

## TRAVEL DEMAND MANAGEMENT EVALUATION: CURRENT PRACTICE AND EMERGING ISSUES

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### ABSTRACT

Travel Demand Management, or TDM, is increasing in importance as a key strategy for achieving mobility, air quality and energy goals. Recent federal legislation has underscored this importance by requiring consideration or implementation of TDM strategies and, in doing so, requiring rigorous evaluation of the effectiveness of proposed strategies.

This paper explores TDM evaluation issues from two perspectives. First, the current "state of the practice" is described for TDM evaluation. TDM evaluation serves two needs: "routine" monitoring of program compliance under the growing regulatory environment, and "research" activities to assess the effectiveness of TDM strategies. One dilemma posed by this dual need for evaluation concerns the ability and willingness to collect evaluative data beyond that required for compliance with specific trip reduction targets and mandates. Several key questions are presented in this discussion of the current status of TDM evaluation, including: who performs the evaluations, what is the nature and outputs of these efforts, and how is the information being used?

The other critical part of this paper explores "future directions" for TDM evaluation. The specific federal requirements for TDM and resultant evaluation needs within recent transportation and clean air legislation are mentioned as reasons for increased importance of TDM evaluation. Likewise, the shift from voluntary to mandatory, and the role of TDM in many regions', long range plans, increase the need to produce solid answers on TDM effectiveness.

Key future research issues are outlined that are grounded in the increased specificity and rigor suggested by this new environment. This again points to the fundamental dilemma of balancing reporting of compliance with broader research needs. The specificity and rigor required in this new environment has introduced some new measures to the TDM community that shift the emphasis from participation in programs or HOV modes to vehicle trip and VMT reductions. Compounding this shift is the need to accurately net out the secondary effects of trip reduction, such as use of the vehicle left at home when someone telecommutes. Finally, the paper inquires into appropriate evaluation roles among various levels of government and program implementors and sets the stage for a discussion of the TDM evaluation research priorities that will result from the conference.

### INTRODUCTION

#### Background

Travel Demand Management, also referred to as Transportation Demand Management or TDM, is becoming an increasingly important strategy for addressing congestion, energy and air quality problems in many urban areas in the U.S. and abroad. TDM strategies attempt to shift travelers from drive alone to higher occupancy and non-motorized modes or to different work starting times or even locations. In the 1970's, TDM was embraced as a response to the gas crises of 1973 and 1979. In the 1980's, TDM was encouraged at the federal level as part of an overall emphasis on "privatization" of transportation or as a local response to growth management concerns. In the 1990's, recent federal, state and local legislation are requiring consideration of demand management techniques in addition to capacity expansion as part of the planning process or even requiring mandatory trip reduction programs among employers and developers. In addition to TDM strategies at the trip destination end, area-wide strategies such as congestion pricing and HOV lane systems are being implemented. From this evolution of TDM, it might be generally concluded that TDM is taking its place as an accepted strategy for providing efficient and effective mobility, along with roadway expansion, transit, and traffic flow improvements (sometimes referred to as Transportation Systems Management or TSM). While TDM has a long track record of innovation, documentation of results has largely been anecdotal or based on individual case studies. For TDM to remain a widely accepted part of the urban transportation planning process, it is believed more

comprehensive and rigorous evaluation is needed to document the effectiveness of various TDM strategies and packages of measures. Through careful evaluation of *ex post* results, planners, policy-makers and implementors can be better assured that *a priori* forecasts of TDM effectiveness will be defensible, especially when making policy trade-offs between demand management strategies and supply options.

### **Purpose**

The purpose of this white paper is to provide a synopsis of the current "state of the practice" in TDM evaluation, suggest some future evaluation issues that will likely affect TDM, and finally to recommend some key research priorities within the area of TDM evaluation. This paper is not intended to assess nor recommend specific techniques and analytical methods; rather it is intended to explore issues related to the need for and use of evaluative information on TDM and relate these uses to key directions in U.S. transportation and environmental policy. Several TRB papers have addressed specific methodological issues (see for example: Erik Ferguson, "Overview of Evaluation Methods with Applications to TDM" presented at the 70th Annual Meeting of TRB, January 1991) or have provided detailed examples of TDM evaluation (see for example: Steve Beroldo, "Improving The Effectiveness Of A TDM Program Through Evaluation—A Case Study," presented at 69th Annual Meeting of TRB, January 1990).

### **Overview**

This paper is organized into three sections. The first section describes TDM evaluation as it now exists in the U.S. and defines this current practice in terms of the types of evaluation being performed, who is performing the work, what types of information are being collected, and how the information is being used. The second section postulates the future direction of TDM evaluation by suggesting what some of the key research issues and evaluation measures will likely be and defining appropriate roles for agencies and implementors. Finally, the paper enumerates several research priorities for TDM evaluation.

## **TDM EVALUATION: STATE OF THE PRACTICE**

### **Why Evaluate TDM?**

The growing importance of TDM as a solution strategy for urban transportation, energy and environmental problems was discussed in the introduction. At the federal level, TDM has been elevated to a key component of transportation planning and programming within the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Trip reduction strategies will now need to be considered first when addressing transportation needs and this will require solid analytical techniques to project the number of trips that can be reduced by various TDM strategies in order to meet future travel demand and compare the results to capacity expansion methods.

The Clean Air Act Amendments of 1990 require consideration of Transportation Control Measures (TCMs) to offset growth in Vehicle Miles of Travel (VMT) and, therefore, mobile source emissions. A rigorous analysis of TCM effectiveness is required for many urban areas that do not meet ozone or carbon monoxide standards. The Clean Air Act also mandates a specific TCM, Employee Commute Option (ECO) programs, in several non-attainment areas. These programs, also known as Employer Trip Reduction (ETR) programs, set a specific performance target for program effectiveness at each work site.

This growing need to forecast the effectiveness of TDM strategies to meet future travel demand or to meet specific trip reduction targets reinforces the critical need to better document and quantify the effectiveness of existing efforts. Unfortunately, relatively little solid empirical evidence exists on the effectiveness of TDM strategies. Given TDM programs have now been in existence for 20 years in many areas and considerable experimentation has occurred, a solid body of rigorous, standardized and convincing evidence does not exist. This may be due to the fact that TDM has, up to now, not been well funded by the public sector, as compared to the expectations placed upon it, and because many TDM techniques are implemented by the private sector, which has not placed a priority on research. Finally, the TDM profession is comprised of two distinct groups, those with transportation planning and engineering background and those with marketing and administration backgrounds. These two groups approach evaluation from different perspectives.

Whereas traffic engineering and transit planning professions have relatively accepted analytical practices, TDM has not progressed to the point of having such accepted practices.

Over the past several years, evaluation activities have clearly increased in the U.S. and some of these efforts will be mentioned later in this section. The rigorous evaluation of HOV facility performance is one outstanding example. However, systematic and ongoing programs to evaluate the effectiveness of TDM programs are relatively new and rare and such a body of knowledge will be needed before TDM planning can be a widely accepted practice. An analogy often cited relates to the ITE Trip Generation rates. These rates are derived from multiple data points for various land uses. Trip reduction rates may someday be derived from multiple data points for various sites and TDM strategies.

### What Kind of TDM Evaluation is Being Performed?

There exist two primary types of TDM evaluations currently being performed:

**“Routine” program monitoring** refers to data collection, reporting and analysis of information from employers, developers and others for the purpose of determining compliance with TDM requirements placed on the private sector.

**Research on TDM cost effectiveness** refers to the evaluation of specific TDM programs or demonstration projects to assess the effectiveness of various strategies or packages of strategies as implemented and, hopefully, to gauge the cost effectiveness of the effort, in terms of cost per trip reduced or per traveler placed into a non-SOV arrangement.

The specific kinds of information being collected and evaluated for each type of evaluation will be discussed below. However, it may be useful to describe routine monitoring as documenting what happened, and cost effectiveness research as assessing both what happened and why. Additionally, the latter type of evaluation is ultimately intended to allow comparisons among TDM strategies and other mobility measures for meeting the same objectives.

### Who Performs TDM Evaluation?

It is useful to briefly enumerate the range of agencies and implementors that currently perform TDM evaluation of both types mentioned above. This illustrates the wide variety of perspectives and capabilities involved with TDM evaluation. Three types of evaluators include: regulators, funders, and implementors.

**Regulators** include those agencies and jurisdictions that have placed requirements on employers and developers and the form of evaluation is generally of routine monitoring. Employer regulations, and concomitant reporting requirements, are generally administered by special districts, such as air pollution control districts (e.g. South Coast Air Quality Management District in California), or state and county government agencies (e.g. Maricopa County in Arizona). Some employer requirements are overseen by cities or groups of cities through joint powers organizations (e.g. Interjurisdictional TSM Authority in San Mateo County, California). Developer requirements, often mandating ongoing reporting of trip generation or TDM program progress, are usually administered with cities or counties, whatever unit of government controls land use.

**Public Funders** include agencies that provide special funding for TDM demonstrations and research or allow use of discretionary funds for TDM implementation or evaluation. The Congestion Mitigation/Air Quality (CMAQ) funds made part of ISTEA could dramatically increase the number of TDM programs funded. Agencies applying for CMAQ must project and then document the travel and emission impacts of their projects, and this will require solid a priori and ex post evaluation. Currently, public funders of TDM research include federal agencies, such as the U.S. Department of Transportation and the Environmental Protection Agency. State agencies performing or funding TDM evaluation include state air quality or environmental agencies (such as the California Air Resources Board), energy agencies (such as the New York State Energy Office) and Departments of Transportation (such as

the Florida Department of Transportation). Some regional planning agencies as well as cities and counties perform or fund TDM evaluation.

**Implementors** of TDM programs also perform evaluations to determine the efficiency and effectiveness of their efforts so as to fine tune programs and assure ongoing funding. Some employers perform evaluations of specific TDM strategies above and beyond any routine monitoring required. Some cities also perform evaluation to document the results of locally-initiated efforts or to monitor the effectiveness of developer requirements. Many regional ridesharing agencies perform evaluations to determine the effectiveness of their many outreach efforts or to document the effectiveness of various TDM strategies for the purposes of providing information to employers and other partners. Transit providers sometimes conduct TDM evaluations to document the results of programs they have initiated or to compare ridesharing options to transit service provision in certain areas. Finally, some Transportation Management Associations (TMAs) have performed evaluations for either the same reasons as ridesharing agencies or to document the effectiveness of employer programs being assisted by the TMA as compared to unaffiliated employers.

### What are the Nature and Outputs of Current Evaluation?

As mentioned above, current TDM evaluation can be categorized as falling into two types: routine monitoring and research. The former is useful in describing the effective of current efforts at the site level and the latter is driven by the need to ultimately project the future effectiveness of TDM.

**Routine Monitoring**—As TDM programs become more prevalent and are driven by trip reduction regulation, there is a need to monitor the effectiveness of programs and the attainment of targets or intended outcomes. Much of this reporting is performed at the site level by the regulated entity. The data is largely used for determining compliance and less for diagnosing results or a lack thereof. The information is largely self-reported via employee or traveler surveys and then reported by the employer to the regulator.

The two potential problems with this monitoring involve issues of reliability and uses of the data. Reliability problems arise from the use of self-reported results without rigorous controls on the quality or accuracy of the data. For example, most trip reduction requirements allow written surveys with some minimal response rate for compliance, but do not allow for sampling. While standard questions and forms are used to assure that mode shift data are consistent, survey methodologies vary. One example of this problem concerns literacy and language barriers. Some employers resort to filling out surveys for employees that cannot or will not complete a survey so as to fulfill the response rate requirement. Another problem involves the type of data collected. While mode utilization data is collected, sufficient detail is not collected on trip-chaining or mode access issues so as to estimate VMT impacts of mode shifts.

Regulatory agencies tend to be less concerned with using the data for research purposes than for tracking compliance. Their staffs focus on administering the programs and approving plans. Plan review is most often performed using more professional judgement than empirical evidence or analytical methods. However, the data could be used for research purposes by agencies with the responsibility for providing technical assistance on TDM effectiveness. As a specific example, while Maricopa County requires survey data from Phoenix area employers, the Regional Public Transportation Authority (RPTA) processes the data, the Metropolitan Planning Organization uses the data for applied research, and the RPTA uses the information to assist employers in preparing effective trip reduction plans. Clearly, the responsibilities of similar organizations in other regions might vary given varying regulations and circumstances. Other examples are provided in the next section.

**Research**—Most TDM research is performed to document the results of a TDM demonstration or to develop empirical evidence on what TDM strategies work best. This latter research area often supplies information needed to predict the potential of TDM when applied to new or different areas. The case study method of quasi-experimental research design is most often used to determine the effectiveness of a given strategies or package of measures. This typically involves before and after comparisons of mode split, vehicle trips, or vehicle occupancy. Alternatively, participation of employees in commute options is sometimes tracked to show the utilization of various

strategies. Such studies are often focused on single sites or a single employment center. When multiple “data points” or “observations” are used to develop trends, cross-sectional (several similar cases) methods are used far more than longitudinal methods (same case over time). Finally, to accurately quantify and separate the effects of a given TDM measure or program, some comparison is needed to determine the portion of change due to the phenomenon tested versus that attributable to external or other forces (such as gas price increases, regional marketing campaigns, “natural” changes in travel behavior, such as a change in job or residential location). Likewise, the small changes in behavior (often less than 5% shifts) observed may require sample sizes to attain accurate results (outside the range of error) that are cost prohibitive when measured among the general population.

Some of the problems inherent in the current research practices have to do with the rigor in which evaluation is undertaken, and as with monitoring, the prevalence of self-documentation. The use of careful before and after studies and the use of controls is not as widespread as simply documenting the utilization of various strategies or alternative modes and inferring resultant effectiveness of the strategy tested. Separating out the effects of individual strategies is often difficult as is controlling for externalities. Finally, standardized methods, evaluation measures and reporting principles have not been developed, although some efforts in this area are being fostered by the new environment that is focusing increased attention on TDM.

### **How is the Current Information Being Used?**

As alluded to above, the current evaluative information is being used for a variety of purposes, some related to regulatory monitoring and some related to applied research. The information derived from research results (either using monitoring or case study data) tend to be used for several purposes, including:

**Determining effectiveness**—the primary use of the information is to determine the effectiveness of individual TDM options, incentives, or supporting measures. In some cases, cost effectiveness is explored as it relates to the implementor (employer costs) or the planner (comparative cost effectiveness of TDM versus other approaches to fulfill policy objectives).

**Assessing factors influencing effectiveness**—in addition to exploring the effectiveness of TDM measures, some research is used to determine the full range of factors that influence TDM effectiveness, such as employee demographics, worksite characteristics, and various qualitative influences. Standard regression analysis and other multivariate methods are often used, but results are often inconclusive. This is because incomplete or inadequate data are used or complex dependent variables, such as average vehicle ridership, are used.

**Developing predictive tools and implementation guidance**—research information is often used to provide guidance on which TDM strategies work best under various conditions and to meet various objectives. Beyond written guidance, however, analytical techniques and predictive tools have been developed to allow policy-makers, planners, and implementors to better forecast the likely effect of proposed TDM strategies. Some of this guidance and predictive methods use experiential-based relationships (likely % trip reduction) or elasticities (% change in mode given a % change in an incentive or strategy). However, since TDM is largely a mode choice issue, individual or disaggregate choice techniques are desirable to estimate “coefficients” of change. The California Air Resources Board has sponsored recent research to quantify the impacts of individual trip reduction measures applicable to employer sites and shopping centers. Unfortunately, individual employee data is often not reported to regulators or researchers, rather aggregate employer statistics are reported and are used as the basis of guidance.

**Use of other data**—TDM research does not rely solely on site level data collected for monitoring or research purposes. Regional travel data and national census (journey to work) data are often used to track trends in mode utilization and travel patterns. However, regional and national data may not serve the specific needs of TDM research well. Regional mode choice models do not forecast trip elimination (i.e. telecommuting) or non-motorized modes. In fact, most regional models only predict future use of drive alone, rideshare (carpool and vanpool) and transit modes. National data is reported in terms of auto driver and passenger, but not drive alone versus high occupancy modes.

## **TDM EVALUATION: FUTURE DIRECTIONS**

### **Why Will TDM Evaluation Increase in Importance?**

TDM research will become increasingly important over the next several years. The need for, type of and content of TDM evaluation will similarly be elevated in the future. While the introduction provided some indication of the policy forces that are elevating the importance of TDM, some specific influences are described below.

**ECO and TCM provisions of the CAAA**—The Clean Air Act Amendments of 1990 reinforce the need for TDM via mobile source requirements as implemented through Employee Commute Options (ECO) and Transportation Control Measures (TCM). The Clean Air Act also requires a new level of rigor and accuracy in TDM analysis. TDM analysis, when performed for Clean Air plans, needs to quantify not only utilization, mode shifts or vehicle trip reduction, but requires the analysis of Vehicle Miles of Travel (VMT) and speeds in order to provide input to emission forecasts. Recent difficulty with providing clear and definitive guidance on TCM analysis is testimony to the challenge presented by the Clean Air Act. It might also be concluded that the level of VMT reduction necessary to meet mobile source emission reductions is beyond empirical experience and will test the ability to forecast the limits of TDM effectiveness. Additionally, ECO provisions for severe and extreme ozone non-attainment areas will require sound guidance for plan preparation and review. Given the large number of employers affected and the need to meet trip reduction targets in a relatively short time frame, the burden will be on TDM evaluators to provide guidance on the most effective strategies.

**CMS and CMAQ provisions in ISTEA of '91**—The transportation reauthorization of 1991 included three key provisions that affect TDM. First, the flexibility in local funding decisions offers more opportunity for funding of TDM programs. Indeed, the Congestion Mitigation/Air Quality (CMAQ) program provides funding for non-attainment areas and can be used on projects that reduce emissions. In fact, the CMAQ project approval process requires that emission reduction potential be forecast and actual reductions documented. Second, Congestion Management System requirements are being interpreted as requiring regional transportation planning to consider TDM and TSM solutions before approving capacity expansion project for single occupant vehicles. This will require TDM solutions to be evaluated in a comparative fashion against other strategies. CMS also places a heavy emphasis on monitoring, and this will require evaluation of the TDM strategies implemented. Finally, conformity requirements relate to the need for the regional Transportation Improvement Program (TIP) to conform with the State Implementation Plan (SIP) for the non-attainment area. This means that projects cannot be in the TIP if they are not consistent with the mobile source reduction strategies in the SIP.

**Increasing role of TDM in long range regional plans**—Air quality and congestion management goals have also prompted regional planning agencies to rely on TDM as a long range solution strategy expected to address a significant proportion of growing travel demand. Trip shifting and trip reduction strategies are a major part of long range plans for both the Southern California Association of Governments' Regional Mobility Plan and the Los Angeles County Metropolitan Transportation Authority's 30-year transportation plan. TDM is thus being forecast well beyond its traditional short-term focus to a level not before experienced. The modeling limitations of regional forecasting, vis-a-vis TDM measures (except for pricing measures) and higher occupancy modes, were discussed earlier in this paper.

### **What Will Some of the Key Research Issues Be?**

Based on the increasing role that TDM is envisioned to play in the transportation planning process, several emerging issues arise that will both shape the nature of evaluation and its role in solidifying TDM as a major solution strategy, when compared to highways and transit.

#### **Issue #1      Can the rigor suggested by new federal mandates be imposed on the TDM community?**

Given that TDM evaluation was earlier described as largely anecdotal or based on a very limited set of cases, the ability of the TDM planners and practitioners to integrate their solid experience-based

instincts with the more rigorous methods used by traffic engineers and transportation modelers may be a key factor in successfully broadening TDM base.

**Issue #2 Can research needs be balanced with regulatory reporting?**

Given that the emphasis on TDM is clearly moving from voluntary approaches to mandatory requirements (e.g., ECO requirements), the emphasis on data collection and monitoring will be on compliance, not experimentation. Therefore, one key issue that has already emerged in southern California and Arizona involves the ability to balance research and reporting needs. Many employers, burdened with new administrative and reporting requirements, are very reluctant to participate in research efforts, even if they are dovetailed onto compliance surveys. Either evaluation efforts have to rely on compliance data, or such data needs to be incorporated into reporting requirements in some fashion. An ancillary issue may be the lack of specific funding for research, beyond administration of the regulation. Recent changes to federal and state funding, however, may provide more flexible funding for applied research (e.g. CMAQ funding from ISTEA or AB 2766 funds in California).

**Issue #3 Can we collect sufficient data to calculate VMT reductions?**

The objective of most emission reduction, and to a lesser extent congestion management and energy reduction mandates, is to not only shift travelers out of single occupant modes and reduce vehicle trips, but to reduce VMT. While a vanpooler may not drive their automobile in the worksite parking lot, some studies show that a large proportion of vanpoolers drive to their pick-up location. This means that a cold-start has likely occurred and this defeats much of the emission benefits of the vanpool trip. Determining the most efficient, yet sound method for collecting VMT information, short of mandating travel diaries, will be a challenge to the TDM evaluation community.

**Issue #4 What is the cost of evaluation and who should bear the cost?**

As the rigor and breadth of TDM evaluation increase, so potentially do the costs of collecting and analyzing the information. While the role of information systems has been reinforced by ISTEA, concomitant funding priorities have not followed and the cost of planning and monitoring transportation system performance and program/project effectiveness is being cited as a major barrier to implementing such information systems. TDM evaluators will need to find cost effective methods to collect data in sufficient detail to predict or document the actual impacts of TDM programs and policies.

**Issue #5 What is the role of the Census and Journey to Work data?**

Census data, particular Journey to Work and the National Personal Transportation Survey, provide invaluable information on national and local trends in mode use, trip distance, auto ownership and other factors very critical to TDM and transportation planning in general. The widespread impact of Alan Pisarski's Eno Foundation report entitled "Commuting in America" is testimony to the utility of census data. However, a recent proposal to reduce travel information from the census may provide problems for TDM planners who use the census data to determine the representativeness of the situation.

**What Will Some of the Key Evaluation Measures Be?**

The emerging environment for TDM will also likely require a new or modified set of evaluation measures to be used, which will clearly impact the type and content of evaluation efforts. Some of the possible trends and measures that might be used are enumerated below:

**Focus on vehicle trip and VMT reduction**—To have the ability to evaluate the results of TDM programs and assess their impact on congestion and air quality, TDM evaluation measures will likely move from relying on participation levels and aggregate mode split to an emphasis on vehicle trip reduction and VMT reduction.

**Desire to determine net VMT reduction and cold starts**—VMT reductions could simply be stated as average home to work trip length, but should subtract out any SOV use on the way. If a vanpooler accesses the van by driving to a pick-up point, only the van mileage should be considered as a reduction. By looking only at VMT reductions in terms of SOV miles that would have been driven, not total distance, a better idea of TDM impacts on air quality and congestion can be formed. Likewise, determining the number, timing and location of cold starts at the origin end is just as important as assessing the reduction of trips at the destination end.

**Cost per trip or VMT reduced**—Recent criticism of employer trip reduction programs revolves around concerns over the cost effectiveness of TDM programs, in terms of cost per employee, in reducing emissions. However, these cost studies may not have had a complete picture of costs. First, accurate costs are very difficult to obtain, less for proprietary concerns than for a lack of documentation. It could be argued that cost per trip reduced is a good indicator of TDM program effectiveness, while cost per employee is more of an efficiency measure. Also, TDM cost effectiveness should be evaluated in light of net cost per trip reduced, because many implementors realize direct and indirect savings of revenue from implementing a TDM program.

**Comparative cost effectiveness of TDM**—The costs and effectiveness of TDM strategies, when compared to other mobility or air quality strategies will become important as planners weigh the benefits of TDM versus traditional transit and highway solutions. A valid concept for these comparisons would be the cost to accommodate future travel demand via demand reduction or capacity expansion. In other words, how much does it cost society to accommodate the additional *n*th commuter with new road capacity, versus bus service, versus a carpool subsidy, versus telecommuting?

**Site specific versus regional or corridor measurement**—Evaluating the ability of various TDM and other transportation strategies to congestion management, mobility and air quality objectives may depend on the level of analysis. For example, at the site or employment center level, impacts of TDM program can be measured via percent trip reduction or via a normalized indicator, such as vehicle trips/100 employees generated by the site. Regional, subarea or corridor measures, on the other hand, need to look at overall system performance, account for all modes and be understandable. Measures such as travel time for various trip purposes and times of day can reflect the success of trip reduction or shifting measures. Other measures, such as person trips/VMT may be better suited to mobility and air quality goals (if an area is doing the right things, person trips will be accommodated for fewer miles of vehicular travel.)

### **What Are Appropriate Evaluation Roles?**

As the need for and use of TDM evaluation information increase, so will the respective roles of planning, policy-making and implementation entities. The role of federal, state and regional agencies, as well as local implementors, will be modified to respond to this new environment. The possible roles for each type of organization are briefly suggested here:

**Federal Agencies**—Key federal agencies, such as EPA and the Federal Transit (FTA) and Highway Administrations (FHWA) of the U.S. DOT, are now responding to the rule-making and guidance needs of ISTEA and the Clean Air Act. This need creates a role for these agencies of an information clearinghouse, research funders and providers of guidance. The role of the federal government in research funding diminished in the 1980's as technical assistance with existing information seemed to characterize the federal role. However, as the demands of the recent legislation attest, a strong federal role on research and information dissemination is needed. As early examples of applied research, EPA has funded several efforts to evaluate TDM strategies and TCM analysis methodologies. Likewise, joint efforts by FTA and FHWA to research effective TDM actions and provide guidance and training may be precursors to expanded roles. Key professional organizations, such as the Transportation Research Board, the

Institute of Transportation Engineers and the Association for Commuter Transportation, are involved in TDM evaluation and information dissemination activities.

**State Agencies**—With the advent of more flexible federal funding and state responsibilities for air quality attainment, state departments of transportation, environment and energy are becoming more involved in TDM evaluation. States can provide research funding and facilitate information sharing among urban areas, but they can also adopt common formats and methods for TDM evaluation. In California, Caltrans and several regional agencies have been working together to develop a standard TDM survey for employees and common reporting formats and evaluation measures. Just as with federal agencies, research coordination among state departments is crucial. Again using an example from California, several state agencies are coordinating policy and research agendas via a Transportation, Energy and Air Quality (TEAQ) group. State associations among TDM implementors, planners and policy-makers could emerge at the state level and be used to share evaluation information.

**Regional Agencies**—The increased role of regional planning agencies and the impact of TDM at the regional and local level may elevate the role of regional agencies, such as MPOs, regional ridesharing applied research, regional agencies can play the role of database managers and researchers by overseeing data collection efforts for operational and compliance data, processor of that data and provider of applied research. Regional agencies can assemble and analyze data from throughout the region and establish evaluative results on TMD effectiveness based on the unique characteristics of the region. Regional agencies can also coordinate or fund data collection activities by conducting or facilitating independent evaluations. Examples of regional coordination of evaluation efforts include efforts by Seattle Metro to track mode splits at employment sites throughout the region, research efforts on carpool dynamics performed by Commuter Transportation Services, Inc., and, finally, the coordination of TDM pilot project evaluations by the Los Angeles County Metropolitan Transportation Authority.

**Implementors**—Finally, implementors of TDM programs will play an increasingly important role in TDM evaluation. Employers, developers, cities, TMAs, and other entities responsible for implementing TDM programs will be called upon to provide consistent, high quality and robust data for purposes of routine monitoring and applied research. The collection of evaluation data by implementors provides for certain efficiencies, but only when quality control is assured via standard practices and methods. As regional, state and federal agencies develop standardized methods and evaluation measures and look for more and new data, implementors at the local level will be challenged to both implement effective programs, and at the same time collect the evaluative data necessary to develop solid guidance on TDM effectiveness.

## **FUTURE RESEARCH PRIORITIES**

The current practices and future issues discussed above suggest several critical research priorities for the TDM research community and its supporters. The five research priorities stated below are by no means an exhaustive list, but suggest a few research ideas for further consideration. The priorities are somewhat general, but may suggest areas for more specific recommendations.

### **Research Priority #1—Integrating research and reporting data needs**

So as to actively coordinate research and reporting data needs, as a large number of ECO programs are being developed, the TDM research community should outline the rationale for balancing research and compliance needs and specific recommendations for integrated instruments, methods, measures and documentation formats. Part of this issue is convincing TDM implementors that evaluation is constructive, not punitive.

### **Research Priority #2—Tailoring research results for various users**

Assessing research needs and guidance for planners, policy-makers, and practitioners is especially critical so that research results lead to more effective programs and long term results. One potential issue in the TDM field is the need for transportation planners and engineers to understand the marketing aspects of TDM and for implementors

to understand the travel behavioral aspects of TDM strategies. Information and training have to be targeted to each need and developed for joint training purposes.

### **Research Priority #3—Coordinating research efforts**

While the need for coordination may seem obvious, years of declining emphasis in evaluation and recent policy initiatives at the federal level are increasing the number of research projects being sponsored. There is a need, at all levels, to coordinate research needs to assure key questions are being answered and to avoid duplication of efforts. The research needs are great, as documented above, and the need to expeditiously and efficiently perform needed evaluations is equally great.

### **Research Priority #4—Evaluating TDM cost effectiveness**

One specific area of increased focus in TDM evaluation concerns the need to go beyond documentation of results to evaluate the comparative cost effectiveness of TDM as compared to other strategies for addressing air quality and congestion concerns. The need for such research is founded on concerns by the private sector and legislators that TDM requirements place an undue burden on business and may not be the most cost effective means for reaching policy objectives. Efforts to more accurately and fully account for the “economics” of TDM are needed to address these concerns.

### **Research Priority #5—Quantifying and modeling HOV access mode**

One specific research priority concerns the need to evaluate the complete trip of the commuter, to account for stops along the way, use of single occupant vehicle to access HOV options and the need for vehicles mid-day. While several TDM evaluations have documented traveler attitudes toward the need for their cars, what is needed is solid evaluative data on the proportion of commuters who make stops and the length of those trip segments. In that way, the impact of TDM reduction strategies on net VMT reduction can be quantified and predicted. Such detail is needed to accurately estimate the emission and localized traffic impacts of TDM measures. In a similar fashion, TDM pricing strategies that change the timing or location of travel, rather than mode, need to be quantified to assess the true impacts of pricing measures.