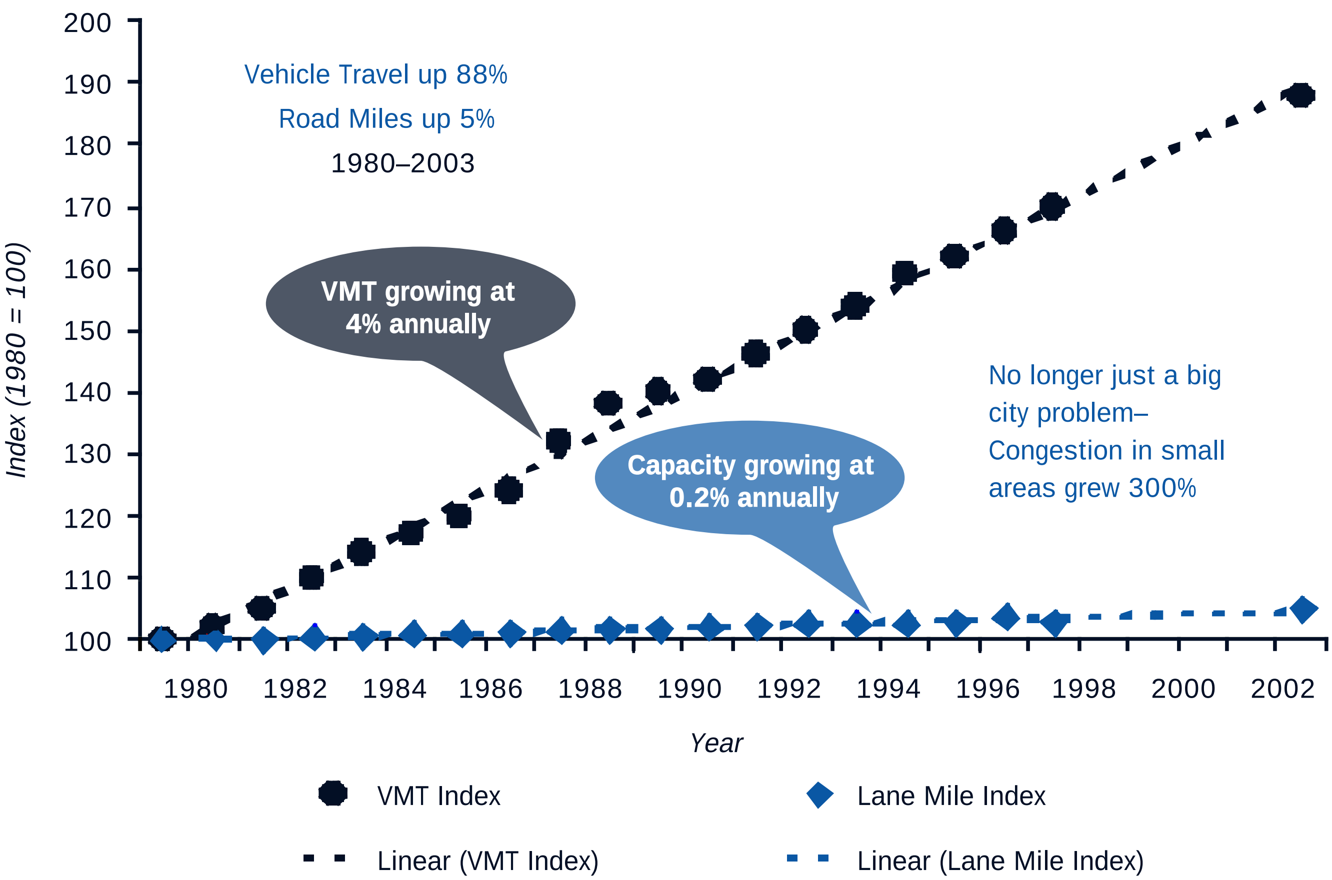


Figure 4. *Challenges of congestion.*

need to use the infrastructure we have more efficiently. One way is to reduce the number of vehicles using the road network at the same time, while maintaining the ability of people and goods to travel and information to be exchanged. One way to accomplish that is through alternative modes of travel, such as public transport and carpooling. Another way is to induce travelers to use other, less congested routes and times of the day. In some cases, the need to travel at all can be reduced through various means, including telecommuting and home shopping. Demand management just makes good sense to encourage better use of what we have and to influence the way we travel, especially during congested periods.

Defining Demand Management

Traditionally in the United States, transportation demand management (TDM) has involved strategies to induce commuters to shift to higher occupancy modes, such as carpooling, vanpooling, and public transport. However, this view is no longer consistent with the broad variety of measures being implemented in the United States and Europe to manage demand. According to the FHWA report *Mitigating Traffic Congestion—The Role of Demand-Side Strategies,* demand management is designed to better balance people's needs to travel a particular route at a particular time with the capacity of available facilities to efficiently handle this demand. A contemporary understanding of demand-side strategies is broader in scope than prior, more traditional views of TDM. Managing demand in the 21st century is about providing travelers, regardless of whether they drive alone, with travel choices, such as work location, route, time of travel, and mode.

In its broadest sense, demand management is defined as **providing travelers with effective choices to improve travel reliability.**

The purpose of the managing travel demand scan was to investigate European experience with managing the demand for vehicular travel, both for passenger and freight and for commuting as well as other trip purposes. Traveler choices might also include a priced option that provides a more reliable travel time. As the next section discusses, many European transportation professionals also differentiate "demand management" from "traffic management."

This broader view of demand management goes beyond traditional commuter markets to include other travel markets and situations, including the following:

- Special events
- Road construction traffic mitigation
- Tourist and visitor accommodation
- School and university travel (student and employee)
- Employment centers and economic development areas, including airports
- Intermodal transfer facilities for passengers and freight
- Incidents and emergencies of a long duration

Types of Demand Management

When assessing European experience with demand management, the scan team categorized four types of demand management strategies:

- Operational (such as dynamic route information on highways)
- Physical (such as auto restrictions in city centers)
- Financial/pricing (such as congestion charging)
- Organizational (such as sustainable travel planning)

This typology serves as the basis for summarizing the key findings of the scan and is used as a means to organize the case studies and overall findings in this report.

Performance Measurement

In looking at various ways to manage demand, the scan team was also keenly interested in assessing how their European counterparts measured success. Thus, during the course of the scan, the issue of performance measurement was identified as a key aspect of efforts to manage demand, more efficiently operate the transport system, and enhance travel time reliability. Performance measurement includes defining objectives, data requirements, and evaluation methods and determining how results are used and reported to policymakers. A 2004 International Technology Scanning Program scan report, *Transportation Performance Measures in Australia, Canada, Japan, and New Zealand* (FHWA-PL-05-001), focused on performance measurement.

European Perspectives on Demand Management

During the scan, several unique and intriguing European perspectives on demand management were presented. These perspectives focused on the concepts of accessibility versus mobility, traffic management versus demand management, and the need to plan for sustainable travel. They are discussed here to provide an understanding of how different perspectives on the issue of congestion essentially all lead to a philosophy of managing demand. These evolving perspectives on managing demand are a principal finding of the scan and the basis for an evolution in thinking. Therefore, it is useful to introduce some of the unique features of these perspectives to illustrate the differences in how Europeans interpret the role and impact of demand management.

Definitions—Before presenting these new perspectives, it is important to define several terms used in Europe when discussing demand management. The term "mobility management," as used in Europe, is more narrowly focused on measures such as information, marketing, partnerships, communications, and promotion of sustainable modes. In a sense, mobility management might be viewed as a subset of measures within the broader U.S definition of transportation demand management. In addition, many Europeans use the term "measure" when referring to a demand management strategy or technique, such as congestion pricing or improved public transport information. It is helpful to recognize the use of these terms when exploring the European experience with demand management. A glossary of European terms is in Appendix D.

Swedish Perspective—In Sweden, one researcher encouraged the scan team to consider and assess its definitions of "accessibility" and "mobility" when considering demand management. The researcher suggested that mobility relates to moving (the possibility to move oneself), while accessibility involves the possibility of reaching something desirable (which does not necessarily involve moving cars or even people). Within this context, demand management includes measures to assure accessibility by influencing travel needs and decisions before trips are made.

The Swedish presented a conceptual framework titled "TOAST" (Temple Of A Sustainable Transport System, figure 5), which includes six tenets to a more sustainable transport system:

- Plan for the long-term, more sustainable future.
- Develop the bicycle as a primary mode.
- Develop public transport to serve many types of travel.
- Work with companies on employee and business travel.
- Make car traffic more sustainable.
- Support the process with mobility management to influence travel before it starts.

These activities are viewed as leading to less congestion, less noise, better health, and cleaner air. This framework to support accessibility has encouraged, in part, many Swedish cities to develop comprehensive, sustainable transport plans and institutionalize demand management into planning activities, as described in Chapter 2. The most recent transportation infrastructure legislation in Sweden (2001) challenged the Swedish Road Administration (SRA) to do the following:

> "Work with measures influencing the demand for transport towards a sustainable transport system, i.e., travel that is more effective, more environmentally sound, and more safe than travel by car."

Dutch Perspective—Researchers in the Netherlands provided a more targeted conceptual framework, one that differentiates demand management from traffic management (see schematic in figure 6). This schematic differentiates travel demand from traffic demand and capacity (network) demand. In between these types of demand are choices that travelers can make, such as mode choice between transport demand and traffic demand, route choice between traffic demand and capacity demand, and even lane choice once the user is on a given facility.

According to the Dutch framework, demand management measures (in green) include special facilities (e.g., HOV lanes), on-trip or invehicle information, pretrip or near-trip information from work or home, and pricing. Traffic management measures include dynamic road signs, incident management, and intelligent vehicles. Data and information to manage these systems flow through control centers.

Figure 5. *Temple of a Sustainable Transport System (TOAST).*

This perspective helped the scan team differentiate demand management measures from certain traffic or network management techniques by providing a litmus test of travel choice. If travelers are presented with a choice of

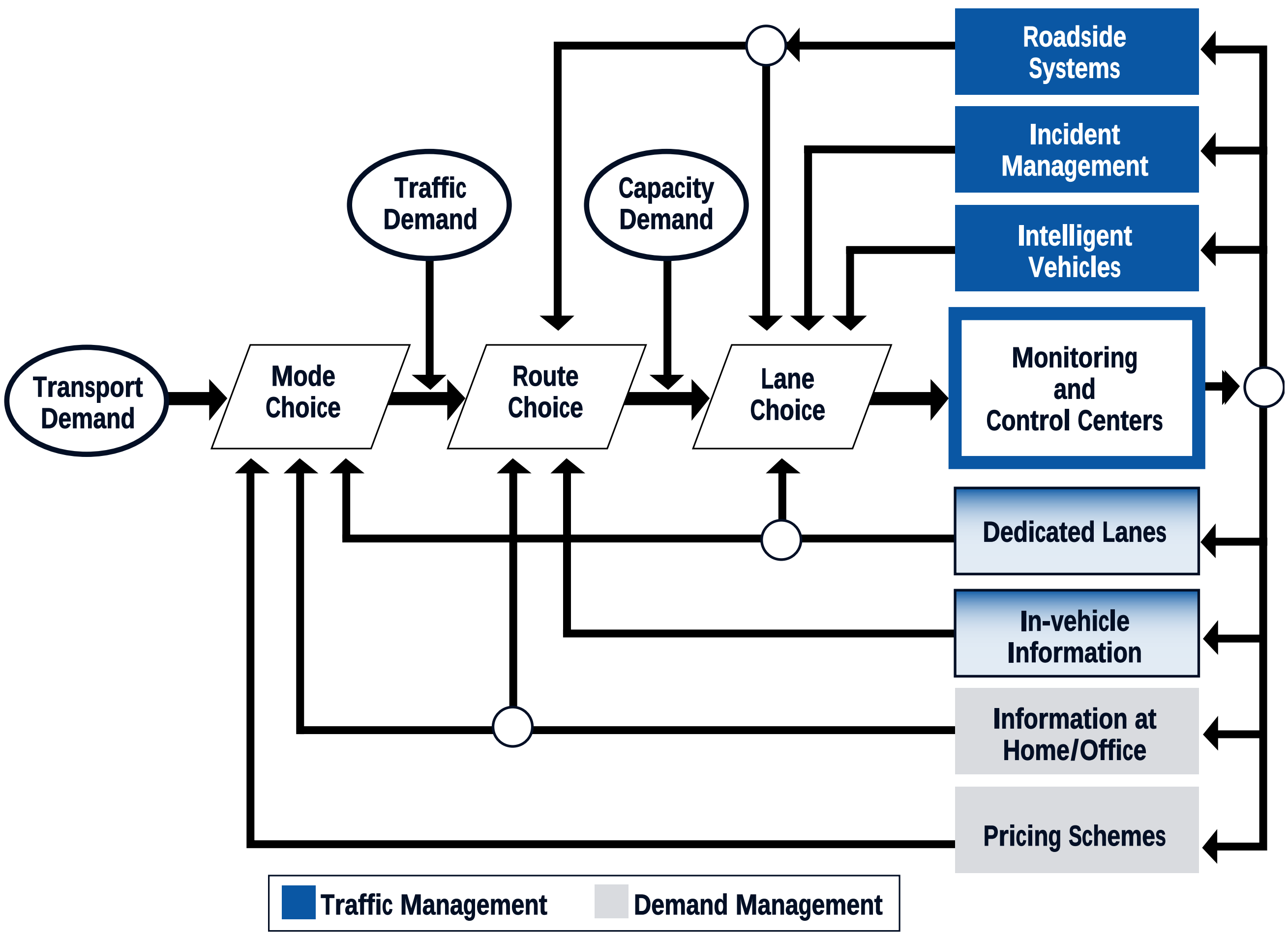


Figure 6. *Demand versus traffic management: Dutch model.*

mode, route, time of day, or even destination before they choose to get into their cars, this is considered demand management. If, however, users have no choice in their travel (for example, they are diverted around congestion via closures, directional signage, or enforcement), then this is deemed network management. In between these forms of management is traffic management, where choices on when or where to travel can be affected, but mode and destination choice are often already determined. In fact, the Dutch clearly delineate pretrip, near-trip, and on-trip decisions, based on traveler information needs for each.

British Perspective—The British government has launched an initiative to encourage citizens, businesses, schools, and other government agencies to "do their bit" by "making smarter choices." At the heart of the campaign is the notion of influencing travel decisions that people make to help cut congestion. In its new brochure, "Making Smarter Choices Work," the government acknowledges that "persuading people to break the habit of simply getting in their car for almost every journey is not easy." However, measures have been developed to influence behavior toward more sustainable modes, including walking, cycling, public transport, carpooling, and new options to reduce the need to travel at all. The measures are applied to work, school, shopping, and other trips.

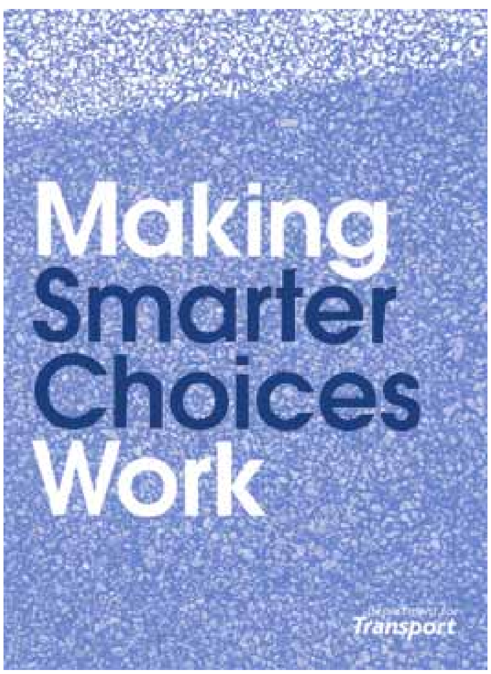


Figure 7. *"Making Smarter Choices Work" brochure.*

These European perspectives are interesting in their emphasis on sustainability, accessibility, demand versus traffic management, and smarter choices. They all, however, are founded on the same underlying notion that we need to manage demand to more efficiently use our transport system, enhance travel time reliability, and provide travel choices, be they mode, location, route, or time of travel. This is at the heart of demand management. These new perspectives on demand management may foreshadow a new way of thinking in the United States, an evolution that moves us from simply accommodating vehicles on an increasingly congested road system to managing the demand for travel—for some trips, perhaps before people even get into their cars.

European Context

During the scanning study, it became apparent that many of the plans and programs being implemented were, in part, influenced by the European Union (EU) and other international perspectives. This European context is important to understanding the motivations for many of the specific demand management strategies observed on the scan. All of the countries visited are EU members, although two (Sweden and the United Kingdom) are not part of the euro zone (i.e., countries that have adopted the euro as their currency).

The European Commission (EC) is the administrative body of EU and one of the three main governing institutions; the other two are the European Council and the European Parliament. Europe is a very urbanized region of the world and it is in these urban areas (which comprise 80 percent of Europe) that transportation, environmental, and energy policies meet. EC desires comprehensive, coordinated solutions to these problems and has set policies and developed programs to accomplish this. EC is also committed to improving safety on roads. European transport policy set two crucial targets: freeze modal split at 1998 levels by 2010 and reduce road fatalities by 50 percent (toward a goal of zero deaths). In energy policy, EC desires the substitution of 20 percent of transport fuels by alternative fuels. Environmental policy sets new air quality standards, in part to assist member states in fulfilling their commitments to the Kyoto Protocol (an international agreement to reduce greenhouse gases) and to address the long-term health effects of transport-related pollution. The overall objective of EC's 2001 Transport Policy is to do the following:

> "Meet the demand for accessibility, while minimizing the negative effects of transport, with an expectation of strong economic growth that should not be minimized."

This policy, contained in the 2001 *White Paper on Transport*, was undergoing a midterm review in 2005, after which more results on progress toward these objectives were expected to be available (*www.europa.eu.int*).

At the heart of this policy is the concept of decoupling traffic growth from economic growth. Historically, growth in transport use has paralleled economic growth, since transport demand is generally derived from the economy. However, some economists have forwarded the notion that this consistent relationship does not need to occur. Indeed, transport demand (in terms of demand for vehicles and roads) can be decoupled from economic growth if appropriate measures are in place to assure accessibility without restricting mobility of people and goods. This concept of decoupling is central to the notion of sustainable growth and transport. The long-term aim of the internalization of external costs for all modes of transport, and particularly road pricing, is one central strategy to induce users to pay for a higher share of the negative impacts of traffic. While transport growth (i.e., VKT) is still increasing in the EU at a rate close to gross domestic product (GDP), there are early signs that decoupling may be occurring.

One concrete way in which the EC is working to fulfill its transport, energy, and environmental objectives is through extensive research and the dissemination of findings and technology transfer. EU spends a significant part of its budget on research and development. A comprehensive research and development "framework programme" is in its sixth iteration and has funded large-scale pilot programs on advanced traveler information, marketing, mobility management, pricing, ITS, and many of the other topics of interest to the scan team. These initiatives mainly come from the Directorate General for Transport and Energy. A critical part of these European research projects is evaluation. For example, project MOST ("MObility STrategies for the next decades" found at http://mo.st) produced a standardized monitoring and evaluation toolkit for mobility management projects, and it has been customized for use in Sweden (see Chapter 2).

One example of EU-supported research is the CIVITAS (CIty VITAlity Sustainability) Initiative, which tests integrated strategies for clean transport *(www.civitas-initiative.org)*. CIVITAS supports the packaging of technology and policy measures in the area of energy and transport. This results in packages of strategies implemented at the local level, including clean vehicles, public transit innovations, demand management, pricing, traveler information, etc.

Figure 8. *CIVITAS logo.*

CIVITAS initiatives are being implemented in 36 cities in 17 countries, using local partners and independent evaluators. The program aims to test and evaluate new policies and packages of measures in real-world settings to assess the technological as well as political issues involved in the adoption and use of cleaner and more sustainable modes. These programs also allow EC to perform benchmarking for other localities. Two CIVITAS projects, in Bristol and Winchester, England, are discussed in Chapter 2. CIVITAS projects are also underway in Rome, Stockholm, and Rotterdam, and are linked with the strategies described in the case studies that follow.

Information on other European research projects and findings is available at *www.cordis.lu* and *www.eltis.org*.

Case Studies

This chapter describes the findings from each site visit, some focused on a particular city and some focused on all demand-side initiatives in a country. For each case study, a context is provided and key measures are described, organized by the four types of demand management enumerated in the last chapter: physical, operational, financial/pricing, and institutional. The role of and examples of performance measurement are also discussed.

Figure 9. *Historic center of Rome.*

Rome, Italy

Need and Context for Demand Management

"All roads lead to Rome" is a notion that many associate with the imperial period of Roman influence. However, those same roads are now choking the very livelihood that made Rome great. The city of Rome has a population of 2.8 million inhabitants and 1.5 million jobs. The Lazio region, with Rome at its center, has more than 5 million people. Almost 2 million cars and more than 500,000 motorcycles and motor scooters are registered in Rome. The mode split for travel in Rome is 60 percent private vehicle and 40 percent public transport and walking. The pressures of so many people and vehicles have created two interrelated problems, traffic congestion and environmental degradation.

Therefore, Rome's General Traffic Master Plan includes a central strategy to improve mobility, modify mode split in favor of public transport, increase traffic safety, decrease air and noise pollution, safeguard health, and preserve Rome's historical and architectural heritage. The strategy is to discourage or prohibit private car use in the core and gradually relax these restrictions outside the core. At the heart of this strategy is demand management, in keeping with the EU policy on sustainable transport.

The urban traffic strategy involves five concentric zones (figure 10) emanating from the historic core with increasing constraints on the automobile, especially gross polluters, as one gets closer to the center. In the historic core, measures have been implemented to restrict access to the private car and to improve public transport. Within the "Railway Ring," noncatalyzed cars are prohibited and parking pricing is used. At the "Ring Road," an extensive system of park-and-ride lots and public transport improvements has been implemented to increase the share of commuters and other travelers entering the city by public transport.

The key institutions involved in maintaining mobility and accessibility in Rome are ATAC SpA (Agenzia per i Transporti Autoferrotranviari del Comune di Roma), the Agency for Bus and Railway Transport in the municipality of Rome, and STA (Servizi per la Mobilita del Comune di Roma), the Mobility Agency for Rome. ATAC is responsible for all public travel and STA for private travel. ATAC is a newly formed (1997) public company of the city of Rome charged with managing mobility. During 2005, STA became part of ATAC. ATAC was created, in part, to help privatize some of the public transport services and reduce the operating deficit of the system. STA also is responsible for working with Roman companies to comply with a national mandate to implement employer TDM plans for all worksites with 300 or more employees.

Physical Measures

Rome has implemented several physical measures to restrict access by cars and improve public transport services and quality, including access restrictions, public transport improvements, and installation of ITS infrastructure.

Figure 10. *Concentric zones for automobile restrictions in Rome.*

Figure 11. *Limited traffic zone boundary map.*

In 1989, the city of Rome adopted a limited traffic zone (ZTL) to reduce the number of cars clogging and polluting the innermost core area, using an access control system (ACS) that relied on paper permits and police enforcement employing barricades. In 1994, the ZTL was expanded and a penalty was introduced for being inside the zone without a permit. Finally, in 1998 an automated ACS was approved, largely pushed by local, national, and European environmental policies. The ZTL covers about 5 square kilometers and has 22 access points, as shown in figure 11.

The automated system uses a dual system of onboard units (OBUs), or transponders, and photo enforcement using automated number plate recognition (ANPR) software. The access control system became fully operational in 2001. STA manages the access control system and has issued about 150,000 permits to various authorized users, including resident, nonresident, disabled, taxi, delivery, etc.

A significant part of Rome's strategy to reduce car use is to improve the public transport system, both in terms of expansion and modernization. Each year, Rome's bus system carries 880 million riders, the tram system moves 46 million passengers, and the underground system transports another 265 million riders.

Some 350 km of new urban rail are being constructed, including new tram lines that were inaugurated for the Roman Catholic Church's 2000 Jubilee Year. The national and regional rail systems have been reoriented to serve as more of a commuter rail system with integrated fare payment and 15 new park-and-ride connections at suburban rail stations. Another part of the public transport strategy is to use clean and electric vehicles in the historic core. New trolley bus lines are being implemented, including one hybrid line (Line 90) that uses overhead power until it reaches the center and then uses battery power. Rome boasts Europe's largest electric bus fleet and has about 500 clean fuel buses as well. Finally, Rome offers the public a fleet of electric scooters and recharging stations, many at park-and-ride lots, to provide a clean alternative to motor scooters.

Many ITS applications were implemented in anticipation of the millennium, which corresponded to World Youth Day and Jubilee Year events in 2000, many of them in 15 months. They included traffic control systems (for 400 signals and 48 variable message signs (VMS)), as well as management and monitoring (60 cameras) of entry to the access control zone; fleet management systems to monitor public transport, charter buses, and taxis; integrated ticketing and fare payment systems; and traveler information systems.

Operational Measures

Many of the operational strategies, which support demand management, involve the integration of services, information, and payment systems, and other complementary measures.

ATAC now coordinates all bus, rail, and tram services, and soon will be responsible for traffic management as well. Information integration refers to both pretrip and on-trip information, delivered through various means, including the Web, cell phones, kiosks, onboard displays, and in-terminal monitors. ATAC's Web-based route planner software includes photos of many of the bus stops on the system. Information on service status is available by radio in the underground metro system. Variable message signs near ZTL access points also inform users of current conditions (figure 14). By the end of 2005, ATAC planned to have real-time information for its entire fleet to monitor service quality and performance on the entire system. Ultimately, the public transport and traffic control systems will be fully integrated to manage public and private vehicles throughout the system. Finally, electronic payment is being implemented using smart card technology and other forms of electronic payment. One concrete example of this integration is the METREBUS pass. Holders of annual METREBUS multimodal tickets can park free at the park-and-ride lots (13,000 spaces) and use public transport to access Rome.

Figure 12. *ZTL access point.*

Figure 13. *Hybrid trolley bus in Rome.*

Figure 14. *Variable message sign at ZTL access point.*

Several complementary measures have also been implemented, some under the auspices of the EU CIVITAS MIRACLES program. One involves collective taxis that serve a niche between a conventional taxi and a bus. Eight passenger vans are used on eight lines that involve route deviation. Users book seats in advance through a call center. The Roma car-sharing service has been implemented for the occasional needs of users who do not have a car or who may avoid the purchase of a second car. Some 300 members belong to the car-sharing service, have access to a clean fuel vehicle, do not pay parking fees in the center, have access to the ZTL, and can use lanes restricted to taxis and public transport vehicles. This new form of collective car ownership is popular in Europe and is being piloted in the United States.

Finally, as mentioned above, the city of Rome has responsibility for working with companies to implement mobility management programs. Each worksite with 300 or more employees is required to have an in-house mobility manager and develop a TDM plan. STA provides technical support and training to these managers and assists with plan development and implementation. In one case, ATAC cofinanced a new employee bus service to one of Rome's major universities.

One good example of demand management for an unplanned major event involved the death and funeral of Pope John Paul II. Given the overwhelming flood of mourners into Rome, ATAC worked with other agencies and existing public transport users to develop a shuttle system that offered free, 24-hour service between the Termini train station and Vatican City as well as other shuttle services for Romans. This service required the use of more than 100 vehicles that were taken off existing routes. To spare these vehicles, the rest of the system adopted a Saturday schedule (60 percent of weekday service levels).

Financial/Pricing Measures

The key pricing measures being implemented in Rome are road pricing and parking pricing.

The access control zone described above involves the sale of annual permits to nonresidents to allow certain users to enter the historic core. Nonresidents (employed in the zone), who comprise 17 percent of the permit holders and 23 percent of the daily users, are tightly controlled and must pay US$425 (€340) per year for a permit and must prove that they have an offstreet parking space for their use. The violation rate is about 5 to 8 percent and the penalty is US$85 (€68) per infraction. The system generates US$72 million (€58 million) in permit and penalty revenue per year

Figure 15. *Car-share vehicle in Rome.*

against operating costs of US$4 million (€ 3.2 million).

After 3 years of operation, evaluations have revealed that traffic flows have decreased by 15 to 20 percent, average speed in the zone has increased by 4 percent, and public transport use is up by 5 percent as a result of the ZTL and pricing scheme. At the same time, however, the use of two-wheeled motor-driven vehicles has increased by 10 percent (partially to get around the permit fees using moped, motor scooters, and motorcycles). Since many of these are highly polluting two-stroke engines, the environmental impacts of the access control zone may be negligible (although policy changes are being contemplated to overcome this unintended effect). There does not appear to have been a negative effect on businesses in the core because accessibility and walkability have increased as a result of fewer cars, but merchants are still mixed on their attitudes toward the access controls. New access control zones have been added to popular pedestrian areas with expanded hours into the evening.

Rome estimates that over half of the unbuilt (without buildings) area of the historic city core is occupied by automobiles. Rome has more than 65,000 onstreet parking spaces. The blue zone, or core, includes 6,200 parking spaces controlled by automated payment machines that cover multiple spaces. Rome collects more than US$28 (€ 22) million from its parking system, or an annual average for US$588 (€ 470) per parker. There are three means for paying parking fees. The first is a paper ticket distributed by automated machines. The second is an "electronic wallet" debit OBU that can be activated when parking. Finally, cell phones can be used to pay for parking using Global Positioning System (GPS) technology. This provides real-time information to STA to track parking use. Within the core, variable pricing has been implemented to manage parking demand. Parking rates vary by time of day and location and range from US$0.63 (€ 0.50) to US$1.88 (€ 1.50) per hour.

Revenues from access permits, parking charges, and violations derived from private transport are reinvested in collective transportation, such as new tram lines, clean trolley buses, car sharing, and other services.

Institutional Measures

The new organizational model to provide for mobility is called the "Roman Model," which combines public oversight for planning, regulating, and monitoring mobility with outsourcing of service delivery through competitive bidding. Indeed, as STA is merged with ATAC, public transport and traffic management will be combined into a single entity, allowing for the integration of resources, information, operations, etc. Both organizations now provide traveler information on traffic conditions and public transport service, and the merging of the two will fully integrate this information to provide one source of public and private transportation information.

One reason for creating ATAC as a limited public corporation was to allow it to have access to capital markets that the municipality would not have. Therefore, ATAC has restructured the public debt of the public transport system and is reducing the overall deficit through asset management (ATAC owns all of the vehicles), new revenue sources, and reduced operating costs through competitive tenders for service delivery.

Performance Measurement

Rome is increasingly relying on performance measurement to create an efficient and effective transport system. ATAC monitors the performance of contract service providers to assess ontime reliability. This information is used to penalize operators who do not meet contractual standards. In fact, the service contracts include payment penalties for missed and late runs and this has improved service quality and rider satisfaction.

Conclusions from Rome

Staff members at STA and ATAC believe that access control and road pricing are an effective combination and that one key to their success is the careful management of the permitting, enforcement, and monitoring processes. A principal finding from Rome is that access control and pricing have reduced congestion in Rome's historic core, but increases in motor scooters and motorcycles might offset the environmental benefits. Rome is taking steps to integrate motor-driven cycles into its demand management scheme.

Stockholm, Sweden

Need and Context for Demand Management

Stockholm is a dynamic city located on 14 islands where Lake Mälaren opens into the Baltic Sea. Only two major bridges provide access into central Stockholm and each carries 120,000 to 130,000 vehicles per day. Some 240,000 commuters enter the city each day from a region with 1.8 million inhabitants (760,000 in the city of Stockholm). While Sweden is experiencing traffic growth of 1.5 to 2.0 percent a year, Stockholm's traffic is increasing at twice that rate, even though the share of peak commuter trips carried on public transport is an impressive 75 percent.

One solution strategy involves the completion of the inner and outer ring road systems to move traffic around central Stockholm. The key link in this system is the so-called "Western Highway" on the outer ring. Improvements to the inner ring include a new tunnel south of central Stockholm, the Södra Länken. Another long-term strategy is improvements to the rail system. About 500 trains come into central Stockholm daily on two tracks built in the 1870s. Plans are in place to build new tracks and a separate station for commuter rail, but they will not be completed until 2012.

Some politicians in Stockholm want a more immediate response to traffic congestion and its attendant environmental and safety issues. In 2002, the Green Party included public transport improvements and congestion pricing as part of its national policy agenda. A national law was passed mandating that congestion charges be implemented on a trial basis within 4 years. One unique aspect of the congestion pricing mandate is that it was imposed on the city and not conceived as a local solution as part of the conventional planning process. The objectives of the Stockholm Trial are to reduce congestion, maintain accessibility, and improve the environment. Key components of the Stockholm Trial are improved public transport services, a system of park-and-ride facilities, and a cordon congestion charging scheme in the form of a congestion tax. The total budget for the trial is more than US$500 million (SEK3.8 billion). The trial is a cooperative undertaking of the Swedish Road Administration (SRA) and the city of Stockholm and includes significant improvements to public transport in the region. More information on the pricing pilot is provided below.

Physical Measures

As mentioned above, Stockholm is making improvements to its circumferential road system and rail network. The opening of the Södra Länken Tunnel south of Stockholm was accompanied by several key measures, including extra lanes at bottlenecks, an exclusive bus lane, intercept park-and-ride facilities, traffic management (ramp metering and signal timing) to maintain minimum speeds in the tunnel, cell and radio capabilities in the tunnel, road assistance services, video monitoring, and speed controls.

Public transport improvements include new tracks for commuter rail trains and a new commuter rail terminal near the existing central train station. New park-and-ride facilities are being built throughout the region, served by 16 new express bus lines using almost 200 new buses.

Figure 16. *Central Stockholm.*

Operational Measures

Sweden has developed a national strategy for traffic management using ITS, including five key priorities:

1. Safety
2. Measures for commuters
3. Measures for freight movement
4. Quality assurance for data
5. User reliability

Sweden leads many countries of the world in road safety and has a Vision Zero policy aimed at eliminating road fatalities. One small measure in response to this policy was a speed limit reduction on residential streets from 50 to 30 kilometers per hour (km/h). Speed adapting systems are being placed in vehicles to alert drivers of unsafe speeds. One interesting question on the relationship between safety and demand concerned induced demand: When users perceive the system to be safer, do they actually travel more?

The Swedish ITS program includes a state-of-the-art traffic management center, speed and lane management, incident management, and roadside assistance. Examples of ITS measures, implemented as part of the new tunnel, are enumerated above.

SRA's Road Assistance program (akin to freeway service patrols in the United States) includes four assistance vehicles, two tow trucks, and even motorcycle units for use in space-restricted situations (such as tunnels). The drivers are trained emergency medical technicians and have lifesaving and firefighting equipment. SRA estimates that incidents cost Sweden US$33 million (SEK250 million) annually in lost productivity and activity because of delays.

The Road Assistance program in the Stockholm area is directed by Trafik Stockholm, the regional traffic management center (TMC). Trafik Stockholm is a joint venture of the city of Stockholm and SRA (see figure 17). Trafik Stockholm operates an integrated system that provides the following:

- Traffic monitoring
- Traffic information
- Traffic management
- Road assistance
- System surveillance

Information sources include police, radio stations, SRA, city traffic monitoring data, and public transport operators. Information processed by the TMC is provided to travelers via traffic advisory radio, Internet, personal digital assistants (PDAs), variable message signs (VMS), invehicle systems, and the motorway control system using speed and lane control. Trafik Stockholm is empowered by Swedish law to change speeds or close lanes on the system (which in many cities requires police approval). The information is provided free to anyone to use or sell. Archived data are also used for traffic and transport planning purposes by the city and SRA.

Figure 17. *Swedish Road Assist vehicle.*

Figure 18. *Trafik Stockholm.*

One outlet for road and public transport conditions is *www.trafiken.nu,* a Web site with a name that means "traffic now." The service is available in several of Sweden's largest cities and one tourist destination. Dynamic, real-time information is provided to users for pretrip decisions and the effort is part of Stockholm's CIVITAS project. Market research has shown that many users delay departure times (predominantly women) or change their travel mode (men) as a result of the information, and this research is testimony to Sweden's customer orientation.

Several complementary operational measures to the congestion pricing trial are being implemented as part of Stockholm's CIVITAS Trendsetter project, including bus priority schemes, traveler information delivery systems, and real-time bus arrival information at stops. Another operational measure is free onstreet parking for alternative-fuel automobiles.

Financial/Pricing Measures

A principal reason for visiting Stockholm as part of the scan was to learn more about the congestion pricing pilot project. The timing of the scan was fortuitous in that the "before" evaluation of the Stockholm Trial had been completed and the pricing pilot was scheduled to begin soon. Transit service improvements, including the new bus lines, were started in August 2005, new park-and-ride facilities were scheduled to open in the fall, and the congestion charge was set to begin in January 2006. While the national Parliament mandated the congestion charges in 2002, 2 years were required to pass local enabling legislation and resolve taxation issues associated with the charge (the charge is officially a national tax on the car owner). There were also delays in procuring the infrastructure for the vehicle identification and charging system.

The goal of the Stockholm Trial is to reduce traffic entering central Stockholm by 10 to 15 percent. A cordon has been established around the innermost islands of the archipelago with 18 charging points (figure 19). A charge of US$1.33 to US$2.66 (SEK10 to SEK20) will be imposed for each crossing of the cordon, depending on the time of day. The maximum charge will be US$8.00 (SEK60) per day. Crossings are estimated at 500,000 a day. At the end of each day, each traveler must make a "tax decision" and pay for the charges. Car owners have 5 days to pay before adjudication begins.

Estimated impacts include a 10 to 15 percent reduction in traffic into the city center (20 percent at cordon points) during peak periods, a 7 percent increase in public transport use (12,000 new riders, above current high levels), and an increase in traffic on the circumferential roads.

The technology used for the charging scheme involves both electronic identification using onboard units (OBU), or transponders, and automated number plate recognition (ANPR) photo systems that work independently. Only the photo system will be used as part of the payment and enforcement process (since a photo was deemed necessary for adjudication). Information on the Stockholm Trial is available at *www.stockholmsforsoket.se.*

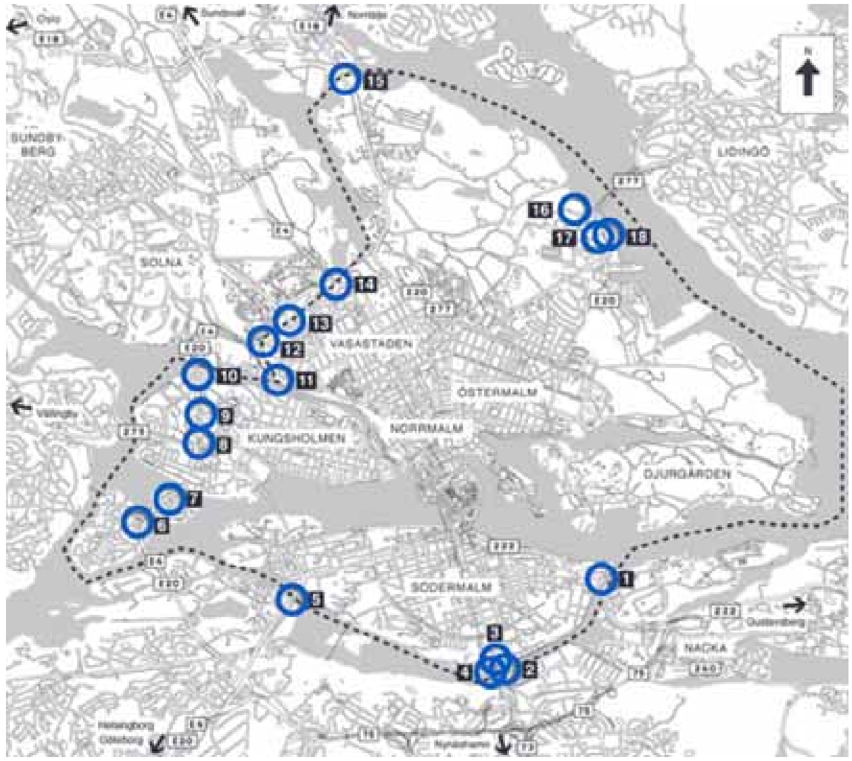


Figure 19. *Map of pricing cordon around central Stockholm.*

Institutional Measures

Demand management is also being institutionalized into national and local transportation plans and programs. Mobility management (MM), defined in Sweden as "soft measures to influence travel before it starts," includes carpooling, working from home, information campaigns, travel planning, home delivery, etc. In the past 5 years, MM has been institutionalized in policy, planning, and programs. In the national Infrastructure Bill of 2001, SRA was mandated "to work with measures influencing the demand for transport towards a sustainable transport system, i.e., travel that is more effective, more environmentally sound and more safe than travel by car. . . . One such measure is Mobility Management." MM has been integrated into Sweden's local planning handbook and a standardized evaluation methodology has been created (System of the Evaluation of Mobility Projects, or SUMO). The national government is funding MM activities, partially with environmental funds, to operate mobility centers around Sweden, develop local MM projects, and create integrated, sustainable transport programs (described in the section on Lund).

One of the most significant examples of institutionalizing demand management in the transport planning process is the Swedish Four-Stage Principle, a new standardized approach for assessing highway needs adopted by SRA in 2002. The Four-Stage Principle requires planners and engineers to evaluate options in the following order:

Step 1—Measures that affect the demand for transport and the choice of mode

Step 2—Measures that affect the more efficient use of the existing road network

Step 3—Measures that make improvements to existing roads

Step 4—Measures that make new investments in road capacity or major rebuilding

Planners and engineers, therefore, are required to consider and rule out demand management and traffic management before they can consider improvements or new construction. This has created a new way of approaching and advancing transport projects at SRA that has resulted in application of alternative solutions rather than traditional capacity projects.

Performance Measurement

The Stockholm Trial and congestion tax will be a true test of the ability of the city, SRA, and public transport operator to implement a fully integrated package of incentives, services, and disincentives aimed at reducing peak-period car use—all to be tested in less than 1 year. The treatment of the congestion charge as a tax provides considerable challenges to both administering the pricing test and in user acceptance and public attitudes toward charging. However, the trial is being carefully evaluated and reports are provided monthly to policymakers and the public. An extensive before-and-after evaluation includes consideration of traffic flow impacts, public transport ridership, economic and air quality impacts, and travel times to measure the performance of the test in reducing congestion. A longitudinal survey with 36,000 respondents is underway to track behavior and attitude changes. The trial period will conclude at the end of July 2006 and results will be used to inform the public as part of a national referendum to be held on September 17, 2006. Information on the Stockholm Trial is available at *www.stockholmsforsoket.se*.

Conclusions from Stockholm

Staff members at the city of Stockholm and SRA believe that the primary unexpected lesson they learned from planning the Stockholm Trial is that they did not focus enough on the ultimate consumers, spending much of their time on fiscal and taxing issues and the technology of pricing. Public opinion is split, with almost one-third of residents thinking that the congestion charging scheme is a very good idea and an equal proportion thinking it is very bad. The fall 2006 election will provide the ultimate test in the form of a national satisfaction poll on congestion charging and its benefits.

Lund, Sweden

Need and Context for Demand Management

Lund is a very old university town located in the southwest corner of Sweden, near the city of Mälmo in the Skåne region. This also places Lund near the new Öresund Bridge that links Sweden to Denmark. While the entire Öresund region of southern Sweden and Copenhagen has 3.5 million inhabitants, the city of Lund has 77,000 residents and the conurbation has 105,000. The University of Lund is one of Sweden's oldest with 34,000 undergraduates, 3,100 graduate students, and 5,300 employees. The university also boasts a teaching hospital and has spawned a technology center.

Some 25,000 commuters come into Lund each day and 35,000 change modes at the Lund rail station (figure 20). The current mode split for travel in Lund is about 45 percent automobile, 45 percent bicycling and walking, and 10 percent public transport. While many of the shortest trips are made by bicycle (over 50 percent of trips of 1.5 km or less), the car is still the predominant mode for many trips.

Town planning in Lund took a decided shift about 35 years ago to protect the historic core of the city by limiting automobile access and providing priority to bicyclists and pedestrians. In 1969, the municipal council decided against building a new southern arterial and in 1971 all nonauthorized traffic was banned from the city center to enhance the nonmotorized and public transport circulation and preserve the city's medieval core. This changed the course of town and transport planning, which has evolved into today's integrated sustainable transport initiatives. Sustainable transport planning in Lund does the following:

- Places high priority on walking and bicycling
- Aims to reduce car traffic, especially in densely populated areas
- Locates new residential areas within cycling distance to work locations and the city center
- Extends public transport and ties it to socioeconomic goals
- Ties mobility management closer to land use planning

In the 1990s, after making significant commitments to reorient the city to nonmotorized modes, a major push was made to reduce the demand for car travel. The city set goals for traffic, including maintaining 1995 traffic levels through 2005, reducing per capita car use and city center traffic by 10 percent, and increasing bicycle use by 15 percent. The city also committed to a Vision Zero policy with reductions in road deaths and reductions in carbon dioxide emissions. Responses to the European Agenda 21 sustainable planning initiative and Lund's general plan update led to the development and adoption of LundaMaTs, Europe's first integrated sustainable transport plan.

LundaMaTs includes five key components (tied to the TOAST concept described in Chapter 1) to reduce car traffic growth and mitigate its negative effects:

1. Introduction of sustainable urban planning
2. Recognition of a bicycle city
3. Extended public transport with improved integration
4. Environmentally friendly car traffic
5. Employer transportation, including more sustainable commuter transport

LundaMaTs has involved more than

Figure 20. *Bicycle parking at Lund rail station.*

SEK30 million (US$4 million) in funding from local, regional, and national sources. The specific projects and programs implemented under LundaMaTs and the resulting impacts are discussed in the following.

Physical Measures

Lund has provided considerable infrastructure for nonautomobile modes. To promote bicycling as a primary mode, Lund has built a cycling network of 170 km of paths, including bicycle and pedestrian underpasses at key arterials. There are almost 5,000 bicycle parking spaces in the city center and 16 bike-and-ride facilities at bus stops. The train station includes a bicycle station called the Lundahoj. The bicycle station includes secure bicycle parking, repair, rental, and bicycle and traffic information from SRA. Staff from the Lundahoj also patrol the area to increase the security of bicycles parked around the train station.

One impetus for this physical enhancement was a city policy stating that "unprotected road users (bicyclists and pedestrians) shall have priority (over cars)." This has led to the reallocation of road space to these users and speed reductions. As a result of the "bicycle city" component of LundaMaTs, bicycle volumes have increased 1.25 percent a year since the 1990s.

Finally, an environmental zone has been established around Lund to prohibit heavy-duty diesel trucks from entering the zone, in line with European regulations on older trucks larger than 3.5 metric tons in gross weight.

Operational Measures

One measure to improve public transport and provide integration of local and regional systems is the bus rapid transit project called the Lundalänken, or Lund Link. The Lund Link connects the train station and city center with the university, hospital, and technology center. A direct connection is provided at the train station with real-time information displays of the next buses to depart. This high-frequency service uses a dedicated busway on much of the 10-km corridor, with many buses traveling on to residential areas. In places where buses are mixed with traffic (near the train station), priority is given to buses using signal preemption. Stations along the busway include shelters with real-time bus information. The Lund Link was opened in 2003 with the aim of improving the competitiveness of public transport.

The city has purchased land along the corridor at the end of the busway so that development can occur in a more transit-friendly manner. This is accompanied by decreased parking requirements and information on how living in the corridor can reduce the need for a second car.

As a result of the Lund Link, public transport ridership has increased by 20 percent in the corridor and about 120 new car parking spaces have been avoided.

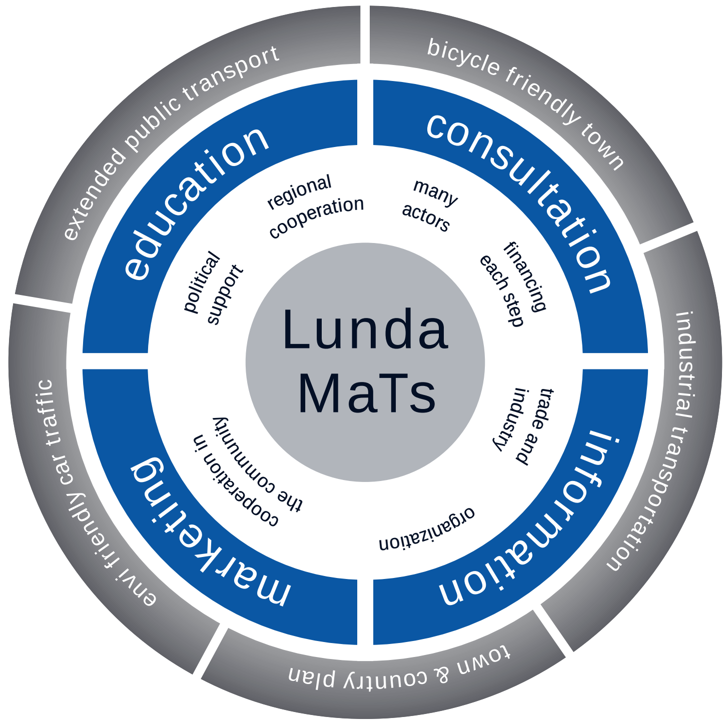


Figure 21. *LundaMaTs schematic.*

Figure 22. *Bicycle underpass in Lund.*

Financial/Pricing Measures

One unique aspect of the Lund Link and its integration with longer range planning involves how it is financed. In addition to funding from the region to initiate the service and build the busway, some revenue from the sale of land along the route is used to further develop public transport in the corridor.

To induce a mode switch to transit, those willing to try public transport for 1 year were provided with a significant financial incentive in the form of a free annual pass. These so-called "test riders" were recruited from outlying neighborhoods where transit was available, but driving was the predominant mode of travel. Mobility Center staff literally

Figure 23. *Lund Link exclusive busway.*

went door to door to provide personalized information on alternatives to the car, talking with 13,000 residents. The aim was to encourage, inform, and then induce trial use of public transport or bicycling. Some 340 test riders were recruited to try riding the bus. At the end of the free pass trial period, half continued to ride the bus. One year after the end of the trial period, over 40 percent continued to use public transport.

Institutional Measures

One of the most interesting aspects of LundaMaTs is the ability to institutionalize sustainable transport into the city's plans, programs, and policies. During the plan's development, elected officials were very active in crafting the programs and policies and providing vision. LundaMaTs implemented a variety of projects all at once, and this has clearly reoriented the way the city approaches transportation and land use decisions. Lund has just completed a new development guidance handbook that shows the impact of mobility management measures on traffic and the environment using data and experience gathered locally.

Figure 24. *Example of information from Lund.*

Lund's Mobility Center has been instrumental in educating residents, employers, visitors and others on the sustainable travel options available. Mobility Center staff members have worked to create "smart road users," "test riders," and "healthy bicyclists" by working with individuals and companies. While LundaMaTs includes measures to provide positive incentives and some with an element of compulsion, the emphasis is on encouraging voluntary changes aimed at creating an environmentally friendly transportation system.

A comprehensive evaluation of LundaMaTs reveals that after 2 years traffic levels (per capita car use) had decreased by 1 percent over baseline levels and after 4 years by 2.5 percent. This was accomplished by having close to 20 percent of all residents change their behavior in some fashion, such as by bicycling, using public transport, or making smarter choices about commuting and traveling into the city center, or trying to make changes when possible.

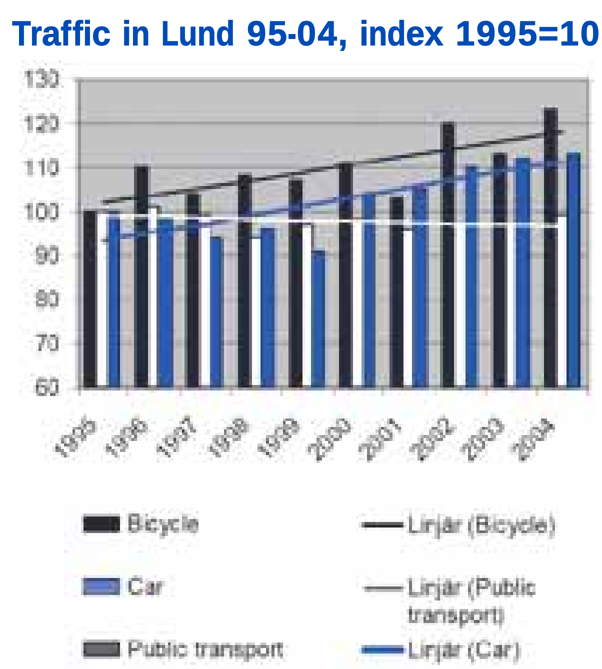
The next phase of LundaMaTs is now being planned to continue sustainable transport initiatives for 10 to 30 more years. The vision statement set forth by stakeholders is that a "transportation system in Lund be designed to meet what humans and the environment can bear." The evaluation will include traffic impacts, as well as social, economic, and environmental impacts. LundaMaTs will become more regional in scope to better address the growth in through trips.

Sustainable urban transport plans are now required of all large Swedish cities and this may become a European-wide requirement in the future.

Performance Measurement

Lund has carefully monitored and evaluated the effectiveness of LundaMaTs to assess its ability to reach its intended goals. The amount of switching to sustainable modes

Table 1. *Traffic in Lund: 1995–2004*.



resulted in an overall reduction in car traffic of over 2 percent in 4 years. This enabled Lund to meet its goal of maintaining traffic levels at 1995 levels. While Lund continues to grow, this growth is being directed in a sustainable manner. Thus, Lund may be one of the first cities to decouple traffic and economic growth.

Conclusions from Lund

Staff members from the municipality of Lund credit the integrated LundaMaTs project with increasing residents' knowledge about sustainable mobility. Information was provided that induced a change in travel behavior. Early involvement by politicians and careful evaluation has enabled the process to continue, resulting in a renewed plan for the next 30 years.

Cologne, Germany

Need and Context for Demand Management

Cologne (Köln), situated on the Rhine River, is considered one of the major crossroads of Europe. At one time, Cologne was one of the most remote colonial (hence the name) cities in the Roman Empire. With a population of 1.1 million in the city of Cologne and more than 3 million in the region, more than 400,000 workers commute into Cologne each day from seven principal origin areas. Only four bridges cross the Rhine, and these carry 120,000 cars per day. Some 180,000 vehicles a day use the autobahn east of Cologne, which is part of a 52-km ring road system.

As such, the roads into and around Cologne are heavily congested. Of the 12,000 km of federal roads in the Cologne area, 2,000 or one-sixth are congested during much of the day. Today, there are significant pressures to expand the road system in an already very dense urban area and, indeed, lanes are being added to the ring highways to the west and east. But traffic management is a key part of the solution as well. Congestion costs billions of euros each year and the benefits of managing traffic not only include addressing congestion, but also reducing accidents and emissions.

Traffic control systems have been developed by the Federal Ministry of Transport, but traffic in and around Cologne is managed by both the city of Cologne and the State of North Rhine Westphalia. The state controls the highway system and the city controls arterials and the public transport system. In fact, 84 percent of the transportation budget in Cologne is spent on public transit, 15 percent on roads, and 1 percent on traffic management. The city estimates that it receives six times the benefits for each euro spent on its overall transport program.

Two major federal initiatives were partially responsible for leading the scan team to Cologne: an advanced traveler information pilot program called Stadtinfoköln, and the new federal road charging system for heavy trucks.

Physical Measures

In addition to widening of the Cologne ring highways, the public transport system is being improved and expanded. The Kolnerverkehrsbetriebe (KVB) system, including trams, buses, and an underground system, carries 230 million riders per year. The KVB is in the middle of a US$1.25 billion (€1 billion) improvement program over 12 years to upgrade right-of-way, rolling stock, and stations and expand the system, notably the tram network. Improvements include the introduction of low-floor vehicles, prioritization schemes to increase speeds, an advanced schedule information system, dynamic information displays at platforms, and fare system integration.

A park-and-ride system has been established along key arterials feeding into the city center where travelers can park and transfer to streetcars. There are five integrated park-and-ride facilities at tram stations, including 2,300 spaces. One innovative aspect of these facilities is the information system that provides drivers with real-time travel time comparisons. When approaching a park-and-ride lot and tram station, drivers can read a dynamic display panel,

Figure 25. *Cologne, Germany.*

Figure 26. *Travel time comparison display on Cologne arterial.*

which shows the current travel time into the city center, the equivalent travel time by public transport, and how soon the next tram will arrive (see figure 26). This enables drivers to make informed choices about staying on the road or transferring to public transport. This travel time comparison initiative was integrated into the park-and-ride system as part of the Stadtinfoköln project discussed below.

Operational Measures

The Federal Ministry of Transport developed several traffic control systems used in Cologne, including route control (managing traffic on existing segments), network control (distributing traffic on the entire system), and junction control (managing traffic onto or entering from one road to another).

The German route control system is similar to that used throughout northern Europe to harmonize flow on key segments. Overhead displays warn motorists about upcoming congestion and provide information on the source of the slowing (e.g., construction, incidents, weather, etc.). The data needed to manage a route include traffic volumes for cars and trucks, speeds, and weather. The relationship of the volume and speed of cars to the volume and speed of trucks is used to manage traffic, and historic data are used to predict conditions over the next 30 minutes.

Information is coordinated by regional traffic management centers, like the one controlling the greater Cologne region and operated by North Rhine Westphalia (figure 27). Information is provided to the police and radio stations. Current and predicted conditions on key routes are also provided on a state Web site (*www.autobahn.nrw.de*) and are available in other forms, including invehicle and via personal electronics, to allow drivers to better choose the time they travel.

The ITS infrastructure installed to manage the system around Cologne was prompted by a massive accident caused by fog on the A4 autobahn between Aachen, to the west, and Cologne. These control systems cost between US$125,000 and US$375,000 (€ 100,000 and € 300,000) per kilometer of highway, and segments are prioritized for this treatment based on the volume of accidents, traffic, and available funds. The route control system has reduced accidents and enhanced traffic flow to provide more efficient use of the road system. Some 900 km of the national autobahn system have route control for traffic management in this region.

One unique measure used in northern Europe is the Radio Data System–Traffic Message Channel (RDS-TMC) used by many radio stations on a periodic or episodic basis. When an alert on nearby congestion or an incident is broadcast, the motorist's car radio increases in volume or interrupts a compact disk and provides information on the location and duration of the congestion or incident. The information is provided by public traffic information services to public and private radio networks free of charge. Moreover, the same data are used in onboard navigation systems to provide dynamic route guidance so drivers can avoid congested roads.

Network control aims to move motorists around major backups or incidents by either providing information on alternative routes (additive approach of adding information on directional signs on alternatives) or rerouting traffic by changing destination signs (substitutive approach of integrating VMS into regular

Figure 27 . *North Rhine Westphalia Traffic Management Center display.*

highway signage). The additive approach offers drivers a choice of travel route and the substitutive approach, in essence, makes the decision for drivers. An agreement between North Rhine Westphalia and the Netherlands (called CENTRICO) also manages traffic between Cologne and Eindhoven to reroute traffic under certain conditions.

Junction control includes both ramp metering to manage flow onto highways and lane controls to close the main lane nearest the on-ramp to ease flow onto the highway (figure 28). Germany is also experimenting with the temporary use of the hard shoulder (currently only under the control of police) and photo enforcement of speeds on the autobahn (see more about this in the sections covering the Netherlands and the United Kingdom).

The city of Cologne is also extensively involved in traffic management for travelers once they are off the highway system or using alternative modes. In fact, the city of Cologne has a Traffic Management Department. In addition to road construction and maintenance, traffic management in Cologne relies on the following:

- Parking management system
- Traffic control systems
- Traffic management center
- Video observation
- Traffic counts via induction loops and infrared detection

Traffic management in Cologne involves both a collective system involving traffic, parking, and park-and-ride management systems and an individual system providing information to travelers through dynamic navigation and other personal and invehicle devices. Information from Cologne's traffic management system is used for variable message signs, video text on TV, TV and radio reporting, newspapers, the Internet, information kiosks, invehicle systems, cell phones, and the parking management system.

Cologne's dynamic parking management system helps efficiently move cars off the streets into 37 parking structures containing 22,000 spaces. Drivers are directed to one of four major parking zones by dynamic display signs that show the available number of spaces in that area using real-time information (figure 29). Some 23 VARIO variable message signs are also used to provide additional information on special events, current conditions, incidents, advisories to switch to public transport, etc. An evaluation in 2000 estimated that the parking management system reduced 9.4 million km of travel by cars searching for parking and reduced traffic by 3.2 percent in the city center.

Innovations in parking management are discussed below, but the integration of parking and traffic management is being realized for large-scale events, such as those at the new soccer stadium being built for the 2006 World Cup. Traffic coming to the new Sportpark M_ngersdorf will be presorted on the highway system to route cars to available parking lots and parking shuttle systems. An even more dramatic example of parking management was the closure of highways, including a 13-kilometer segment of the A1 autobahn used to park buses during the World Youth Day event in August 2005 that brought 1 million pilgrims to the Cologne region.

Figure 28. *Junction control scheme on German autobahn system.*

Figure 29. *Parking information display in Cologne.*

Financial/Pricing Measures

While in Cologne, the scan team learned about the national truck tolling scheme. Germany's central European location, coupled with its extensive national highway (autobahn) network, results in significant goods movement by trucks passing through the country. In response to a mandate from the European Parliament and enabling legislation from the German Parliament, the Federal Office for Goods Transport (Bundesamt f_r G_terverkehr) and the firm Toll Collect GmbH developed and implemented a distance-based truck toll system for German highways in a public-private partnership. Several other central European countries have new tolls for trucks, but the size of Germany's highway network and truck volumes presented unique challenges to not impede traffic flow. Germany adopted the truck tolls to have trucks pay part of the cost of maintaining the highway system, which has been greatly impacted by increases in truck travel, especially since the inclusion of Eastern European countries in the EU.

All heavy commercial vehicles of 12 metric tons or more used for moving goods are required to pay a distance-based toll to use the German highway system. The system is operated by Toll Collect GmbH. Truck operators have three ways to pay the toll: 1) automatically with an onboard unit (OBU) working with GPS, cell phone, and short-range communications technology, 2) manually at one of 3,500 toll station terminals (figure 30), or 3) on the Internet.

More than 80 percent of tolls are paid using OBUs, with one-third of the units installed on foreign trucks. Some 300 control bridges over the highway collect data from OBUs and take photos for ANPR enforcement. OBUs can pinpoint the location and direction of a given truck on any of 5,200 route segments on 24,000 km of German highways.

For trucks not exhibiting a valid registration and payment, some 280 mobile enforcement vehicles from the Federal Office for Goods Transport are used. The system experienced delays in getting started because of technical glitches with OBU performance in heavy-duty vehicles. Toll Collect GmbH, in operation since the beginning of 2005, and the Federal Office for Goods Transport had checked (by all tracking and enforcement means) 13.1 million trucks by the end of September 2005, with a violation rate below 3 percent.

Institutional Measures

A federal pilot program entitled Stadtinfok_ln was initiated in 1999 to provide better information on traffic and traveler choices to individuals. While collective management systems controlled traffic and parking, traveler information tended to be mode specific and not well integrated. A system was created that feeds needed data into the Cologne traffic management center to manage the system and to a new system to provide real-time information to individuals in a coordinated fashion.

The pilot was one of five projects funded in Germany as part of a "Mobility in Urban Areas" program, including projects in Frankfurt (WayFlow), Stuttgart (Mobilist), Munich (MOBINET), and Dresden (Intermobil). Stadtinfok_ln was intended to build a comprehensive, user-friendly traffic and transport information system (see figure 31). The project

Figure 30. *German toll payment station.*

Figure 31. *Traveler information in Cologne.*

cost US$20 million (€16.3 million), half paid for by the federal program. The funding was strictly for research and the creation of the information system and included no funding for ITS infrastructure.

Innovative products resulting from Stadtinfok_ln include the following:

- An onstreet parking information system that collects information on current space availability from automated ticketing machines and predicts availability for the next hour.
- Adaptation of invehicle navigation systems to provide dynamic parking information, route guidance, parking reservations, and electronic payment.
- Door-to-door public transport and park-and-ride information, including schedule information, interactive maps, and precise walking directions on the Internet and on hand-held PDA devices, as well as individual schedule information on cell phones using short message service (SMS) text messages (*www.vrsinfo.de*).
- The dynamic system to provide information on parking availability and park-and-ride options via VMS and individual information (e.g., real-time data to warn travelers that downtown lots are 90 percent full and recommend use of park-and-ride lots).
- Real-time travel time comparison information between driving to the city center and switching to park-and-ride tram service.

All in all, Stadtinfok_ln has succeeded in integrating existing information systems and created new services. But most important, it has improved the variety of user interface, supported multimodal choices, and developed predicted conditions and travel times while keeping the consumer in mind. The greatest barriers to the development and adoption of these information services tended to be more institutional than technical.

Performance Measurement

The German traffic management systems the team observed in Cologne are grounded in performance measurement to assure optimal operation of the transport system given the severely congested conditions. For example, the algorithm to lower speeds on the region's highway system is based on the mix and speeds of cars and trucks to assure safe conditions. Information on road conditions and parking availability are monitored all along the traveler's path to provide real-time information and advice on traffic conditions on regional roads, availability of park-and-ride lots, city traffic conditions, and parking lots in the center.

Conclusions on Cologne

By introducing a comprehensive set of highway, road, and parking management schemes; improving public transport; and implementing advanced traveler information systems, Cologne has achieved an almost 10 percent reduction in peak-period traffic into the city center at a time when traffic on regional highways has increased by 18.5 percent. This is partially a result of a 25 percent increase in public transport use. However, mode, route, and time choices have enabled travelers to make smarter decisions about when, where, how, and whether to travel into Cologne.

The Netherlands

Need and Context for Demand Management

The Netherlands is a very densely populated country that sees itself somewhere between a city-state and a country. It has 16 million inhabitants, with almost half living in the Randstad, or core, region bounded by Amsterdam, Rotterdam, The Hague, and Utrecht.

This area is highly congested, compounded by growth in truck traffic from the Port of Rotterdam, the world's busiest port. The national road system includes 3,200 km of highways, 2,300 km of which are high-speed facilities and more than 1,800 km of which have traffic monitoring (figure 33 on the next page). In 2004, the Dutch reported more than 36,000 traffic jams on this system, with delay increasing 12 percent over the previous year.

Dutch national transport policy has evolved over the past 10 to 15 years and new policies are in the works. The Second Transport Structure Scheme (SVV2), adopted in the early 1990s, set forth quantifiable targets for the environment, safety, and accessibility. To achieve these targets, the growth in automobile use was to be halved, from a projected growth of 70 percent by 2010 to 35 percent. To do this, the Dutch employed both "push" measures to make the automobile less attractive for certain trips (through pricing,

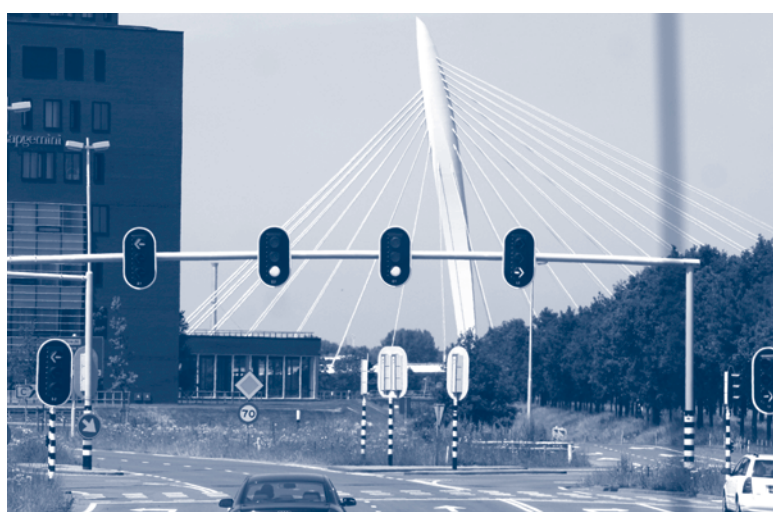


Figure 32. *View of Rotterdam.*

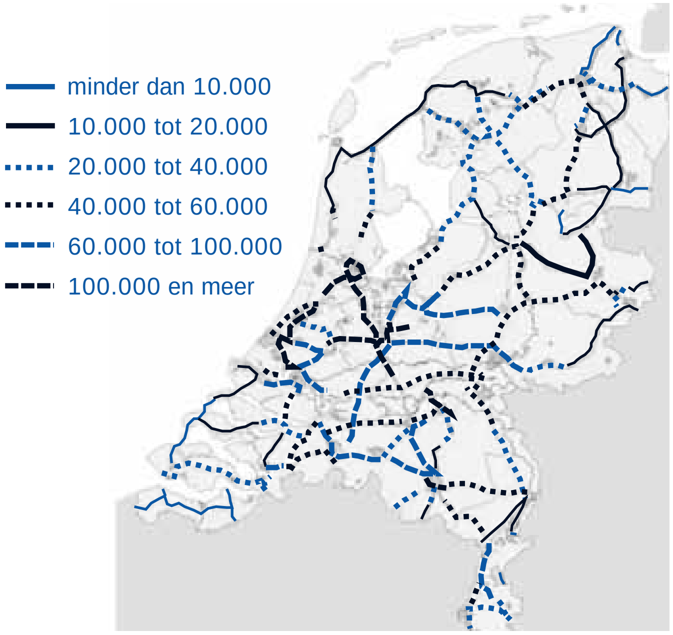


Figure 33. *Map of Dutch road network.*

parking management, etc.) and "pull" measures to make alternatives to the private car more attractive (including public transport, bicycling, and ridesharing). While the Dutch made great strides in refocusing projects and local policies on more sustainable transport options, a midterm review of the plan concluded that it would not achieve its goals. More conservative policymakers called for short-term capacity enhancements to help move cars and people.

The new Dutch Mobility Policy Document (Nota Mobiliteit), now being debated, recognizes that mobility is part of modern society, but proposes that the user of the transport system should pay the full cost of this privilege. Components of the proposed policy include 1) better use of existing infrastructure and improvements to alternatives for the car, 2) capacity enhancements where bottlenecks occur, and 3) a pricing policy that would replace fixed user costs with variable charges tied to use of the system. More information on the emerging national policy is provided below.

Some of the innovative measures undertaken over the past 10 years include advancements in traffic management, the introduction of mobility management, and a better understanding of the linkages among land use, car use, and accessibility.

However, another shift in the past 10 years is the decentralization of planning and implementation. Provincial and municipal governments and new public-private partnerships now have much more control on how transport issues are solved in the Netherlands. The VERDI expertise platform has been established to provide expertise and know-how possessed by the central government. The national government sees its role as developing new measures, testing their effectiveness, and providing guidance and technical assistance on local applications. The scan team's host in the Netherlands was the AVV Transport Research Center (Adviesdienst Verkeer en Vervoer) of the Rijkswaterstaat (RWS), part of the Ministry of Transport, Public Works, and Water Management, comparable to the U.S. Department of Transportation's (USDOT) Volpe National Transportation Systems Center. AVV provides much of the research and development work to address traffic congestion and seek new and enhanced solution strategies.

Physical Measures

In a move to provide capacity enhancements to address growing demands on the road system, the Dutch have employed several efficiency improvements on their national highway system. This includes rush hour lanes (use of the hard shoulder with slower speeds during peak periods, as shown in figure 34), plus lanes (narrower lanes on the left using lower maximum speeds than other lanes, as shown in figure 35), a reversible tidal-flow lane (a separated median lane that operates in the peak direction), an exclusive bus lane near Schipol Airport, and exclusive truck lanes near Rotterdam. The Netherlands has less than 100 km of these facilities, implemented in the most congested corridors, with another 460 km planned (which will then comprise one-quarter of the monitored road network).

The Dutch dynamic traffic management system, which allows for speed control and information on most main highway segments, enables special lanes to be operated while minimizing safety concerns. Since the introduction of rush hour and plus lanes, no fatal accidents have occurred on these segments. Again, one impetus for these efficiency improvements is political pressure to address capacity issues (that lanes are being added), even at the cost of lower speed limits. However, the potential environmental consequences of these measures, to increase speed by making operational improvements or adding temporary capacity, are also being debated in the Netherlands.

Operational Measures

The Dutch have been innovators in highway operations to improve efficiency, a set of measures they call "dynamic traffic management" (DTM). The goals for traffic management include enabling transport growth while maintaining reliable and predictable door-to-door accessibility.

The Dutch conceptual framework provided in Chapter 1 (figure 6) shows how mode choice can affect transport demand, how route choice can affect traffic demand, and how lane choice can affect capacity efficiency. This leads to two basic management strategies: demand management and traffic management. Demand management includes pricing, information, and dedicated lanes for bus or HOV. Traffic management includes highway control systems, incident management, and intelligent vehicle applications. Traffic management (control) and demand management (information) are coordinated at traffic management centers.

Specific strategies include the following:

- Motorway signaling (motorway traffic management (MTM) system)
- Ramp metering
- Dynamic route information panels
- Traveler information

Motorway signaling involves overhead displays showing speed limits that can be changed to slow traffic during congested periods and when approaching incidents (figure 36). The system was first deployed in 1981. The Dutch road network has about 1,000 km of signaling, mostly in the dense Randstad area in the south of the Netherlands. AVV research has shown that motorway signaling improves vehicle throughput by 4 to 5 percent and has reduced primary and secondary accidents significantly.

More recently, the Dutch have implemented dynamic speed enforcement using ANPR systems to maintain an 80 km/h limit on a section of motorway (see figure 37 on next page). License plates are read entering and exiting the enforcement zone, speed is calculated, and violators are automatically notified. This has resulted in 50 percent fewer incidents, 15 to 20 percent reductions in nitrogen oxides (NOx), 25 to 30 percent reductions in particulate matter (PM10), and reductions in noise affecting adjacent neighborhoods.

Ramp metering helps regulate the flow on highways and has led to measured speed increases and allowed capacity increases of up to 5 percent. Since 1989, 44 access points have been metered with another 16 planned. The Dutch learned about ramp metering from observing U.S. installations.

While signaling and ramp metering improve system efficiency, they do not really offer travelers choices. Demand management can be affected by on-trip and pretrip information. On-trip information is provided by a variety of mechanisms, including radio, invehicle navigation, and dynamic route information panels (DRIP), which are similar to variable message signs (VMS). These DRIPs are generally located over motorways and can provide information on queuing and travel time changes due to congestion (see figure 38 on next page). About 100 DRIPs have been installed on the Dutch network since 1990. The Dutch road network, like the German network, often allows for alternative routing to be suggested. Therefore, DRIPs are sometimes used to show the travel time to a major destination via two alternative routings to help with driver choices. Research suggests that 8 to 10 percent of drivers react to the information provided on the DRIPs, which may lead to a 0 to 5 percent improvement in network performance. AVV's Test Center is experimenting with new means for displaying information on road conditions and even with flexible lanes with dynamic lane markings to accommodate rush hour lanes.

The Dutch highway system is managed from five traffic management centers, with the National Traffic and Information Management Center in Utrecht responsible for national coordination. Early in their existence, the role of TMCs was traffic control, which evolved into regional traffic management and, ultimately, network management. The current focus is managing the new network of rush hour lanes and

Figure 34. *Rush hour lane.*

Figure 35. *Plus lane.*

Figure 36. *Overhead motorway traffic management system.*

Figure 37. *Photo enforcement of highway speeds.*

Figure 38. *Dynamic route information panel.*

Figure 39. *Utrecht Traffic Management Center.*

providing quality information to travelers and various information providers (radio, auto club, etc.). The Utrecht center (figure 39) is organized to perform both network monitoring and control on a regional scale and to serve as a conduit for information distribution on a national scale. In fact, the center is organized with regional traffic management on one side of the building, information management on the other, with a meeting room in between for the national coordination of major events.

An information policy has been developed to guide the balance between simply providing travelers with information and managing the system. Traffic conditions and travel choices are provided to travelers in cases of predictable, recurring congestion and as part of road reconstruction activities. However, when nonrecurring incidents and major calamities occur, the information policy dictates that the system be managed through advisories and even road closures or other means that do not involve user choices. Figure 40 provides a schematic to show the situations under which information and system management are employed.

But it is information, especially pretrip information, that helps travelers choose which mode, time, and route is best for them. Traffic information is collected on the road system and from transport providers and processed by the Information Management Center. Under the Dutch policy on decentralization and privatization, information distribution is performed by some 15 service providers, who can sell the information to the media or others. One new model for information service delivery is SWINGH (Samenwerken in Groot Haaglanden or Working Together in the Greater Hague Region), a consortium of government, business, public and private information sources, and transport service providers organized to provide real-time, multimodal information to travelers.

A survey of 150 commuters was conducted in the Netherlands on the use of travel information to make decisions related to traveling to or from work. Two out of every five commuters said they used "near-trip" information right before commuting. The most common source of information was teletext (43 percent) on television before commuting to work, radio during the trip (88 percent), and the Internet (85 percent) when traveling back home. Of those using near-trip information, 57 percent used it to determine the best route, 39 percent used it to leave earlier, 25 percent used it to leave later, 13 percent used it to decide to stay home and work, and only 3 percent used it to change mode to public transport or bicycling. On-trip information, used during car travel, was also explored. Almost 9 out of 10 (88 percent) use information provided on their car radios, 9 percent use cell phones for information, and 5 percent use dynamic route information panels (DRIPs) on the highways. Like most European countries, the Netherlands continuously broadcasts traffic information in

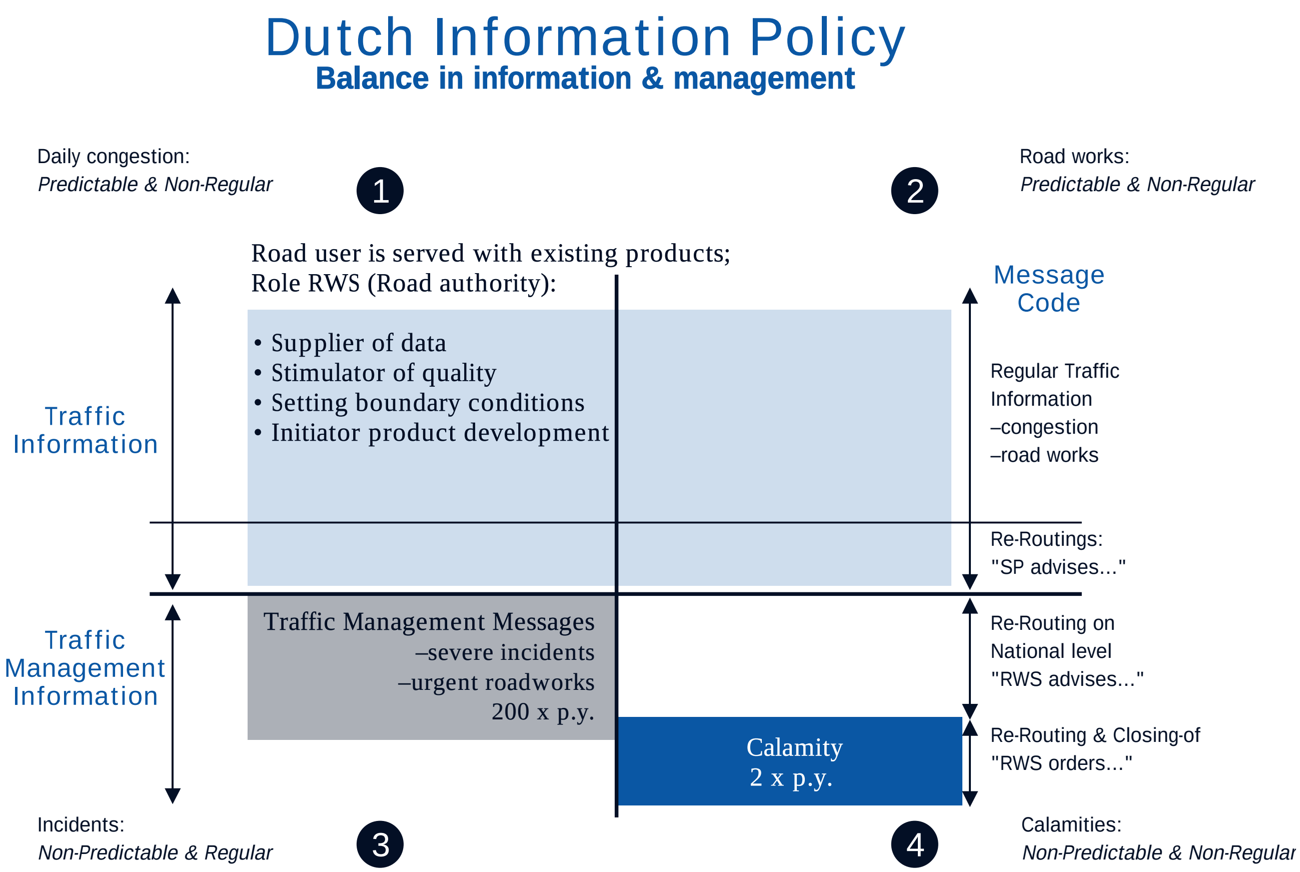


Figure 40. *Traffic information matrix*

RDS-TMC digital code on the national radio network, and this information can be presented and used by onboard navigation systems.

This AVV study provided interesting insights into future trends for traveler information. The study concluded that traveler information was going from collective to individual, static to dynamic, broadcast to interactive, and roadside to invehicle. It also reported that information is evolving from one mode (cars) to multimodal and from supply based (planned travel) to mobility based (how to travel).

The predominant type of information is changing as well, from the length of congestion (length of the queue) to travel time or delay. AVV has also developed a travel time prediction capability that uses historic traffic information to predict where, when, and how long delay will occur. This resulted in the development of a customized pretrip predictive tool that uses average travel times to predict a range of forecast travel times based on a given origin and destination, day of the week, and desired departure time. This system differs from the predictive tool developed in Cologne, Germany, that uses data from the last few hours (not historical) to project conditions for the next 30 to 60 minutes.

The Dutch travel time predictive tool is valuable for use with route-planning software, which calculates travel times on free-flow, uncongested conditions. The Dutch tool was developed for the Internet and tested on RWS employees, who were largely pleased with the information and ease of use. AVV officials believe that this tool could help level off the peak period by moving travelers to the shoulders of the peak with better information that results in more reliable travel times. Unfortunately, the private information service providers are not yet convinced that the information would be desirable or trusted by the public, so it has not yet been adopted in the Netherlands.

Financial/Pricing Measures

Like the Swedes, the Dutch differentiate between "mobility" and "accessibility," maintaining that residents should have access to activities, but should not be guaranteed a specific level of mobility to get there. "Paying for mobility" is a key policy element in the new Dutch Mobility Policy Document (Nota Mobiliteit) discussed below.

Congestion pricing was a key part of the new Dutch national transport policy (SVV2), but was not tested or implemented because of political concerns over user acceptance, as has been the case in the United States. The policy document concludes that road pricing is one method of paying for road use that is necessary to maintain reliable travel times while continuing economic growth. A "paying for mobility" platform has been established to recommend a program of testing and adopting new pricing measures. This will likely involve pilot projects during the first part of the new national transport plan and national deployment of one or more options in the second part. The platform is developing pilot projects, but it appears that cordon charges (like London, Stockholm, and Rome) will be tested and adopted first, followed by distance-based charges on the national network (also being contemplated for the United Kingdom). The Dutch are not developing road pricing to generate new revenue, but to restructure user charges away from excise taxes toward user charges that reflect the full social costs of mobility.

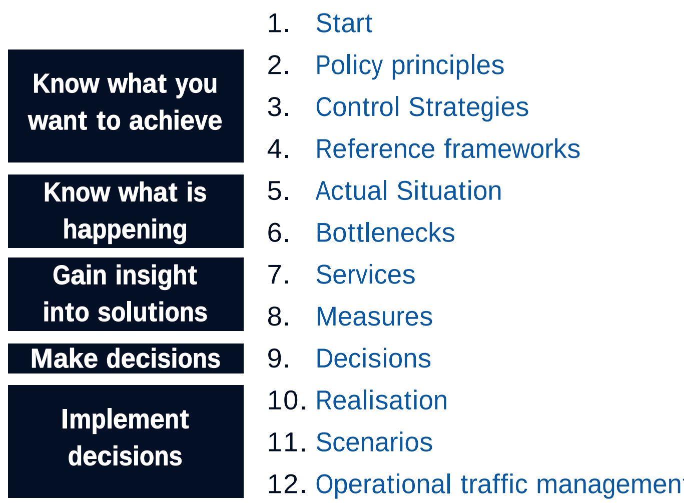


Figure 41. *Sustainable traffic management process.*

Institutional Measures

The Dutch have reoriented several policies and practices based on their extensive experience with transportation management, including demand management and dynamic traffic management. First, they are revising the planning process to include sustainable travel. They are also reorienting mobility management and institutionalizing integrated, coordinated traffic management.

The national government, in its role to assist lower levels of government, has developed many tools based on its experience with traffic management. This includes the *Handbook on Sustainable Traffic Management*, which outlines a stakeholder process for planning traffic management strategies for a given region or situation. It allows for an integrated set of measures to be developed, from localized strategies to network management techniques. As with the national mobility policy, the objective of sustainable traffic management is travel time reliability, which will help with overall network performance. The sustainable traffic management approach enumerates 12 steps from stakeholder involvement to implementation and operation, as shown in figure 41. The process has been used in about 50 locations since its introduction in 2002 and is being integrated into national highway planning processes. Planners, engineers, consultants, and others have been trained in the process, which basically prioritizes facilities and actions based on a consensus of needs and problems.

Another means of managing demand that has evolved considerably in the Netherlands is mobility management (MM). The Dutch view MM as getting (or even seducing) people to make smarter travel choices by organizing and promoting alternative options. In the 1990s, the Dutch examined U.S. experience with transportation demand management (TDM) and the RWS undertook several pilot programs, including carpool matching, vanpooling, employer TDM programs, transportation management associations, and others. Under SVV2, goals for mode shift were established, but not realized on a widespread basis. Decentralization of transport in the Netherlands led to a different role for central government, that of setting the policy framework, transferring knowledge from its experience, facilitating innovation, and monitoring results. The implementation of MM measures is now in the hands of the provinces, municipalities, and their public and private partners. This has turned MM upside down, shifting the emphasis from government trying to manage commuter travel to new partnerships to assure accessibility to key locations that are "mobility generators." The new Mobility Policy Document establishes new roles for MM, including requirements for environmental clearances and large-scale events.

One example of this is the "accessibility contract" negotiated between public and private interests in the Bezuidenhout employment center near The Hague. Regional, local, and business interests developed a covenant to reduce single-occupant car use to the center. The region provided a new bus service from a nearby rail station in exchange for major employers' commitments to induce their employees to use public transport, carpooling, and bicycling. The agreement resulted in a 6 percent reduction in car use to the center and has served as a model for such a quid pro quo agreement. These accessibility contracts evolved from the more unilateral approach called the A-B-C Location Policy, in which new developments near rail stations could not build employee parking to induce public transport use by future tenants.

Mobility management has also been effective during highway reconstruction projects. During the reconstruction of the A10 West near Amsterdam, several mitigation measures were introduced for commuters into the area. Measures implemented included park-and-ride enhancements, shuttles, individualized travel advice services, flex time, telecommuting, and free public transport tickets. Combined transport and event tickets have also been used in the Netherlands for sporting events, such as soccer matches and the Rotterdam Marathon.

An extensive evaluation of the A10 reconstruction mitigation scheme revealed that many commuters changed their arrival and departure times, telecommuted, and bicycled to work. Car use decreased by 5 to 10 percent during the reconstruction period, but car use increased on adjacent arterials, leading to negative impacts in some neighborhoods. Lessons learned from this experience are being applied to reconstruction mitigation on the nearby A9 and a new type of travel pass is being developed to allow use of any public transport service in the area.

Performance Measurement

The Dutch are also rethinking the way they measure system performance. The new Mobility Policy Document (Nota Mobiliteit), being considered by Parliament, aims to link spatial planning with transport policy and environmental protection. It sets a common framework for the continued decentralization to the provincial and local levels (figure 42).

One interesting aspect includes the way mobility on the nation's road system will be measured. The performance measurement system involves travel time reliability and predictability. An average door-to-door travel time is being developed for a hypothetical 10-km trip in each part of the country and is being based on perceived travel times developed from the annual Dutch Travel Survey. The performance measure is then assessed as the ratio of the peak-hour travel time to the free-flow travel time. The proposed policy calls for 95 percent of all road trips to be on time. According to the policy, on time during the peak hour would be only 1.5 times that of uncongested times nationally and not more than 2.0 times in urban areas. This travel time reliability will be monitored and reported to key stakeholders, including Parliament.

Conclusions on the Netherlands

The Dutch approach to managing demand has evolved to more dynamic traffic management to achieve reliable travel times. The Netherlands' extensive research and experience in traffic management, mobility management, and accessibility have served all levels of government and industry during the movement toward decentralization and informed new national policy now being adopted.

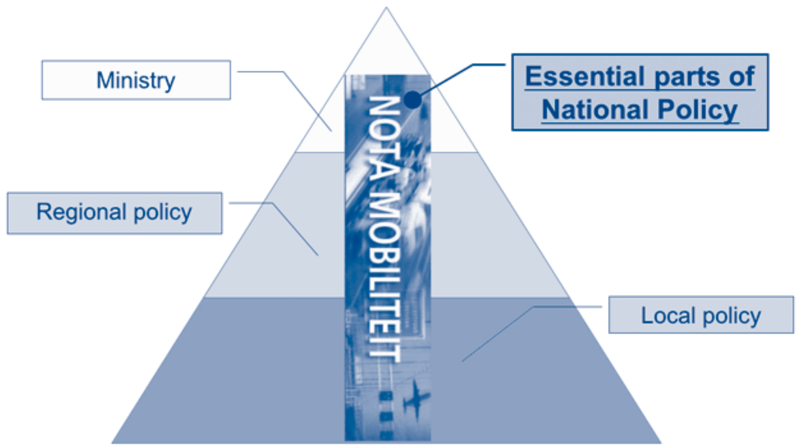


Figure 42. *Nota Mobiliteit pyramid.*

However, decentralization and new public-private partnerships occasionally have led to the slower adoption of innovation, as is the case with the travel time prediction software developed by AVV.

The United Kingdom

Need and Context for Demand Management

A visit to the United Kingdom provided the scan team with the dual benefits of observing the well-publicized Congestion Charging Scheme in London and learning about other methods for managing congestion and demand throughout the country.

Road traffic has grown by 79 percent since 1980, but this growth slowed in the 1990s. As such, the United Kingdom has been able to show a decoupling between transport growth and economic growth. Using "traffic intensity" (total vehicle miles driven divided by GDP) as

Figure 43. *Greater London.*

an indicator, travel has been growing at a lower rate than economic growth. Since 1992, while GDP has grown by 36 percent, road traffic has grown by only 19 percent. Road users view congestion as a more serious problem in cities and towns than on motorways. In fact, average speeds in Greater London are 24 km/h (15 mi/h) and below during peak periods and only 32 km/h (20 mi/h) during offpeak periods.

The national road network in England includes 7,754 km (4,818 mi) of motorways (freeways) and trunk roads (figure 44). Two-thirds of the congestion on this network is recurring and is caused by increased volumes. This network is managed by the Highways Agency (HA), an executive agency of the Department for Transport (DfT). In London, Transport for London (TfL) manages traffic, administers the Congestion Charging Scheme, and oversees public transport, including London's extensive underground and bus networks. Greater London is Europe's largest urban area

Figure 44. *British national road network.*

with more than 7 million inhabitants and employment of 1 million in Central London.

At the national level, the Department for Transport and the Highways Agency are developing plans and programs to better manage traffic and influence travel behavior by inducing travelers to make smarter choices. The motto of the Highways Agency is "safe roads, reliable journeys, informed travelers." This includes a major emphasis on treating road users as customers. In London, commitments to "do something about traffic" led the mayor to impose the Congestion Charging Scheme and make significant improvements to bus service into and within London.

Physical Measures

Two road improvements intended to give priority to higher occupancy vehicles carrying more travelers are the bus lane to Heathrow Airport and the planned carpool lane on the M1 to Luton. The 5.6-km (3.5-mi) bus lane on the M4 to Heathrow was opened in 1999 at a cost of £1.9 million (about US$3 million) and is available to buses and taxis (figure 45). An evaluation of the bus lane showed that it reduced travel times for bus users by 3.5 minutes and rush hour travel times for all car users by 1 minute and that travel times had become more reliable for all users.

Figure 45. *M4 bus lane.*

In fall 2005, the Highways Agency was scheduled to begin construction of an HOV lane on the M1 between St. Albans and Luton (Junctions 7 to 10). This location was selected over four other sites near Manchester, Leeds, and London. This 2+ carpool lane (for vehicles with two or more occupants) will be completed in 2008 and will be accompanied by complementary strategies to market the facility and allow for park-and-ride opportunities. A comprehensive before-and-after evaluation is underway to assess impacts on traffic flow, travel times, vehicle occupancy, accidents, and driver attitudes.

Operational Measures

The British have employed several operational measures to improve the efficiency of the existing network and manage demand at large traffic generators, including Heathrow Airport and the site of the British Grand Prix.

The Highways Agency has developed an active traffic management (ATM) system, similar to the Dutch concept of dynamic traffic management, and is implementing it on a 16-km (10-mi) stretch of the M42 east of Birmingham in the West Midlands (figure 46). While Britain has used changeable speed control signs since 1964 and has been monitoring speeds and detecting incidents with its motorway incident detection and automatic signaling (MIDAS) system, closed-circuit cameras, and Trafficmaster™ APNR systems for many years, the M42 combines these with new measures. These innovations include use of the hard shoulder, as

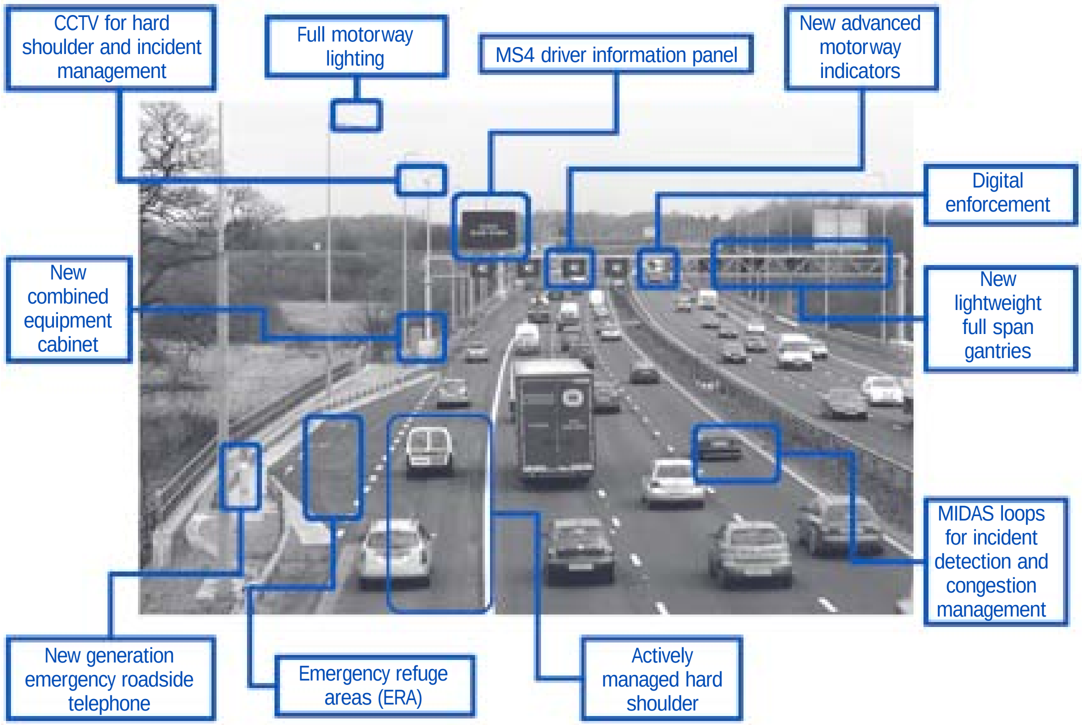


Figure 46. *M42 with active traffic management.*

is done in the Netherlands, and new rapid response incident management practices borrowed from the United States. The purpose of the ATM pilot is to make travel times more reliable and reduce congestion by giving drivers more and better information and responding to incidents more quickly. Finally, the ATM system will also include automated enforcement of the posted speed limit using ANPR. This photo enforcement on a high speed facility is used elsewhere in the United Kingdom, including the enforcement of a 64-km/h (40-mi/h) limit on the M25 near Heathrow and the M4 in Somerset during a major reconstruction project. The pilot ATM system will also rely on Highways Agency traffic officers, who have the power to stop traffic, close roads, direct traffic, and enforce laws. Experience has shown the many benefits of ATM, including improved travel times, fewer accidents, reduced idling and emissions, improved speed compliance, and favorable driver reactions.

The British also use historical data on travel speeds and delay (journey time database) to predict travel times for all links in the road network for 21 types of days (e.g., Mondays during the school year). This information is available to travelers on the Highways Agency information Web site (*www.trafficengland.com*). In addition, the Department for Transport has a multimodal Web site (*www.transportdirect.info*) with a trip planner that uses congested travel times.

One example of managing demand to a major employment center is the Surface Access Strategy for Heathrow Airport, which is based on an effective partnership to effect mode shifting. Heathrow Airport is operated by the British Airports Authority, a private entity, and employs 68,000 workers at 435 companies at or near the airport. About 175,000 air passengers travel to Heathrow daily. In 1994, when a new express rail service (Heathrow Express) was being planned, the Heathrow Area Transport Forum was formed to create modal shifts to more sustainable modes than the private car. At that time, the drive-alone share of workers was 78 percent, and bus and carpool shares had decreased since 1975.

The Surface Access Strategy includes the following:

- Measures and targets to increase public transport use (figure 47)
- Improved facilities for public transport
- Measures to reduce employee car dependence
- Carpooling, bicycling, and pedestrian programs
- Encouragement of new service providers
- Development of an intermodal approach
- Creation of effective partnerships

The strategy is funded by an airport surcharge on parking (passenger and employee) that raises about US$3.6 million (£2 million) per year. The strategy has resulted in several new and improved commute alternatives, including

Figure 47. *Heathrow Fast bus.*

new bus routes, a fare-free zone within the airport area, an employee bus pass that can be used on any service, a carpool matching program, and improved traveler information, including an Intranet travel planner. Careful evaluation has shown that the drive-alone share has dropped to under 70 percent, while the bus share has doubled to 12 percent and carpooling has increased by 50 percent to 6.75 percent, as shown in table 2. The future of the strategy may be in express bus services and carpool initiatives to continue meeting targets in reduced car use. The success of the strategy has been attributed, among other things, to effective partnerships and marketing of the commute alternatives.

Table 2. *Heathrow employee modal split.*

Employee Modal Split					
Year	1975 %	1986 %	1992 %	1999 %	2004 %
Car	71.2	75.7	78.0	71.5	69.8
Car-share	7.6	5.3	4.0	4.0	6.75
Underground	1.2	3.8	6.0	6.3	4.6
Bus	12.8	11.0	6.0	11.7	12
Motorcycle	3.1	1.8	2.0	2.1	1.4
Bicycle	1.7	0.1	1.0	1.3	1.2
Walk	1.3	0.6	0.6	0.6	0.5
Rail	00	00	00	0.8	1.1
Taxi	0.6	0.7	1.0	0.8	0.9
Other	0.5	1.0	1.4	1.0	1.75

The Highways Agency has also developed traffic management schemes for major events and highway reconstruction. The British Grand Prix at Silverstone in Northamptonshire is an event that taxes the highway system for several days. While 100,000 fans attend the Sunday race, more and more fans attend on Friday. This has a tremendous impact on the A43, which normally carries fewer than 40,000 vehicles per day. To help three types of customers—race attendees, local residents and commuters, and long-distance through travelers—HA partners with several agencies and private interests to implement a traffic management scheme for the race, which necessitates the closure of the A43 to nonrace traffic (figure 48). Diversion routes have been designated and a massive information campaign developed to inform all three types of customers of their options. While the primary choice involved in this example is route choice, the Silverstone experience shows that advanced coordination and information can lead to significant behavior change in response to a major planned event.

Figure 48. *A43 closure sign during British Grand Prix.*

The reconstruction and widening of the M25 near Heathrow's new Terminal 5 has included public information campaigns (including outreach to France), ANPR enforcement of a 64-km/h (40-mi/h) speed limit through the construction zone, and vehicle recovery response teams to remove vehicles and reduce incidents. In this case, early evaluation results show that many travelers are changing mode or route to avoid this highly congested segment.

Financial/Pricing Measures

The Central London Congestion Charging Scheme was implemented in early 2003 and involves an area pricing program to charge vehicles in the center of London to accomplish the following:

- Reduce congestion.
- Make improvements in public transport.
- Improve travel time reliability for car users.
- Make the distribution of goods and services more efficient.

It operates weekdays from 7 a.m. to 6:30 p.m. and involves a flat charge of more than US$14 (£8) per day (raised from US$9 (£5) in July 2005) for travel within the charging zone (see figure 49). Enforcement is by ANPR cameras that match vehicle registration to drivers, who must pay for entering the center by 10 p.m. Users can pay daily, weekly, monthly, or annually through the Internet, cell phone, call center, or retail outlets throughout London. Residents who live within the charging zone are eligible for a 90 percent fee reduction.

The net revenue generated from the charges, about US$180 million (£100 million) per year, is used to provide additional and improved bus service and for other transport strategies being implemented by Transport for London. As of the third monitoring report, congestion in the charging zone has been reduced by 30 percent by reducing the number of cars entering the zone by 18 percent. This has enhanced the reliability and speed of buses in central London. About 80 percent of all peak-period trips into central London are now made by public transport. The fact that mayor of London is responsible for both traffic and transit operations is a key factor in the success of the London pricing scheme. These functions are most often separate in the United States.

The mid-2005 increase in the fee from £5 to £8 per day cited above is expected to reduce congestion an additional 4 to 8 percent. There are plans to extend the charging zone into the West End, which is also heavily congested but still has good public transport service. While public support is mixed on the charging scheme and its expansion, it came about as part of a campaign promise by the mayor of London to "do something" about traffic. He was reelected in 2004 after implementing the charging scheme.

Based partially on the success of the London Congestion Charging Scheme, the government is exploring implementing a national road pricing scheme that would set a distance-based fee on car use. A feasibility study completed in July 2004 concluded that road pricing was feasible in about 10 years (the timing due partially to needed technology advances) and could meet the government's objectives of efficient pricing, fairness, inclusion, economic growth, and environmental benefits. A pilot program is being planned to test GPS technology for a mileage-based charging system. It is estimated that a national road pricing scheme could reduce urban congestion by half. Meanwhile, the United Kingdom plans to introduce truck road user charges, similar to the German system, which will help inform a nationwide application of pricing.

The U.K. government takes in US$72 billion (£40 billion) in transport taxes and spends US$9 billion to US$11 billion (£5 billion to £6 billion) on roads and related programs (since transport tax revenue is not hypothecated to transport uses as is the Highway Trust Fund in the United States), including a National Transportation Innovations Fund that rewards areas willing to try new solutions to congestion, accessibility, and mobility. The U.K. government is considering changing its entire scheme for taxing vehicles to national congestion charging, which is expected to

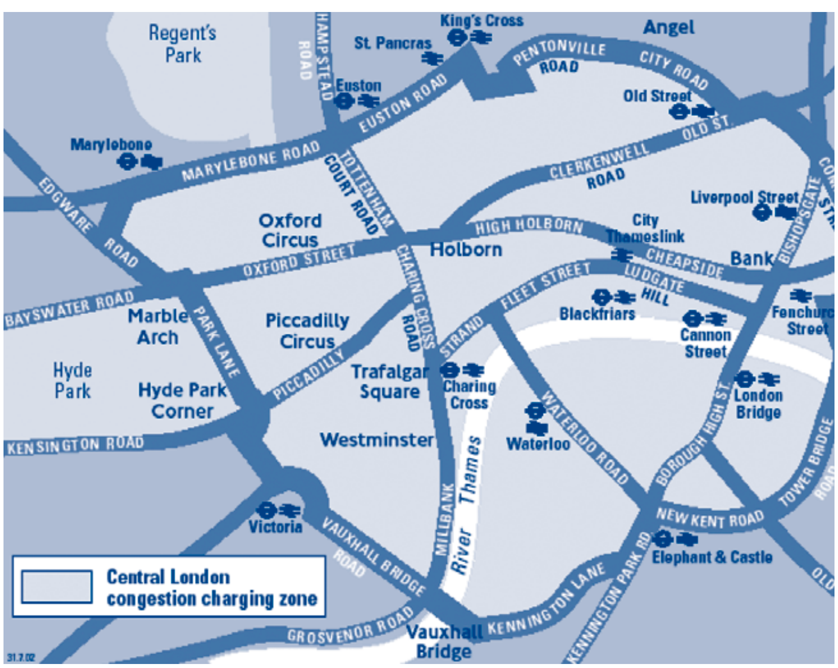


Figure 49. *Map of London charging zone.*

Figure 50. *Charging zone sign.*

generate an equal amount of revenue, but is also estimated to result in almost US$21 billion (£12 billion) per year in economic benefits compared to the current tax system.

Institutional Measures

The United Kingdom has growing experience in innovative institutional strategies to change travel behavior and monitor its effect on congestion. This includes integrated pilot projects and national initiatives to influence travel behavior.

The EU-funded CIVITAS Initiative includes two pilot sites in England, in Bristol and Winchester. CIVITAS seeks to integrate both hard technology and soft policy measures, like combining clean-fueled buses with individualized travel planning to increase public transport use. The CIVITAS pilots in the United Kingdom are partnerships among EU, national agencies (energy, transport, health, and redevelopment), local government, and business. In Bristol, the measures implemented included a taxi-sharing program in an area not well served by conventional transit, a freight consolidation center to reduce delivery trucks, an individualized travel campaign, a car-sharing service, a new information center, and an "information bus" (a mobile transit information center). Results are encouraging; for example, the freight consolidation scheme (in which various trucking services come to a central location outside the retail district and a single truck makes consolidated deliveries to each retailer) has reduced delivery vehicles by 65 percent in the Broadmead district. One benefit of the integrated set of programs is bringing diverse interests together to achieve common societal goals. In Winchester, the emphasis is on environmentally friendly measures, including parking fee discounts at a park-and-ride facility for cleaner cars and new clean buses serving the facility, access restrictions for high-polluting cars, a "bikeabout" program to increase bicycle use, and a Collectpoint parcel service that allows residents to pick up parcels at a nearby convenience store rather than receive deliveries at home (figure 51).

The Department for Transport (DfT) and the Highways Agency have developed concerted programs aimed at changing travel behavior. The DfT conducted a study, reported in *Smarter Choices: Changing the Way We Travel,* on the potential impacts of "soft" measures. The study concluded that these TDM measures, if implemented widely and intensely, could reduce peak-period urban traffic by as much as 14 to 21 percent and nationwide traffic by about 11 percent. A lower intensity scenario was developed as well.

This study led to a new national information campaign called "Making Smarter Choices Work." This campaign promotes "soft" measures: workplace travel planning (similar to employer trip reduction plans in the United States), school travel plans, personalized travel planning, public transport information and marketing, travel awareness campaigns, carpooling, car sharing, teleworking, teleconferencing, and home shopping. DfT has performed extensive research based on pilot programs and is committed to institutionalizing these measures. For example, the national government has provided funding so that local governments and schools can hire travel planners to help develop programs at workplaces and school sites. DfT is also funding three "sustainable travel towns" to integrate the components of the smarter choices campaign in a medium-sized city. The government's plans are ambitious. For example, it hopes to have a travel plan in place in every school in the nation by 2010. It is providing expertise and small capital grants to realize what it estimates would be an 8 to 15 percent reduction in traffic around schools. (See figure 52 for an example of a school travel initiative—the "walking bus").

Figure 51. *Winchester Collectpoint location.*

The Highways Agency has also developed a program called Influencing Travel Behavior to mainstream demand management measures into the agency's ongoing operations and plans. HA defines influencing travel behavior as "managing the demand for journeys within the capacity of the truck road and motorway network." This includes influencing the land development control process not only to consider road access, but also to consider means to reduce demand. It also involves HA in the workplace travel planning process at sites where employees rely on the national road network. In addition, tourism and leisure travel are being targeted so that travelers might seek information on alternatives during their holiday planning. As mentioned earlier, HA is also

Figure 52. *"Walking bus" school travel initiative.*

working to demonstrate HOV lanes and carpooling. A schematic showing all of the elements of the initiative on influencing travel behavior is shown in figure 53. While these activities all seem reasonable, the real story in HA is the institutionalization of demand management in the everyday workings of a highway agency and a commitment to consider demand-side strategies by forming new partnerships with local government and business.

Performance Measurement

The way congestion management performance is measured in the United Kingdom is evolving. DfT has established a policy of congestion targets for the road system, based on the notion of accountability for public expenditures on the system. While the long-term strategy involves road pricing, interim targets have been set on achievable improvements, such as the new HA traffic officers and active traffic management. The principal performance measure is based on improved travel time reliability and is measured against the 90th percentile of travel times. In other words, the government seeks to see improvements in travel time reliability by reducing travel times for the worst 10 percent of congested trips. The national network has been divided into 98 key routes and the 90th percentile travel time calculated over a 1-year period. HA is charged with showing improvements in these travel times or it will lose highway investment funds in that area.

Conclusions on the United Kingdom

The United Kingdom provides evidence of government leadership in tackling traffic demand in almost every way possible. The London Congestion Charging Scheme was made possible by a courageous elected leader willing to use all means possible to manage demand. The British government is also deploying several other measures, including active traffic management and TDM, to assist travelers in making smarter choices on mode, route, time of travel, and even location.

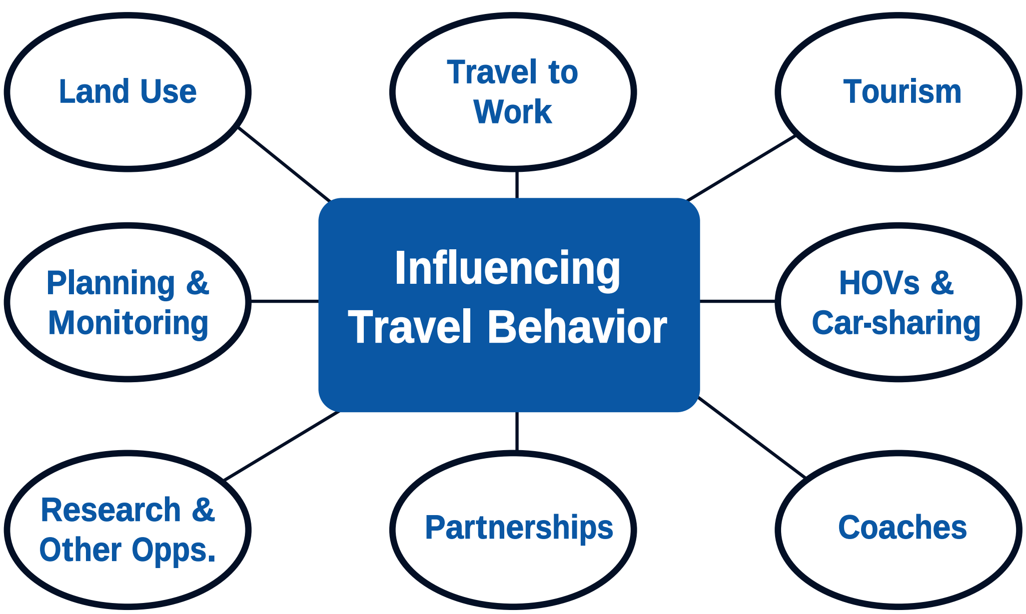


Figure 53. *Influencing travel behavior schematic.*

Key Findings

Based on the case studies summarized in Chapter 2, the scan team developed a set of key findings. The findings are organized by the four types of measures—physical, operational, financial/pricing, and institutional—plus separate findings on performance measurement.

Physical Measures

Physical measures either restrict the use of cars in certain areas or during certain times of the day, or involve strategic improvements to the transportation network to enhance system efficiency or provide new capacity for public transport or high occupancy vehicles. The physical measures observed in Europe to influence demand include the following:

- An **access control system** in Rome operates as a physical barrier by restricting vehicles from the historic core during much of the day. A limited number (150,000) of permits are sold that allow access by some vehicles. Rome also bans all cars without a catalytic converter from the core. The access control zone has resulted in a 20 percent reduction in traffic during the restricted part of the day, but has had an unintended effect of increasing the use of higher polluting motor scooters.
- Several countries the scan team visited are making improvements to their public transport systems by building extensive **park-and-ride facilities** on the periphery of cities and offering express bus or rail service into city centers. Winchester, United Kingdom, offers parking price discounts for lower emission vehicles at its main park-and-ride facility. Rome has built park-and-ride lots outside its "green area" (it has designated transport services for each concentric ring around the center) and added 350 km of new urban rail lines. Stockholm is building a new rail tunnel for commuter rail trains and a new commuter train terminal in the city center.
- Strategic **road improvements** to complete urban highway networks are being debated in Stockholm, which has already built a new tunnel to the south of the city center. The role of these improvements is being considered in light of congestion charging schemes that will push some traffic around the city.
- **HOV lanes** are being constructed on the M1 in England between London and Luton to demonstrate the efficiency and effectiveness of such a facility to encourage ridesharing (2+ carpools). Bus lanes (using red pavement in the United Kingdom) serve buses and other high occupancy vehicles (HOVs) to Heathrow and Schipol airports.
- The Dutch are **using the hard shoulder** as rush hour lanes and narrower plus lanes in the median to enhance capacity during the most congested periods. These are accompanied by slower speed limits and have not resulted in any fatal accidents since being implemented. However, some in the Netherlands see these as capacity improvements and are questioning their environmental impacts.

Operational Measures

At the heart of operational measures to manage demand are enhanced choices and traveler information about these choices. Among the interesting strategies the scan team observed were the following:

- **Demand management** was differentiated from **traffic management.** This concept becomes reality at the traffic control centers as decisions are made on when, where, and how users are offered mode, route, and lane choices.
- The traffic control centers provide user choices on route, time, and mode up to the point at which the system is in danger of breaking down. At that point, the German highway network traffic control system **diverts traffic around bottlenecks** with dynamic destination signs, rather than by solely providing travelers with information on the location and severity of congestion.
- Traffic management centers use **real-time, dynamic information** to manage the system and provide users with route choices during their trip. The way they provide individualized and customized data from the centers to users varies among public, public-private, and private providers.
- Newer innovations include the provision of door-to-door **pretrip, near-trip and on-trip information on time, route, and mode choice.** Integrated examples of real-time multimodal information systems include

Stadtinfoköln in Cologne and SWINGH in The Hague.

- In terms of mode choices, carpooling and vanpooling are not widely adopted in Europe, in spite of many pilot programs and the integration of these modes into mobility management initiatives. Most countries are **improving public transport as an alternative to driving,** particularly the implementation of supportive park-and-ride facilities and improved express bus and rail services.
- Demand management is a key part of **highway reconstruction** to mitigate the impacts of the disruption. In the United Kingdom, the reconstruction and widening of the M25 near Heathrow Airport has included public information campaigns (also in France), ANPR enforcement of a 64-km/h (40-mi/h) speed limit through the construction zone, and vehicle recovery response teams to remove vehicles and reduce incidents. In the Netherlands, the reconstruction of the A10 and A9 near Amsterdam have included comprehensive mobility management programs to induce mode, time, and route shifting and have included information on and incentives to use public transport to get to work during the construction period.
- Some European pilot projects have demonstrated various innovative demand management measures. In Cologne, the federally funded Stadtinfoköln project included many elements of real-time traveler information, most of which have now been deployed. One measure piloted but not fully deployed was an **advanced parking reservation and payment system** that built on Cologne's parking information system. Unfortunately, the use of photo billing in garages proved problematic in the pilot trial.
- ANPR (automatic number plate recognition) **photo billing and enforcement** is being used in many of the demand management programs, including Rome's access control system enforcement, Stockholm's congestion charging pilot program, and the London Congestion Charging Scheme. The Dutch are using ANPR technology to enforce an 80-km/h (50-mi/h) speed limit on a motorway near Rotterdam that suffered as a carbon monoxide (CO) hot spot and had noise impacts on an adjacent neighborhood. The United Kingdom is using the same technique to maintain a 64-km/h (40-mi/h) limit on the M25 and M4 through a major reconstruction zone. While photo speed enforcement remains a debated issue in the United States, several European countries are using the technology to automatically enforce high-speed facilities.
- **Travel time prediction,** based on recent (the past few hours) or archived (historic) data, is being developed in many countries. The national traffic information Web site (www.trafficengland.com) operated by the Highways Agency includes both real-time and predicted traffic conditions in terms of average speeds. The system in the Netherlands provides users with predictions of travel times on the highway at a given time of day. The system also informs the user of travel times during periods before and after the desired time. The system in Cologne, developed as part of Stadtinfoköln, predicts travel times on public transit and roads and provides a comparison to users via invehicle or hand-held information or signs near park-and-ride facilities. A system to predict onstreet parking availability and provide this to travelers was also developed. In all, travel time reliability is a significant issue and performance indicator in Europe, as in the United States.
- **Travel time and queue prediction are being used to meet safety regulations** (ability to accommodate emergency vehicles) in a new highway tunnel south of the Stockholm city center (that require the tunnel to be closed if speeds are anticipated to go below 10 km/h). Traveler information via variable message signs (VMS, referred to as dynamic route information panels in the Netherlands) and cell phone service is assured in the tunnel as part of the management strategy. Traffic is managed during incidents by diversion to other specified routes via VMS and slowing or closing ramp meters to deter traffic.
- Planning for demand and traffic management during **large-scale events has been undertaken in a comprehensive, coordinated fashion** using many management techniques. This includes traveler information (British Grand Prix race site at Silverstone), traffic flow and diverse strategies (Silverstone), use of closed highway segments as park-and-ride facilities (World Youth Day in Cologne), integrated event and public transport tickets (Rotterdam Marathon and soccer matches in Germany), and schedule changes to free buses for use in shuttling visitors (in Rome after the death of Pope John Paul II).
- The Europeans have used overhead changeable signs for **speed control** for many years. Changeable speed signs and explanatory icons warn motorists before they reach queuing or incidents. The Dutch and British are even combining ANPR technology with speed control and enforcement on highways.
- VMS and dynamic highway sign technology varied (dynamic route information panels (DRIPs) in the Netherlands and motorway incident detection and automatic signaling (MIDAS) in the United Kingdom) and was a central part of current research, including use of these displays with **travel time and queue length prediction, variable lane widths, and use of the hard shoulder** during rush hour or incidents.
- **Ramp metering** has led to efficiencies on certain congested road segments (in the Netherlands and more recently in the United Kingdom) and in some cases to influencing route and departure time choices (when and where meter queues are consistently long).
- **New public transport services are being developed,**

such as taxi-sharing (Bristol, England) and car-sharing (Rome, Cologne, etc.). However, traditional carpooling, vanpooling, and teleworking are still not widespread, even though many countries are experimenting with programs, technology, and incentives to increase shared rides and trip substitution.

Financial/Pricing Measures

Congestion pricing is widely acknowledged as an effective demand management tool, but it is also being used to address environmental concerns, fund new public transport improvements, and preserve historic city centers. Key findings include the following:

- One focus of the scan was to learn more about **congestion pricing** programs. Congestion pricing schemes are being implemented to reduce congestion (London) and emissions (Stockholm and Rome), not primarily to raise revenue for transport or other uses. The alternative to driving a car into the city center is mainly public transport, which carries 80 to 85 percent of peak-hour commuters in London and Stockholm.
- The Roman pricing scheme is integrated with the **access control system** scheme, in which onstreet parking prices vary by time of day and demand and access permits are sold to residents (for a nominal fee) who live in the historic core, some employees who have dedicated offstreet parking, and other nonresidents (US$425 or € 340 a year). Automobile volumes have decreased by 20 percent in the core as a result of the demand management system in Rome, but scooter use has increased during the same period (prompting consideration of restrictions on these vehicles).
- In Stockholm, the national legislature enacted a law requiring the city to implement a **congestion tax** for cars entering the city center. The pilot program was scheduled to be implemented in early 2006 for 7 months, although the enhanced transit component (which amounts to half of the US$400 million budget) was implemented in August 2005. Users will have to pay the tax daily. A national referendum will be held in September 2006 to decide whether the congestion pricing scheme will become permanent. An extensive "before" evaluation effort was used to plan the pilot program and forecast a 10 to 15 percent reduction in traffic entering the core and resulting improvements in overall accessibility and air quality.
- The **London Congestion Charging Scheme** has been in place since 2003. In July 2005, the daily charge was increased from US$9 to US$14 (£5 to £8). There are plans to extend the charging zone into the West End of London. Enforcement and payment are accomplished with ANPR cameras and license plate recognition software. Since implementation, traffic is down by 18 percent in the zone and congestion levels are down 30 percent. The major shift has been to public transport, mostly bus services, which have been improved using the revenue.
- Much of the revenue from pricing schemes is being used to **improve public transport.** This is partially explained by the fact that both traffic and public transport are often controlled by municipal government in Europe, making the integration of traffic reduction and public transport enhancements easier to implement.
- One source of anxiety with congestion charging and access control schemes is the **impact on businesses** in the zone. In Rome, some businesses are pleased that the access controls have made pedestrian movement much easier and people have returned to the core to shop and eat. In London, evaluations have concluded "broadly neutral impacts on overall business performance." In both cities, the attitudes of small businesses toward the restrictions are mixed.
- **Ease of payment and user acceptance** are key issues in the implementation of many of these programs, affecting the nature of the efforts in Rome, Stockholm, and London. The treatment of the congestion charge as a tax in Sweden—and the resulting requirement to pay the tax every day the cordon is crossed—is being viewed as a potential barrier to user acceptance.
- **Truck pricing systems** have been implemented for trucks over 12 metric tons (European law, with plans to lower the limit to 3.5 tons) in several central European countries, including Switzerland, Austria, and Germany. The German system is complicated in terms of payment and enforcement and was plagued by implementation delays, but is designed to reduce road damage resulting from wear and tear on the German autobahn network and to reduce environmental and energy impacts of the growth in truck volumes throughout central Europe.
- The Dutch are once again exploring **pricing as a solution strategy,** given growing congestion and environmental concerns about road efficiency improvements such as rush hour lanes and ramp meters. They envision development of a set of pilot projects in the next several years, then adoption of cordon charging schemes (e.g., London), and finally implementation of distance-based charges on the highway network. The United Kingdom is also considering a distance-based pricing scheme for the national highway network in 10 years.
- Financial incentives are also being used as a demand management strategy. As part of a highway reconstruction project near Amsterdam, **free monthly transit passes** were distributed to area residents and workers to complement transit service improvements and employer-based TDM initiatives.

- In terms of **financing transportation solutions,** the Roman model includes the creation of a public corporation (ATAC) owned by the city of Rome that can borrow money in private capital markets and make decisions to reduce operating deficits.
- In much of Europe, **transport taxes** on fuel, vehicles, and freight are not hypothecated for use in the transport sector, but go into the general fund. Thus, it is even more impressive that the British government spends a significant portion of its budget on transport and initiatives related to demand management.

Institutional Measures

Demand management requires new partnerships, planning processes, and approaches to address traffic congestion. The ability to institutionalize a demand management philosophy in supply-oriented organizations is a key factor in the success of the endeavor. The integration of many strategies into a cohesive, comprehensive approach is one key to maximizing intended effects.

Partnerships

- Traveler information is often gathered and compiled by the public sector and **disseminated by public and private operators.** The Utrecht traffic control center, for example, manages the system on one side of the building and disseminates information to providers through the information center on the other side. Sometimes conflicts can arise when the private providers do not want to use real-time or predicted information that they fear will not be accepted by travelers. This is the case with the travel time prediction software developed by AVV, but not yet adopted by private travel information providers.
- Rome **reorganized its public transport and street management** both to integrate services and information and to reduce the overall deficit (e.g., ATAC and STA). The public transport company, ATAC, contracts with various private-sector operators to provide public transport and related services (car sharing, electric scooters, etc.). STA, the city's department for private transport, is now responsible for the access control system and traveler information services, but this will soon be merged into ATAC.
- One strategy to manage demand is to better coordinate the timing and nature of travel, even in goods movement. The British, among others, have experimented with **consolidated delivery schemes** in which a subsidized carrier assembles deliveries from participating delivery companies at a peripheral location and delivers them to downtown merchants. This has resulted in a 65 percent reduction in delivery vehicles in Bristol. Winchester has experimented with Collectpoint delivery pickup services at neighborhood convenience stores so that parcel delivery vehicles do not need to penetrate neighborhoods to deliver to homes.

Planning

- The Swedes and British are **integrating travel demand management planning into transport and land use plans.** The Swedish Road Administration adopted a Four-Stage Principle that requires consideration of (1) demand management and mode shifting before considering (2) efficiency or systems management, (3) minor improvements, or (4) new investment or major rebuilding. The Dutch A-B-C Location Policy requires that new development near rail stations not build parking facilities for employees. New access contracts are offering preferential highway access to developments that agree to reduce car demand. Finally, the U.K. and Swedish governments have developed best practice and planning guidelines for integrating demand management into new development site planning and approval.
- The United Kingdom and Italy require all municipalities and large employers to develop and implement travel plans or **trip reduction plans at worksites.** Both implement these regulations through local governments and provide funding and technical assistance to local agencies. The British government has a school travel initiative to develop travel plans for all school sites in the United Kingdom by 2010. The Dutch have decentralized their employer demand management programs to allow provinces, cities, and transportation management agencies to tailor programs to meet local needs and focus on accessibility.
- Britain has developed **national initiatives to integrate demand management** into work, school, hospital, and town environments. The Department for Transport's Smarter Choices and the Highways Agency's Influencing Travel Behavior initiatives are consistent with the government's *White Paper on the Future of Transport.* The Smarter Choices program projects that high-intensity "soft" demand management measures could reduce overall traffic levels by as much as 11 percent and lower intensity measures by 2 to 3 percent. These soft measures include travel planning (sustainable travel plans) for towns, employer worksites, schools, hospitals, and new developments.

Integration

- **Comprehensive, sustainable transport planning** has been successfully undertaken in Lund, Sweden, where travel growth (expressed as vehicle kilometers of travel) has been arrested while economic growth continued

(decoupling traffic from economic growth). The integrated program (LundaMaTs) included transit service improvements (a new bus rapid transit line), traffic management, bicycle and pedestrian improvements, and individualized marketing efforts to increase bus and bike use. The city of Lund bought land adjacent to the right-of-way of the bus line and is reselling the land to private interests for sustainable developments. The key to the success of the integrated plan was the involvement of stakeholders, including elected officials, early in the process. This is the same philosophy behind the Dutch sustainable traffic management planning and implementation process and a related user's guide.
- EU is funding major urban pilot programs to test demand management and alternative fuel measures as part of CIVITAS. The CIVITAS Initiative is designed to develop **integrated, sustainable packages of measures,** including clean vehicles, access restrictions, and pricing to manage demand, new forms of vehicle ownership (e.g., car sharing), improved collective transport, efficient goods movement, innovative soft measures to manage mobility, and transport systems and information management. These initiatives include independent and comparative evaluations. So far, EU has invested €100 million in the CIVITAS demonstration program and in work to disseminate findings to other cities and the ascension countries.

Performance Measurement

Performance measurement was a key component of many of the programs, projects, and initiatives the scan team explored. Performance measurement was used to both monitor fulfillment of objectives to assure accountability to policymakers and set future policy objectives based on careful monitoring of the system.
- **Performance-based transport goals** have been developed in several countries, including the Netherlands and the United Kingdom. The Dutch targets (in the proposed Mobility Policy Document) are based on reliable and fast travel times. The policy targets are that average travel times on the highway network during rush hour should not be more than 1.5 times longer than nonrush hour times. The new U.K. policy is based on penalizing areas (in terms of targeted funding) where the average travel times are over the 90th percentile of delayed facilities on a designated network.
- **Performance monitoring** has been used to enforce performance-based contracts, such as the public transport service contracts in Rome. ATAC penalizes contractors for missing ontime performance targets.
- **Evaluation** has been an integral part of demand management programs at the European and national levels. EU developed a TDM monitoring and evaluation toolkit as part of MOST (MObility STrategies for the next decades). This has been adapted by the Swedes as the System of the Evaluation of Mobility Projects (SUMO) and their Mobility Management Monitor to benchmark program performance. Independent evaluation is a key part of the CIVITAS Initiative. Likewise, the large-scale pricing programs in Stockholm and London have included comprehensive pre- and post-evaluation efforts. The adoption of standard evaluation criteria provides a common basis for evaluating and prioritizing resources.

Conclusions and Lessons Learned

Conclusions

The purpose of the scan on managing travel demand was to explore European experience with demand-side strategies that contribute to the more efficient use of highway infrastructure and provide enhanced mobility options and travel choices. What the scan team found was a profound new way of thinking about travel, one that attempts to influence travelers before they get into their cars (promoting nonmotorized modes and alternative destinations of travel) and provides improved options for those drivers who choose to use the road system (faster routes and more reliable travel times). While the policy context and reasons for implementing demand management sometimes differed from the United States, the objectives seem to be consistent: safe operations, improved travel time reliability, enhanced choices, and efficient and sustainable transport systems.

The scan team learned that travel demand could be affected by a variety of measures, in some cases as part of management systems that until now were thought of as operational or "supply management." For example, as part of the management of incidents of a long duration (e.g., natural disaster), the traditional response was to close lanes or redirect traffic from the affected areas. However, better information on the timing of travel, other modes, and even the need to travel could affect travel demand (for example, in some disasters, it may be better to have residents stay home under certain conditions until the infrastructure can handle traffic).

The Dutch model of traffic and demand management (see figure 6) was a key to the scan team's understanding of how demand management fits into the management and operations of the transportation system. A modified version of this model (figure 54) provides a conceptual framework illustrating how many of the management **systems** used to manage travel demand and traffic can affect traveler **choices**—which lane is best, which route or time of departure is fastest, or even which mode of travel or destination is optimal for a given traveler. For example, systems to control the number of directional lanes or maximum speeds might affect only lane choice on a given facility and, therefore, manage only traffic already on the network. But other systems, such as incident management, which have traditionally been considered as influencing only traffic on a given facility, might actually influence route choice, time of travel, destination, and even mode.

Other systems can be viewed as influencing traffic demand and transport demand, beyond managing the traffic on the existing network. Pretrip traveler information systems are clearly designed to encourage more efficient travel by suggesting routes and times of the day that are less congested and offer more reliable travel times. Pretrip information can also influence the mode selected (e.g., public transport or carpooling) or even the destination of travel (whether to work from home or shop closer to home). However, as evidenced by European experience, near-trip and even on-trip information can influence time, route, mode, and destination choice. For example, commuters can be provided with real-time information on travel times to their work location if they continue to drive or shift to a nearby park-and-ride service, as witnessed in Cologne. Finally, while road pricing can clearly affect mode, time, and route choice, it can even influence lane choice, as is the case with high occupancy toll (HOT) lanes in the United States. Pricing can also include incentives for changing modes or time of travel.

In the center of the management systems is the transportation management center (TMC), which both manages facilities and provides information to travelers. Traditional transportation demand management (TDM), such as rideshare matching, promotion of alternative modes, vanpool provision, etc., typically works at the other end of the framework, influencing mode and destination choice based on the need to travel, but it can also be an integral part of the information systems linked to the TMC. Therefore, this conceptual framework, modified from that presented by the Dutch, provides a new way of looking at the need for and management of transport and traffic demand. It provided scan team members with a new perspective on the systems they manage by helping them understand the difference between managing traffic and managing demand.

Overall, most of the places the scan team visited were striving to create more livable, sustainable cities by creating and implementing integrated packages of transportation measures that combined improved alternatives to driving a car, real-time information on traffic conditions and options

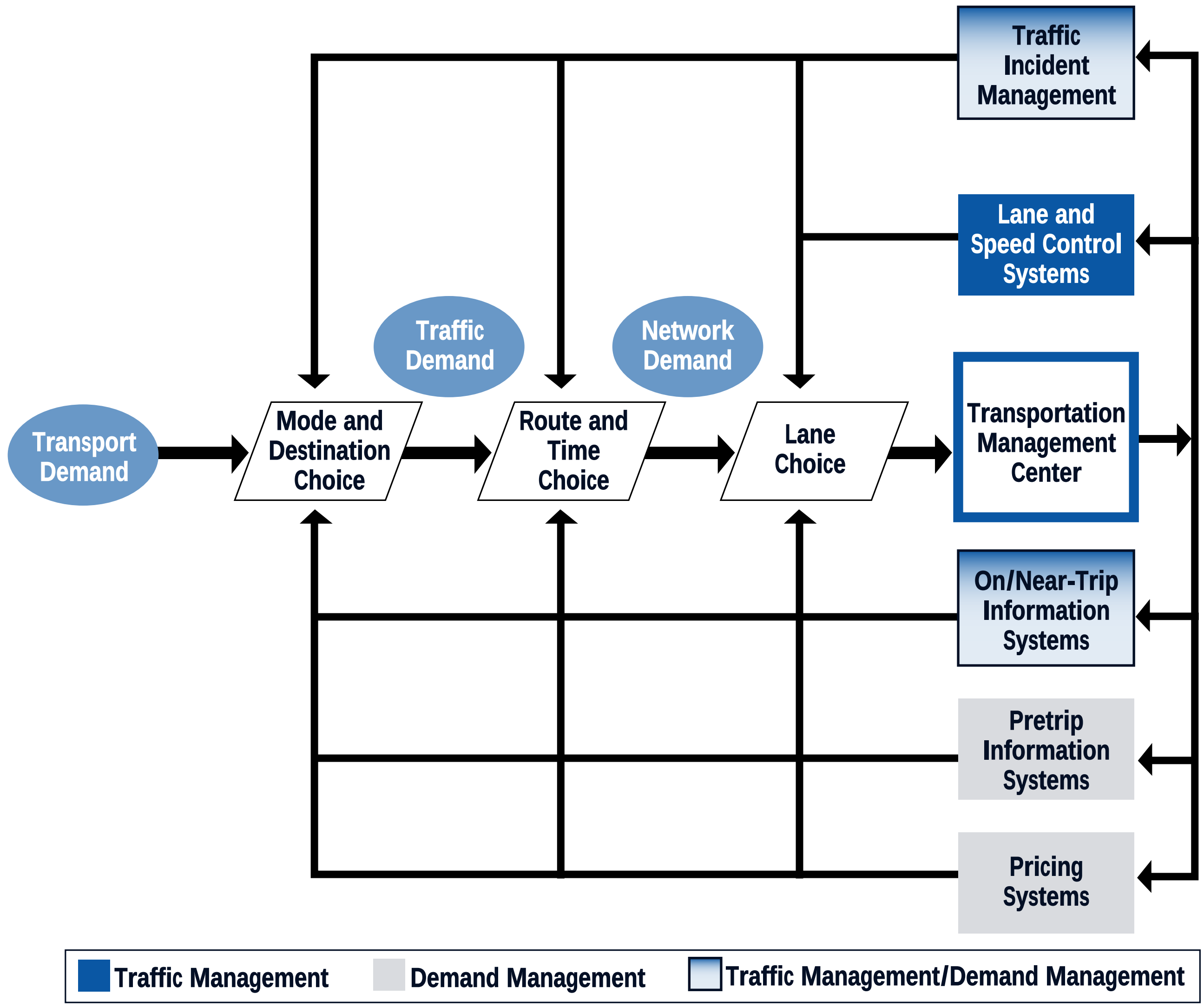


Figure 54. *Demand management and traffic management: modified Dutch model.*

providing pretrip, near-trip and on-trip information, new partnerships to support these enhanced travel choices, and even pricing to reduce the number of cars entering the city centers or on the entire network during congestion periods. They are doing so by integrating demand management into both their long-range transportation plans and short-range operating policies. They are carefully monitoring the performance of the system by looking not only at mobility but also at other measures such as accessibility, air quality, and livability.

Lessons Learned

The following 10 lessons learned are based on the key findings enumerated above and discussions among the scan team members. These lessons may hold promise for addressing congestion, mobility, accessibility, energy, and environmental concerns in the United States.

1. **Transportation management thinking is evolving in Europe.** The Europeans are realizing the benefits of managing demand before cars and trucks get on the road. Many programs are working to provide smart choices and create smart growth. The United States might learn from this new thinking by integrating demand management strategies into the management and operations of transportation systems in the 21st century.
2. **Demand management differs from traffic management.** Demand management maximizes effective choices that provide reliable travel times and addresses the increase in travel demand through means other than

increasing road supply. The mission of one agency the team visited is to work toward "safe roads, reliable journeys, and informed travelers." Thus, the mindset has changed from being an asset manager to a service and choice provider, network operator, and traffic manager.

3. There is a need to bring highway operators, regional planners, information providers, transit service providers, and traditional TDM professionals **together to establish dialog** centered on this new perspective.
4. **Demand management can be integrated** into short-term management and operations as well as long-range plans. Many operational strategies in Europe are designed to modulate demand, not just improve traffic flow and efficiency. The programs are performance based to assure accountability and measure progress against policy objectives.
5. **The decoupling of traffic and economic growth** might be possible by implementing aggressive, sustainable transport planning that promotes more efficient automobile use by providing effective choices to travelers, while creating a desirable environment in which to work, live, do business, and invest. This ability to plan for congestion and demand while maintaining economic development provides a strong policy basis for demand management.
6. **Road pricing,** specifically in the form of area schemes to reduce traffic into city centers, **has proven to be effective** in reducing peak-period traffic, improving air quality, and enhancing the walkability of the urban core. Part of the revenue from these programs is spent on improved public transport services, in the form of park-and-ride systems, new routes, service frequency improvements, and cleaner fleets.
7. **Improved travel time prediction** through new research can offer travelers a powerful tool for travel decisionmaking. This comes at a crucial time as many U.S. cities build travel time indicators into congestion management strategies and performance measurement processes.
8. Dynamic route information panels and variable speed control signs provide **information on congestion, incidents, and alternatives.** The intent is to slow traffic before drivers reach the queue. This has been successfully demonstrated to increase safety, improve efficiency, and reduce delay.
9. Effective individualized and customized **traveler information can influence travelers and other users before they get into their cars and trucks.** This includes multimodal, real-time information on route, modes (transit, shared rides, biking and walking), location (telework), and time choices (leaving earlier or later or working alternative schedules).
10. **Evaluation must be integrated into demand management programs and projects,** including demonstrations and ongoing efforts. Such evaluation needs to be based on standardized performance measurement and monitoring. Results from these evaluations can be disseminated in the form of updated best practices.

Overall, transatlantic research and knowledge exchange of the type inherent in the International Technology Exchange Program will lead to dividends in the United States because demand management research and expertise have progressed rapidly in Europe over the past 10 years. The continued exchange and dissemination of information outlined in the next chapter will help accelerate the evolution in thinking presented in this report.

Summary of Implementation Recommendations

During the scan on managing travel demand, the team observed strong emphasis on the provision of information on the full range of travel choices in readily accessible forms. The information available included pretrip, near-trip, and on-trip information and ranged from door-to-door information tailored to the individual traveler's needs to dynamic pricing information. Travel choices focused on routes, modes, transport costs, time of travel, and the associated congestion dynamics of the day.

This mixture of information and choices supports an active congestion management program for both the on-trip consumer as well as pretrip consumer demand. As a result, European consumers were observed to be empowered to determine on an individual basis what time they should depart, what route they should take, what modes they would employ, where their ultimate destination might be, and what costs they would bear under the associated timeframe. If a transportation alternative was not acceptable to the individual, the potential of rescheduling, delaying, or deferring the trip was observed. As a result of this approach, the scan team concludes that the quality-of-life goal, visually articulated and highlighted by many of our European hosts, is being actively supported.

The scan team recognizes that the social acceptance and expectation of readily available travel information and choices are part of the fabric of the European quality of life. While we realize that this cannot necessarily be accomplished in the United States through transportation engineering and planning in the traditional sense, we believe that objective information, guidance, and support can be provided to engineers and planners throughout the country to capitalize and employ the techniques and strategies observed in Europe. Through this, it is possible not only to manage congestion, but also to support the quality of life in a way that has not yet been fully realized in the United States. As a result, a cultural and mind shift may be realized that benefits the quality of life for U.S. citizens through improved mobility.

To achieve this evolution in thinking, the scan team will advance the following initiatives:

1. **Outreach**—The scan team will engage in initiatives and partnerships to provide objective information to professional organizations and agencies. Efforts will include making presentations at conferences, publishing articles, and making information available by electronic media and on a designated Web site or sites.
2. **Assessment of Domestic State of the Practice**—The scan team recommends the commission of a study to characterize the techniques and approaches used in the United States to support not only congestion management techniques, but also demand management strategies. The treatment of demand management in other professional training materials and university texts will also be explored.
3. **Training**—The scan team will support the development of a training course through the National Highway Institute and/or National Transit Institute that identifies approaches and strategies proven to support congestion management and demand management techniques. Topical information might also be provided through Web-based seminars.
4. **Peer Exchange**—The scan team will encourage and facilitate an exchange among peers from Europe and U.S. jurisdictions actively engaged in designing and implementing demand management strategies to advance opportunities for deployment in U.S. regions.
5. **Demonstration of Observed Techniques**—Strategies and techniques proven to support the management of congestion and demand will be demonstrated through an initiative with one or more jurisdictions prepared to implement measures the scan team observed. Techniques that show immediate promise include travel time prediction using archived data, use of the hard shoulder during peak periods, and demand management strategies for large-scale special events and incidents of a long duration.
6. **Guidance and Technical Support**—The scan team recommends development of advanced guidance to interested practitioners that facilitates the development

and use of congestion and demand management techniques proven by our European hosts. This might include methods for predicting, comparing, and measuring the impact of demand management strategies and guidance on the planning process for integrated congestion management programs.

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Biographic Sketches

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Ann Flemer is the deputy director for operations at the Metropolitan Transportation Commission (MTC), the metropolitan planning organization for the nine-county San Francisco Bay Area. She oversees the agency's programs related to the coordination of the region's transit systems, electronic payment systems, regional traveler information, regional ITS architecture, pavement management, and the Bay Area Toll Authority. She oversees the implementation of system and incident management strategies with the California Department of Transportation and California Highway Patrol, the region's network of roadside call boxes, the $1.5 billion program to upgrade five of the region's State-owned toll bridges, and the FasTrak electronic toll collection system. Flemer has worked in public transportation planning, policy, and finance at MTC since 1982, coordinating interagency public transportation programs on disabled accessibility, marketing, employee development, and fares and schedules, as well as leading the fund programming and allocation process for transportation investments throughout the region. Flemer holds a bachelor's degree in urban studies from the University of California, Los Angeles, and a master's degree in city and regional planning from UC Berkeley. She serves on several technical committees of the Transportation Research Board, focusing on regional system management and operations.

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Amplifying Questions

Introduction

The purpose of this scan is to explore ways other countries have managed traffic by managing demand. The scan team is interested in investigating the physical, operational, financial, and institutional characteristics of practices implemented by countries and/or cities to manage transportation system demand to mitigate traffic congestion.

Topics of Interest

- **Physical** practices might include such features as detour routes, auto use restrictions, parking restrictions, signing, etc.
- **Operational** practices might include traveler information, use of intelligent transportation systems (ITS), signal retiming and coordination, transit service expansion, mode change, etc.
- **Financial** practices might include congestion pricing, variable roadway pricing, tolling, electronic payment services, variable parking pricing, transit subsidies, etc.
- **Institutional** practices might include policies, plans, organizational arrangements, etc.

Applications

The scan team is interested in roles and benefits of these practices (both to managing the system and to the travelers) and how they have been applied in the context of some or all of the following events, conditions, or situations that affect travel demand:

- Special events (e.g., sports or government security)
- Road reconstruction or work zone maintenance
- Tourism or visitor accommodation
- Commuter travel, employment growth, and economic development
- Intermodal transfer facilities for passenger and freight movement
- Long-term incidents and emergencies (e.g., spills of hazardous materials, terrorism, and weather)
- Extreme weather situations

The scan team is interested in learning about projects, programs, policies, and studies that convey each country's experience with the demand management practices applied to the above-listed situations. It would be useful to devote some of each visit (perhaps 30 percent) to site visits to see the projects and places described. Any written materials, hard copy or electronic, that might be useful would be appreciated as well.

United Kingdom

Current Activities of Interest

The scan team is aware of several programs, projects, and initiatives in the United Kingdom that are of interest to this topic:

- The Sustainable Travel Initiative at Department for Transport
- Influencing Travel Behavior program at the Highways Agency
- London Congestion Charging Scheme
- CIVITAS project activities in Bristol
- Demand management measures at Heathrow Airport

Any other examples that help illuminate the role and impact of demand-side measures issues would be helpful as well.

Amplifying Questions

Physical

- How are demand-side techniques planned into reconstruction or maintenance projects?
- What role does safety play in these efforts?
- What is the role of traffic signal control, signage, auto or truck restrictions, roadway metering, and alternative route information in managing demand?
- How are demand management measures used during large-scale incidents and emergencies?

Operational

- How are demand-side techniques integrated into the overall operation of the road system? How are various interests integrated?
- What type of information is available to travelers? Tourists? Special events?
- Is real-time information available on the Internet?
- What is the role of intelligent transportation systems in managing demand?
- How is demand management applied to freight movement?

Financial

- How did you garner political and popular support for pricing?
- What are some of the issues associated with moving to a nationwide system for pricing?
- If there are equity concerns with pricing, how are they addressed?
- What are the key technology considerations in implementing road pricing?
- What supporting strategies are offered to maximize impacts?
- Are incentives given to travelers who use other modes?
- What proportion of the transport budget goes to managing demand?

Institutional

- Is managing demand a recognized element of transport policy?
- Who is responsible for planning, implementing, and evaluating demand initiatives?
- Have you assessed the impact of demand management on the local economy or economic development?
- What new partnerships have formed to implement demand management?
- What performance indicators are used to measure the effectiveness of demand-side initiatives?
- How do demand management measures compare to other solutions?

The Netherlands

Current Activities of Interest

The Dutch have studied and implemented most, if not all, of the demand management practices listed previously. The scan team is aware of a few recent initiatives, including the following:

- Rijkswaterstaat's Roads to the Future reward-based pilot programs
- National studies on pricing, mobility management, accessibility, etc.
- Traffic management measures on the national highway system
- Use of demand management during major highway reconstruction
- CIVITAS project activities in Rotterdam
- Regional coordination of accessibility measures in The Hague (SWINGH)

Any other examples that help illuminate the role and impact of demand-side measures issues would be helpful as well.

Amplifying Questions

Physical

- How are demand-side techniques planned into reconstruction or maintenance projects?
- What role does safety play in these efforts?
- What is the role of traffic signal control, signage, auto or truck restrictions, roadway metering, and alternative route information in managing demand?
- How are variable speed limits used for congestion and incident management?
- How are demand management measures used during large-scale incidents and emergencies?

Operational

- How are demand-side techniques integrated into the overall operation of the road system? How are various interests integrated?
- What type of information is available to travelers? Tourists? Special events?
- What technology is used to provide information on highways?
- What is the role of intelligent transportation systems in managing demand?
- How is demand management applied to freight movement?

Financial

- What proportion of the transport budget goes to managing demand?
- Are transport services packaged with event tickets to encourage other modes?
- Have you assessed the impact of demand management on the local economy or economic development, for example due to enhanced accessibility?

Institutional

- Is managing demand a recognized element of transport policy?
- Who is responsible for planning, implementing, and evaluating demand initiatives?
- What new partnerships have formed to implement demand management?
- What performance indicators are used to measure the effectiveness of demand-side initiatives? How are performance data collected?
- How do demand management measures compare to other solutions?
- What are the benefits of demand management to the overall system?

Sweden

Current Activities of Interest

The scan team is aware of several programs, projects, and initiatives in Sweden that are of interest to this topic:

- The Four-Stage Principle in the national Transport Policy for Sustainable Development
- The congestion pricing pilot program in Stockholm
- CIVITAS project activities in Stockholm
- The comprehensive LundaMaTs scheme in Lund
- Other demand management planning and evaluation initiatives

Any other examples that help illuminate the role and impact of demand-side measures issues would be helpful as well.

Amplifying Questions

Physical

- Are demand-side techniques planned into reconstruction or maintenance projects? What role does safety play in these efforts?
- What is the role of traffic signal control, signage, auto or truck restrictions, roadway metering, and alternative route information in managing demand?
- How are demand management measures used during large-scale incidents and emergencies?

Operational

- How are demand-side techniques integrated into the overall operation of the road system? How are various interests integrated?
- What type of information is available to travelers? Tourists? Special events?
- Is real-time information available on the Internet?
- What is the role of intelligent transportation systems in managing demand?
- How is demand management applied to freight movement?

Financial

- How did you garner political and popular support for pricing?
- What are the key technology considerations in implementing road pricing?
- Are incentives given to travelers who use other modes?
- How will road pricing revenues be used? Who decides?
- If there are equity concerns with pricing, how are they addressed?
- Have you assessed the impact of demand management on the local economy or economic development, for example due to enhanced accessibility?
- What proportion of the national or local transport budget goes to managing demand?

Institutional

- Is managing demand a recognized element of transport policy?
- Who is responsible for planning, implementing, and evaluating demand initiatives? How are they integrated into a systematic approach?
- What performance indicators are used to measure the effectiveness of demand-side initiatives?
- What models or methods are used to predict the impact of demand-side measures?
- How do demand management measures compare to other solutions?

Cologne, Germany

Current Activities of Interest

The scan team is aware of several programs, projects, and initiatives in the Cologne area that are of interest to this topic:

- Integrated traffic management and advanced traveler information (Stadtinfoköln)
- Statewide bicycle information network (Radverkehrsnetz)
- Implementation of truck tolling and traffic management schemes on highways around Cologne
- Traffic management plans for World Youth Day 2005

Any other examples that help illuminate the role and impact of demand-side measures issues would be helpful as well.

Amplifying Questions

Physical

- What is the role of traffic signal control, roadway metering, signage, auto or truck restrictions, and alternative route information in managing demand?
- How are demand-side techniques planned into reconstruction or maintenance projects? What role does safety play in these efforts?
- How are variable speed limits used for congestion and incident management?

Operational

- What are some of the technological tools used to deploy traveler information?
- What types of information are real-time?
- How much information is geared toward pretrip planning?
- How are intermodal facilities integrated into traveler information?

- What technology is used to provide information on highways?
- How is demand management integrated into special event planning?

Financial
- What role has pricing (truck, parking) played in the region's traffic management plans?
- Have you assessed the impact of demand management on the local economy or economic development, for example due to enhanced accessibility?
- What proportion of the transport budget goes toward managing demand?

Institutional
- Is managing demand a recognized element of transport policy?
- Who is responsible for planning, implementing, and evaluating demand initiatives? How are they integrated into a systematic approach?
- What models or methods are used to predict the impact of demand-side measures?
- What performance indicators are used to measure the effectiveness of demand-side initiatives?
- How is the collection and distribution of information coordinated?

Rome, Italy

Current Activities of Interest

The scan team is aware of several programs, projects, and initiatives in the Rome area that are of interest to this topic:
- The Urban Traffic Master Plan, with road pricing and restrictions in the first ring, parking pricing and controls in the next ring, and park-and-ride on the periphery
- Public transport improvements as alternatives to car use
- Mobility management initiatives with companies
- CIVITAS project (MIRACLES) activities in Rome

Any other examples that help illuminate the role and impact of demand side measures issues would be helpful as well.

Amplifying Questions

Physical
- What is the role of traffic signal control, signage, roadway metering, and alternative route information in managing demand?
- How do you restrict cars and motorbikes in the central zone?
- How is parking managed in each zone?
- How have transport services changed with the traffic restrictions?

Operational
- How are softer measures, such as traveler information or mobility management, compared to harder measures, such as traffic restrictions or pricing?
- What have been some of the key technological considerations in implementing traffic management?
- How is information provided to different groups, such as commuters, tourists, special event visitors, etc.?

Financial
- What role has pricing (access, parking) played in the region's traffic management plans?
- How did you garner political and popular support for pricing?
- If there are equity concerns with pricing, how are they addressed?
- How are pricing revenues used? Who decides?
- Have you assessed the impact of demand management on the local economy or economic development, for example due to enhanced accessibility?
- What proportion of the transport budget goes toward managing demand?

Institutional
- Is managing demand a recognized element of transport policy?
- Who is responsible for planning, implementing, and evaluating demand initiatives? How are they integrated into a systematic approach?
- What role has the private sector played in managing demand?
- What performance indicators are used to measure the effectiveness of demand-side initiatives?
- How do demand management measures compare to other solutions?

Glossary

This glossary provides common European definitions of many terms used in this report.

Accessibility
The ability to reach something desirable (which does not necessarily involve moving cars or even people).

Car sharing
A collective form of car ownership that allows members to access and pay for car use by the hour or day.
Note: in the United Kingdom, car sharing is the term for carpooling.

Charging
Pricing of travel by charging the traveler to access a congested area or cross into that area.

Collective transport
Innovative services that group travelers into shared travel arrangements, such as carpooling, taxi-sharing, and targeted public transport services.

Demand management
Reducing the demand for automobile travel during peak periods of use. In the context of this report, it means to provide travelers effective choices to improve travel reliability.

Measure
Synonymous with the U.S. use of the term "initiative," an effort such as congestion pricing, improved public transport information, etc.

Mobility
The need to move oneself or travel to access desired activities.

Mobility management
Often defined as "soft" measures to promote, coordinate, and support the use of travel alternatives that reduce the use of the automobile.

Reliability
In the context of travel time, the perceived relationship of anticipated to actual travel time for a given trip or on a given facility.

Sustainable transport
Nonmotorized transportation (e.g., walking, bicycling, public transport) that does not use nonrenewal energy sources and does not adversely affect the environment.

Traffic management
Measures that more efficiently move vehicles on the road system by offering information on or modulating the time of day, route, location, or even lane of travel.

Transportation demand management
Reducing the demand for the single-occupant car during the most congested periods of the day using measures that provide choices to travelers on mode, time of day, route, and destination of travel.

Travel planning
Development of policies, actions, and services that encourage and incentivize commuters, students, and other travelers to use alternatives to driving alone.

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