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INNOVATION AND RESEARCH SYMPOSIUM



SYMPOSIUM PROCEEDINGS

TRAVEL DEMAND MANAGEMENT INNOVATION AND RESEARCH SYMPOSIUM:
SETTING A STRATEGIC AGENDA FOR THE FUTURE

Key Bridge Marriott
Arlington, Virginia
November 15 and 16, 1993

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Travel Demand Management Innovation and Research Symposium: Setting a Strategic Agenda for the Future

November 15 and 16, 1993

Key Bridge Marriott
Arlington, Virginia

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Symposium Proceedings

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FOREWORD

These proceedings summarize the highlights from the *Travel Demand Management Innovation and Research Symposium: Setting a Strategic Agenda for the Future*. The Symposium was held on November 15 and 16, 1993, at the Key Bridge Marriott in Arlington, Virginia. The Symposium brought together a wide range of individuals from throughout the country to discuss the current status of Travel Demand Management (TDM) activities and to help chart a course to advance the state of TDM practice into the next century.

The two-day Symposium was sponsored by the Transportation Research Board (TRB) of the National Research Council in cooperation with the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA). The Symposium was intended to be a working conference. Summaries of the resource papers commissioned for the Symposium were presented at the opening sessions and the Deputy Administrators from FHWA and FTA presented keynote addresses to help stimulate ideas for later discussion. The majority of the Symposium was then spent in small working groups which identified and discussed TDM issues and research needs. These were presented at the closing session and rated by the participants through the use of a Perception Analyzer—a high tech market research technique.

As you will see from the workshop summaries, the groups discussed a variety of issues associated with planning, implementing, and evaluating TDM strategies and identified a number of critical research needs. Thus, the results from the Symposium should be viewed as helping to establish a strategic agenda for a vibrant ongoing TDM research program. The results will be used to develop more detailed research problem statements that may be funded through FHWA, FTA, TRB, and other public and private sector groups.

A number of people contributed to the success of the Symposium and deserve recognition. First, I would like to thank the other members of the Symposium Planning Committee for the time and effort they put into organizing and leading the Symposium. Wayne Berman and Joe Goodman, from FHWA and FTA, respectively, were instrumental in developing the concept and in obtaining federal funds to support the Symposium. Second, the authors of the resource papers did an excellent job of summarizing the key issues and opportunities associated with TDM. Third, the moderators and recorders from George Mason University and FTA provided valuable assistance in facilitating the workshop sessions. Fourth, the TRB staff—especially Rich Cunard, Reggie Gillum, and Catha Stewart—did an outstanding job with the logistics for the Symposium. Finally, I would like to thank all of the participants for sharing their concerns, ideas, and visions on the future direction of TDM.

These proceedings are intended to help facilitate the development of a multifaceted ongoing TDM research program that is responsive to the needs of federal, state, and local agencies, private businesses and organizations, and other groups. I hope these proceedings will stimulate you to think of creative approaches to TDM and techniques to address the issues associated with traffic congestion, mobility, and air quality and environmental concerns. Your involvement in future activities will be critical to advancing the state-of-the-practice and ensuring a vibrant strategic agenda for the future of TDM.

Katherine F. Turnbull
Planning Committee Chair

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SYMPOSIUM OVERVIEW

Katherine F. Turnbull, Texas Transportation Institute
Michael D. Meyer, Georgia Institute of Technology

The *Travel Demand Management Innovation and Research Symposium: Setting a Strategic Agenda for the Future* was held in Arlington, Virginia on November 15 and 16, 1993. Sponsored by the Transportation Research Board (TRB) of the National Research Council in cooperation with the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), the intent of the Symposium was to review the current status of Travel Demand Management (TDM), discuss issues and research needs, and initiate the development of a strategic agenda to advance the state of TDM practice into the next century. The results of the Symposium, as summarized in these proceedings, provide the basis for a vibrant ongoing research program focused on advancing the state-of-the-practice related to TDM planning, implementation, and evaluation.

TDM includes a wide range of techniques and actions aimed at managing the demand on transportation facilities by encouraging commuters to change from driving alone to using a high-occupancy vehicle or shifting into less congested travel periods. TDM programs may encompass ridesharing, transit, alternative work schedules, parking management and parking pricing, and other techniques.

Although many of these approaches are not new, concerns about increasing levels of traffic congestion and related air quality and environmental issues have placed additional emphasis on the use of TDM strategies in many urban areas. This interest is reflected in the emphasis being placed on the use of transportation control measures to meet the air quality standards contained in the 1990 Clean Air Act Amendments, the mobility enhancement focus of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and local and state growth management initiatives. As a result, TDM continues to be of interest to transportation professionals, private sector groups, policy makers, and others.

Realizing this continued interest, the Transportation Research Board (TRB) established a TDM Task Force in 1990. The Task Force provided a focus for TDM within the TRB structure, undertook a number of activities, and worked cooperatively with other groups and organizations on TDM projects. One of the major activities of the Task Force was to initiate planning for a national symposium on TDM with funding provided by FHWA and FTA. TRB

officially initiated planning for the Symposium in early 1993 with the appointment of a Symposium Planning Committee. This group was responsible for identifying the key issues to be addressed, selecting the resource paper topics and authors, and organizing the general sessions and working groups.

The invitation-only Symposium brought together key representatives from public and private sector groups involved in TDM. Individuals from federal, state, and local governments, transit and rideshare agencies, Transportation Management Associations and Organizations, private businesses, consulting firms, universities and research institutes, and other groups provided a diverse mix of perspectives and opinions. Participants spent most of the two days in working groups discussing the current status of TDM, issues limiting the effectiveness of TDM, research needs, and strategies to help advance the state of TDM practice into the next century.

To help establish a common base for the working group discussions, eight resource papers were commissioned for the Symposium. These were provided to participants prior to the Symposium and six of the eight were presented at the opening sessions. The resource papers provided an excellent starting point for the working group discussions. The resource papers and authors were:

- *The State-of-Practice of Travel Demand Management*, Michael D. Meyer, Sarah Siwek, and Wayne Berman
- *Demographics and Market Definition*, Brad Edmondson
- *Driving Forces That Have Shaped Travel Demand Management*, Tad Widby
- *Travel Demand Management Evaluation: Current Practice and Emerging Issues*, Eric Schreffler
- *Implementation Issues and Barriers*, Katherine L. Gerwig
- *Integrating Travel Demand Management Strategies*, Michael Replogle and Hank Dittmar
- *Travel Demand Management and Intelligent-Vehicle Highway Systems*, Katherine F. Turnbull and G. Sadler Bridges
- *Impact of Telecommunications Technology*, E. M. and Linda T. Risse and Jon Williams

Each of the working groups addressed a wide range of issues and concerns related to TDM programs. The discussions focused on the five general areas of market and constituency development; legislative and policy development; planning, implementation, and evaluation; institutional and organizational development; and operational and technological development.

The working groups identified key issues and research needs for each of the five focus areas. These were then compiled and presented at the closing session. A market research tool, called the Perception Analyzer, was used at this session to provide the Symposium participants with the opportunity to rate the composite list of 42 strategies and research topics. Each participant was provided with a hand held rating dial. A 100 point rating scale was used to measure the importance of each strategy and research need, with 0 = not important and 100 = very important. Each of the 42 strategies was presented, with participants rating the importance of each. The responses were tabulated during the session, allowing the preliminary results to be presented before participants left the Symposium.

A number of the 42 strategies and research topics were related and were consolidated into 24 research studies. The high priority research studies—with ratings of 75 and above, and the medium priority projects—with ratings of 50 to 74—in each of the five general areas are highlighted next.

MARKET AND CONSTITUENCY DEVELOPMENT

High Priority

- Enhanced Understanding of Commuters as Consumers
- Develop Realistic TDM Goals and Objectives
- TDM Outreach, Planning, and Program Development Strategy
- TDM Market Research

Medium Priority

- Innovative TDM Marketing Campaigns
- TDM Education and Training Programs

LEGISLATIVE AND POLICY DEVELOPMENT

High Priority

- Examination of Flexible Funding Opportunities of the ISTEA and Other Programs to Support TDM
- Assessment of Land Use Policies Supporting Transit and TDM
- Examination of Tax Policies to Support TDM
- Examination of Pricing Strategies to Support TDM
- Examination of Performance-Based Regulations

- Analysis of Parking Strategies to Support TDM

PLANNING, IMPLEMENTATION, AND EVALUATION

High Priority

- Incorporating TDM into the Transportation, Air Quality, and Land Use Planning Process
- Guidelines for Planning, Implementing, and Evaluating TDM
- Comprehensive TDM Research Program
- Enhanced TDM Modeling Tools
- Guidelines for Areawide TDM Programs

Medium Priority

- TDM Strategies for Non-Work Travel
- Development of State-of-the-Art Public Domain Rideshare Matching System

INSTITUTIONAL AND ORGANIZATIONAL DEVELOPMENT

High Priority

- Facilitate Development of Public/Private Coalition to Advance TDM

Medium Priority

- Guidelines for Public/Private Partnerships in TDM
- Analysis of Organizational and Institutional Needs and Objectives

OPERATIONAL AND TECHNOLOGY DEVELOPMENT

High Priority

- Expand the Effectiveness of TDM through the Application of IVHS Technologies
- Develop and Implement an Outreach Program to Facilitate the Integration of IVHS and TDM

The identification of these TDM strategies and research studies, which are described more extensively in these proceedings, is intended to help facilitate the development of a multifaceted TDM research program. Thus, the results from the Symposium represent the starting point for an ongoing, robust TDM research program that is responsive to the needs of public agencies, private businesses, transportation professionals, TDM practitioners, policy makers, and other groups. It is realized that not all relevant issues, opportunities, and research needs were discussed extensively in the two days. Other efforts will be needed in the future to further refine and advance the efforts initiated at the Symposium.

The Symposium proceedings represent the collective experiences of the foremost TDM practitioners and

researchers in 1993. It is likely that such experiences will expand significantly over the next few years. In particular, the TDM requirements of the ISTEA-mandated congestion management system create a national market for TDM analysis capabilities. The employer commute options (ECO) program of the Clean Air Act Amendments provides employer-based TDM program experience in nine major metropolitan areas. Public concerns for the negative traffic impacts associated with growth will continue to provide interest at the local level for TDM activities. Although the Symposium provided an excellent overview of the state-of-practice of TDM, it represents only one point in time. The most exciting and challenging experiences with TDM lie ahead. We must pursue the research statements outlined in these proceedings to lay the groundwork that practitioners 10 years from now can use to implement the TDM programs of the future.

The TRB TDM Task Force will use the results from the Symposium to develop a comprehensive ongoing TDM research program. Numerous opportunities exist to advance the work started at the Symposium. Potential funding sources for the research studies and strategies include the FHWA, FTA, the National Cooperative Highway Research Program (NCHRP), the Transit Cooperative Research Program (TCRP), national organizations, state departments of transportation, transit and ridesharing agencies, metropolitan planning organizations, private sector groups, and others. Developing the preliminary research studies into more detailed problem statements for consideration by potential funding sources represents one important activity to help implement the results of the Symposium. The proceedings from the Symposium will help guide these efforts and will assist in advancing the state-of-the-practice of TDM.

INTRODUCTION

Katherine F. Turnbull
Symposium Planning Committee Chair
Texas Transportation Institute



It is a pleasure to welcome you to the *TDM Symposium on Innovation and Research*, sponsored by the Transportation Research Board (TRB), the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA). As indicated by the title, the focus of the Symposium is on setting a future agenda for TDM. I am looking forward to a very interesting and productive two days, and I thank you all for attending.

I have had the opportunity to serve as the Chair of the Symposium Planning Committee over the past six months. I would like to recognize and thank the other members of the Planning Committee. Members of the Committee included Mike Meyer, Diane Davidson, Mary Lynn Fischer, Jim Sims, Phil Winters, Byron York, Bill Roach, Jon Williams, Hank Dittmar, Les Hoel, Wayne Berman, and Joe Goodman.

I would like to thank these individuals for the hard work they have put in over the last six months. They were responsible for identifying the key issues to be addressed at the Symposium, selecting the resource paper authors, and organizing the general sessions and working groups. I think you will see their efforts reflected in the quality of the presentations today and in the overall Symposium.

I would like to thank the authors of the resource papers, many of whom you will hear from this morning. I hope you have had a chance to review these prior to the Symposium. The authors did an excellent job of capturing the key issues associated with TDM today. The resource papers were developed to help create a starting point for

the workshop discussions and to stimulate your thinking on creative ways to address major concerns.

In addition, I would like to recognize the efforts of the TRB staff. Rich Cunard was extremely helpful in organizing the meetings of the Planning Committee and the Symposium. He provided excellent guidance throughout the process. Both Reggie Gillum and Catha Stewart have done their normal outstanding job with the arrangements and registration.

As noted in the letter of invitation and the registration information, this Symposium is intended to be a working conference. The general sessions have been limited by design to provide more time for the working groups. Rather than talking at you, the Symposium is intended to provide the opportunity for you to talk with other experts in the TDM arena. You have been invited to participate in the Symposium because of your experience and expertise in TDM. Thus, your charge over the course of the Symposium is to help set the strategic agenda for the future of TDM.

I would like to review the agenda for the Symposium to give you a better idea of the activities for the next two days. The resource papers will be summarized during the first two general sessions this morning—just in case you have not had the opportunity to read them all. A short presentation will also be given on the recent federal initiative related to the “cash-out” parking proposal. You will have the opportunity to hear more about the federal perspective on TDM from the two luncheon speakers—the Deputy Administrators from FHWA and FTA. The afternoon will be spent in the working groups discussing current issues associated with TDM.

We will reconvene tomorrow morning to hear the summaries from the first working group sessions. The remainder of Tuesday morning will be spent back in the working groups discussing future research needs. After a group lunch, the final wrap-up session will summarize the major issues and opportunities facing TDM. Representatives from George Mason University and FTA staff will help facilitate the working group sessions. An innovative market research technique, called the “Perception Analyzer” will be used with the final closing session. This technology will give you the opportunity to help rate the importance of different issues, research needs, and potential projects. Similar to picking your favorite ending to a movie, this session will allow you to identify the key focus areas for future TDM activities.

The Symposium represents an excellent opportunity to help identify priority issue and research areas and to help advance the state-of-the-practice with TDM. Results from the Symposium will be used by TRB, FHWA, FTA, and other groups for programming future research projects and activities. Given limited financial and human resources, the strategic agenda should focus on those issues that you feel are critical to ensuring successful TDM programs.

It has been a pleasure to serve as Chair of the Planning Committee and to have the opportunity to help organize this Symposium. I would like to again thank the other members of the Planning Committee and TRB, FHWA, and FTA for their sponsorship of the Symposium. I would also like to thank all of you for taking the time from your busy schedules to participate in the Symposium. I hope you will find it a worthwhile and productive two days. Your involvement will be critical to insuring the success of the Symposium and achieving the goal of setting a strategic agenda for the future of TDM.

Bert Arrillaga

Federal Transit Administration



Good Morning. On behalf of the Federal Transit Administration (FTA), I am happy to welcome you to the *TDM Innovation and Research Symposium*. I would like to thank Joe Goodman from FTA and Wayne Berman from FHWA for all their hard work in coordinating the activities of the two agencies to help support this Symposium. It is a pleasure for FTA to co-sponsor this event with TRB and FHWA.

The goals of this Symposium focus on setting a strategic agenda to help guide future TDM research conducted by the U.S. Department of Transportation, TRB, and other groups. The FTA's Office of Technical Assistance and Safety has been involved in numerous TDM activities over the years and participated on the Planning Committee for this Symposium. We look

forward to using the results from the Symposium to help identify future research needs related to TDM.

It is great to see so many of the TDM experts from all over the country assembled here. This process—of bringing together the top experts, researchers, and practitioners—is consistent with the approach the Office of Technical Assistance and Safety has used in the past to identify priority transit research needs and to provide guidance to other transit programs. I am sure many of you have participated in recent Planning and Research Conferences and other specialty conferences sponsored by FTA. For example, specialty workshops have recently been held on congestion pricing and fare policies, and an upcoming conference will examine transit operational planning.

You will have an opportunity at this Symposium to spend a good deal of time in small groups discussing what is working in TDM, what is not working, and where additional efforts are needed to improve the current state-of-the-practice. Your insight and input will be critical to help identify areas for improvement. Your assistance is also needed to identify the best methods to disseminate information to technical staff members and decision-makers at the local, state, and federal level and in private businesses.

All types of TDM measures—improved transit services, transit subsidies, travel allowances, HOV facilities, carpooling, vanpooling, telecommuting, congestion pricing, and other strategies—are valuable tools for use by state and local governments and employers to meet the requirements of the ISTEA and the 1990 Clean Air Act Amendments. Case studies of employer experience with these measures have shown that they can be effective in reducing single-occupant automobile commute trips. In some cases, changes of up to 30 percent to 40 percent have been recorded at a single site. Area wide data from Southern California on the impact of Regulation 15 indicates only an average of a 3 percent to 5 percent reduction in single-occupancy commutes has been accomplished on a regional level, however. These differences raise a number of questions and issues which need to be examined further. For example, can the exemplary experiences of the standout case studies be duplicated on a regional scale?

This Symposium has been organized to produce tangible and useful products to help guide federal and other research projects over the next few years. In addition, the Symposium will identify changes in policies that may be necessary to help advance TDM. Thus, this

will be a working symposium. I hope you will find it a challenging and valuable opportunity to provide your thoughts and ideas to help shape the future agenda for TDM. Your creative thinking will be critical to the success of this Symposium and the future of TDM.

Dennis C. Judycki

Federal Highway Administration



Good Morning. It is a pleasure and an honor to welcome you to the *TDM Innovation and Research Symposium* on behalf of the Federal Highway Administration (FHWA). The FHWA is pleased to be a cosponsor of the Symposium, along with the Federal Transit Administration (FTA) and the Transportation Research Board (TRB). This Symposium represents a unique opportunity for all of us who have been involved in TDM activities over the years to help shape future plans and programs. You will have the opportunity over the next two days to discuss different ideas and options, and to develop recommendations to help set the future agenda for TDM.

It was exciting walking in this morning and talking not only to a number of old friends, but also seeing all of the experts in the TDM arena assembled here. I know you are all busy people, and we hope you maximize your participation over the next two days. I think it is a real compliment to the Symposium that we were able to attract so many key people. I hope you will find the sessions both stimulating and enjoyable.

Now is an appropriate time to take a renewed look at TDM and to consider how this important element fits into the overall transportation system. A good deal of work has been done in this area, including many projects sponsored by FHWA, but much more is needed. Your help will be critical in developing a strategic agenda for the future of TDM.

I would like to take this opportunity to let you know of FHWA's continued support for TDM and to highlight a few of the TDM-related projects currently being sponsored by the Department. Wayne Berman has provided a great deal of leadership on these activities and you will have a chance to hear from Jane Garvey, FHWA Deputy Administrator, later in the day. The continued support and enthusiasm of FHWA is reflected in the work of these two individuals and many others within the Department.

FHWA continues to be actively involved in a wide range of TDM research studies, demonstration projects, and technical assistance activities. Recent projects include the development of a technical assistance manual on implementing effective TDM measures, a new training course on planning and implementing TDM programs that will be available in 1994, guidance manuals on employer-based and government-based TDM programs and market research, and a microcomputer analysis tool for evaluating the impact of TDM projects.

The Intermodal Surface Transportation Efficiency Act (ISTEA) really institutionalizes operational improvements and TDM as important elements of the transportation system. In fact, emphasis is now being placed on not adding new capacity for single-occupant vehicles. Rather, exploring TDM measures and other techniques to encourage greater use of all high-occupancy commute modes are now major priorities in many areas. The 1990 Clear Air Act Amendments also place much greater emphasis on TDM measures.

In addition, numerous opportunities exist to enhance the use of TDM through the application of intelligent-vehicle highway systems (IVHS) technology. If you have not read the resource paper prepared by Katie Turnbull and Sadler Bridges on TDM and IVHS, I would encourage you to do so. It presents a number of excellent ideas on how IVHS and other advanced technologies can enhance TDM strategies. I would encourage you to think of creative ways to combine the two programs. IVHS is a robust program that is growing very rapidly. Initially oriented around six general categories, IVHS is now being characterized by user service areas. These are being used to develop a national program plan, which will focus on 27 user services. TDM is one of the user service areas. I would encourage you to consider ways to link the TDM wagon to the IVHS star during your discussions over the next two days.

Thank you again for your time, your attention, and your participation in this Symposium. The next two days

will be very important in helping to advance TDM. Your involvement in the working groups will be critical to developing a strategic agenda for the future of TDM. I am looking forward to your insights and the guidance you will provide on research needs and priority activities to help advance TDM into the next century.

PRESENTATION OF RESOURCE PAPERS AND KEY ISSUES

State-of-the-Practice, Driving Forces, and Demographics

Mary Lynn Tischer

Virginia Department of Transportation



It is a pleasure to have the opportunity to summarize the first three resource papers: *State-of-Practice of TDM* by Michael D. Meyer, Sarah Siwek, and Wayne Berman; *Driving Forces That Have Shaped TDM* by Tad Widby; and *Demographics and Market Definition* by Brad Edmondson. I think these three papers do an excellent job of setting the context for the more detailed discussions that will occur in the working groups over the next two days.

I would like to start with Tad Widby's paper which examines the driving forces behind TDM programs. He uses four categories—regulations, economic forces of employers, individual behavior, and demographics and land use—to describe the key factors that have shaped TDM strategies. He notes that the two major regulatory issues behind most TDM efforts are a result of concerns over severe traffic congestion and non-attainment of air quality standards. Both of these issues are exerting pressure on many areas to implement a variety of TDM measures.

A number of economic forces affecting employers may also motivate the use of TDM programs. These factors include zoning ordinances, uniform building codes, working conditions and employee benefit packages, and other related elements. In this environment, TDM programs may be used to support employee recruitment and employee retention. In some cases TDM may be used as part of a relocation package or to reduce costs for the employer. For example, TDM programs may be promoted by employers to reduce the cost of building new parking facilities or other improvements.

Individuals are also responding to a wide range of social, economic, and environmental factors. We are well aware of the preference for the automobile across the country. Demographics and land use represent the last category of forces behind TDM identified by Widby. These are structuring agents which help segregate activities and different population segments.

Widby describes TDM in the context of asset management. This suggests that there can be productivity improvements and innovations, but that there will not be any wholesale changes in these forces. Thus, he cautions against painting too rosy a picture for TDM.

The paper provides a good summary of the different federal, state, and local legislation and policies that have influenced the development of TDM programs. At the federal level, the National Environmental Policy Act of 1970 and the Clean Air Act of 1970 helped establish the initial course for TDM by identifying air quality non-attainment areas and requiring transportation control plans. More recent amendments to these acts and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 further strengthen many of these provisions. The Energy Tax Act was also important in that it established tax credits for employers investing in vanpool programs.

At the state level, Widby notes that a number of states have passed legislation relating to requirements for planning, implementing, and evaluating TDM programs, state tax credits for TDM activities, and trip reduction regulations. Many local governments have developed similar programs and policies to address specific concerns.

The paper suggests that the ISTEA and the 1990 Clean Air Act Amendments institutionalize TDM. The flexible funding offered by the ISTEA, as well as the new requirements, all support TDM activities. The paper stresses that TDM alone can not address all the congestion and environmental issues facing many areas, however. Thus, expectations for TDM programs need to be realistic.

The paper concludes by raising a number of questions related to the future of TDM. The first of these addresses the need for a better analytical basis for estimating the expected results of different TDM strategies. The second examines how many programs are developed based on the hope that the desired results will in fact occur. The third considers what would happen to TDM programs if air

quality concerns were not a driving force. The last set of questions relates to potential alternative future directions if TDM measures are successful and also if they are not successful.

I would next like to summarize the paper by Brad Edmondson on the demographic and market factors that may influence TDM. The paper begins with an overview of recent trends in commuting. These include the increased use of single-occupant vehicles from 1980 to 1990 and the corresponding decrease in rideshare modes. This is occurring at a time when the number of jobs increased by some 19 million; accounting for an increase of approximately 22 million more drivers.

The paper includes a number of graphics that illustrate the percentage of the population within geographic regions that drive alone to work. The trends indicate that single occupant vehicle use increased faster where it was already high and in areas of rapid economic growth. There are many factors contributing to the increase in drive-alone commuters. These include the increase in multiple function commutes, the increase in women in the work force, and changes in lifestyles. For example, he notes that one of the most rapid increases in single-occupant commuters was among mothers with pre-school children.

The paper also discusses the impact of demographic trends on commuting patterns. For example, the largest increase in vehicle miles of travel (VMT) between 1983 and 1990 was in the 16 to 19 year old age group. Older individuals are also driving more. Between 1983 and 1990 VMT for males over 65 increased by 27 percent and VMT for females over 65 increased by 44 percent. At the same time the low income population—which traditionally has relied heavily on public transportation—increased, but their use of transit decreased.

Edmondson notes that Americans appear to be more environmentally conscious today, with some 70 percent of the population describing themselves as environmentalists. This does not necessarily translate into concern over changing driving habits, however. Changing commute habits is often ranked low in terms of environmentally friendly actions that individuals would take. He stresses that the more complex patterns of commuting in the 1990s reflect a more complex society, where individual demographic and lifestyle choices are far more powerful determinants of behavior than group or institutional affiliations.

He also describes recent changes in employment and how these changes are affecting travel. Some of the

trends discussed in the paper include the continued growth of new jobs in suburban areas, the changing nature of employment from manufacturing to service-based, greater use of staggered and flexible work hours, split-shift parents, two job households, and two job workers. All of these trends have resulted in a greater dispersion of commuter traffic—both geographically and in time.

Edmondson briefly discusses recent trends in home-based work and different types of telecommuting, which are described in more detail in other resource papers. Estimates are that approximately 20 million to 39 million Americans currently work at home. Most of these are manufacturing or service jobs and 25 percent of these are self-employed individuals.

The paper concludes with a summary of the factors that appear to be working against greater use of high-occupancy commute modes, as well as the trends that may support HOV use. Most of the demographic and geographic trends are working against ridesharing and transit. The dispersion of both the population and jobs, along with trends toward more diverse work shifts, erratic schedules, smaller offices, and multiple-stop commute trips are not conducive to increasing the use of high-occupancy modes. On the other hand, there are a few trends that may encourage greater use of transit. Since mobility usually declines with age, the increase in the population in the 45 and older age group may result in more stable communities, longer job tenure, and more predictable daily routines. If this occurs, many of the programs now being implemented could be effective for a long period of time.

The last paper is the *State-of-Practice of Transportation Demand Management* by Michael D. Meyer, Sarah Siwek, and Wayne Berman. The authors note that TDM programs are being implemented and evaluated at all levels of government, in private industry, and at different points in the transportation planning and program development process. Provisions in the ISTEA provide further incentives to the evaluation of TDM strategies in metropolitan areas.

This paper examines TDM programs in the context of travel markets and identifies some of the market characteristics that may influence the success of different strategies. Alternative TDM strategies are reviewed with respect to both geographic application and trip purpose. The geographic levels discussed include sites, subareas or corridors, and regions. The authors evaluate the TDM strategies used at these levels by trip purpose. They note that TDM programs have been most successful at the

employment site level, with fewer successful applications recorded for programs covering larger geographic areas. Thus, most TDM strategies focus on work trips. The paper also examines the various delivery methods that have been used with TDM measures. Most site specific programs focus on a single employer, while Transportation Management Associations or Organizations (TMAs/TMOs) provide the basis for subarea or corridor programs. At the regional level, metropolitan agencies are often responsible for developing and implementing TDM programs.

The authors note that the most successful TDM strategies have involved a mix of incentives and disincentives. Financial incentives, which reduce the cost of travel, may include direct subsidies and transportation allowances. Indirect incentives could include awarding points for ridesharing which could be redeemed for merchandise or additional vacation time. Parking supply and pricing could be used as incentives or disincentives. It appears difficult to implement parking strategies on a subarea or regional level, however.

The paper discusses the importance of packaging different TDM strategies for a successful program, rather than just focusing on a single strategy. The authors raise a concern with this approach however, in that alternative strategies may be mixed without adequate consideration being given to the desired impact. They note that more analysis needs to be done on what combination of TDM strategies is most appropriate. Too often one TDM strategy after another is implemented without an overarching strategic plan.

The financing problems commonly associated with TDM programs are discussed in the paper. At the regional level, most TDM activities rely on traditional funding sources available through FHWA and FTA, while site specific programs are usually financed by private businesses. They note the need to develop strong public and private constituencies to allow TDM to successfully compete with more traditional projects in the transportation planning and project selection process.

Several barriers to the successful implementation of TDM programs are identified and discussed. These barriers generally fall into the three areas of motivation, empowerment, and perceptions. The authors further identify approaches to address and overcome these barriers. For example, since TDM necessitates change from existing behavior, there must be some motivation to achieve the desired change. This motivation usually takes the form of some benefit that participants hope to gain.

A second factor for success is empowerment—which includes providing the political, organizational, technical, and financial resources necessary for a successful program. Finally, many barriers are the result of misperceptions concerning TDM measures. Communication, understanding, and compromise are key ingredients for overcoming these misperceptions.

A case study of a county-wide TDM program in the Los Angeles area is also summarized. This case study illustrates the use of multiple delivery systems, multiple funding sources, and the packaging of demand management strategies. It also points out the importance of building a political constituency for TDM and the need to use a variety of financing methods. Finally, the case study illustrates the lack of evaluation funds typical of most TDM projects.

The paper concludes with a series of recommendations for additional research. Suggested issues for further study include identifying and assessing TDM packages of alternatives for application at the subarea and corridor level and on a wider regional level. The need for more detailed evaluations of case study examples is also noted. Examining TDM applications for non-work trips, especially in tourist areas, represents another research topic. Other recommendations for further research include examining alternative funding sources, conducting longitudinal studies of trip reduction programs in the air quality non-attainment areas, and further market research to better understand travel behavior.

State-of-the-Practice of Travel Demand Management

Sarah Siwek

Los Angeles County Metropolitan Transportation Authority

Ms. Siwek discussed the resource paper that she co-authored with Michael Meyer and Wayne Berman. In addition to highlighting a few points from the paper, she identified some concerns related to the future of TDM. She noted that these issues reflect her experience in the public sector with planning, implementing, and evaluating TDM measures. She emphasized the paper's recommendations for research and stressed the importance of following through on these. Ms. Siwek discussed the following issues in her presentation.

- Although the ISTEA and Clean Air Act Amendments have elevated TDM into more of a key component of the transportation planning and programming process, TDM still does not appear to be considered a full

partner in this process. For example, in response to financial problems, the Los Angeles County Metropolitan Transportation Authority recently reduced its TDM budget by 7 percent for the next three years, and reduced the TSM, bikeway, and pedestrian-oriented project budget by a similar amount. These cuts are being made at a time when the Los Angeles area is facing major traffic congestion and air quality problems.

- Identifying and assessing packages of TDM alternatives that can be applied at the subarea/corridor and regional levels is critical. Planners and policy makers need to realize that implementing region-wide TDM programs is very different from implementing employer-based, site specific programs. Currently, very little information exists on the experiences with corridor or regional level TDM programs. Case studies highlighting the best practices at the subarea/corridor and regional levels should be developed to help provide needed guidance.
- More examination of alternative institutional configurations for planning and implementing subarea/corridor and regional TDM programs is needed. This research should include analyzing the roles and responsibilities of the different agencies and private sector groups involved in implementing demand management programs.
- Additional research is also needed to assess the effectiveness of TDM applications in non-work travel markets. For example, in the Los Angeles region, only about 32 percent of the 23 million daily trips are work-related, leaving a huge number of trips that receive little attention in the current approach to TDM measures. In addition, TDM applications in tourist areas are becoming more important and need to be examined more closely.
- Additional evaluations of employer-based programs are needed to provide a more comprehensive understanding of the effect of different strategies. Conducting longitudinal studies of the employer trip reduction programs in air quality non-attainment areas would be of benefit to assess the effectiveness of different approaches. Further, longitudinal case studies could be used to ascertain the best techniques for future use.
- Conducting market research and customer focus groups in those TDM travel markets that are not currently well understood is also needed. The results

of this research would add to the existing body of knowledge and would enhance the ability to package TDM programs to better meet the public's needs.

Driving Forces That Have Shaped Travel Demand Management

Tad Widby

Parsons Brinckerhoff Quade & Douglas, Inc.

Mr. Widby provided some additional insight into a few points related to his resource paper on forces shaping TDM. Many of his comments focused on the legislative and regulatory environments influencing TDM. He also discussed the need to consider the use of IVHS and other advanced technologies to help enhance TDM programs. He emphasized the following points in his summary.

- Demand management programs rarely develop spontaneously in the absence of regulations or the existence of some benefit to employers or commuters. If government regulations are the only reason for implementing TDM strategies, however, it is unlikely that programs will be very successful. Rather, too many government regulations may provoke a negative reaction. Although trip reduction ordinances may be required in response to air quality concerns, the long-term survival of TDM programs will depend on demonstrated benefits to the target markets.
- The ISTEA and the 1990 Clean Air Act Amendments have helped institutionalize TDM. Although much of the focus of these two acts is on air quality non-attainment areas, the policies relating to the transportation planning and project selection process relates to all urban areas.
- Although it is true that Americans prefer to drive alone rather than use other modes, repeating this message does a disservice to TDM. Automobiles are popular in part because of the numerous incentives to their use. When alternatives to SOVs are provided with similar incentives, however, a percentage of commuters will switch.
- As a profession TDM practitioners must be more open to dealing with new technologies, finding ways to adapt technologies, and developing and implementing innovative approaches utilizing advanced technologies. Although many people feel that IVHS and other new technologies may lead to an increase in the number of vehicles on the road, they can also be used to make HOV modes more attractive. Examining ways to

make IVHS work to support TDM should be a top priority. A number of opportunities exist to apply new technologies with TDM. These include providing information to commuters about available choices, current traffic conditions, and the status of buses.

Demographics and Market Definition

Brad Edmondson

American Demographics

Mr. Edmondson discussed his resource paper on defining markets for TDM programs and the effect of recent demographic changes on travel demand. He noted that TDM can benefit from greater use of market-driven programs. He also discussed the rich data sources that are available in many areas that could be used to focus TDM programs on market-based needs. He emphasized the following points in his presentation.

- TDM professionals should think of themselves as marketing transportation services, rather than promoting a single approach. In order to compete with the private automobile, TDM practitioners must identify and focus on specific market niches best suited to these techniques. At the same time, the weaknesses of the automobile and concerns related to its use must be exploited. TDM practitioners should identify ways in which people are dissatisfied with driving and then stress the benefits offered by alternative modes. Businesses are shifting away from being product-driven and toward being market-driven, and TDM professionals should take note of this change. It is more effective to ascertain what consumers want, through a variety of consumer information systems, and then provide products and services that meet those needs.
- The relatively unpopular option of changing personal driving habits is beginning to attract attention among those who have already adopted other environmentally friendly behaviors such as recycling, joining environmental groups, and “green-friendly” voting. The gap between knowing something is the right thing to do, and actually doing the right thing, follows a predictable sequence. First, there is rising public awareness that something is the right course of action. This is followed by rising public dissatisfaction with the behavior that is perceived as the wrong course of action. Finally, behavior slowly begins to conform to the correct course of action. Examples of cases that have followed this process include the civil rights and environmental movements.
- Two recent polls illustrate the public’s increasing awareness of the various costs associated with automobiles and the validity of demand management options. The first poll is an ongoing survey of what people consider to be necessities of life. The general pattern in a consumer society is that things that were once considered luxuries begin to be perceived as necessities. Since the recession in 1990, the proportion of people who say that a car, in particular a second car, is a necessity is decreasing. People are starting to realize that a second car is becoming more expensive and that there are other alternatives available. The second poll asked 500 people how they felt about mandatory carpooling programs. Approximately 58 percent of respondents indicated that they favored such programs. Thus, it appears that the public is recognizing in the abstract that TDM strategies are a good idea and is ready to accept them if they are presented in a way that meets the public’s needs.
- There is a great deal of market information available through private data vending companies on demographics, attitudes and lifestyles, purchase behavior, and media behavior. The Census and the National Personal Transportation Survey represent only a fraction of the information available. This information should be used to a greater extent in developing, implementing, and evaluating TDM programs.
- While the private automobile is the most heavily subsidized form of transportation, this fact is not widely known. The TDM community should take the opportunity to promote carpooling and mass transit based on cost savings. Thus, TDM marketing should stress the financial benefits to the individual of ridesharing, rather than the societal costs of subsidizing private automobiles. It is sometimes easier to achieve societal goals by appealing to the individual’s self-interest than by stressing the common good.
- Public agencies that sponsor TDM programs can overcome the significant public mistrust of the government by informing the public that the problems—air quality, environmental degradation, traffic congestion, and mobility issues—are the responsibility of all citizens. This should be followed with the agency providing ways for the public to solve these problems.

Current Practices, Implementation Issues, and Integrating Travel Demand Management Strategies

Sarah Siwek

Los Angeles County Metropolitan Transportation Authority



It is a pleasure to have the opportunity to summarize the three resource papers: *TDM Evaluation: Current Practice and Emerging Issues* by Eric N. Schreffler; *Implementation Issues and Barriers* by Katherine L. Gerwig; and *Integrating Transportation Demand Management Strategies* by Michael Replogle and Hank Dittmar. These three papers, on evaluating, implementing, and integrating TDM, relate well with each other. In discussing the three papers, I would like to note their common themes, as well as the ties to major elements of the Intermodal Surface Transportation Efficiency Act (ISTEA). I would further like to present some ideas for your consideration over the next day and a half.

Eric Schreffler's paper on evaluation and current TDM practices discusses a wide range of issues. The major focus is on what is being evaluated, how is it being evaluated, and who is conducting the evaluation. It also examines future improvements in the evaluation process and identifies specific ideas for further research. Kathy Gerwig's paper on implementation issues addresses the roles, responsibilities, and interactions among the different groups developing TDM programs. It examines the future of TDM related to these issues and discusses whether the concept of trip reduction through employers yields the results that have been estimated and hoped for. The paper by Mike Replogle and Hank Dittmar on the integration of TDM provides a broad view of TDM in the transportation planning and investment process. They discuss the need to consider TDM early in the planning process, rather than after the fact as a mitigation strategy. The paper examines the need for comprehensive evaluative tools and addresses the trade-offs and cost-benefits of various transportation investments, including TDM, pricing, and

other strategies. Finally, the paper presents ideas for consideration by federal, state, and local agencies related to advancing TDM.

The paper by Eric Schreffler on TDM evaluation practices begins by noting that the ISTEA and the 1990 Clean Air Act Amendments require a thorough understanding of the impacts and effectiveness of different TDM strategies. Although TDM has been around for at least 20 years, little solid empirical evidence exists on the effectiveness of many strategies. This may cause some problems for advancing the state-of-the-practice, as TDM may be perceived as a soft set of strategies lacking hard evidence on their impacts. Schreffler stresses the need to conduct rigorous evaluations of proposed strategies through systematic and on-going programs.

The paper discusses the distinctions between monitoring TDM programs for effectiveness and compliance purposes and evaluating TDM projects for research needs. Monitoring tends to be compliance-oriented, focusing on self-reporting by project sponsors or employers who are trying to comply with a regulatory program. Thus, monitoring looks at what has happened. Research and evaluation of the cost-effectiveness of TDM strategies examines not only what happened, but why it happened, and the costs associated with making it happen. Research needs are further complicated by requirements for extensive data, evaluation tools, longitudinal studies, and on-going monitoring. Schreffler stresses that research is essential for multimodal and intermodal planning to support the systems approach to transportation planning, including examining trade-offs between alternative investments.

The paper examines the various groups currently involved in evaluating TDM programs. These include regulators, implementors, researchers, and professional organizations. Each of these groups have different perspectives and needs. The regulators are interested primarily in compliance. The implementors—who include the private sector, transportation management associations (TMAs), and other groups funding the different programs—are interested in the cost-effectiveness of the various TDM strategies. Researchers want to examine the full range of issues associated with planning and implementing different strategies and analyzing the results.

Although the private sector wants and needs information on effectiveness, they do not always have the means to collect and analyze evaluative information. This may result in the private sector wanting information which the public sector has, but is unable to provide. It is

difficult for decision-makers to allocate funding for transportation control measures (TCMs) and TDM strategies without good information on the effectiveness of different techniques.

Schreffler identifies balancing research needs with regulatory reporting as a key issue. Integrating rigorous methods with experience-based instincts is one way of accomplishing this. He suggests that TDM professionals need quantitative measures rather than just anecdotal information. The management systems requirements of the ISTEA also support the need for more rigorous evaluation measures. TDM professionals need to identify the kind of data necessary for comprehensive evaluations and the costs associated with rigorous evaluations.

Schreffler suggests that future evaluation measures should focus on vehicle trip, net trip, and vehicle miles of travel (VMT) reductions. Identifying the most appropriate evaluation measures to use with different TDM strategies will be important. For example, Los Angeles is currently examining how to estimate the impacts of strategies such as park-and-ride lots, which require people to drive their cars in order to connect with transit. Determining techniques to accurately measure the emission reduction potential of these programs and projects is difficult. Schreffler suggests that the issue of cost-per-trip-reduced needs to be considered, examining all costs and benefits related to both the demand management strategies and the other modal investments that may be under consideration.

The paper examines various shortcomings in the current modeling process. These will need to be addressed to meet many of the ISTEA requirements. Schreffler suggests that major improvements are needed in the current modeling capabilities, particularly related to modeling demand management strategies. The ability of present regional models to do this appears to be very limited.

Schreffler also emphasizes the need for improving the dissemination of information on TDM programs. In the two years since the passage of the ISTEA, a good deal of time and money has been spent examining the issues of multimodal planning, performance measure development, and demand management programs. Better methods and mechanisms are needed to help ensure the timely dissemination of this and other information to all groups interested in TDM.

Schreffler notes that evaluations are often viewed as a threat or punishment by TDM implementors. Rather than looking at evaluations in a negative light, implementors

should be strongly supporting and encouraging good evaluations. It will be difficult, if not impossible, to integrate TDM into the mainstream of transportation planning and decision-making unless an objective examination is made of the effectiveness of programs and strategies. When compared with other modes on a level playing field, demand management strategies appear to be cost-effective alternatives.

In closing, Schreffler cites three priorities for evaluating TDM programs. The first relates to integrating data needs. Factors he suggests for consideration include the use of employee surveys to derive evaluation data, improving other data collection instruments, and balancing the types of data provided by implementors with their usefulness for evaluative purposes. The second priority focuses on tailoring the results of evaluative exercises to the user's needs. The last priority is a more detailed examination of TDM cost-effectiveness and how trade-offs are made between competing projects.

Kathy Gerwig has been responsible for implementing TDM programs with private sector groups over the years. Thus, she provides an excellent perspective in her paper on implementation issues and barriers on the needs and problems associated with TDM in the private sector. It is important for those of us working in the public sector to understand this perspective so that we can better target TDM programs and policies. This paper examines the use of employer-based work trip reduction programs which have been a major focus of TDM strategies to date. It also outlines the need to look seriously and aggressively at non-work trips, which comprise a majority of trips today.

The paper addresses a variety of issues associated with funding demand management programs. Gerwig suggests that the private sector is currently being asked to pay for TDM programs. The public sector, which is requiring these programs, is often not providing adequate information on the cost-effectiveness of different strategies to help the private sector develop and implement effective programs. She also identifies some of the benefits realized by the private sector from TDM strategies. These include enhancing customer accessibility to businesses, reducing unproductive time workers spend in traffic congestion, and the potential for reducing the costs of building and maintaining parking facilities. In order to realize many of these benefits, however, TDM strategies need to be large-scale, region-wide programs.

The paper further discusses the need to balance economic growth and environmental objectives. Gerwig

discusses some of the labor union issues that may influence the ability of private businesses to implement TDM programs and suggests ways to address these. She also discusses market-based TDM approaches, including parking pricing. Gerwig stresses the need to ensure that adequate alternatives to single-occupant vehicle travel are provided to participants. These must be attractive and viable options. She notes the potential for public policy conflicts when different levels of governments mandate different programs. One example of this is the congestion management program mandates in California and the Congestion Management System requirements contained in the ISTEA. The paper suggests that conflicting programs should be examined and eliminated and duplication of efforts should be addressed.

Gerwig also discusses the importance of education in TDM. Gerwig notes that TDM implementors, particularly those involved with employer-based programs, can be used to help educate society on travel choices and travel behavior options. Thus, one of the benefits of employer-based programs relates to their educational value. Employer-based programs also help broaden the transportation planning process, which is one of the objectives of the ISTEA. Opening the process up to public interest groups, the public, environmental groups, and others will help carry out some of the mandates of the ISTEA.

Finally, Gerwig suggests that more interaction is needed between decision makers, technical staff members, and private sector implementors. Establishing stronger partnerships and working relationships among these groups would further benefit TDM and would support the objectives of the ISTEA. Individuals in the private sector responsible for implementing TDM programs have much to share with their public sector counterparts. Thus, she notes that all groups would benefit from greater interaction and sharing of information.

The paper by Mike Replogle and Hank Dittmar addresses integrating TDM into the ongoing transportation planning process. The paper points out that transportation systems management (TSM) and TDM strategies have traditionally had a short-term focus, which may result in overlooking long-term opportunities to shape travel demand. The authors suggest that TDM should be part of the on-going focus of the Congestion Management Systems required in the ISTEA. Further, they indicate the potential of TDM to help boost the productivity of transportation investments and to strengthen the economic performance of the country. The paper discusses the need to integrate TDM into all aspects of transportation and

community planning. Rather than being considered as an after-the-fact mitigation strategy, TDM should be included in the initial stages of the planning process.

As pointed out in other papers, the authors identify the need for better resources, better tools, and better data to support the implementation and evaluation of TDM. They note that the ISTEA provides some of the resources necessary to accomplish this and allows greater flexibility in the use of funds. Further, they note that additional data is available in many areas that could be used to improve the transportation planning process.

Replogle and Dittmar suggest that TDM must encompass a broad range of strategies and must focus on all types of trips. Currently, most TDM programs address only work trips. They suggest that non-work trips, short trips, urban design issues, land use issues, and new technologies all need to be considered in the development of TDM measures. All of these issues should be addressed in the strategic agenda from this symposium.

The paper identifies a number of lessons that can be learned from past activities. Many of these relate to the experience with different programs during the 1970s. For example, the authors suggest that the California Congestion Management Program and the use of performance measures based on level-of-service standards promotes new road capacity and ignores system performance. This may be counter to the ISTEA objectives focusing on systems analysis and systems performance measures. They also summarize the experience with different aspects of the on-going Montgomery County, Maryland program.

Replogle and Dittmar suggest that the ISTEA provides an opportunity—through the Congestion Management Program—to evaluate system performance, to examine investment options using a fully allocated cost benefit analysis structure, to consider secondary impacts of alternatives, and to analyze induced and latent demand. To accomplish this however, much more work will be needed in the development of analytical tools and procedures to level the playing field for consideration of the different transportation strategies and investments. Institutional barriers, including the need for education and training within the transportation profession, are also discussed. Further, the authors note the failure to consider land use, urban design, and pricing policies in the transportation planning process.

The paper discusses the importance of understanding the context in which demand management strategies are implemented and the influence of external factors on the results. The authors point out that the existing environmental conditions are critical. For example, the options made available to commuters in employer-based programs are important to the success of a program. Transit, carpooling, pedestrian access, and other factors will all impact the effectiveness of a program. The paper suggests that more information is needed to help employers in various parts of the country respond to requirements to implement Employee Commute Options (ECO) programs.

Replogle and Dittmar discuss the need to take a comprehensive view of TDM and to understand the limits of the traditional focus on employer-based peak-period work trips. They also suggest that a long term view is needed to integrate TDM strategies into the overall transportation planning process. Issues related to cultural change and overcoming entrenched interests will need to be addressed in this effort. I would like to suggest another issue that needs to be considered; the "pipeline problem." In most regions, there is a long list of pipeline of approved highway and roadway projects ready to be built and transit projects ready to be constructed. Very few demand management and TSM type projects are currently in the project selection and project programming pipeline. If TDM is to be a major part of the process, it is critical that projects get into the pipeline.

The authors suggest agendas for federal, state, and local governments, MPOs, and transit agencies to help advance TDM. Action items discussed include the release of conformity rules, the parking cash-out option and changes to the IRS code, and IVHS. I think that TDM professionals need to find ways to emphasize the demand management attributes of IVHS and make sure that IVHS investments are not counterproductive to the objectives of encouraging a greater mode shift from single-occupant vehicles to HOVs. The paper further suggests that more champions for TDM are also needed at all levels, as well as greater coordination and cooperation among agencies at the federal, state, and local levels.

State initiatives suggested by Replogle and Dittmar include pay-as-you-drive insurance, HOV take-a-lane proposals using smart card technologies, and priority for TCM implementation. They also recommend that Congestion Management Systems incorporate growth management strategies. Finally, at the MPO level they suggest a need for improved modeling and monitoring capabilities, enhanced plans and approaches, education

programs for the public, and the evaluation of alternative growth and development scenarios as part of the on-going transportation planning process.

In closing, I think each of these three papers provides a great deal of information that should be of help to you over the next two days and should be of use to all groups interested in TDM. Further, I think we have a great opportunity to help set the course for the future of TDM at this symposium. The vision of the ISTEA and the flexible funding it offers provides a great avenue to implement a wide range of innovative programs that are responsive to the needs of each individual area.

TDM Evaluation: Current Practice and Emerging Issues

Richard Kuzmyak
Comsis Corporation, Inc.

Mr. Kuzmyak elaborated on a few points in the resource paper written by Eric Schreffler, also from Comsis Corporation, Inc. Most of his comments focused on the importance of conducting good evaluations to help advance both the practice of TDM and research needs. He noted that the paper contends that it will be difficult to move TDM forward into practical planning and decision-making without better data on the cost and effectiveness of different TDM strategies. Mr. Kuzmyak made the following points related to the issues surrounding data collection and the evaluation of TDM programs.

- Although major advances have been made in developing tools for forecasting the impacts of alternative TDM strategies, there is still much that needs to be done to improve these techniques. A few good examples of historical databases on the impacts of TDM strategies exist, but program monitoring and evaluation have generally not been priorities for the TDM community. Many evaluations still focus on relatively simplistic approaches that may not examine the full impacts and influence of the programs. Further, many TDM programs focus on the more traditional strategies such as transit and ridesharing. Less consideration has been given to developing evaluation capabilities for congestion pricing, land use planning techniques, and telecommuting and compressed work weeks.
- Even with the more traditional employer-based TDM programs, it is still difficult to ascertain with a high degree of confidence the impacts particular incentives will have in different situations. Despite the empirical

work that has been done, it is often difficult to estimate the potential impacts of TDM strategies in different settings. Currently, information on TDM program effectiveness is highly aggregated. Further, since many evaluations are based on self-reported data, concerns may arise over the validity of the information. There is often little uniformity among data available from different projects. This variability makes comparisons among projects difficult, if not impossible. Thus, many evaluations are based on limited information. As a result of these limitations, it is usually more appropriate to discuss a range of potential impacts rather than trying to focus on a specific estimate of performance.

- Comsis Corporation has completed a number of studies recently for the California Air Resources Board that may set the stage for future TDM data collection and evaluation programs. These studies included the collection of data from a number of firms in the Southern California and Sacramento areas that have implemented TDM strategies. This information was used to model the anticipated behavior and impacts of different TDM programs.
- The symposium should help identify ways to improve current TDM evaluation efforts. Greater emphasis should be placed on conducting good evaluations. Given the current interest in TDM, now is an appropriate time for TDM professionals, decision makers, and researchers to work together to advance the state-of-the-practice of TDM evaluation.

Implementation Issues and Barriers

Katherine L. Gerwig
Kaiser Permanente

Ms. Gerwig highlighted a few additional points on the role employers play in implementing TDM strategies. Despite the fact that employers have become more sophisticated partners in TDM, many are still not integrated into the design and planning process for TDM programs. California's parking cash-out program provides an example of how employers, who were required to implement the program, were not adequately involved in the design and implementation of the law. Partly as a result, parking cash-out has been very difficult for many employers to implement. Ms. Gerwig highlighted the following points relating to the California parking cash-out program in her presentation.

- The California parking cash-out law became effective prior to any guidelines or any administrative structure being put in place. Thus, when the law became effective, many companies were immediately not in compliance. This was very disconcerting for many employers who had been actively participating in TDM programs and considered themselves good TDM partners.
- There appeared to be little sensitivity in the law regarding what it takes to change parking policies within an organization. Problems faced by companies trying to implement the law included how to inventory thousands of parking spaces, calculating the number of employees who were affected, and developing revised parking policies. Employers also had to set up new systems to deal with the tax consequences of different parking cash-out options. In addition, it appears that there are many cases where parking cash-out can increase costs for employers. For example, employers who have not supplied enough parking to meet the demands of all employees could suddenly find everyone on their waiting list eligible for parking cash-out. In theory, employers could be offering cash-out to many more people than they were providing parking subsidies for. Another potential problem relates to employees parking on neighborhood streets, rather than paying to park at their employment site. Under the California law the employer is responsible for policing employee behavior to make sure this does not happen.
- Consideration should be given to further encouraging partnerships between the public sector and employers affected by TDM programs. For example, based on the California experience with the parking cash-out program, all sides would benefit from providing adequate time to develop well thought-out implementation programs. This would allow time to plan for successful implementation approaches. It would also help employers if the guidelines for compliance were developed and published as soon as the law goes into effect, rather than just setting arbitrary dates to start programs. This provides those responsible for implementing the programs with the knowledge and tools to do so. Finally, it is important for all groups to communicate the positive aspects of the TDM strategy to be implemented and to monitor and evaluate the results.

Integrating Transportation Demand Management Strategies

Michael Replogle

Environmental Defense Fund Transportation Project

Mr. Replogle discussed the paper he co-authored with Hank Dittmar on integrating TDM into the general transportation planning and project selection process. His comments focused on integrating supply and demand management and enhanced planning into the overall transportation system by infusing TDM into the transportation project development and selection process.

Mr. Replogle addressed the following points.

- A recent General Accounting Office (GAO) study examined the attitudes of metropolitan planning organization (MPO) staff members toward demand management strategies. This study found that while more TDM programs are being implemented, many people have relatively low expectations of the impacts of TDM strategies. In addition, the study indicated that many of the programs incorporate only a very narrow spectrum of the potential TDM strategies that are available to address travel demand.
- Most TDM programs focus on work trips. Given the impact of non-work trips on total vehicle miles of travel, it appears appropriate to begin looking at how demand management strategies can be applied to all trips, focusing on accessibility, not just mobility. Further, the idea of proximity planning for both transportation and land use should be considered. The hidden subsidies for the automobile, which have a strong influence on people's commute mode decisions, need to be adequately addressed.
- To improve or reinvent transportation analysis and planning systems, it is necessary to re-think the data collection and the monitoring processes and the use of simulation models. Improving these tools and techniques to incorporate the linkages between land use and transportation, the hidden cost of the automobile, and other factors will be important. Most of the models and other techniques currently in use throughout the country are largely relics from the 1960s and 1970s. Few improvements have been made in many of these models. Currently, the opportunity exists to greatly improve and revolutionize data collection and analysis techniques for travel and land use.
- The Los Alamos National Lab has just demonstrated a prototype system for simulating travel behavior and real-time simulation of individual cars driving on the entire street network in Albuquerque, New Mexico. The system utilizes supercomputer technology that should be widely available in three to five years. This project provides the opportunity to capture the chaotic, self-organizing properties of traffic congestion, to examine unmet latent travel demand, and to evaluate alternatives for adjusting travel behavior. It is important to continue to develop modeling and evaluation techniques such as this and to push the state-of-the-art forward in TDM.
- The rapid advances in communication technology will also influence travel behavior and these factors should be included in the travel demand modeling process. This should include both the potential for information and communication technology to substitute for travel and the use of improved information and communication technologies for data acquisition and monitoring.
- The use of advanced technologies also provides the opportunity to consider and implement a wide range of transportation pricing strategies. For example, electronic smart cards could be used for congestion pricing or other road uses. Pricing strategies must be creative, however, since the public is not generally receptive to new taxes. Opportunities exist to restructure current subsidies and public investments in ways that will reward people for driving less or using high-occupancy commute modes. Initial programs could address strategies such as cashing out parking subsidies and pay-as-you-go auto insurance. Longer term strategies could focus on cashing out the public investment in the roadway system and the transportation infrastructure.
- There is also a need to creatively examine land use strategies and their link to travel demand management. Often these issues are dismissed because of their long-term focus. There are a number of approaches that link with demand management in both short-term and long-term applications. For example, coordinating land use and zoning to allow empty nesters to cash out their large housing investments through the creation of accessory apartments may provide one approach for encouraging market forces to create affordable housing in areas that have lost population through demographic changes. Developing effective and coordinated public policies related to land use, housing, and transportation is important to ensure adequate housing near jobs, to reduce vehicle miles of travel and vehicle trips per capita, and to address environmental

concerns. This should be a fundamental goal of transportation, land use, housing, and economic development policy and planning at all levels of government.

Proposed Federal Legislation on "Cash Out" Parking Policy

Jonathan Kessler

Environmental Protection Agency

I appreciate the opportunity to present a brief summary of the recently proposed federal legislation on the "cash-out" parking policy. This proposal was part of the Climate Change Action Plan which was announced by President Clinton on October 19, 1993. The parking cash-out policy was included in this action plan for a number of reasons. First, although environmental issues were a main consideration, parking cash-out was also felt to be good public policy. Second, as you are all aware, parking management is one of the most effective TDM measures. Third, it was felt that this approach had a reasonable chance of getting through the Congress. Thus, there was relative agreement from governmental, private sector, and public analysts that the cash-out parking policy addresses important environmental issues, represents an effective TDM strategy, and is good public policy.

The cash-out parking policy addresses an odd quirk in the federal tax code that essentially makes it "tax smart" for employers to provide free parking and makes it "tax stupid" for employers to provide other travel-related benefits. The IRS has calculated the tax impacts of an employer subsidizing employee parking, transit passes, or an extra \$100 in salary. Under the current law, there is a huge tax advantage to subsidizing only parking. This certainly acts against many TDM and environmental programs focused on encouraging greater use of high-occupancy commute modes. One of the major obstacles at the federal level has been to make people aware of this part of the tax code and its implications.

The goals of the cash-out parking policy are relatively simple. First, the approach focuses on a tax neutral program. Rather than raising taxes, the policy is designed to maintain the tax advantages of providing free parking to employees, but to also provide the same tax benefits for providing transit passes, or allowing employees to cash-out their subsidized parking fees. The program also attempts to increase the choices available to commuters, without raising taxes or increasing direct costs to businesses.

I think the current proposal succeeds in making the tax code work for the environment, for commuters, and for employers. Thus, it benefits multiple groups. The proposal maintains the current benefits of employer provided parking. That is free or reduced price parking will continue to be tax-deductible to employees and tax-exempt to employers. However, in certain cases this status is available only if the employer provides a choice of travel benefit options to employees. The other options, or a commuter allowance, must be equal to the cost or the fair market value of providing the parking benefit. A cash allowance or tax-free transit pass equal to the cost of parking could be some of the options offered.

The proposal focuses on firms with 25 or more employees. Since the proposal should not result in significant costs to businesses, there did not appear to be any rationale for exempting small business. However, any business which wanted to participate in the cash-out program could do so without a tax penalty. This represents a major change from the current law. It is expected that the policy will be used primarily in urban areas where air quality and environmental issues are major concerns.

The proposal applies to parking located in controlled lots. This is parking offered to employees that is not located in a lot used primarily by customers, such as a shopping mall parking lot. Finally, the proposal applies only to parking that is leased by the employer from a third party, where the lease gives an option for the employer to reduce the amount of parking spaces without penalty. That is, as the lease turns over, the employer has the discretion to reduce parking expenditures in response to employees taking advantage of the cash-out option. The notion behind this is that we do not want any employer to be in the position of being double charged—paying both for parking and paying people not to use it. Since it is difficult for employers to reduce expenditures on owned parking, in our proposal as in the California law, employer-owned parking is exempt.

Experience from the few areas implementing this approach seems to indicate that the cash-out option works. Although much research is needed on this topic, data provided by the California Air Resources Board suggests that on average about 20 percent of eligible employees trade their parking spaces for other options when parking cash-out programs are offered. It is important to point out that a large percentage of these commuters appear to switch to carpooling.

The most important part of the cash-out proposal means that commuters will have more choices and options available. Currently, some 90 percent of Americans who drive to work receive free parking as their only transportation benefit choice. The cash-out policy would provide a multitude of choice for commuters, including free parking, a commuter cash allowance, a transit pass, or other alternatives.

Preliminary analysis indicates that approximately 10 percent to 15 percent of those offered the cash-out option would accept it. This estimate increases over time due to a number of factors. By the year 2000, it is forecast that between four to five million commuters would be taking advantage of the parking cash-out program.

The proposal would further have a significant impact on the Environmental Protection Agency's (EPA) Employee Commute Options (ECO) or employee trip reduction program and would help support other TDM programs. Studies indicate that parking subsidy reform is one of the most important determinants influencing the effectiveness of ECO and trip reduction programs. The cash-out policy will make ECO a more cost effective programs, as it makes the job of getting people out of their cars much easier for employers.

The exact approach for implementing the proposal has not yet been determined. Once there is a better indication of the direction Congress may take, the EPA will begin to focus on the implementation aspects of the program. This would be done cooperatively, working with states, local governments, and employers. It would also have to be coordinated with existing programs related to the Clean Air Act Amendments and state and regional programs.

Consideration has been given to the fact that the proposal may result in the need to provide new or additional transit services to accommodate increased ridership levels. These service enhancements would require additional funding. At this point, no specific recommendation has been included in the proposal on possible sources for these increased funds. One option might be to use some of the tax revenues that should be generated by the program. This is certainly an issue that will need to be examined in more detail with the help of the transit community. It is expected that most commuters who opt to cash out would choose to carpool however. Ridesharing could be further encouraged by providing preferential parking for carpools and vanpools.

Based on data from California and very limited data from other sources, the EPA has estimated that roughly 45 percent to 50 percent of parking provided by employers at controlled lots is leased. Of that amount, about 15 percent is leased in such a way that the employer can reduce the amount of parking provided without penalty. This parking would be subject to the proposed cash-out legislation.

In closing, the cash-out proposal is good for commuters, employers, and the environment. It takes a current benefit—subsidized parking—and expands it to cover other commute options. Thus, it greatly encourages commuters to use high-occupancy commute modes rather than driving alone. At the same time, it does not penalize employees or employers who continue to select subsidized parking. Support from all groups—the business community, environmental organizations, and TDM proponents—will be needed to advance this proposal. The EPA is interested in working with all these groups to help ensure passage of the proposal.

KEYNOTE SPEECHES

Jane F. Garvey
Deputy Administrator
Federal Highway Administration



I am delighted to have the opportunity to participate in the TRB National *TDM Innovation and Research Symposium: Setting a Strategic Agenda for the Future*. The symposium will help develop ideas, options, and recommendations to advance the state-of-the-practice in TDM into the next century. The results of this symposium will also serve to identify the future roles and markets for TDM. This is especially critical to help ensure that future transportation investment decisions will enhance mobility, relieve congestion, and improve air quality.

It is clear to me from listening to the comments and discussion in the sessions this morning that there has been a shift in how we define and discuss transportation issues. There is a growing recognition that our financial and natural resources are limited. There is also a growing realization that the traditional approaches are not necessarily appropriate for the future. For example, it is evident that the era of building the Interstate System is over and we must look to other means to address our problems. Certainly the greatest challenge will be to better manage the transportation system to provide for the efficient and effective movement of both people and goods.

I believe that TDM strategies are an important component in managing the transportation system and that these measures will continue to play a critical role in the future. My work at the Massachusetts Department of Public Works has given me an appreciation for the role TDM plays in helping to provide mobility choices and

reduce traffic congestion through the use of high-occupancy vehicles.

TDM will be an even more important element of our transportation policy in the future as a result of the federal, state, and local efforts to clean the air, reduce energy use, relieve traffic congestion, and improve mobility. FHWA views the products of this symposium as significant in helping to define the shape and position of TDM to further address these mandates.

The results of this symposium will also provide a significant boost to the future prospects for TDM within both the public and private sectors. For the TRB, the results will identify research needs to help advance the state-of-the-practice. For FHWA and FTA, the results will help to guide the development of policy, research, and demonstration initiatives to foster TDM and the use of high-occupancy vehicles. There is clear support for the future of TDM within the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and the results of this symposium will assist in advancing these measures.

For state and local agencies, the results of this symposium will help identify key institutional, organizational, and policy issues for TDM to be an effective, credible, and integrated function in the transportation planning and decision-making process. This conference is especially timely because state and local agencies are in need of guidance to address the new transportation planning requirements of the ISTEA and the trip reduction requirements of the Clean Air Act Amendments of 1990. For example, the congestion management system required by ISTEA recognizes the role of TDM in congestion relief. This symposium should also help provide direction to state and local efforts to enhance mobility choices for the economically disadvantaged, especially those living in inner city areas.

This symposium marks the first time that transportation professionals have had the opportunity to focus on the future of TDM. As such, it will help respond to questions being raised by representatives from the transportation and environmental community at all levels of government, and in the private sector, on the future of TDM. These questions include the role of TDM, the effectiveness of different strategies, regulatory-based measures vs. market-based measures, the use of different pricing techniques, and the responsibilities of the public and private sectors. Discussing these and other

issues in your working groups will help provide the best choices for decision-makers, and ultimately the public.

Since I will not be able to participate in your working group sessions, I would like to offer a few thoughts for your consideration. First, we need to rethink what TDM is and what it can be. TDM should be viewed as more than just a regional ridematching service or a promotional campaign. While these activities are part of TDM, they are certainly not what will sustain it in the future. We know that TDM can have localized impacts and benefits. While the areawide and environmental benefits of TDM are being studied and debated, we should not lose sight of the significant impacts TDM can have on meeting our mobility needs. We need to think of TDM in terms of mobility and what that means to the public, especially those in economically disadvantaged situations. TDM could be thought of as providing transportation choices as well as tools that help us meet congestion and environmental goals.

TDM can be market-based as in parking or congestion pricing. It can also be regulatory-based as in state or local trip reduction laws. It can be voluntary as in employer benefit programs and it can also be mandated through legislation. Further, many TDM programs represent mixes of all these approaches.

TDM measures are often focused on localized programs. Given the proper settings, however, TDM can also have corridor or areawide applications. TDM can be as simple as a vanpool program or it can incorporate more complex telecommunication and other IVHS technologies. The future of TDM is only limited by our imagination.

As you think about what TDM can be, I suggest that as part of your discussions you also try to develop and reach a consensus on a meaningful definition or vision statement. Such a definition or vision would be a valuable product that can directly contribute to future efforts in and support for TDM.

We also need to rethink where the TDM planning, implementation, and evaluation functions are placed within our transportation and environmental institutions. This is perhaps one of the biggest issues that you may want to discuss in your working groups. In many public organizations, TDM is not incorporated into the mainstream traffic management and operational functions. In many cases, TDM responsibilities are located in a separate ridesharing agency or in the marketing or planning section of a metropolitan planning organization. As a result, TDM is not readily thought of or generally

made part of traffic or congestion management programs. If we are serious about making TDM a credible and integrated part of our transportation system, we need to tie it closer to the mainstream activities.

At an employment site, TDM is often a secondary responsibility for a person that may not have a strong interest or sensitivity for what is needed. As a result, TDM may be considered only as an afterthought or viewed simply as a ridematching service or a promotional activity designed to barely meet some policy or requirement. Although this may be fine to get TDM programs off the ground, especially during periods like the energy crisis, it is not a situation that will lead to effective TDM measures. Such an organizational placement will not lead to attaining significant changes in mode share or sustaining the long term development of TDM as a credible activity in the future.

Changing employer attitudes and obtaining greater acceptance of TDM is a difficult undertaking. This change is critical however, especially if we are to meet the challenges of the Clean Air Act Amendments and the ISTEA. I do not have any easy answers to this problem. I think strong outreach and technical assistance efforts, along with the establishment of public-private partnerships, can play an important part in this effort, however.

I think that we also need to promote and foster public-private partnerships to implement TDM programs. Several successful and effective Transportation Management Associations (TMAs) around the country provide good models for these partnerships. Successful programs are more than just arrangements to promote ridesharing. The better TMAs are developers and providers of a wide range of TDM services. The application of new technologies will also provide important opportunities to further establish such partnerships. As telecommunications and other advanced technologies become more of a reality, there will be greater opportunities for linkages with transportation-oriented IVHS technologies. Public-private partnerships can be built to provide traveler information to offices and homes to allow people to make better decisions about the transportation services and facilities they use.

Another potential aspect of public-private partnerships can be illustrated through the use of high occupancy vehicle (HOV) lanes. The public sector does a good job at building these lanes, but encouraging people to use them requires support from the private sector. This

coordinated approach can help address the “Empty Lane Syndrome” that is a problem on some facilities.

We need to think of the operation of an HOV lane as not just a public responsibility. In some areas, the HOV lanes alone may not be enough of an incentive for people to switch to carpools, vanpools, or buses. This is true especially if employers offer free parking or are inflexible about employee work hours. Other TDM incentives and programs, offered in the public and private sectors, must be incorporated into the planning for and operation of HOV lanes to ensure their effectiveness. Public-private partnerships can help to develop the markets and incentives to use these facilities. In order to create the market and demand for carpools, vanpools, and buses we need to think of an HOV lane as more of a public-private partnership.

In conclusion, I would like to thank the Transportation Research Board, along with the Symposium Planning Committee, for organizing and arranging this important symposium. I challenge you to use your imagination and to think creatively about where we need to go with TDM from a variety of perspectives. Be innovative and creative in your thinking and do not let your discussions be limited by current thinking or traditional attitudes. It is important to remember that laws, policies, regulations, and technologies can be changed and improved. With time, support, and research, attitudes and perceptions can also be changed. This symposium provides the opportunity to meet these challenges.

Thank you for the opportunity to let me speak to you and to share my thoughts. I look forward to seeing the results of the symposium.

Grace Crunican
Deputy Administrator
Federal Transit Administration



It is a pleasure to have the opportunity to speak to you today. I would like to share with you some observations on the federal role in travel demand management (TDM) for your consideration in developing a strategic agenda for TDM. The Federal Transit Administration (FTA) has been actively involved for many years in numerous areas related to TDM. As I travel around the country, however, I find that many areas are taking creative and innovative approaches to TDM, congestion management, and other issues. Thus, I would suggest that a strategic agenda for TDM consider the needs of federal agencies and organizations—such as FTA, FHWA, and TRB—as well as those of state and local governments, regional agencies, and private sector businesses and groups.

Much of the interest in TDM is being driven by issues related to the environment, traffic congestion, and mobility. Even with these concerns, however, some of the requirements of the 1990 Clean Air Act Amendments may be ahead of the public’s recognition of the problem. It is important to recognize this and to develop and implement TDM strategies that provide realistic alternatives for commuters. Thus, TDM should focus on measures that can contribute to improving mobility and the quality of life in metropolitan areas, rather than just addressing specific regulations.

I think that the Clean Air Act Amendments have been beneficial in helping to focus public attention on some very important issues. The Act represents just the first step, however. The difficult and challenging part will now be to implement the requirements of the Act and other related federal, state, and local legislation. The work you are pursuing at this symposium will help in addressing this challenge. All groups—including federal, state, and local governments, private businesses, and the environmental community—will need to work cooperatively to meet the goals of the Clean Air Act Amendments.

Addressing these issues will be difficult because it will require individuals to change their behavior. We know this is not an easy task, especially when it means a change from driving alone. The experience with other major social changes—such as recycling, the civil rights movement, and anti-smoking campaigns—show that behavior can be changed, however. These areas have little in common, except that major changes have occurred in people’s behavior related to each over the last twenty years. TDM is currently going through similar changes. These will not happen overnight, but in the next twenty years I think you will see significant changes in commuting behavior. It is possible that the cashing out of

employer-provided parking, as proposed in the President's Climate Change Action Plan, could be the key policy leading to new commuting behavior. It will remove a major incentive to drive alone.

Maintaining this long term perspective and focusing on the bigger picture is important for those of you involved in TDM. This will enable you to better evaluate alternative strategies and to design programs that best meet the unique characteristics of different metropolitan areas and the needs of different commuters. The strengths and weaknesses of various approaches should be considered, focusing on the big picture of improving mobility and quality of life.

It is important to remember that we are not investing in transit merely as a clean air solution. Transit has many other benefits related to enhanced mobility, energy savings, and the quality of life. Portland, Oregon provides a good example where multiple measures are being used to begin to influence a major change in people's travel behavior. Measures used in Portland include urban growth boundaries to help contain urban sprawl; parking management policies to address pricing, on-street parking, and the length of time people park; a free fare transit zone downtown to encourage transit use; and a coordinated bus and LRT system. Portland is also considering pricing strategies to manage demand.

Portland has also used a wide range of planning activities—including the development of a downtown plan, a central city plan, and a comprehensive plan which is required by state law—to support these actions. The plans are coordinated and are used to develop a set of comprehensive policies and programs for the area. The public has been actively involved in devising these policies and plans. Thus, the public is very aware of the transportation issues confronting Portland and can make informed decisions on the alternatives presented during the planning process. In general, the public seems to understand the bigger picture of improving the quality of life in the Portland area.

A major part of TDM and other related programs needs to focus on educating the general public, especially in those areas where the problem may not be well understood. This education should focus on why the regulations are being imposed and the consequences of inaction. To accomplish this, I would suggest you consider two items in your strategic agenda. First, develop an education program that explains to the general public the problems currently facing many metropolitan areas. This should focus on describing all aspects of the

problem, not just air quality issues. Include the public in the discussion of TDM and enlist their help in identifying the measures that may be most realistic to pursue. A national public awareness campaign would be one approach worth considering.

Second, be specific with your ideas for legislative or policy changes. As part of this, identify the groups and individuals that will be most helpful. If specific changes are needed at the local level, be clear about what those changes are and who will be responsible for implementing them. Also, be explicit about suggestions for FTA and FHWA, especially those related to demonstration projects, technology transfer, funding, and program support. This administration is very committed to promoting transit. It recognizes the connections between transit, aviation, highways, and railroads, and the link these modes have with land use, development, and the economy. The various federal agencies are working together to help promote intermodal projects and approaches.

I appreciate the opportunity to speak to you today and I look forward to seeing the results of this symposium. You have an audience at the federal level that is very interested in what you have to say and we hope to be able to implement some of the recommendations you develop.

WORKING GROUP SUMMARY

A major portion of the Symposium was spent in small working groups discussing the current status of TDM, issues associated with the successful implementation of TDM programs, the future vision for TDM, and priority research needs. Members of the Symposium Steering Committee served as the chairs of the five working groups and staff from George Mason University and FTA acted as facilitators and recorders. The chairs of the five working groups were:

- Diane Davidson
- Bill Roach
- Jon Williams
- Jim Sims
- Wayne Berman

Each of the working groups addressed a wide range of issues and concerns related to TDM programs. The discussion focused on the five general areas of market and constituency development; legislative and policy development; planning, implementation, and evaluation; institutional and organizational development; and operational and technological development. To help ensure that all of these areas were addressed, each of the working groups started with a different topic.

The working groups identified key issues and research needs for each of the five focus areas. These were then compiled and presented at the closing session. The Perception Analyzer was used at this session to provide the Symposium participants with the opportunity to rate the composite list of 42 strategies and research topics. Each participant was provided with a hand held rating dial. A 100 point rating scale was used to measure the importance of each strategy and research need, with 0 = not important and 100 = very important. Each of the 42 strategies was presented, with participants rating the importance of each. Additional information on the background and geographical location of participants was also obtained through this process. The responses were tabulated during the session, allowing the preliminary results to be presented before participants left the Symposium.

This section summarizes the results from the working groups and the closing session. The major issues and research needs identified by the working groups for each of the five focus areas are presented first. The major topics of discussion are outlined,

followed by a summary of the research needs and strategies. The 42 strategies and research topics discussed at the closing session, which are listed in Appendix A, have been consolidated into 24 research studies. These are grouped by high priority projects—those with Perception Analyzer ratings of 75 and above—and medium priorities—those with perception analyzer ratings between 50 and 74. Finally, a short summary is provided of the variations in priorities based on the participants' work responsibilities and employment.

MARKET AND CONSTITUENCY DEVELOPMENT

Discussion of Issues

A wide range of issues was discussed by all the working groups related to TDM marketing and constituency development. These focused on a number of common themes associated with developing a better understanding of commuters as consumers, greater use of market research and marketing techniques, and the need for education and constituency building. Although many participants noted that advancements have been made in these areas, most felt that additional research was needed to advance the state of TDM practice.

The groups discussed the issues associated with TDM marketing and constituency development from a number of different perspectives. These included examining the needs of commuters, local TDM practitioners, public and private sector implementing groups, private businesses, and public policy makers. A number of common issues and research needs emerged from these discussions in the different working groups.

For example, developing a better understanding of commuters as consumers was identified as an important issue to ensure that TDM strategies are matched to the needs and demands of different market segments. This market research could then be used to develop comprehensive programs providing multiple strategies matched to specific market segments. Appropriate marketing and information programs could also be developed and implemented based on this information. The need to include both public and private sector groups in this effort was noted as important.

The lack of advocacy groups supporting TDM was also discussed. The development of broad based coalitions of public and private sector interests to promote TDM was identified as critical to advancing TDM. Along with this, the development and implementation of comprehensive ongoing education and outreach programs at the national, state, and local levels was recommended in a number of groups. Further suggestions were made on elements to be included in these programs.

Research Needs and Studies

High Priority

Enhanced Understanding of Commuters as Consumers. Commuters represent a diverse group with different needs and demands. Socio-economic factors, job responsibilities, work and home locations, child care needs, automobile availability, and other elements all influence individual commute habits. The ability of commuters to utilize various TDM strategies will depend on how well the specific actions meet their individual needs and demands. Thus, an enhanced understanding of the characteristics of all commuters is needed to ensure that TDM strategies represent realistic alternatives.

This research would focus on defining the attributes of different commuters. It would examine the needs and demands placed on different types of commuters in various geographic settings. Factors such as job and home responsibilities, work locations, socio-economic characteristics and other elements that influence commuters' mode choice would be analyzed.

The results of this research would be used to develop profiles of different types of commuters. This information would form the basis for the development of market-based TDM programs to be undertaken in subsequent studies. The results would be of use to all groups interested in developing realistic TDM programs that address the needs of diverse commute groups.

Develop Realistic TDM Goals and Objectives. One of the concerns with many TDM programs is that they are often based on unrealistic goals and objectives. This may be the result of overly ambitious federal or state regulations, inaccurate projections, misjudging commuters' needs, and underestimating responses to certain strategies. Developing realistic goals and objectives for TDM programs is critical to establishing TDM as a credible approach to addressing congestion,

mobility, and air quality concerns. Further, it is important that these be communicated to policy makers, as well as other transportation professionals, to establish realistic expectations for TDM.

This research would start by examining current TDM goals and objectives. A state-of-the-art review would be conducted to identify the goals and objectives being used in association with different TDM programs throughout the country. Goals and objectives addressing mode change, congestion reduction, air quality, energy, economic development, productivity, mobility, and quality of life would all be considered in this analysis. The nature and focus of the goals and objectives would be examined. The measures of effectiveness used to determine if the objectives are being met would also be assessed. Finally, the degree to which the objectives are being achieved would be considered.

Based on this analysis, and the assessment of commuters as consumers, a realistic set of TDM goals and objectives would be developed. These would address goal areas such as mode change, congestion, environment and air quality, energy, economic development, mobility, and quality of life. Appropriate measures of effectiveness would also be identified. The results of this analysis would be of use to TDM professionals in developing reasonable goals and objectives for different strategies. They would also be of use in communicating realistic expectations for TDM to policy makers and elected officials.

TDM Outreach, Planning, and Program Development Strategy. A number of activities were identified as important to help ensure that TDM becomes an integrated part of the overall transportation planning, programming, and decision making process. Elements suggested by the different working groups included the development of a comprehensive outreach effort and enhancing the integration of TDM early in the federal, state, and local transportation decision-making processes.

This study would examine these, and other related elements, and develop a comprehensive ongoing *TDM Outreach, Planning, and Program Development Strategy*. Items to be addressed in this study would include the following:

TDM Outreach Program

- Involvement of key public and private sector stakeholders
- Process to nurture and promote TDM champions
- Consensus building program
- Approaches to integrate TDM into traditional transportation engineering and planning
- Enhance ongoing communications among all groups

TDM Integration into Traditional Transportation Planning and Project Selection Process

- Examine historical approach to the transportation decision making process
- Identify and evaluate innovative approaches currently in use
- Assess opportunities in ISTEA for new approaches
- Evaluate TDM's contribution to transportation synergy, rather than as an isolated transportation component
- Develop suggested approaches

The outcome of this research study would be the development of an ongoing TDM outreach effort. This would include a program aimed at promoting TDM at the federal, state, and local levels and specific techniques that can be used to integrate TDM into the ongoing transportation planning and project selection process.

TDM Market Research. Innovative market research techniques are used extensively with private sector products and services. Historically, these approaches have not been used as widely with public sector activities, including TDM. It appears that TDM professionals could learn a great deal from the private sector in the use of these techniques. This could greatly enhance the development of market-based strategies that address the needs of commuters.

This study would examine the market research techniques being used to develop and market products and services in the private sector and would translate this experience into use with TDM programs. This would be accomplished through a state-of-the-art review of market research tools and techniques. In addition to assessing the use of these approaches in the private sector, examples of these techniques being utilized with TDM programs and other public sector projects would be examined. For example, innovative market research techniques have been used with some TDM programs around the country. The research might include more

detailed case studies of both private and public sector market research approaches. These case studies would focus on the techniques identified as most appropriate for use with TDM programs.

A *TDM Market Research Guide* would be developed based on the results of this research study. It is envisioned that the guide would include a discussion of the different market research techniques available and an indication of those most appropriate for use with TDM strategies. More detailed information would be provided on how to use these techniques. This would include a discussion of using a market research firm or conducting activities in-house, the general costs associated with different techniques, and the advantages and limitations of different approaches. Thus, the guide would provide step-by-step guidance to TDM professionals interested in utilizing a wide range of market research techniques.

Medium Priority

Innovative TDM Marketing Campaigns. In addition to the use of market research techniques to develop market-based TDM strategies, many groups discussed the need to utilize innovative marketing techniques to promote these concepts. The marketing efforts of TDM programs pale in comparison to those used by automobile companies and other related groups. A wide range of promotional activities could be used to effectively market TDM.

Like the market research study described previously, this study would examine the marketing techniques and promotional activities used extensively to sell products and services. This analysis would include an examination of both the general approaches and the specific media used. It would also assess the costs of different approaches and the benefits of various approaches. The study would also examine successful marketing programs developed and implemented by public sector organizations, including appropriate TDM marketing programs.

The results of this assessment would be used in two ways. First, a comprehensive *TDM Marketing Manual* would be prepared. This would describe the different marketing and promotional techniques that may be appropriate for use with TDM programs. Special emphasis would be placed on innovative approaches for enhancing public acceptance and use of TDM. The elements of each technique would be presented, along with general costs, potential benefits, and the specific

steps needed to plan, implement, and evaluate each method. Thus, this manual would provide a practical guide for TDM professionals and others interested in developing innovative marketing programs.

The second result of this study would be a comprehensive TDM marketing campaign. This would provide a continuous and coordinated program to encourage the use of high-occupancy commute modes and public acceptance of TDM. It would include a range of elements and communication devices. A major focus of the campaign would be on the competition to TDM—the single occupant automobile. Possible marketing strategies might focus on the mass media, specific targeted promotional efforts, and other techniques. This campaign could then be implemented by numerous groups throughout the country.

TDM Education and Training Programs. The need for improved educational programs and training opportunities was noted by a number of the working groups. A wide range of programs was suggested focusing on educating public policy makers and the general public, as well as technical training for TDM and other transportation professionals. This research study would address these concerns through the development of a series of TDM education and training programs.

The study would assess the need for different types of TDM education and training programs and would develop specific programs to address these. This effort would be coordinated with related research studies and the ongoing activities of other groups. It is anticipated that the following elements would be considered:

- educational programs aimed at public officials and federal, state, and local decision-makers
- educational programs aimed at chief executive officers and other private sector decision-makers
- educational programs aimed at the public
- educational and training programs aimed at transportation engineers and planning professionals
- specific training programs aimed at TDM professionals

A variety of approaches may be appropriate for these different programs. These may include workshops, peer-to-peer training, executive outreach programs, newsletters, videos, presentations, training courses, changes in university courses and curriculum content, and other innovative techniques. These efforts

would promote the benefits of TDM, identify the true costs associated with other commute modes, and provide more detailed training for TDM and transportation professionals.

The research study would develop specific programs aimed at each of these groups. These programs could then be implemented by FTA and FHWA, national organizations, universities, and state and local groups. The education and training programs would help advance the state-of-the-art and ensure consistency in TDM practice. They would further assist in promoting TDM at all levels.

LEGISLATIVE AND POLICY DEVELOPMENT

Discussion of Issues

Legislative and policy issues were discussed extensively in all the working groups. In addition, many of the comments made on other topics also focused on needed policy changes to support TDM activities. These discussions focused on both broad based policy initiatives and specific strategies necessary to promote TDM or to reduce benefits currently being provided for single occupant vehicle use.

Participants in the working groups noted that there are many policies and laws that provide either direct or indirect advantages to the use of private vehicles over high-occupancy commute modes. Changes in federal, state, and local policies will be needed to fully advance TDM into the 21st century. Many of these changes relate to providing individuals who use HOV modes with the same benefits given to individuals who drive alone. In other cases, it means taking a more proactive role supporting TDM strategies through policy development.

Many of the specific suggestions concerned the need to change federal tax policies related to parking, fringe benefits, and transportation programs. Utilizing tax strategies to encourage greater use of TDM and HOVs was identified by a number of the working groups. The need to increase the flexible funding provisions of the ISTEA and other programs was also discussed. Other suggestions focused on the development and implementation of transit friendly land use and development policies, greater use of pricing strategies to encourage HOVs, and the development of performance-based guidelines.

Research Needs and Studies

High Priority

Examination of Flexible Funding Opportunities of the ISTEA and Other Programs to Support TDM.

The Intermodal Surface Transportation Efficiency Act (ISTEA) provides much greater flexibility in the use of funds within different programs. Further, states and MPOs are given increased responsibilities and authority in the transportation planning and project selection process under the ISTEA. In addition, new programs—such as the Congestion Mitigation and Air Quality Improvement Program (CMAQ)—provide funding for projects primarily in air quality non-attainment areas to help meet air quality requirements. Many of these projects are related to TDM strategies or supporting components.

Experience with the use of the flexible funding provisions of the ISTEA, the CMAQ program, and other programs to fund TDM is just beginning to emerge. For TDM to take full advantage of the funding opportunities of these and other programs, a better understanding of the requirements, procedures, criteria, and decision making process is needed. This research would enhance the potential use of these programs for TDM projects through an analysis of the opportunities and requirements of the different funding sources.

The study would examine the programs contained within the ISTEA and other federal legislation that could be used to support TDM activities. The research would assess the project eligibility, funding, and agency requirements associated with the different programs. It would also consider the flexible funding provisions of different categories contained in the ISTEA. The study would examine if the eligibility criteria for different programs should be changed to provide greater opportunities for TDM and would consider the need to standardize the requirements of different programs. It would also consider how existing transportation policies relate to the objectives of the ISTEA.

Further, the study would examine how these programs are actually being administered at the state and local levels. This would include an examination—possibly using a case study approach—of examples where these programs have been used to fund TDM activities and projects. This analysis would analyze not only the types of projects being funded, but also the process, project selection criteria, decision making authority, institutional roles and responsibilities,

and other factors that may influence the successful funding of TDM through these programs.

The outcome of this research would be a comprehensive assessment of the opportunities provided by the different programs within the ISTEA and other legislation to fund TDM programs. It would discuss the various programs and would identify realistic opportunities to pursue TDM projects. Detailed information would be presented on the steps and actions needed to apply for funding through the different programs. It would also outline possible changes needed to enhance the use of these programs for TDM activities. Thus, the results would provide a valuable guide for TDM professionals and others interested in using the provisions of the ISTEA and other legislation to support TDM.

Assessment of Land Use Policies Supporting Transit and TDM.

Land use and development policies and practices have important influences on TDM and transit use. Experience from around the country—and around the world—indicates that transit and TDM are most effective when supportive land use and development policies are in place. These may include policies and programs related to land use, zoning, development design, development densities, and joint development. Ensuring that land use and development practices are supportive of TDM and transit is critical to successful TDM efforts.

This research would examine the application of land use and development policies to support TDM. It would start with an assessment of current land use policies and programs. A case study approach would be used to examine both good and bad examples of land use/TDM coordination. The case studies would assess both the specific techniques used—such as zoning, development design, joint development, and other regulatory tools—and the institutional and organizational arrangements. Factors that appear to be critical for successful projects would be identified, along with issues that may need to be considered.

The result of the research study would be a guide describing land use and development policies and practices supporting TDM and transit. It would provide a practical guide for TDM and transportation professionals, land use planners, city administrators, developers, and policy makers to follow in better integrating transit into new and existing land uses. It would also outline how the individuals and agencies responsible for land use and transportation decisions

need to work together to plan and implement the recommended approaches.

Examination of Tax Policies to Support TDM. Many current tax policies, especially those at the federal level, either directly or indirectly encourage commuters to drive alone. Tax rates on gasoline, fringe benefits, commute allowances, home loans, and other elements all support the use of single-occupant vehicles. Inequities in tax policies will need to be addressed in order for TDM and HOV strategies to be competitive with driving alone.

This research study would begin to address these concerns through a comprehensive assessment of current tax practices and the identification of potential changes to support TDM. The study would include a comprehensive assessment of federal tax policies that encourage single-occupant vehicle use. Although the major focus of the study would be on federal tax practices, state and local tax policies would also be considered. The assessment would examine the purpose and intent of the tax and the impact on encouraging commuters to drive alone. It would also evaluate taxes that may result in disincentives to HOV use or TDM strategies.

The study would also examine potential changes in existing tax policies, realignments in tax strategies, and new tax practices to both encourage greater use of HOVs and TDM and to discourage commuters from driving alone. Thus, tax strategies providing incentives to HOV use would be evaluated as well as those focusing on disincentives to SOV use. Potential approaches for consideration at the federal, state, and local levels would be outlined.

The results of this research would be a comprehensive assessment of the impact current tax policies have on encouraging commuters to drive alone. It would further provide an action plan for a new tax strategy that would both level the playing field between SOV and HOV modes and would support effective TDM programs. The results would thus be of benefit to public and private sector groups interested in developing taxing strategies that encourage TDM.

Examination of Pricing Strategies to Support TDM. A number of pricing strategies have been suggested by different groups and individuals to discourage driving during congested periods and to encourage greater use of HOVs. Commonly referred to as *congestion pricing* or *roadway pricing*, most approaches focus on the

concept of charging for the use of roadways or other transportation facilities. A variety of approaches have been suggested. These include time-of-day or variable pricing—which would charge more for the use of facilities during the peak-periods or when congestion levels are worse—pricing SOVs and not HOVs, and other strategies.

To date, congestion pricing has not been implemented extensively in the United States. A number of studies, and a few demonstration projects are currently underway, however, focusing on different approaches to pricing. This research study would examine the current status of these activities and would evaluate the use of different pricing strategies to support TDM. The study would be coordinated with other related activities and the examination of parking policies to support TDM described later in this section.

The results of this study would provide a detailed assessment of pricing strategies that could be used to support TDM and to encourage greater use of HOVs. This would include a description of each strategy, the estimated impacts, how it could be implemented, the anticipated costs and revenues, and the potential issues associated with its use. Approaches that appear most feasible would be identified and potential demonstration projects and operational tests would be described.

Examine the Use of Performance-Based Regulations. Many of the regulations promulgated at the federal, state, and local levels are prescriptive in nature. Requirements for reducing vehicle miles of travel or increasing vehicle occupancy levels by certain amounts are just two examples of prescriptive approaches taken in recent regulations. Performance-based regulations, rather than prescriptive requirements, may be a more appropriate approach in many instances. This research would examine the potential use of performance-based regulations for TDM-related programs. This would include an analysis of the advantages and disadvantages of performance-based versus prescriptive regulations. Further, it would outline how performance based regulations could be implemented, monitored, and evaluated.

The study would include a review of current regulations to determine the use of both prescriptive and performance-based regulations. It would also include an examination of performance-based measures used to regulate other businesses, public programs, and services. This information would be used to suggest

possible performance-based measures for TDM programs.

The results of this research would be an assessment of the potential to utilize performance-based, rather than prescriptive, regulations for TDM and related requirements. It would provide specific suggestions on approaches that appear most feasible and would outline how performance-based regulations could be implemented. It would also identify positive demonstration projects to test the use of performance-based TDM regulations. This information would be of use by all groups at the federal, state, and local levels.

Analysis of Parking Strategies to Support TDM.

Numerous studies have indicated that parking rates and parking availability are critical factors influencing an individual's mode choice decision. Commuters who have access to low cost and readily available parking are more likely to drive alone than those who pay high parking rates or have to park at some distance from their work site. This study would examine the influence of parking on commute mode choice and would outline TDM supportive parking policies, programs, and strategies that could be implemented throughout the country.

The research would first assess the influence parking policies and pricing strategies have on commute mode choice. This would be accomplished through a state-of-the-art review and case studies examining the use of different parking programs, policies, pricing techniques, and other parking related incentives and disincentives. The results of this assessment would be used to identify those approaches which appear most successful at encouraging greater use of HOVs and which support TDM.

The research results would provide a comprehensive assessment of the role parking plays in influencing mode choice decisions and the current practices in use throughout the country. It would also outline approaches that could be used to support TDM and HOV use. This would include a listing of parking programs, policies, pricing techniques, and other activities that could be implemented by public and private sector groups, organizations, and businesses. Thus, the research would provide a practical guide for TDM and transportation professionals interested in using parking to support TDM programs and HOV use. It would also help educate policy makers on the impacts of different parking policies and pricing strategies.

PLANNING, IMPLEMENTATION, AND EVALUATION

Discussion of Issues

A wide range of issues associated with planning, implementing, and evaluating TDM programs were discussed in the working groups. Although many participants indicated that progress has been made on many of these concerns, most felt more work was still needed to advance the state-of-the-practice relating to planning, implementing, and evaluating TDM. Further, greater sharing of information on project experience—both good and bad—was noted as important.

Issues raised by the working groups included the need to better integrate TDM into the transportation, environmental, and land use planning processes; developing guidelines for TDM monitoring and evaluation; disseminating project information and research results in a timely manner; developing better TDM modeling tools and techniques; developing a comprehensive ongoing TDM research program; examining areawide TDM programs; and developing a state-of-the-art ride matching system.

The fact that research studies and other activities are currently underway in some of these areas was noted. Thus, working group participants stressed the need to coordinate research projects in this area with other ongoing activities. They also stressed the need to coordinate these studies with the ongoing activities of TRB, FHWA, FTA, the Institute of Transportation Engineers (ITE), the Association for Commuter Transportation (ACT), and other groups.

Research Needs and Studies

High Priority

Incorporating TDM into the Transportation, Air Quality, and Land Use Planning Process. One of the issues identified by the working groups as limiting the effectiveness of TDM is the lack of consideration of TDM in the transportation, air quality, and land use planning processes. In order to become an effective tool, TDM must be an integral part of these processes and must be considered early in the decision making process. This research would help facilitate greater integration of TDM into the overall transportation planning process.

The research study would first examine how TDM is currently being addressed in these processes at the federal, state, and local levels. This would include an analysis of when in the decision making process TDM alternatives are considered and what information is used in the evaluation of alternatives. The main focus of the research would be on the planning and project selection process used at the state and metropolitan planning organization (MPO) levels. This would include an examination of how TDM is considered in the federally-mandated 3-C (comprehensive, coordinated, and continuing) process, as well as in the 15 metropolitan and 20 state planning elements contained in the ISTEA.

The results of this analysis would provide a comprehensive assessment of existing practices, including the best examples of TDM integration into these planning processes. Further, it would outline suggestions and recommendations for enhancing the integration of TDM into the transportation, air quality, and land use planning and decision making processes at all levels. Thus, the results would be of benefit to federal, state, and local groups interested in further integrating TDM into the ongoing comprehensive transportation planning and project selection process, and related environmental and land use processes.

Guidelines for Planning, Implementing, and Evaluating TDM. Although some guidelines exist on planning, implementing, and evaluating TDM strategies—and other efforts are underway—many participants indicated that additional research is needed in this area. A key concern related to these suggestions was the need to ensure that reasonable and defensible evaluations are performed to accurately determine the impacts of TDM strategies.

This research would examine the current state-of-the-practice with TDM planning, implementation, and evaluation. This would be accomplished through a review of existing research, as well as coordinating with projects currently underway. Additional analyses would be conducted to examine existing and new techniques and approaches for planning, implementing, and evaluating TDM. Further, the methods most appropriate for use with different types of TDM techniques would be evaluated. This might include detailed case studies, as well as examining evaluation techniques used with other types of projects and programs.

This information would be used to develop a set of guidelines for planning, implementing, and evaluating

TDM programs. A comprehensive manual would be prepared summarizing the effectiveness of different approaches, the applicability of different techniques to various settings and issues, and the guidelines for planning, implementing, and evaluating TDM. The evaluation section would include a discussion of appropriate measures of effectiveness, data collection and monitoring techniques, and other elements. This would provide a practical tool for TDM and transportation professionals. It would also help ensure an overall consistency with evaluation techniques, allow for the development of a national TDM database, and would assist in ensuring that TDM evaluations provide accurate information for public and private sector decision makers.

Comprehensive TDM Research Program. An ongoing comprehensive TDM research program was identified as a critical need by many of the working groups. Many participants indicated that the Symposium represented just the start of such an effort. Two days did not provide enough time to fully discuss all the relevant issues and research needs associated with TDM. Further, new issues and opportunities will arise in the future that will need to be addressed through an ongoing research program. Thus, the research needs identified by the working groups and summarized in these proceedings were felt to represent just the starting point for the development of an ongoing, robust TDM research program.

This study would develop and implement a comprehensive ongoing TDM research program. Elements to be addressed in this research would include:

- Ongoing process to identify and rank TDM research needs
- Identification of potential funding sources
- Process for development of detailed proposals and problem statements for specific funding sources
- Process to monitor, evaluate, and reprioritize research needs
- Information documentation and technology transfer process

It is anticipated that the TRB TDM Task Force would take the lead in developing this ongoing research program. These efforts would be coordinated with other appropriate groups, however. These would include related TRB committees, the Institute of Transportation Engineers, Association for Commuter

Transportation, and other groups. The outcome of this effort would be the development and implementation of a comprehensive ongoing TDM research program.

Enhanced TDM Modeling Tools. Many participants noted the need for improved modeling capabilities in order to better estimate the potential impacts of different TDM strategies. Currently, adequate techniques and models are not available for estimating the influence different approaches may have on encouraging greater use of HOVs and reducing VMT and congestion levels. Further, enhanced techniques are also needed to estimate the potential air quality and environmental impacts of alternative TDM strategies.

This research study would examine the current status and capabilities of existing models and techniques. This would be accomplished through a state-of-the-art review of the modeling tools and techniques currently being used throughout the country. This would include an examination of sketch planning models, microcomputer modeling capabilities, and larger scale models being utilized for TDM and air quality analyses.

This assessment would be used to identify the strengths and weaknesses of different approaches, the most appropriate models to use for different types of analyses, and areas for improvements. Based on this analysis, a comprehensive approach to improving TDM modeling techniques would be identified and implemented. Thus, the intended outcome of this research would be the development of enhanced TDM modeling tools and techniques.

The results would be of immediate benefit to TDM and transportation professionals responsible for estimating the potential impacts of alternative TDM strategies. Providing more accurate assessments of TDM strategies will help ensure that decisions regarding TDM and other transportation improvements provide the most cost effective and efficient solutions. In addition, the results will help in the development of a comprehensive database on the influence of TDM strategies.

Guidelines for Areawide TDM Programs. In many areas, TDM strategies have focused on corridor or area-specific applications. Oftentimes this has occurred in response to specific problems or opportunities in these areas. Fewer examples exist of areawide TDM programs. Reasons for this may include the difficulties in obtaining agreements from multiple jurisdictions involved in areawide applications, identifying

appropriate strategies for different market and geographic areas, and obtaining funding and implementing areawide strategies.

This research study would examine the issues associated with areawide TDM programs and would develop a set of guidelines for planning, implementing, and evaluating areawide TDM programs. This would be accomplished through a review of current areawide programs, an examination of the institutional and implementation strategies used, and the development of new and innovative approaches to overcoming identified issues and problems. A case study approach could be used to provide a comprehensive assessment of the institutional arrangements, program elements, costs, funding sources, and experiences with existing areawide TDM programs. This information would be used to identify approaches appropriate for more widespread use, issues encountered and techniques used to address them, and new techniques that could be used to enhance areawide programs.

The outcome of this research would be a practical guide for developing, implementing, and evaluating areawide TDM programs. It would include information on organizational approaches appropriate for promoting areawide programs, techniques to evaluate areawide alternatives, and implementation strategies and potential funding sources. It would also outline the steps for a comprehensive ongoing evaluation plan.

Low Priority

TDM Strategies for Non-Work Travel. To date, most TDM programs and strategies have focused on work-related travel. Little emphasis has been placed on examining and implementing TDM measures addressing non-work travel. This research study would address this void by analyzing potential TDM strategies for non-work trips, identifying the potential impacts of these approaches, and developing a structured demonstration program to test and evaluate the most feasible measures.

Current TDM programs focus almost entirely on reducing peak-period work-related commute trips. This emphasis reflects the need to address traffic congestion, air quality and environmental concerns, and mobility issues in many metropolitan areas. This approach is reflected in federal, state, and local regulations—such as the federal trip reduction requirements for extreme and severe air quality non-attainment areas—which focus on reducing single occupant vehicle use and increasing

average vehicle occupancy levels during the morning peak-period.

Although the work-related peak-period focus of TDM programs is appropriate given that the heaviest demands on the transportation system occur during these periods, the impact of non-work travel should not be dismissed. Non-work trips account for a significant percentage of the total travel in most urban areas and non-work travel continues to increase at a rapid rate. This research would examine the needs and demands of non-work travel and would examine possible TDM strategies to address these trips. It would also identify the impact of non-work trips on congestion levels and air quality.

The results of this research would be a comprehensive assessment of non-work travel. This would provide a market-based assessment of the trip and individual characteristics associated with non-work trips. Based on this analysis, it would also contain an evaluation of potential TDM strategies appropriate for non-work trips. This would include the identification of possible demonstration projects and operational tests to further explore the use of TDM techniques to reduce increases in non-work travel.

Development of State-of-the-Art Public Domain Rideshare Matching System. A number of computerized rideshare matching systems are currently available through public sector groups and private vendors. Each program has advantages and disadvantages, strengths and limitations. With many transit systems, rideshare agencies, and other groups moving toward greater use of geographic information systems (GIS) and other sophisticated databases, there appears to be an opportunity to develop greatly enhanced, computerized rideshare matching systems.

This research would examine the current state-of-the-art computerized ride matching systems and would develop a new public domain software system. The strengths and weaknesses of current programs would be analyzed and the potential for enhanced capabilities would be researched. This information would be used to develop a new computerized ride matching system utilizing the latest technologies. The system would then be made available to public and private sector groups throughout the country.

INSTITUTIONAL AND ORGANIZATIONAL DEVELOPMENT

Discussion of Issues

A number of different institutional and organizational issues were discussed in the working groups. Many participants suggested that institutional barriers were limiting the deployment and effectiveness of TDM strategies in some areas. Identifying existing and potential institutional and organizational issues, as well as possible techniques to overcome them, was rated as an important area for additional research.

The institutional and organizational issues raised during the working group discussions included better defining the roles and responsibilities among the various groups involved in planning, implementing, and evaluating TDM programs; enhancing opportunities for public/private partnerships; creating more support for TDM at all policy and governmental levels; and removing policy and legal restrictions limiting TDM strategies. It was further suggested that there was a need to make greater use of the flexible funding provisions of the ISTEA to promote TDM projects.

Many of the issues related to institutional and organizational development were closely connected with those associated with legislative and policy development. The research needs related to coalition building, public/private partnerships, and organizational and institutional needs and objectives are summarized here.

Research Needs and Studies

High Priority

Facilitate Development of Public/Private Coalition to Advance TDM. One of the factors limiting greater use of TDM strategies identified by many of the working groups was the lack of a strong advocacy coalition for TDM. Such groups have been used to successfully promote many other activities, products, and services. A broad based coalition, comprised of representatives from public and private sector groups at the national, state, and local levels could help educate others, promote TDM efforts at all levels, and lobby for funding.

This study would examine public/private coalitions that have been successful in advancing other projects. Groups that may be appropriate examples include the

Highway Users Federation, the Good Roads Association, the American Association of State Highway and Transportation Officials, and different professional associations. The study would focus on identifying the factors that have made these groups successful. Elements relating to organizational structures, membership composition, responsibilities, educational and outreach services, lobbying and promotional activities, and other efforts would be examined. The results of this analysis would be used to identify possible approaches to the formation of a national TDM coalition.

The outcome of this study would be a plan for the development of a national TDM coalition. It is anticipated that this plan would include an outline of the organizational structure, the membership composition and dues, the goals and objectives for the coalition, and an initial set of work activities. The plan would also address how federal and state governments—which have been identified as especially critical to the future success of TDM—would be included.

Medium Priority

Guidelines for Public/Private Partnerships in TDM. Many of the issues discussed in the review of the current state-of-the-practice related to the complex environment within which TDM must be implemented and the diverse nature of the public and private sector groups involved in planning, implementing, operating, and evaluating TDM programs. For TDM to be successful, public and private sector organizations will have to work much more closely and cooperatively. New and creative approaches may be needed to help bring these groups together to promote mutually beneficial programs.

This research would help promote the development of innovative public/private partnerships to advance TDM. To accomplish this the study would examine public/private partnerships currently used by successful TDM programs. The use of creative public/private alliances for transit, transportation, and other projects would also be considered. Factors to be examined in the assessment would include the roles and responsibilities of the different groups, funding, the legal and regulatory environment, the institutional and organizational setting, the nature and scope of the TDM strategies, and the unique elements of each approach.

Based on this analysis, a set of general guidelines would be developed to facilitate greater use of

public/private partnerships in TDM. The guidelines would provide practical information for use by TDM practitioners in both the public and private sectors, as well as policy makers and senior management. The guidelines would help identify possible public/private alliances to address different institutional, legal and financial settings, as well as TDM strategies. It would further outline the circumstances for effective partnerships between the public and private sectors. Thus, the results would provide guidance on innovative public/private partnerships to address a wide range of issues and needs.

Analysis of Organizational and Institutional Needs and Objectives. The nature of TDM programs throughout the country varies. The focus of TDM programs, and the specific strategies being pursued, depend on the issues facing the area, the goals and objectives of the responsible organizations and institutions, available financial resources, and legislative mandates. This research would examine the differences in organizational and institutional needs and objectives that exist throughout the country, as well as those within individual metropolitan areas.

The study would first examine the various organizational approaches, needs, and objectives currently found in different metropolitan areas. The results of this analysis would be used to develop a typology of organizational needs and objectives. These would then be examined in more detail—possibly through a case study approach—to identify how different organizational needs and objectives impact the success of TDM programs.

The results of this analysis would help define the institutional needs and objectives found in different areas and how these can be used to influence the successful development of TDM strategies. It would help define the roles and responsibilities of the various groups involved in TDM and would assist in facilitating improved interaction among all groups.

OPERATIONAL AND TECHNOLOGICAL DEVELOPMENT

A number of the working groups discussed the use of intelligent vehicle highway systems (IVHS) and other advanced technologies to enhance the application of TDM programs. The major issues identified related to exploring the application of IVHS technologies to overcome barriers to the use of TDM strategies and to enhance the management of TDM programs, integrating

TDM into the IVHS program, and conducting specific research and demonstration projects.

Workshop participants suggested that although TDM has not been a major focus of IVHS activities to date, it appears that a wide range of advanced technologies may help enhance TDM strategies. To be effective, IVHS technologies will need to be designed to make TDM more convenient and attractive to users, as well as improving the management and administration of TDM programs.

A number of factors limiting the potential integration of IVHS and TDM were identified. First, it was noted that the IVHS community has not embraced TDM as a major focus area. TDM is one of the 27 user services identified in the *National IVHS Program Plan* currently under development, however. Further, some of the projects being pursued under the advanced public transportation systems (APTS) and advanced traveler information systems (ATIS) categories relate to TDM strategies. It was felt that TDM will need to be better integrated into the Federal IVHS program to help ensure adequate consideration.

Many groups and individuals within the IVHS community are not aware of TDM activities or the needs of TDM practitioners. On the other hand, many people involved in TDM programs are not familiar with IVHS, the potential benefits of combining the two, and the potential funding sources available for demonstrations and operational tests. Thus, the need to educate individuals involved in both TDM and IVHS was suggested. Developing and initiating outreach activities to build better working relationships between these two groups was emphasized.

Developing a comprehensive program of research, demonstration projects, and other activities was identified as one important way to advance the combination of IVHS and TDM. It was further suggested that these should focus on market-based strategies to improve the application and effectiveness of TDM. It was also noted that the development of consistent data and technical standards to support TDM/IVHS applications was important.

Research Needs and Studies

High Priority

Expand the Effectiveness of TDM through the Application of IVHS Technologies. Research in this

area would focus on examining the potential to enhance the effectiveness of TDM strategies and programs through the application of IVHS and other advanced technologies. To accomplish this, a number of activities would be conducted as part of this research effort.

First, technologies that could be applied to enhance market-based TDM strategies would be explored. This step would assess available and potential technologies to improve the effectiveness of TDM strategies. Technologies designed to overcome specific barriers to TDM would be examined, along with applications focusing on making TDM strategies more convenient and easier to use. The use of advanced technologies to encourage greater use of telecommuting would also be considered. Further, applications focusing on enhancing the management and administration of TDM programs would be examined.

Based on this analysis, a series of demonstration projects, operational tests, and deployment projects would be identified. It is anticipated that a comprehensive program would be developed to test a wide range of technologies in diverse market-based applications and settings. Further, the research would examine the data and technical standards of TDM/IVHS applications. This would be coordinated with the development of the national systems architecture which is currently underway.

The outcome of this research would be a comprehensive program to test and evaluate the application of IVHS technologies to enhance TDM strategies. The results of this research could be integrated into the programs and plans of federal, state, and local agencies and organizations. These might include FHWA, FTA, and other federal agencies; TRB, *IVHS America*, and other national organizations; state departments of transportation; metropolitan planning organizations; TMOs/TMAs; transit agencies; and local jurisdictions. Further, private sector consulting firms and technology companies may find the results of use in developing future programs and products.

Develop and Implement an Outreach Program to Facilitate the Integration of IVHS and TDM. One of the factors that appears to be limiting the integration of IVHS and TDM is the lack of familiarity among individuals in both groups. Many TDM practitioners and others involved in TDM activities have only a limited awareness of IVHS, the wide range of advanced technologies being explored, and the funding opportunities available through numerous programs.

Similarly, few individuals in the IVHS arena have a good understanding of the nature and scope of TDM, the potential opportunities to apply IVHS technologies to address specific issues, and the environment within which TDM strategies need to be implemented.

An outreach program, which would bring together representatives from both groups, is needed to bridge this gap. This study would develop and implement an outreach program to facilitate greater interaction and communication between the TDM and IVHS communities. To accomplish this, the study would examine the current level of knowledge and understanding of TDM practitioners to IVHS, and IVHS representatives to TDM. It would also examine outreach and education programs used by other groups that may serve as models. The study would also be coordinated with related activities of other national organizations.

The results of the research would be the development of an outreach program to help facilitate greater integration of IVHS and TDM. Elements that may be included in this program are workshops, one-on-one meetings, executive tours, newsletters, conference presentations, and other outreach activities. The study results would provide an indication of the groups best capable of carrying out the specific activities, the resources needed to pursue each action, and coordination activities with other organizations.

SYMPOSIUM PARTICIPANT PROFILE

The final session was attended by 73 of the Symposium participants. In addition to rating the 42 strategies and research needs, participants were asked to provide information on the nature of their jobs and the region of the country they were from. Figure 1 illustrates the employer of the Symposium participants. As shown, the Symposium attracted a mix of representatives from both the public and private sectors. Figure 2 illustrates the geographic distribution of participants.

Participants were also asked about their primary interest in TDM. As shown in Figure 3, implementation and evaluation ranked as the major interest with 40 percent, followed by legislative and policy development, market and constituency development, technology development, and institutional and organizational development.

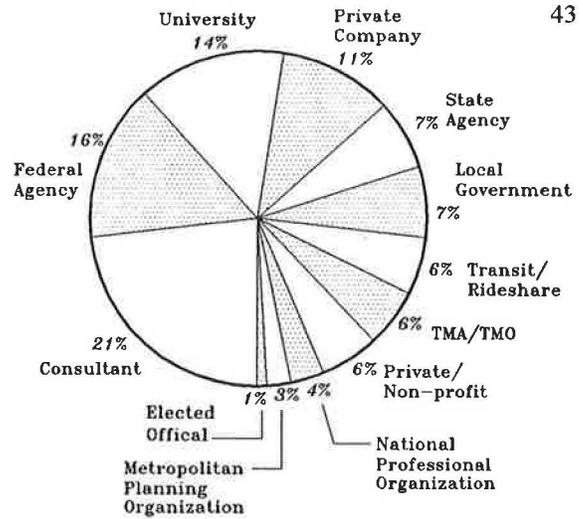


Figure 1
Employer of Participants

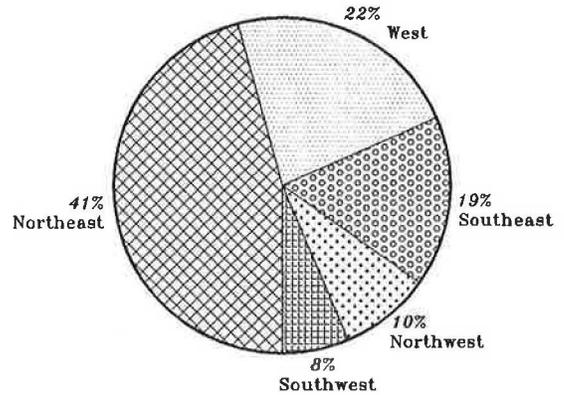


Figure 2
Geographic Region of Participants

QUESTION: Which of the following best represents your interest in TDM ?

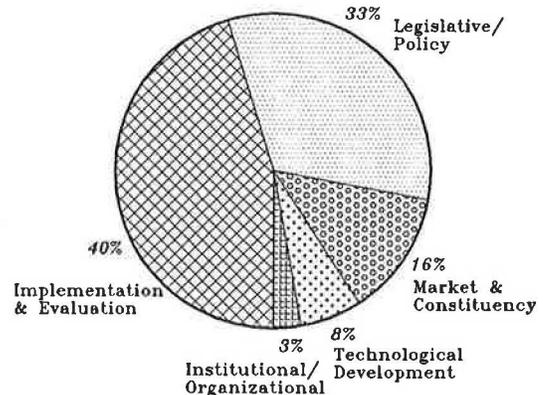


Figure 3
Participant's Interest in TDM

Approximately 60 percent of all participants identified regulatory factors as the driving force behind TDM in their area. Regulatory concerns were rated slightly higher by participants from the West and Southwest than those from the Northwest, Northeast, and Southeast.

Overall, approximately 53 percent of the participants were optimistic about the future of TDM. Some 22 percent were neutral and 22 percent were pessimistic about future TDM efforts. The outlook for TDM varied among the types of participants, however. Individuals from governmental, transit, ridesharing, and TMO/TMA groups tended to be more optimistic than private sector representatives and consultants.

Finally, the strategies and research needs were rated somewhat differently by the various groups of participants. The following highlight the general areas of interest among the different groups.

- Consultants—Realistic goals for TDM, reasonable evaluations, land use policies supporting transit and TDM, a TDM manual, an ongoing TDM research and planning program, and technology development.
- Private Businesses—Impact of non-work trips, technology development, development of public/private coalitions and opportunistic partnerships, reasonable evaluations, land use policies, and tax policies.
- Government—Land use policies, tax policies, development of public/private coalitions, realistic goals, outreach activities, reasonable evaluations, and an ongoing research and planning program.
- Transit, Rideshare, TMA/TMO, and National Organizations—TDM manual, tax policies, outreach and education activities, land use policies, an ongoing research and planning program, market research and innovative marketing programs, and reasonable evaluations.
- Universities and Research Institutes—An ongoing research and planning program, land use policies, technology development, development of public/private coalitions, outreach and education activities, and reasonable evaluations.

THE STATE-OF-PRACTICE OF TRAVEL DEMAND MANAGEMENT

by

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INTRODUCTION

Travel demand management (TDM) strategies have become an important element of federal, state, and local efforts to provide mobility in urban areas while at the same time helping to achieve other societal goals such as clean air. Both the federal Clean Air Act Amendments and the Intermodal Surface Transportation Efficiency Act (ISTEA) require consideration of TDM strategies. Many states, including Maine, Washington, California, and Oregon, have state-level initiatives that require an assessment of TDM strategies as part of transportation planning. The U.S. DOT planning regulations implementing ISTEA have similar assessment requirements for metropolitan areas. And at the local level, many communities have, for years, required new developments to explore the use of TDM strategies to mitigate the impact on the surrounding community. As TDM becomes a more important element in transportation planning, and certainly as we begin to identify needed areas of TDM research, it is an important point of departure to examine where we currently are in the practice of TDM.

Recent data from national surveys and from the U.S. Census suggest that the American love affair with the automobile continues unabated. Even in those cities where massive investments in alternative forms of transportation have occurred the average vehicle occupancy has generally declined. One of the problems with using such data, however, is that national and regional data often blend together travel behavior that occurs in many different travel markets. Success in one travel market at developing effective travel demand management strategies could be overwhelmed numerically by the large numbers of travelers in other markets who are not subject to TDM incentives/disincentives. Given that TDM strategies are primarily aimed at changing the travel behavior of individuals, an assessment of the current state-of-practice necessarily must start by looking at the different travel markets found in a typical U.S. metropolitan area.

The purpose of this paper is to describe the state-of-practice of TDM in the U.S. As noted above, this assessment is based on the concept of travel markets, and the characteristics of these markets that cause success or failure at implementing TDM programs. Of some importance in understanding the state-of-practice is acknowledging the institutional foundation of the TDM programs that have been successful, and similarly the institutional hurdles that have caused other programs to fail, or to never begin. The final section of this paper presents recommended research projects that would provide an important basis for determining effective strategies that could be used to implement TDM programs.

TDM ALTERNATIVES/STRATEGIES AND MARKETS

TDM Alternatives and Strategies

Before discussing the current state-of-practice of TDM, it is important to first define what is meant by the term. Quite simply, TDM programs are designed to maximize the people-moving capability of the transportation system by increasing the number of persons in a vehicle, or by influencing the time of, or need to, travel. To accomplish these types of changes, TDM programs must rely on incentives or disincentives to make these shifts in behavior attractive.

The term TDM encompasses both alternatives to driving alone and the techniques or strategies that encourage the use of these modes. The application of such TDM alternatives and the implementation of supporting strategies can occur at different levels under the direction of a variety of groups. Certainly, one level of application found in many parts of the country is at individual employer sites, or at locations where there are many employers grouped together. In this situation, the employers become the important implementers of the TDM actions, even though they may be responding to a government mandate to do so.

Another level of application is on an areawide basis where government agencies often have lead responsibility. In this type of application, the primary focus of the TDM program is to affect as many travelers as possible. However, experience has shown that the effectiveness of areawide TDM programs very much depends on the type and level of participation of employers.

At the level of the employment site, typical TDM alternatives to single occupant vehicles include [U.S. DOT, 1993]:

- carpools and vanpools,
- public and private transit, including buspools and shuttles; and
- non motorized travel, including bicycling and walking.

TDM programs can also include alternatives to influence when travel occurs during a day, or if it occurs at all on some days. These efforts, which are usually classified as “alternative work hours,” include:

- compressed work weeks, in which employees work a full 40-hour work week in fewer than the typical 5 days; and
- flexible work schedules, which allow employees to shift their work start and end times (and thus travel times to less congested times of the day).

A special kind of alternative which influences where work occurs is telecommuting. Telecommuting programs allow employees to work one or more days at home or at a “satellite work center” which is often closer to their homes and thus does not require a longer trip into the primary work location.

At the areawide level, the types of TDM alternatives that can be considered include:

- Service improvements to transit service that provide savings in costs and travel time.
- Provision of preferential lanes on or access to major roads serving the area which provide time savings to those using ridesharing.
- Application of areawide cost surcharges or subsidy measures designed to make the relative cost of single occupant vehicle use higher than that for high occupancy vehicles.

A typical example of areawide cost surcharges would be parking surcharges placed on employer and public parking lots that would provide a differential cost structure for single occupant vehicles versus ridesharers.

TDM strategies include financial or time incentives for the use of alternative modes; information dissemination and marketing activities to promote these modes; and supporting services that make the use of alternatives more convenient or that remove psychological impediments to their use. Examples of TDM strategies include:

- financial/time incentives, for example preferential parking for ridesharers, subsidies for transit riders, and transportation allowances;
- parking management programs;
- priority treatment for ridesharers, for example, provision of preferential access and egress to parking lots; and
- information and marketing, such as on-site availability of transit schedules, periodic prize drawings for ridesharers; and guaranteed ride home programs.

Market Environments for TDM

As noted in the previous section, there are many different types of TDM alternatives and strategies that can be used to affect individuals' travel behavior. So too are there many different types of travel markets in which these alternatives can be applied. Although these markets can be defined along several dimensions, the two most important include geographic application and trip purpose.

Geographic Application

TDM alternatives have traditionally had their greatest success at the individual employment site level. Table 1, for example, shows some of the results of a recent study which undertook case studies of employers around the U.S. that had implemented a TDM program. As can be seen in this table, some of these employers have successfully reduced trip-making at their sites to very impressive levels. As can also be seen in this table, and which will be discussed later, most of the successful TDM programs have used a variety of incentives and disincentives associated with the individual TDM alternatives to reinforce the trip reduction behavior.

The next geographic level of application is at the subarea or corridor level. This application is primarily oriented once again to employer participation, but this time involving numerous employers and other groups that might have some interest in good transportation (e.g., developers, chambers of commerce, public transportation agencies, etc.). One of the organizational phenomena that has corresponded to the increased TDM application at the subarea or corridor level has been the creation of transportation management associations (TMA's). As of 1991, there were over 110 TMA's in the U.S. in various stages of operation [Ferguson, Ross, and Meyer, 1992]. Over two-thirds of these TMA's had been created as recently as 1988, and most were formed by developers or employers with the primary focus on implementing a TDM program to reduce traffic congestion in the TMA's commuter influence area [Ferguson, 1990].

The third area of application for TDM is at the regional level. At this level, the focus has been the use of TDM as one element of an overall congestion reduction strategy [Meyer, 1990] or as an implementing mechanism for legislation focused on such things as growth management or air quality. A typical example of a TDM alternative at this level of application is a trip reduction ordinance aimed at certain target markets. For example, Maricopa County, AZ, Sacramento County, CA, and the South Coast Air Quality Management District in California have specific reduction targets for employers with 100 or more employees. A similar requirement has recently been put in place in the State of Washington.

Trip Purpose

Another dimension for TDM markets is the trip purpose. The most important trip market for TDM application as it has been applied in the U.S. has been the work trip. This has been the market most easily identified as causing the greatest level of congestion on the road system, and one where the most alternative travel options are available (e.g., greater amount of transit service available during the peak hours). In addition, the institutional focus for TDM applications to the work trip has been the employer, a fairly well-defined organizational structure with capability of reaching the intended target market. However, recently there has been a growing concern about other types of trips. For example, can TDM alternatives be applied successfully for shopping trips or tourist trips? A recent study for the Maine Department of Transportation on Route 1, a heavy tourist-traveled corridor, illustrated some of the TDM alternatives and strategies that could be considered for this type of market [Vanasse Hangen Brustlin, 1993]. Some of the corridor-level TDM actions included a regional ridesharing program, an intercity bus service between two major cities in the corridor, improved bicycle and pedestrian facilities, and a highway advisory radio to provide tourists with better information on alternative modes. The local TDM actions, that is, those under the jurisdiction of local governments, included establishing a network of park-and-ride lots and initiating a shuttle bus service between the park-and-ride lots and shopping areas.

Figure 1 shows how the TDM travel markets can be viewed. This figure suggests that there might be very different TDM alternatives and strategies that could be successfully applied in each of these different markets. It also suggests that regional TDM applications often must work off of a foundation of TDM participation that occurs at lower levels of

Table 1. Characteristics of Employer TDM Programs

Program	Vehicle Trip Reduction	Travel Base	Type Area ¹	Preferential Reserved Parking	Restricted Parking	Parking Charges	Employer Support Levels			Legal Requirement	Employee Modal Split ²			
							Transit	Carpool	Vanpool		SOV	Transit	Carpool	Vanpool
Travelers	47.9%	10,000	CBD	YES	YES	YES	HIGH	HIGH	HIGH	NO	33%	36%	19%	8%
US West	47.1	1,150	SBD	YES	YES	YES	LOW	HIGH	NONE	YES	26	13	60	--
NRC	41.6	1,400	ISI	YES	YES	YES	MEDIUM	MEDIUM	NONE	YES	42	28	27	--
GEICO	38.6	2,500	SBD	YES	YES	YES	HIGH	HIGH	HIGH	YES	40	31	20	8
CH ₂ M Hill	31.2	400	SBP	NO	YES	YES	HIGH	HIGH	NONE	YES	64	17	12	--
State Farm	30.4	880	SBP	NO	NO	NO	NONE	HIGH	MEDIUM	YES	68	--	31	2
Pacific Bell	27.8	6,900	SBP	YES	YES	NO	HIGH	HIGH	MEDIUM	YES	63	2	22	11
Hartford Steam Boiler	26.6	1,100	CBD	NO	YES	YES	HIGH	HIGH	HIGH	NO	40	36	21	1
Swedish Hospital	26.1	2,500	ISI	NO	YES	YES	HIGH	MEDIUM	MEDIUM	YES	33	44	23	--
Bellevue City Hall	25.8	600	ISI	YES	YES	YES	MEDIUM	HIGH	MEDIUM	NO	62	7	29	4
San Diego Trust & Savings	22.7	500	CBD	NO	YES	YES	HIGH	MEDIUM	NONE	YES	44	37	14	--
Pasadena City Hall	21.0	350	SBD	NO	YES	YES	HIGH	HIGH	HIGH	YES	68	7	27	2
TransAmerica	20.0	2,700	CBD	YES	YES	YES	MEDIUM	MEDIUM	HIGH	YES	46	14	21	19
ARCO	19.1	2,000	CBD	NO	YES	YES	MEDIUM	HIGH	HIGH	YES	46	20	20	14
Varian	17.7	3,200	SBP	NO	YES	NO	MEDIUM	LOW	LOW	YES	62	8	21	3
AT&T	13.4	3,890	SBP	YES	YES	NO	LOW	MEDIUM	MEDIUM	YES	71	2	22	3
Ventura County	13.0	1,850	OSI	NO	NO	NO	MEDIUM	MEDIUM	NONE	YES	69	2	23	--
COMSIS	10.6	260	SBD	NO	YES	YES	MEDIUM	MEDIUM	NONE	YES	54	18	25	--
3M	9.7	12,700	OSI	NO	NO	NO	LOW	LOW	HIGH	NO	83	2	14	8
Allergan	7.0	1,250	SBP	YES	NO	NO	MEDIUM	MEDIUM	HIGH	YES	76	1	14	7
UCLA	6.6	18,000	ISI	NO	YES	YES	HIGH	LOW	HIGH	YES	74	6	10	6
Chevron	3.7	2,300	SBP	YES	NO	NO	HIGH	MEDIUM	HIGH	YES	82	1	11	6

¹ CBD – Central Business District; SBD – Suburban Business District; ISI – Inner Suburb, Isolated; OSI – Outer Suburb, Isolated; SBP – Suburban Business Park

² May not sum to 100% because of walk, bike, other.

application. This figure can also be used to identify where research is needed as it relates to different TDM market applications.

	Site	Subarea or Corridor	Regional
Work			
Shopping			
Tourist			
Other			

Figure 1. TDM Travel Market Definition

Fitting TDM Strategies to Markets

Different TDM alternatives have been used in different markets to influence trip-making behavior with varied levels of success. By combining the TDM alternatives and the TDM markets discussed later, we can see which types of TDM alternatives can fit with what type of market. Such a combination is shown in Table 2 (this table should not be considered the definitive statement of all the TDM alternatives and all of the TDM markets; it simply is presented as an example of how one can look at the combination of the two).

What has been the state-of-practice of TDM application in the TDM markets shown in Table 2? By far, the most evidence of success of TDM application has occurred at the site level and for the work trip. As was shown in Table 1, the individual employer level can be a very successful application if supported with strong motivational incentives and disincentives. Recently, the subarea/corridor level application has been the focus of several efforts, many under the guidance of transportation management associations. The level of success in this implementation environment has been less clear. In many cases, evaluations have not occurred of the trip reduction impact of subarea/corridor TDM efforts. The proposed ISTEA planning regulations for congestion management systems, however, have a very clear corridor focus on its application of TDM alternatives and strategies. Therefore, it is likely that this geographic application environment will become more important over the next few years.

Clearly, the market most devoid of TDM applications is the regional market, for all trip purposes. Very few jurisdictions (outside of California) have developed areawide or regional TDM programs whose intent is to reduce traffic congestion or vehicle miles traveled (the exception to this is the Los Angeles County Metropolitan Transportation Commission which is discussed in Section 4.0). The Clean Air Act Amendments of 1990 could change this for non attainment areas where transportation control measures might be applied to meet the area's emissions target. In most cases, however, outside the context of the Clean Air Act Amendments or of statewide growth management legislation, there have been few regional applications of TDM.

It should also be noted as well that the work trip has received the most attention in TDM programs. Very few examples can be found of tourist-oriented or shopping TDM programs.

ELEMENTS OF TDM PRACTICE

There are several characteristics of TDM programs that merit special attention when describing the state-of-practice. They include the different delivery mechanisms for TDM, the packaging of TDM alternatives and strategies, the approaches to marketing, the use of incentives and disincentives, and financing. Each will be discussed below.

Table 2 TDM Alternatives and Markets

	Site	Subarea or Corridor	Regional
Work	<ul style="list-style-type: none"> carpools vanpools public/private transit non motorized travel, including bicycling and walking alternative work hours site telecommuting parking management at site 	<ul style="list-style-type: none"> subarea rideshare coordination corridor improvements to provide HOV treatment parking management in area transit subsidies or service improvements in targeted area subarea telecommuting 	<ul style="list-style-type: none"> areawide rideshare coordination improvements to alternative modes, eg., transit, bicycles, etc. provision of preferential treatment for HOV areawide cost surcharges or subsidy measures areawide telecommuting trip reduction ordinances
Shopping	<ul style="list-style-type: none"> shuttles/transit subsidies pedestrian and bicycle access urban design teleshopping 	<ul style="list-style-type: none"> shuttles with park-and-ride lots teleshopping transit services 	<ul style="list-style-type: none"> teleshopping transit subsidies and special services
Tourist	<ul style="list-style-type: none"> shuttles parking management transit services 	<ul style="list-style-type: none"> park-and-ride lots parking management transit services/shuttles 	<ul style="list-style-type: none"> regional transit services marketing park-and-ride lots
Other			

Delivery Mechanisms

One of the most important elements of successful TDM implementation is having a strong institutional mechanism for planning and implementing a TDM program. The delivery mechanisms for TDM will vary again by the type of market that is being targeted. Table 3, for example, shows the different types of delivery mechanisms that can be found in the U.S. for the different application environments. Evidence from case studies around the U.S. suggests that as one reaches a broader application environment, the more important a consistent delivery mechanism is. For example, the trip reduction ordinance or growth management legislation requirements on travel behavior are necessary prerequisites for significant impacts at the regional scale. Similarly, at the site level, the delivery mechanisms can be more internal to the organization sponsoring the TDM program.

One of the reasons there are more site-specific TDM programs in the U.S. is that there are only a few locations that have a regional delivery mechanism that can be used for TDM program implementation. Those states that have growth management or air quality laws often have some form of trip reduction requirements that acts as the foundation of TDM program implementation. However, most states and metropolitan regions do not have such a foundation, and except in the context of the Clean Air Act Amendments, there do not seem to be many jurisdictions heading to put such a foundation in place.

The state-of-practice with regard to TDM delivery mechanisms, therefore, can be best described in the following manner:

1. The types of institutional mechanisms that can be used at the site level to implement TDM programs are fairly well known and have been used for many years. To a large extent, these delivery mechanisms have focused on the employer.
2. The most recent evolution in TDM delivery mechanisms has been the formation of subarea or corridor organizations that focus on providing mobility options to member organizations. The best example of this is the transportation management association.
3. The least developed delivery mechanism for TDM program implementation is found at the regional level. In those cases, where legislative imperatives (e.g., clean air or growth management) have intervened in the process, jurisdictions have created the mechanisms to implement TDM programs, for example, trip reduction laws.
4. As one goes from the site level to the regional level, the mix of participants varies dramatically. The site level TDM delivery is provided primarily by the employer, and most often the private sector employer. The regional implementation delivery mechanism is found most often in the public sector, although the major participants still lie in the private sector. The subarea and corridor applications are often very mixed in participation. In most cases, the institutional structure is dominated by private sector interests, but there are a few examples where state and local governments have also worked together with the private sector to provide overall direction to the TDM program.

Table 3 Example Delivery Mechanisms for TDM Programs

Site	Subarea or Corridor	Regional
Employer transportation coordinators	Transportation management associations	Trip reduction ordinances
Personnel department	Chambers of commerce	Adequate public facilities ordinances
Part time transportation manager	Transportation management districts	Growth management legislation
Voluntary participation	City or MPO transportation coordinator	State, MPO, or transit agency transportation coordinator
Negotiated traffic mitigation		
Site design		

Incentives/Disincentives

The first step in the process of changing people's travel behavior is to have available to them appealing alternative travel options. The previous paragraphs have described some of the alternatives that can be considered for different TDM programs. However, we know from TDM examples around the U.S. that it is not enough to simply make these alternatives available, but that incentives for their use (and disincentives for the auto) are necessary for the TDM alternatives to be successful. These alternatives have to be made attractive in their own right so that they become the mode of choice for travelers. In particular, the incentives and disincentives associated with TDM alternatives applied at the areawide level are an important part of the success of such programs. The following paragraphs describe the types of TDM strategies that have been used to support TDM programs.

The underlying theory of what mode travelers will choose suggests that there are certain characteristics of the chosen mode and of its competitors that are important to the traveler. To be effective, TDM strategies need to reflect these characteristics. Certainly, the costs associated with each mode are very important. These costs include such things as tolls, parking charges, and fares. In addition, the amount of travel time associated with each modal option is an important determinant in the selection of a travel mode. In addition to these "economic" considerations, travel choice is often influenced by other considerations such as convenience, personal attitudes, other trip making responsibilities during the day, and safety.

The following TDM strategies have been used in different parts of the U.S. to provide the necessary support to TDM alternatives so that they become more appealing as travel options. These strategies can be divided into three major categories: financial incentives, parking management programs, and time incentives in the form of priority treatment.

Financial Incentives. One of the strongest incentives that can be provided to a commuter is to reduce the cost of travel. Many ways of providing this cost reduction in a TDM program have been tried. Ridesharing and thus splitting the costs associated with the trip is an immediate cost reduction perceived by the travelers. However, this reduction in costs might not be sufficient to overcome some of the negative perceptions travelers have of carpooling. In such cases, additional financial incentives might be necessary, and these can take many forms. They can be direct cash transfers to users of the TDM alternative as an inducement, or they can be reductions in fees or fares associated with other TDM alternatives. There are three major types of financial incentives that have been used:

- Direct subsidies
- Transportation allowances
- Indirect financial incentives

Direct subsidies are financial payments that the user perceives as reducing the cost of travel. For example, such subsidies might include discounted transit passes, reduced or free parking for high occupancy vehicles, reduced tolls for vanpools, and cash payments for forming vanpools. These subsidies provide a positive economic incentive to shift from driving alone to alternative modes. In addition, they can also be used to target public policy initiatives to certain population groups or geographic areas. For example, the Commonwealth of Massachusetts developed a program of subsidizing new vanpools \$185 per month for 12 months for vans that originated at or were destined to communities along Route 128, a major congested beltway around Boston. This program was part of a comprehensive program to reduce congestion on this important regional highway. In a two year period, over 60 vanpools were formed.

As illustrated in this Massachusetts example, vanpool programs have been a major beneficiary of direct subsidy programs. Other types of subsidies provided on an areawide basis, often by government programs, include:

- Users lease vans from areawide agency at reduced costs
- Vans are insured and maintained by third party
- Agency assists in providing riders for the vanpool
- Free parking or reduced tolls are provided to vanpools

Many transit agencies have developed comprehensive fare programs for employers in their service district. Some of the measures have included monthly or weekly passes which provide easier access to the transit system at a discounted price, free fare in central business districts, "free" ridership days, establishing a peak/off peak fare differential to encourage more discretionary trips to be taken on transit during the off peak, fare simplification, restructuring the fare basis (e.g., going to a distance-based fare rather than a flat fare) and employer fare subsidy programs. These measures can often provide important benefits to the transit agency. For example, a downtown fare free zone in Seattle is estimated to have reduced congestion by two to four percent in the downtown area. A free fare in off-peak hours demonstration in Denver resulted in a 50 percent increase in off-peak ridership. A reduced fare during holiday seasons promotion in Long Beach resulted in a 30 to 40 percent increase in ridership on these days.

Transportation allowances are regular, periodic payments provided either as a cash payment or a one-time income adjustment. The transportation allowance is perhaps the best way of influencing the mode choice decision of an individual traveler. Employees are given a basic transportation stipend each month, set often at a level that equals the price of parking at the site. The employee can use this sum to park at the site, or the money can be used to pay for other, much less expensive TDM alternatives. The employee pockets the difference. This TDM strategy directly affects the traveler's decision where it is most important—the cost.

TDM programs can offer users other non-cash rewards for participating in the program, rewards that have economic value to the user. These include providing extra vacation time for users of ridesharing programs, awarding of points that can be redeemed for merchandise at local stores, and free or discounted equipment such as walking shoes and bicycles. These indirect financial incentives are not often part of an areawide TDM program, but rather become characteristics of individual programs established in response to a TDM program mandate.

The supply and pricing of parking is one of the most important factors that influences travel behavior. And in very few cases (downtowns being the exception), parking supply and pricing is not managed for the purposes of influencing mode choice. The areawide nature of parking supply lends itself naturally to being a component of an areawide TDM program. This areawide application would be required for two major reasons: to make sure that parkers would simply not leave "controlled" parking lots and use nearby "uncontrolled" lots; and to establish a level of equity for all employers in the area so that free parking cannot be used as an unfair advantage in attracting business or employees.

A parking management program is any plan by which parking space is provided, controlled, regulated, or restricted in any manner. This includes both on-street and off-street parking and parking provided at peripheral locations to intercept commute traffic coming into the congested area. Parking management programs can include three major elements:

- preferential parking for ridesharers
- parking pricing
- parking supply reductions

Both the pricing and supply reduction strategies can be very controversial. Developers and the financial institutions backing the developments expect to see sufficient and easily accessible parking to the development site. Even if the local community agrees to allow reduced parking in the zoning code, the financial arrangements surrounding a potential site could become a significant barrier in implementing such a policy.

Time Incentives. Next to cost, the amount of time traveling to a destination is one of the most important considerations in choosing a mode of travel. A less costly travel alternative will not necessarily be that appealing if the additional time it takes to reach the destination by that mode is considered too great. One of the ways of making TDM alternatives more attractive is thus to reduce the travel time associated with their use. This is most often done by providing preferential treatment at congested locations for high occupancy vehicles. This is one of the supporting TDM strategies that is directly under the control of the public sector, and one that is often considered as part of a TDM package.

Typical time-related improvements that relate to these different trip times include such things as increasing the coverage of transit service so that users do not have to walk or drive as far, increasing bus frequency so that waiting time is decreased, establish coordinated route transfers to assure that vehicles arrive within a reasonable amount of time of each other, and enhancing the relative advantage of one mode versus another. The most used means of doing the latter is to provide preferential treatment for high occupancy vehicles. In addition to the actual time savings associated with the use of HOV lanes, recent research has suggested that the mere existence of the lane is an important consideration for potential ridesharers.

Another location in the road network where congestion can significantly add to the travel time of a typical commute is the access points to the network. The specific types of measures that can be considered here include bypass ramps at ramps, or the construction of HOV-only ramps onto the freeway, and similar bypasses at other access points such as toll booths or garage entrances and exits.

The state-of-practice in using incentives and disincentives in TDM program implementation varies significantly around the U.S. However, one statement can be made with some certainty. TDM practice to date clearly points to the use of incentives and disincentives as a critical ingredient in the overall success of TDM programs. In addition, case studies from around the U.S. suggest that unless required by law, very few subarea or regional TDM programs have associated with them incentives or disincentives that significantly hinder the use of the automobile. For example, the disincentive that would probably have the most impact, the pricing or limitation of parking, is not found in many TDM applications at the subarea or regional level. Such use is found at the site level where the employer has control over the land and indirectly over the travel behavior of the employees. Where such disincentives require public sector action, and where they require public or political consensus, their use has been quite limited.

Marketing

Each of the alternatives and strategies described above will only be effective if commuters are made aware of them, and of the relative advantage over using the automobile. At the very least, information dissemination on the alternatives available to commuters is an important step. This could include establishing a central phone number for information relating to all travel options in an area including the schedules of transit service. Another action includes establishing an employer transportation coordinator program which provides each employment site with individual trip planning assistance and markets commute trip options inside an employment site. In fact, most trip reduction ordinances and regulations require employers to select and train such a coordinator.

Of particular importance to ridesharing programs (and also a bicycle incentive) is the existence of a guaranteed ride home program. Surveys of those who did not use ridesharing services indicated that one of the most important concerns for potential ridesharers is the fear that they will get caught at work without any means of responding to a family

emergency. In response, many rideshare programs have begun to offer a guaranteed ride home if such an emergency arises. This guaranteed ride would entail the use of fleet vehicles, taxis or even rental cars. The guaranteed ride home offer has led to an increase in the level of ridesharing where it has been instituted. Evidence also shows that the guaranteed ride home program has not been used by employees for frivolous trips.

As noted in a recent report, the primary application of marketing and complementary programs such as guaranteed ride home is to the home-to-work commuting market [Comsis, 1993]. Such programs have little application outside of the work site. The general experience with marketing is that, given its importance to changing travel behavior, most TDM programs begin immediately with some form of marketing effort. The key element to successful marketing efforts, however, has been to develop an institutional mechanism for marketing TDM alternatives in a setting most comfortable to the target audience. For example, having an employer's transportation coordinator being the focal point of marketing and TDM information for that site is more effective than having a third party play this role. Although practice varies from one region to another, the state-of-practice of TDM seems fairly strong as it relates to marketing efforts. Although marketing efforts at a regional scale have been tried in many urban areas, there is little evidence as to their effectiveness.

TDM Packaging

The packaging of TDM alternatives and strategies to form an effective TDM program is a concept that has been discussed for many years (see, for example, [ITE, 1990]). As has been discussed in previous sections, there are many TDM program examples at the site level, and increasingly more at the subarea level, which have a variety of alternatives and strategies being applied. Two cases illustrated the concept of how TDM alternatives can be packaged to develop a TDM program for a particular area.

Brentwood, Tennessee, located close to Nashville, has experienced significant growth over the past decade. A transportation management association, consisting of major employers and public agencies, was formed in 1988 to address the serious transportation problems facing the area. Since then the Brentwood Area Transportation Management Association (BATMA) has helped develop a traffic model that could be used to analyze traffic problems in the area, conducted a parking utilization study, participated in a bike trail and commuter rail study, developed a computerized rideshare program, brokered vanpools, organized a guaranteed ride home program, created marketing materials including a newsletter that reaches 7,000 employees, developed an employer transportation coordinator program, developed a request for proposals for a subscription bus service, participated in a major freeway reconstruction mitigation effort, and lobbied successfully for a reduced parking ordinance.

Medical Area Service Corporation, was formed by the medical institutions in the Longwood area of Boston. Formed in 1972, MASCO is one of the first private, for-profit organizations created to handle transportation problems for a particular area. One of its first tasks was to locate off site parking locations coupled with shuttle bus services to handle some of the travel needs of the 30,000 employees and students that travel to and from the area each day. MASCO began operating the bus shuttle when service did not meet the standards established for it, and since then MASCO has expanded into rideshare matching services, preferential parking for vanpools, shuttle services to and from rail stations, transportation coordinator programs, and traffic analyses (with its own staff) of impacts of new developments. Perhaps unique for an organization of its kind, MASCO has recently become a developer of a mixed use development site which includes a 750-car garage. One of the reasons for this role was to allow MASCO to establish a parking management/pricing program for these parking spaces that would equitably serve the area.

A recent survey of transportation management associations identified those services most often provided by such organizations. The survey results are found in Table 4 and illustrate the state-of-practice of TDM services at the subarea/corridor level.

Table 4. Frequently Offered TMA Products and Services

	% of TMAs
<u>Information and Assistance</u>	
Car/vanpool matching information	96
Transit route information	88
Computerized matching assistance	83
Transit scheduling information	77
Personalized matching assistance	73
Professional coordinators	67
New hire orientation meetings	54
<u>Program Operations</u>	
Guaranteed ride home	71
Vanpool operations	63
Buspool programs	38
Fleet pool programs	19
<u>Alternative Work Hours</u>	
Flexible work hours	56
Staggered work hours	52
Adjustable hours for ridesharing	46
Compressed work weeks	46
<u>Convenience Incentives</u>	
Carpool preferential parking	58
Vanpool preferential parking	58
On-site transit pass sales	50
Shuttle buses for midday use	46
Fleet vehicles for midday use	29

Note: 110 TMAs responded to the survey.

Source: [Ferguson, Ross, and Meyer, 1992]

The concept of packaging TDM alternatives is well accepted by the profession. However, there are two important aspects of this packaging process that merit special attention in that they define the major deficiencies in the state-of-practice with regard to TDM packaging. The first element is the packaging of TDM alternatives without considering improvements to the transportation system that might be needed to make the TDM program more successful, and vice versa. A good example of this is a TDM program aimed at reducing congestion in a particular subarea, but without considering the intersection improvements, highway signing, preferential ramps or driveways, or additional transit services that might be necessary. In other words, the state-of-practice seems to be one which separates the strategies aimed at modifying demand from those aimed at providing infrastructure improvements that could support these strategies. A good example of the reverse is the designing and opening of a high occupancy vehicle lane without giving much thought to the supporting TDM strategies (that could be applied at the subarea/corridor or regional level) that would make sure the HOV lane was used. There are several examples of such situations around the U.S.

The second element of the packaging process that is important to note is that the packaging of TDM alternatives is often done without much analysis given to what combination of alternatives makes most sense. There are many examples of TDM programs which include a variety of alternatives, such as vanpools, carpools, transit subsidies, parking surcharges, and heavy marketing. However, case studies of these examples have indicated that the different TDM alternatives and strategies brought together in this program often evolve incrementally over time, or were simply used because this is what other programs had used. Little analysis was often done to determine which alternatives would provide the greatest impact for the amount of money spent implementing the program.

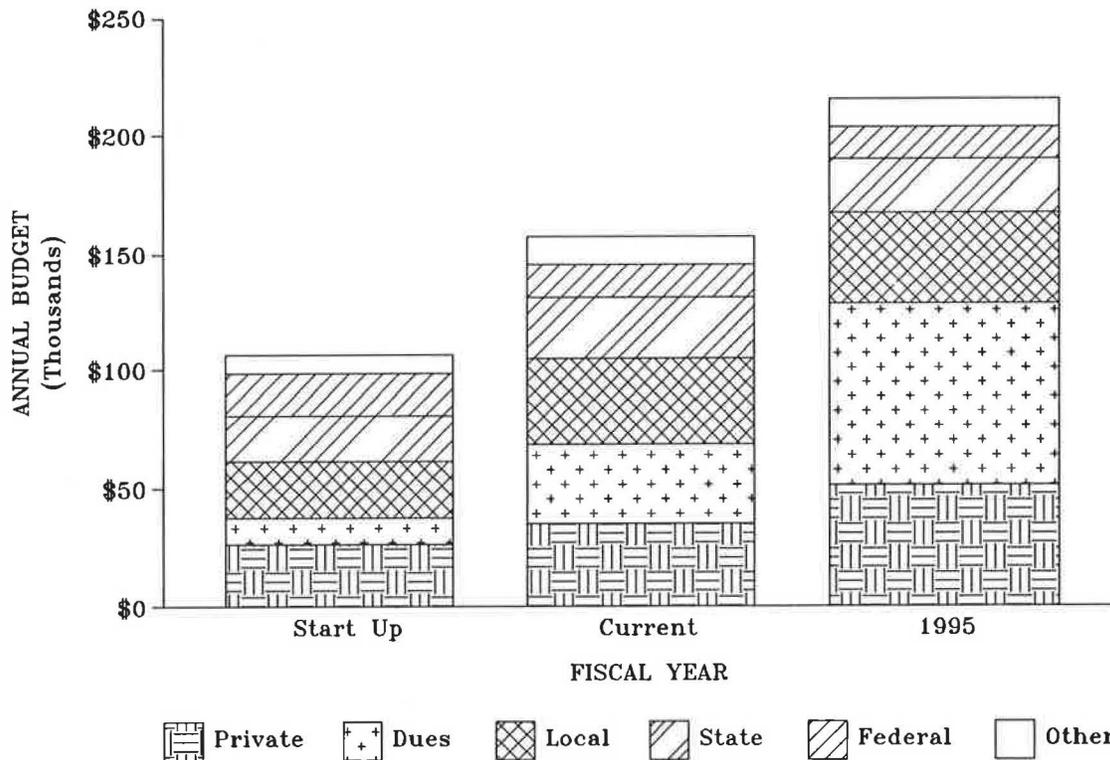
Financing

The state-of-practice for TDM financing is very difficult to gauge. At the local level, employers who are involved in TDM fund the cost of operation out of the general budget. There is very little information in the literature on what these costs are. At the subarea/corridor level, the information is available on type of funding that is used to support TMA activities. Figure 2 shows the different funding sources for these operations. One of the interesting aspects of this figure is that state funds are often used to support such activities. One of the important characteristics of TDM funding in many parts of the country is that the funding sources for TDM implementation include both the private and public sectors.

At the regional scale, the source of funding for TDM projects falls mainly within the traditional sources of funding for transportation projects. The ISTEA provided greater flexibility in funding TDM alternatives, and for non attainment areas, in particular, the congestion mitigation and air quality (CMAQ) funds are an important source of funds for TDM projects. There is some evidence to suggest, however, that the first year's use of the CMAQ funds emphasized traditional transportation projects. It would seem then that TDM projects need to develop stronger regional constituencies for them to compete successfully with long-standing project selection priorities.

LOS ANGELES COUNTY CASE STUDY

The following case study illustrates many of the points made previously about TDM applications in a complex environment. The Los Angeles case was chosen because it is one of the few TDM programs in the U.S. being implemented at a regional scale. As such, it represents one of the more difficult environments for TDM applications.



Dues and other are mainly but not exclusively private sources of funding. Local, state and federal are public sources of funding.

Figure 2. TMA Annual Budgets by Source of Funding

The Los Angeles County Metropolitan Transportation Authority (MTA) has developed a comprehensive Transportation Demand Management (TDM) program designed to assist the eighty-eight cities in Los Angeles County in meeting their responsibilities to implement Transportation Control Measures (TCM) in accordance with the 1991 Air Quality Management Plan (AQMP) for the region. In addition, the program was designed to meet the California requirements for the implementation of Congestion Management Plans (CMP) to address mobility deficiencies caused by new development. The development of a comprehensive approach to meet both sets of mandates in one program has not been attempted elsewhere in the region.

Phase I of the program began in June 1992 and includes the implementation of 101 different demonstration projects through the county. The Board adopted program objectives were:

To demonstrate and quantify the cost-effectiveness of TDM strategies in reducing congestion by eliminating peak period trips, reducing vehicle miles traveled on the regional system, and reducing emissions.

To promote new and innovative approaches to relieving congestion.

To encourage cooperative implementation agreements between cities, and TDM and transportation providers.

To promote and stimulate interest in intermodal and multi-modal approaches to addressing congestion.

Phase II includes a TCM quantification methodology unique to Los Angeles County, cost-benefit assessment information, and emissions reduction estimates incorporated into a program which meets all federal, state, and regional air quality requirements. Dual goals of the program are to provide an option to local jurisdictions to regional regulations governing the implementation of TCMs, and to gain broad based acceptance by local jurisdictions that demand side solutions to transportation problems exist and should be seriously considered for implementation. This phase of the program is in the final stages of development with completion scheduled for Fall 1993.

This case study will address the initial phase of the program and will provide information on project selection criteria, delivery mechanisms, funding sources, evaluation efforts, marketing issues, and a perspective on future efforts to implement TDM/TCM strategies in Los Angeles.

Project Selection Criteria

The Los Angeles County Transportation Commission (LACTC) (predecessor to the MTA) adopted criteria for project selection and funding which included both quantitative and qualitative criteria. Project applicants were requested to address the criteria in their applications and the MTA staff evaluated and ranked proposals prior to presentation to the Board for approval. The criteria were:

Regional Significance: This criteria was intended to assess the demand for the project and the expected congestion relief and mobility improvement benefits. Possible measures included: daily trips eliminated, reduction in VMT, and number of new persons served. In addition, the project sponsors were asked to describe whether the project, if successful, could be replicated elsewhere in the County. It should be noted that the applicants made their own estimates of the benefits of their projects. MTA staff reviewed these estimates but did not change them as they had intended to measure the actual effectiveness of each project against these projections upon project completion.

Intermodal Integration: Applicants were requested to describe the degree to which the project would integrate alternative transportation modes (i.e., feeder services to regional bus or rail system).

Cost Effectiveness: The applicants were requested to calculate the estimated cost/benefits of the project using the unit of analysis selected to assess regional significance. In addition, cost reduction opportunities were to be assessed if the project created options for service delivery which were anticipated to be more cost effective than those in place at the time.

Project Need: The applicant was asked to describe how the project would fulfill transportation needs and whether the project represented a new and/or innovative solution to the transportation needs of employees, patrons, and residents of the jurisdiction it would serve.

Environmental Enhancement: The applicant was asked to describe how the project would address MTA long term planning efforts to encourage mode shift or satisfy TCM requirements of that jurisdiction.

Equity and Economic Development: The applicant was requested to estimate the tangible benefits that could be realized during the course of the project and how the project would be coordinated with other programs, (i.e., housing, jobs, redevelopment).

Commitment: The applicant was asked to describe the level of local commitment to the project once MTA funding is exhausted and what local matching funds they would commit to the project.

Leverage of Funding Sources: The applicant was asked to calculate the cost/benefit of the project under two scenarios: cost per trip reduced based on only MTA share of funding, and cost per trip reduced based on the entire project budget.

One additional criterion was that no long-term commitments be made to funding any of the projects. The Board wanted the discretion to evaluate the projects upon completion so that ineffective and costly projects could be discontinued. Thus, all projects have a discrete schedule ranging from six months to two years with most projects having a eighteen-month to two-year schedule.

Consistent with the MTA's desire to assist local governments implement TCMs as required in the regional Air Quality Management Plan (AQMP), most of the 101 projects which were selected specifically address one or more of the TCMs listed in the Clean Air Act Amendments Section 108(f)(1)(A). All projects are required to have a marketing component and all project sponsors are required to collect basic data which will assist the MTA in evaluating the effectiveness of the projects. In addition, a separate third party evaluation process is underway on a limited number of projects and will be discussed later in this paper. Attachment A provides a listing of the 101 projects and brief description of each project.

Delivery Mechanisms

Cities were encouraged to submit project applications for funding and also urged to work with TMA/TMOs, transit operators, neighboring jurisdictions, the private sector, and other TDM providers to facilitate implementation of projects. Below is a chart identifying the sponsoring entity of the 101 projects:

Cities and County Sponsors:	51 percent of projects
TMA/TMOs Sponsors:	30 percent of projects
Public Agency Sponsors:	16 percent of projects
Other Sponsors:	3 percent of projects

In many cases, services provided through the project are contracted to a third party. In some cases, sponsors are contracting for consulting assistance to assist in carrying out the project.

As many of the projects are funded in part with federal funds, the projects sponsors had to learn about and comply with various requirements regarding use of those funds. This has slowed progress in the initiation of certain projects but as sponsors fully understand federal requirements, these types of delays will be rare.

Financing

In all cases, local matching funds were required as a criterion for project selection although no prescribed proportion of matching funds was mandated. The total budget for all projects is \$54 million with \$12.5 million in local matching

funds with the balance a combination of federal Congestion Mitigation and Air Quality (CMAQ) and local sales tax funds which are dedicated to transportation improvements in Los Angeles County.

The securing of federal CMAQ funds for the program was a lengthy and cumbersome process due, in part, to the fact that the CMAQ program had just been created as part of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and that the Federal Highway Administration (FHWA) regional office had never evaluated such a diverse group of TDM projects. Further, federal guidelines on the CMAQ program were issued after the projects had been approved at the local, regional, and state levels thus making the job of FHWA staff difficult.

As part of the process of obtaining CMAQ approvals from FHWA, the MTA had to estimate the air quality benefits of each project for FHWA evaluation. Attachment B presents an overview of the estimated benefits of the first sixty-five projects submitted for federal approval.

Evaluation Program

At staff's recommendation, a condition of the original approval was that a third party, independent evaluation effort would be undertaken in order to objectively assess the impacts of these projects. In addition, staff intended to compare the original estimates of impacts with actual results.

The MTA contracted with four consulting teams for this work, however, shortly after contract execution, the new CEO was requested by an outgoing Board member to substantially reduce the evaluation budget. Subsequently, the evaluation budget (approximately 5 percent of the total program budget) was reduced by 75 percent and rather than evaluating all projects, twelve projects were selected to remain in the third party evaluation process. All other projects will be evaluated to the best of staff's ability. However, MTA staff is concerned with the lack of an objective and methodologically sound evaluation process for the majority of projects given the necessary reliance on sponsor provided information.

The evaluation criteria for all projects include: cost effectiveness, participation rates, vehicle trips reduced and vehicle miles traveled reduced. The projects which remain in the third party evaluation process will also be evaluated explicitly in terms of qualitative criteria such as the circumstances enhancing or hindering a project's potential transferability.

Qualitative criteria for internally evaluated projects will also be assessed to the fullest extent possible. For these projects, the regional Regulation XV database will be used as a surrogate for baseline and control data, to match employers by project according to several parameters including:

- Employment size—number of employees
- Employment type—by Standard Industrial Code
- Location—according to three primary locations: CBD with a Regulation XV AVR target of 1.75; outlying areas with a target AVR of 1.5; and remote areas with a target AVR of 1.3
- Job categories—professional, vs. clerical, etc.
- Mode split

Thus, while the availability of credible and objective evaluative information was originally envisioned to be a key outcome of the Phase I program, much less comprehensive information than originally hoped for will be available at the completion of these demonstration projects. This has, in part, affected the development of the Phase II program as staff had depended on the results and data from Phase I to guide future TDM investments by the MTA.

Case Study Conclusion

The MTA program represents an ambitious approach to implementing a county-wide TDM program in a complex political and institutional environment. While the MTA and its predecessor agency have invested in TDM strategies on a limited basis for several years, very little quantitative or objective evaluative information exists in the County or in the

region. The MTA is truly experimenting on a variety of fronts with this program: multiple delivery mechanisms; two distinct evaluation processes; a host of different funding sources; and the entire concept behind the Phase II program which is designed to consolidate a host of government transportation and air quality mandates into an optional program for city implementation.

Notwithstanding air quality and congestion management program mandates, the future of the program and of the MTA role in funding and implementation of non-infrastructure related TCMs and TDM strategies is uncertain at this time. In August 1993, the budget reserve for the Phase II program for the fiscal year beginning in June 1994 was reduced by 75 percent over the next three years due to financial problems of the MTA.

The lack of political constituency on the MTA Board for the TDM program may seal its fate. This is further exacerbated by the Catch 22 situation staff finds itself in: in order to build the political constituency, evaluative information is needed; yet, evaluation in a truly sound methodological and objective manner requires funding. Thus, it will be interesting to follow the MTA program as it winds its way through the dynamic and complex world of transportation investment decision-making in Los Angeles County.

IMPORTANT FACTORS FOR SUCCESS

As has been described in previous sections, TDM has seen varied success around the U.S. One of the most important factors in the success of TDM, no matter at what level of application and in what travel markets, is the thoughtful consideration of the steps needed to implement the program, and the identification of strategies to carry out this implementation. Without careful consideration of how the implementation of each strategy relates to all the other actions in the package, and to the perceived benefit of key participants, the overall program could very well fall victim to a lack of commitment and interest.

A recent study of suburban mobility options in Pennsylvania identified several barriers to successful implementation of TDM in that state [Comsis, 1991]. Because these barriers are common in many parts of the country, they are included here as examples of the types of barriers that need to be overcome.

1. There is no current requirement for local areas to consider or engage in Transportation Management programs.
2. There is no existing body to effectively champion or implement a Transportation Management program.
3. Existing legal and regulatory powers of municipalities or derivative management organizations are inadequate to implement or enforce Transportation Management programs.
4. Funding for transportation programs that incorporate Transportation Management is inadequate or restricted.
5. There are currently no incentives (programmatic, social or economic) to businesses or individual travelers to alter their behavior and practice Transportation Management.
6. Organizations that would perform Transportation Management planning or program operation lack complete understanding, tools, and training.
7. Successful implementation of Transportation Management ideas and programs is greatly impeded by misunderstanding and negative attitudes on the part of the public, the business community, elected officials and transportation agencies regarding the nature of the transportation problem and the mixture of actions which are necessary to solve it.

These seven barriers can be further classified into three major areas where obstacles to implementation seem to arise: *motivation, empowerment, and perceptions*. Each of these is discussed below.

Motivation: TDM actions often represent substantial change from existing norms of behavior. This change could occur in organizational philosophy, approaches to finance, the process of decision-making on land use, infrastructure or transportation service provision, and, most fundamentally, in individuals' travel behavior. Change is often difficult to achieve. And thus, some form of motivation is necessary to achieve desired change. With relation to TDM, this change might focus on the developer to design a project that is conducive to TDM; the employer to find alternative ways for employees to travel to work or to locate in an area where employees will have the best travel and housing options; the individual traveler to consider using an alternative to driving alone; and the household to take advantage of residential locations that minimize commute distances and maximize availability of alternatives.

At its most basic level, the motivation for TDM participation is primarily one of self benefit. By implementing a TDM program, will the participants meet the requirements of a state or local statute and thus avoid the sanctions and/or embarrassment of non-compliance? Or, will the TDM program greatly ease the congestion problem in an area and thus make the commute easier? Or, by encouraging multi-occupant vehicle commutes, can the capital expense of future parking expansion be avoided? No matter what the reason(s), the participants in a TDM program must be motivated to participate.

The key challenge to those who are the initiators of the TDM program must be to motivate other participants to join the program. To do this, one must ask what is likely to motivate participation? What services are to be provided to participants that they might feel are beneficial? Or, what negative implications of non-action need to be emphasized to convince possible participants?

Private employers and corporate managers are key participants of TDM programs. Because the organizational culture of these participants is based on responding to top management direction, the successful inclusion of these participants in a TDM program requires that top management be committed to the program. Often, meetings are held early in the formulation stage to simply enlist top corporate support for TDM programs. The importance of these meetings thus rests in convincing corporate leaders of the importance of their participation and in sending this message to those subsequently responsible for implementing individual corporate elements of the program. The corporate leaders must be able to determine clearly what benefits will accrue to their company by participating in the program. In other words, they must be motivated. And, as the TDM program evolves over time, this motivation might change. For example, corporate leaders located in a high growth, congested area might enthusiastically endorse a transportation management association that is primarily involved in ridesharing activities. However, as congestion lessens or economic circumstances requires corporations to cut back their number of employees, the TMA might have to refocus its services and, once again, motivate corporate leaders to participate. There is some evidence to suggest that this is exactly what is happening in those areas of the country facing a downturn in economic conditions.

Providing motivation presupposes that there is some group able to do so. Experience with TDM programs around the country shows that the most successful programs are those which have some local body or corporation which is willing to champion a TDM program. It is usually this champion that provides the initial outlay of entrepreneurial energy which rallies other groups to participate. Public agencies are often not able to serve in this champion role. Many public agencies must work within existing institutional confines, or have restrictive geographic venues. Some governments lack sufficient power to direct other governments, or to work across jurisdictional boundaries. In addition, government agencies often have no effective means of involving the private sector in its activities. Finding a champion in such an institutional structure who can then motivate other participants is probably the most important obstacle that must be overcome in the implementation of TDM programs.

Empowerment: Once there is agreement among the participants to form a TDM program, there needs to be political, organizational, technical or financial capabilities that empower the participants to carry out the program. For example, a review of TDM programs in the U.S. indicated that the existence of a local TDM ordinance is a key factor in the successful implementation of TDM programs [U.S. DOT, 1993]. Without such empowerment, local interests have a weak basis for generating support behind such a program. Likewise, inadequate legal and regulatory powers of municipalities or management organizations to implement or enforce TDM programs is a significant detriment to implementation. The Pennsylvania review referenced earlier conducted an assessment of such powers in municipalities

in Pennsylvania and found that insufficient municipal powers were a serious obstacle [Comsis, 1991]. In particular, the limited powers were found in the following areas:

- Counties offer planning support, build roads, and provide advisory recommendations, but have no control over municipal zoning decisions.
- Neither the county nor municipality, once zoning is in place, can effectively restrict or phase development in relation to adequate transportation facilities.
- Local municipalities/counties lack the power to levy taxes or assess fees for anything but adjacent transportation improvements; recent changes to the state law on impact fees appears to have taken away the municipalities' ability to negotiate with developers for needed actions.
- Local municipalities/counties are unable to enact ordinances to control traffic generation at development sites, or enforce those actions if implemented.

Along with political or regulatory empowerment, funding is another important resource that allows TDM participants to implement an effective program. Although TDM strategies are often considered low-capital actions, funds are still necessary to provide the initial investment in planning or marketing that serve as the foundation of a good TDM program. And, in other cases, strategic transportation projects (a park-and-ride lot) or services (bus shuttles) might be necessary to make the program work. Some of the most effective TDM programs have occurred where the state government, most often the state department of transportation, has provided matching funds to locally generated contributions.

Another form of empowerment is the technical skills necessary to analyze, develop and implement a successful TDM program. As found in the Pennsylvania study, important skills and capabilities include:

- Understanding the nature of the suburban mobility problem, the trends and relationships which have produced the problem, and consequently why new highways alone cannot solve the problem.
- Having a basic understanding of the relationship between land use patterns, auto dependency, and travel behavior.
- Being aware of the "menu" of Transportation Management options, and having a sense of the travel markets/situations where they are most applicable; separating traditional perceptions about the appropriateness of particular solutions from objective evidence.
- Having the technical tools, information and training to properly evaluate the effectiveness of the different options.
- Having knowledge of how to manage the "process" of Transportation Management, in terms of organizational development, education, outreach and promotion, consensus building, implementation and sustenance of the effort."

When such technical capability does not exist, TDM advocates often have a difficult time showing the benefits of the program and in developing the most effective application. Although technical resources are most important in the initial formative stages of a TDM program, the ongoing effectiveness (and mid-stream corrections) of TDM programs often require constant technical analysis and evaluation.

Perceptions: There is often a great misunderstanding on what TDM can accomplish, and perhaps an even greater misunderstanding of what the different actors involved have to offer. In particular, in those situations where the TDM program involves the participation of both private and public sector representatives, there can be serious misperceptions of the motivations and roles of each group [Gordon and Meyer]. Even within each sector, there are often preconceived notions on what different actors will likely contribute to the development of the program. Highway agencies are viewed as wanting to expand highway capacity. Transit agencies are viewed as mainly interested in providing fixed-route bus service. Planning agencies are viewed as global thinkers, with little ability to contribute to operations-oriented strategy formulation. Developers are perceived to be mainly interested in profit. Employers are considered to be unconcerned with employee transportation. Many of these preconceived notions must be overcome before any concerted effort can be undertaken in developing a successful TDM program. Put simply, such a program requires the participation of all of the groups mentioned above. Communication, understanding, and a willingness to compromise are key ingredients to successful implementation.

Overcoming the barriers or challenges to implementation requires a strategic perspective on what steps need to be taken and who needs to be involved [Lloyd and Meyer, 1984]. In particular, the development of a successful package of TDM strategies requires more than just the identification of the individual actions and perhaps the creation of a special organization to oversee their implementation. All too often, the TDM package consists of actions that were considered most easy to implement. What is needed is a process that results in a good understanding of the magnitude of the program and thus the level of TDM application that is necessary. However, combined with this process should be an institutional analysis which systematically identifies barriers to implementation for each action in the TDM program and assesses a range of strategies for overcoming the barriers.

Although the identification of strategies to overcome implementation barriers is specific to a particular context, there are some strategies that have been used to implement successful TDM programs that merit special attention. These strategies will be discussed as they relate to the three major areas of barriers described above.

Motivation: Motivation can be provided in many different ways, using both the “carrots” and “sticks” approach. Certainly, creating a *statute* or using existing *regulatory authority* to establish mandatory participation in a TDM program is one way of “motivating” participants. Air quality legislation is one example of such an approach. However, in those areas that do not currently have such a statute, the process of developing one and gaining political acceptance is often difficult, mainly because such statutes or regulations are often tied to the land use decision-making process. And adding requirements to the development review process can become very controversial. Successful passage of such statutes usually occurs in those cases where proponents are able to appeal to a large number of constituencies, environmentalists, neighborhood associations, public finance representatives, planners, and often the business community itself.

In combination with the statute/regulation, or indeed even in their absence, TDM proponents need to look carefully at what *economic incentives* can be used to interest possible TDM participants. Examples of such incentives that have been used in different parts of the country include receiving government grant funds to initiate TDM activities, receiving “bonuses” on development review for having a TDM strategy as part of the proposal, giving priority to the implementation of strategic transportation projects that are part of an overall TDM program, and receiving ongoing funding for certain types of services or projects if TDM participation is maintained (e.g., government subsidy of vanpools).

Although not a form of economic incentive, evidence suggests that psychological incentives can also be used to motivate participants. For example, in one case, a letter from the governor of the state asking for corporate participation in a corridor-level TDM program was cited by many employers as the reason for their participation [Meyer]. Being asked by your peers is another strategy used to obtain participation. If a letter from a governor won't do it, what about a letter from a chief executive of a nearby corporation? As noted earlier, one of the first steps often taken in the initiation of TDM programs is to have a meeting with all top managers of corporations in the affected area so that they can hear their peers explain the benefits of participating.

Empowerment: Providing the TDM program with the political, organizational and technical resources needed to be successful requires a careful examination of what resources are necessary and who should control them. Certainly, the statutory and regulatory requirements that motivate participation also empower the TDM participants to aggressively pursue their goals.

RECOMMENDATIONS FOR RESEARCH

TDM research recommendations should be based as much on an assessment of historical deficiencies as on the likely future imperatives caused by expected demands and environmental influences. In the case of TDM, this paper has identified several gaps in knowledge relating to TDM applications in different travel markets. Of some interest to this conference, these gaps seem to correspond to likely future needs and requirements. The Clean Air Act Amendments place a great deal of emphasis on regional application of TDM actions. In fact, in the case of nine serious ozone nonattainment areas, employee trip reduction programs are mandated. The proposed ISTEA planning regulations relating to congestion management systems also place emphasis on TDM strategies, with particular attention given to corridor-level applications. All of this leads to the following areas of recommended research.

1. Identify and assess packages of TDM alternatives that can be applied at the subarea/corridor and regional levels to maximum effect. This would entail not only evaluating likely impacts, but also the needed institutional structures and incentive/ disincentive programs necessary to implement such a program.
2. Develop case studies of best practice at the subarea/corridor and regional levels to showcase efforts that have succeeded.
3. Investigate alternative institutional configurations for implementing subarea/corridor and regional TDM programs. This would include identifying innovative funding strategies for TDM programs at this level of application.
4. Assess the effectiveness of TDM applications in non-work travel markets. Of growing importance are TDM applications in tourist areas.
5. Conduct longitudinal studies of the nine nonattainment areas implementing employer trip reduction programs to assess program effectiveness.
6. Conduct market research and customer focal groups in those TDM travel markets not well understood.

Perhaps most importantly, ISTEA and the Clean Air Act Amendments have established a new environment for TDM implementation. Given that much of the TDM success in the U.S. is associated with borrowing from experiences elsewhere, it might be quite useful to identify several cities which are "market leaders" and can serve as models for other cities. These cities could be the target of demonstration programs, or simply monitored over time to show what progress is being made. The analogy that is most useful here is the concept of an operational demonstration that is being funded under the IVHS program. These demonstrations are aimed at testing the technology, as well as gaining customer acceptance of the new applications. The need is identical for TDM.

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DEMOGRAPHICS AND MARKET DEFINITION

Brad Edmondson, American Demographics

INTRODUCTION

Despite substantial efforts to promote ridesharing and mass transit, the proportion of employed Americans who normally commute to work alone rose from 64 percent in 1980 to more than 73 percent in 1990.¹ The persistent trend toward single-occupant vehicle (SOV) travel leaves those who favor mass transit and ride sharing facing two major challenges. The first is to devise transportation alternatives that commuters find more economical and more convenient than driving alone. The second is to use land-use planning and other measures to encourage short, multi-purpose trips and discourage long daily drives.

This paper's intent is to stimulate debate on four related questions. First, what were the commuting trends of the 1980s? Second, what social and demographic forces caused them? Third, what are the most likely commuting trends of the 1990s? And finally, what actions will most effectively promote the objectives of transportation planners?

COMMUTING TRENDS OF THE 1980s

The 1990 census revealed explosive nationwide growth in single-occupant vehicle travel. It showed that the nation's net gain of 19 million jobs between 1980 and 1990 was exceeded by a net gain of 22 million single-occupant commuters. The proportion of commuters who use mass transit remained stable in the 1980s, but the proportion who use rideshare arrangements fell from 20 percent to 13 percent.²

Average commuting time and distances also increased in the 1980s. The proportion of workers who spend less than 30 minutes going to work dropped from 72 percent in 1980 to 68 percent in 1990. The proportion who spend at least 45 minutes on the road each way rose to 14 percent from 12 percent.³

The single-commuter and longer-trip trends of the 1980s were simply extensions of trends that began four decades ago. Between 1960 and 1990, for example, the population of the United States increased 39 percent and the number of workers increased 78 percent. But the number of workers who cross county lines to get to their jobs tripled, from 9 million to more than 27 million. And the proportion of cross-county commuters doubled, from 12 percent of all workers in 1954 to 24 percent in 1990.⁴

The proportion of SOV commuters varies widely according to local conditions. The unique characteristics of local areas can have strong effects on SOV commuting. The two metropolitan counties with the highest rates of SOV work commuting are both in suburban Detroit, where healthy incomes and automotive jobs make personal transportation almost universal (Table 1). But even neighboring counties can have widely varying rates. For example, the ratio in Orange County, California is at least 3 percentage points higher than the rate in neighboring Los Angeles County.

¹1990 Census.

²Ibid.

³Ibid.

⁴Richard Forstall, "Going to Town," *American Demographics*, May 1993, p. 42.

TABLE 1 Where SOV is King

Metropolitan counties with the highest proportion of single-occupant vehicle commuters cluster in the Midwest and South.			
(35 metropolitan counties with the highest proportion of commuters driving to work alone, 1990)			
rank/ county	metro	percent SOV	total commuters
1	Macomb, (Detroit, MI PMSA)	87.4	349,937
2	Oakland, (Detroit, MI PMSA)	87.4	546,636
3	Johnson, (Kansas City, MO-KS MSA)	86.5	193,006
4	Warren (Cincinnati, OH-KY-IN PMSA)	86.3	54,076
5	Midland (Saginaw-Bay City-Midland MI MSA)	85.8	33,634
6	Warrick (Evansville, IN-KY MSA)	85.6	21,566
7	Sullivan (Johnson City-Kingsport-Bristol, TN MSA)	85.5	64,499
8	Trumbull (Youngstown-Warren, OH MSA)	85.5	95,997
9	Lake (Cleveland, OH PMSA)	85.4	107,589
10	Bay (Saginaw-Bay City-Midland, MI MSA)	85.4	47,138
11	Monroe (Detroit, MI PMSA)	85.4	59,492
12	Waukesha (Milwaukee, WI PMSA)	85.3	162,059
13	Howard (Kokomo, IN MSA)	85.3	36,703
14	Hamilton (Indianapolis, IN MSA)	85.2	57,278
15	Mahoning (Youngstown-Warren, OH MSA)	85.1	103,902
16	Greenup (Huntington-Ashland, WV-KY-OH MSA)	85.1	13,920
17	Stark (Canton, OH MSA)	85.0	161,334
18	Genesee (Flint, MI MSA)	85.0	174,589
19	Saginaw (Saginaw-Bay City-Midland, MI MSA)	84.8	85,480
20	Kent (Providence, RI PMSA)	84.8	81,053
21	Lee (Albany, GA MSA)	84.7	7,326
22	Livingston (Detroit, MI PMSA)	84.6	57,448
23	Boyd (Huntington-Ashland, WV-KY-OH MSA)	84.5	19,726
24	DeSota (Memphis, TN-AR-MS MSA)	84.4	32,719
25	Cobb (Atlanta, GA MSA)	84.4	250,985
26	Shelby (Birmingham, AL MSA)	84.4	49,622
27	Randall (Amarillo, TX MSA)	84.3	45,163
28	Medina (Cleveland, OH PMSA)	84.3	59,385
29	St. Louis (St. Louis, MO-IL MSA)	84.3	501,082
30	Gwinnett (Atlanta, GA MSA)	84.1	200,970
31	St. Charles (St. Louis, MO-IL MSA)	84.1	111,051
32	Fayette (Atlanta, GA MSA)	84.0	31,492
33	Summit (Akron, OH PMSA)	83.9	231,292
34	Macon (Decatur, IL MSA)	83.9	51,721
35	Canadian (Oklahoma City, OK MSA)	83.8	35,698
	National Average	73.2	

Source: U.S. Census

A closer look at trends in specific counties reveals the major social and demographic trends that fueled the nationwide increase in solo commuting. During the 1980s, SOV commuting increased fastest where it was already highest: namely, in the eastern half of the country. Among the 40 metropolitan counties that combine the fastest growth rate in solo commuting with a high base rate, 6 are in Minneapolis or St. Cloud, Minnesota; 10 are elsewhere in the Midwest, 8 are in the East, and 15 are in the South (Table 2).

Rapid growth in the proportion of solo commuters is usually a sign of rapid economic change. In Pulaski County, Missouri, the share of solo commuters increased faster than in any other county of 10,000 or more, as non-commuting farm jobs were replaced by jobs at Fort Leonard Wood (Table 3). The solo-commuter population also exploded in outer-ring suburban counties like Loudon, Virginia and St. Charles, Missouri.

Only one metropolitan county actually reduced its proportion of solo commuters in the 1980s. San Joaquin, California (Table 4) has an aggressive ride-sharing program. But the leading reason for the decline is that many residents commute 40 or 50 miles from their homes in Stockton to jobs in the Bay Area. The high cost of extreme long-distance commuting makes ride-sharing easy to sell, according to Andy Chesney of the San Joaquin Council of Governments.

In fact, California is home to 15 of the 35 metro counties with the slowest growth rate in SOV commuting in the 1980s. The slow growth rate of many Western counties may be due to the lengthy commutes of residents. San Joaquin County may show that even if gasoline costs remain stable, commuters will abandon SOV commuting at a point where its financial and time costs are greater than the alternatives.

Local governments have traditionally stressed voluntary efforts to reduce solo commuting. But as the problem worsens, some mandatory measures are being adopted. Last year's amendments to the federal Clean Air Act require some metropolitan areas to improve air quality; in response, local governments are passing commuter laws that may eventually penalize employers and solo commuters.

Yet penalizing solo commuters will not promote alternatives if solo commuters feel that they have no realistic alternatives. Demographic changes have made commuting more complex than it was 30 years ago. Some drivers in 1993 go from a suburban home to a downtown office and back at predictable times, just as their parents did in 1963. But others work sporadically or at off hours, commute from suburb to suburb, or must make multiple stops on their way to and from work. The more complex patterns of commuting in the 1990s reflect a more complex society, where individual demographics and lifestyle choices are far more powerful determinants of behavior than group or institutional affiliations.

Penalizing behavior without understanding its cause makes it likely that the penalties will not have the intended effect. Planners will have more success if they begin by studying commuters' complex transportation needs. The only way for them to compete effectively against the SOV trend is to understand those needs and serve them better than private automobiles do.

COMMUTER TRENDS OF THE 1990s: CAUSES, EFFECTS, AND RESPONSES

Why do commuters choose driving alone, even if alternatives are available to them? The simplest answer is that the alternatives do not meet their needs. Commuters in the 1990s are as diverse as the labor force itself.

To promote their objectives effectively, transportation planners must learn to think as business owners do in a competitive marketplace. They must first understand that there are many different segments of transportation consumers, and each segment has radically different needs. Then they must craft a strategy, rooted in consumer information, that will encourage consumers to choose mass transit and ridesharing over private vehicles.

The most powerful causes of change in commuting have been working parents, the changing nature of employment, the changing habits of "fringe" drivers, and a changing mix of vehicles. This section will consider each cause, explore the effects of each cause, and suggest responses planners might consider.

TABLE 2 Where SOV is Worst

Some metropolitan counties with high proportions of single-occupant vehicle commuters also have high growth rates for SOV commuting.

Many are in outer suburbs with lots of working parents.

(35 metropolitan counties with the fastest growth rates of SOV work commuting that had above-average rates of single-occupant vehicle work commuting in 1990)

rank/ county	metro	percent increase 1980- 1990	percent SOV 1990	total commuters
1	Los Alamos (Sante Fe, NM MSA)	18.6	81.5	9,797
2	Stokes (Greensboro-Winston-Salem-Hig, NC)	18.2	75.9	18,722
3	Herkimer (Utica-Rome, NY MSA)	17.6	75.4	26,906
4	Carver (Minneapolis-St. Paul, MN-WI MSA)	17.1	77.0	25,705
5	Sarpy (Omaha, NE-IA MSA)	17.1	82.4	55,185
6	Woodford (Peoria, IL MSA)	16.9	78.7	15,112
7	New Kent (Richmond-Petersburg, VA MSA)	16.7	76.4	5,265
8	Calumet (Appleton-Oshkosh-Neenah, WI MSA)	16.4	74.9	17,270
9	Bristol (Providence, RI MSA)	16.4	80.7	23,957
10	Loudoun (Washington DC-MD-VA, MSA)	16.1	78.0	50,164
11	Andersen (Knoxville, TN MSA)	16.1	82.7	30,240
12	Grundy (Joliet, IL PMSA)	16.0	81.5	14,899
13	York and Poquoson (Norfolk-Virginia Beach-Newport News, MSA)	16.0	81.8	26,940
14	Goochland (Richmond-Petersburg, VA MSA)	15.9	79.1	6,929
15	St. Charles (St. Louis, MO-IL MSA)	15.9	84.1	111,051
16	Dade (Chattanooga, TN-GA MSA)	15.7	75.1	5,691
17	Harrison (Louisville, KY-IN MSA)	15.7	76.4	13,628
18	Putnam (Charleston, WV MSA)	15.4	81.2	17,731
19	Franklin (St. Louis, MO-IL MSA)	15.3	75.8	36,922
20	St. Charles (New Orleans, LA MSA)	15.2	81.5	17,593
21	Washington (Minneapolis, St. Paul, MN-WI MSA)	15.1	80.2	75,493
22	Wayne (Rochester, NY MSA)	15.1	79.3	41,699
23	Madison (Jackson, MS MSA)	15.1	79.8	23,723
24	Sherburne (St. Cloud, MN MSA)	14.9	77.1	20,178
25	Dallas (Des Moines, IA MSA)	14.9	75.7	14,824
26	Powhatan (Richmond-Petersburg, VA MSA)	14.9	77.3	7,040
27	Cumberland (Portland, ME MSA)	14.8	76.2	122,741
28	Sheboygan (Sheboygan, WI MSA)	14.8	76.1	51,384
29	Benton (St. Cloud, MN MSA)	14.6	75.7	14,774
30	Anoka (Minneapolis-St. Paul, MN-WI MSA)	14.6	79.7	130,912
31	Cabarrus (Charlotte-Gastonia-Rock Hill, NC MSA)	14.6	80.6	51,039
32	Rockingham (Lawrence-Haverhill, MA-NH PMSA)	14.6	81.1	131,576
33	Jefferson (St. Louis, MO-IL MSA)	14.5	80.4	80,695
34	Paulding (Atlanta, GA MSA)	14.5	77.6	20,400
35	Orleans (Rochester, NY MSA)	14.5	75.7	10,760
	National average	8.82	73.2	

Source: U.S. Census

TABLE 3 Centers of Rural SOV

Nonmetropolitan counties with the fastest growth in single-occupant vehicle commuting are on the borders of metro areas, or have undergone rapid economic change.

(counties with 10,000 or more residents with the fastest growth in people who commute to work alone, 1980-1990)

rank/ county	metro	percent increase 1980-1990	percent SOV 1990	total commuters
1	Pulaski, MO	25.9	63.5	20,088
2	Chaffee, CO	25.2	70.5	4,863
3	Hardin, KY	24.0	71.5	42,532
4	Floyd, VA	21.3	70.3	5,509
5	Routt, CO	20.8	71.9	8,165
6	Juneau, AK	20.6	60.7	14,240
7	Elmore, ID	20.5	72.6	10,154
8	Kewaunee, WI	20.1	65.2	9,259
9	Onslow (Jacksonville, NC MSA)	20.1	61.6	86,801
10	Greene (Charlottesville, VA MSA)	19.9	67.1	5,372
11	Liberty, GA	19.8	63.6	26,932
12	Hickman, TN	19.7	70.3	6,884
13	Mariposa, CA	19.7	67.1	5,734
14	Lake, MN	19.6	75.7	4,217
15	Beltrami, MN	19.4	71.3	13,704
16	Door, WI	19.3	72.9	11,661
17	Richlan, MT	19.2	74.0	4,502
18	Rolette, ND	19.1	67.9	3,692
19	Larue, KY	19.0	73.1	4,740
20	Custer, NE	18.9	71.4	5,517
21	Somerset, ME	18.8	74.8	21,105
22	Hood, TX	18.8	77.9	11,628
23	Los Alamos (Sante Fe, NM MSA)	18.6	81.5	9,797
24	Lincoln, WY	18.5	67.9	4,976
25	Fremont, WY	18.5	71.4	13,605
26	Potter, PA	18.5	70.3	6,658
27	Teton, WY	18.2	70.7	6,481
28	Limestone, AL	18.2	80.0	23,975
29	Benton, IA	18.2	69.4	10,139
30	Dickenson, VA	18.2	74.4	4,941
31	Leslie, KY	18.2	69.7	3,591
32	Stokes (Greensboro-Winston-Salem-Hig)	18.2	75.9	18,722
33	Ashe, NC	18.1	68.6	10,174
34	Madison, NC	18.1	71.4	7,493
35	Rockbridge, VA	18.1	77.6	8,544

Source: U.S. Census

TABLE 4 Where SOV is Slowing

Of the 35 metropolitan counties with the slowest growth in single-occupant vehicle commuting in the 1980s, 15 are in California.

(35 metropolitan counties with the slowest growth in single-occupant vehicle work commuting, 1980-1990)

rank/ county	metro	percent increase 1980- 1990	percent SOV 1990	total commuters
1	San Joaquin (Stockton, CA MSA)	-0.0	74.6	191,111
2	Tulare (Visalia-Tulare-Porterville, CA MSA)	0.3	71.3	116,533
3	Sutter (Yuba City, CA MSA)	1.4	76.5	26,137
4	Los Angeles (Los Angeles-Long Beach, CA PMSA)	1.4	70.1	4,115,248
5	New York (New York, NY PMSA)	1.7	7.8	754,148
6	Stanislaus (Modesto, CA MSA)	1.9	76.7	147,406
7	Orange (Anaheim-Santa Ana, CA PMSA)	1.9	76.8	1,278,661
8	Hudson (Jersey City, NJ PMSA)	2.1	42.4	262,745
9	Cameron (Brownsville-Harlingen, TX MSA)	2.3	69.3	84,642
10	Riverside (Riverside-San Bernardino, CA PMSA)	2.3	73.8	482,618
11	Fresno (Fresno, CA MSA)	2.4	75.2	265,397
12	Harrison (Longview-Marshall, TX MSA)	2.4	76.1	22,368
13	Kern (Bakersfield, CA MSA)	3.0	74.7	213,525
14	San Bernardino (Riverside-San Bernardino, CA PMSA)	3.0	75.2	265,397
15	Clark (Las Vegas, NV MSA)	3.2	74.8	371,128
16	District of Columbia (Washington, DC-MD-VA MSA)	3.2	35.0	304,428
17	San Mateo (San Francisco, CA PMSA)	3.6	72.5	346,559
18	Monterey (Salinas-Seaside-Monterey, CA MSA)	3.6	67.5	164,270
19	Ouachita (Monroe, LA MSA)	3.7	81.8	57,021
20	Passaic (Bergen-Passaic, NJ PMSA)	3.7	70.7	220,595
21	Cumberland (Vineland-Millville-Bridgeton, NJ MSA)	3.7	75.2	59,774
22	Philadelphia (Philadelphia, PA-NJ PMSA)	3.9	44.7	640,577
23	Bronx (New York, NY PMSA)	4.0	24.9	429,777
24	Ector (Odessa, TX MSA)	4.0	80.5	48,912
25	Webb (Laredo, TX MSA)	4.0	68.1	44,910
26	Kings (New York, NY PMSA)	4.0	22.5	901,010
27	Terrebonne (Houma-Thibodaux, LA MSA)	4.0	75.4	34,613
28	Santa Cruz (Santa Cruz, CA PMSA)	4.1	70.4	115,199
29	Hidalgo (McAllen-Edinburg-Mission, TX MSA)	4.2	70.6	119,196
30	Smith (Tyler, TX MSA)	4.3	82.1	65,846
31	Merced (Merced, CA MSA)	4.3	72.8	68,697
32	Nueces (Corpus Christi, TX MSA)	4.4	75.5	121,392
33	Liberty (Houston, TX PMSA)	4.4	73.5	19,974
34	McLennan (Waco, TX MSA)	4.4	79.6	81,434
35	Santa Barbara (Santa Barbara-Santa Maria-Lompney MSA)	4.5	70.4	401,173

Source: U.S. Census

Working Parents

Probably the most important reason for the long-term increase in single-passenger commuters is the increasing presence of women in the labor force. Between 1980 and 1990, the proportion of adult women in the labor force increased from 51 percent to 57 percent, while the proportion of men actually declined from 77 percent to 76 percent. Gains were rapid among women with children living at home, and most rapid among women with preschool-aged children.⁵

This trend had a direct effect on commuting. Between 1983 and 1990, the number of miles driven by women grew 49 percent, from an annual average of just 6,400 miles to almost 9,500 miles. The number of miles men drove increased only 19 percent, from 14,000 to 16,600.⁶

The peak driving years for women are also the peak years for child-bearing and errand-running: ages 20 to 34. Women in this age group drove an average of 11,200 miles in 1990, an increase of 4,100 miles or 57 percent since 1983. Men this age drove an average of 18,300 miles in 1990, and increase of 16 percent.⁷

The peak driving years for men are the peak years of labor force participation: ages 35 to 54. Men in this age group travelled an average of 18,900 miles in 1990, compared with just 10,500 miles for women. But while the increase since 1983 was just 6 percent for men, it was a startling 43 percent for women. Once again, this increase was fueled by the growing proportion of women that age who hold jobs outside the home.⁸

The characteristics of women's jobs also changed in the 1980s. In many cases, women are no longer the secondary worker in the household. Their commuting needs are just as great and just as substantial as those of men.

Working parents, and especially working mothers, need to stop at day care centers on their way to and from work. They also need to get to their children in emergencies. They also run errands on way to and from work, so the commute usually has multiple functions. Multiple-function commutes make the most efficient use of time, a crucial concern of working mothers. But they make most current mass transit and ridesharing programs difficult if not impossible to use.

To working parents, grocery stores and day-care centers are daily destinations just as important as their offices. Transportation planners might address this trend by encouraging ride-share arrangements among parents whose children share the same day care or private schooling, rather than the same office. Working parents will eagerly patronize multiple-use developments that combine day care with retail and office functions. And employers might be encouraged to have designated "emergency vehicles" that parents might use to reach their children quickly.

Changing Jobs

It is well-known that most new jobs created since 1960 have been in suburbs. But central cities have held onto their jobs or have seen slow job growth. The result is that most suburbs still export more workers than they import, but the gap is narrowing.

The nature of employment has also changed. As America's economic base shifts from manufacturing jobs to jobs that provide information and services, fewer workers must arrive at large factories to begin work all at the same time.

⁵1990 Census data reported by Samia El-Badry and Peter Nance, "Driving Into the 21st Century," *American Demographics*, September 1992, p. 46.

⁶Ibid.

⁷Ibid.

⁸Ibid.

Today's office workers are more likely to arrive in staggered intervals, leave during the day to run errands, leave for the day at different times, and perhaps even return to work in the evening at their primary job or a second job.

This large-scale economic shift has rewarded workers who have a college education, but it has penalized those with less educational attainment. The real wages of Americans who have not been to college has been declining for twelve years in a row, and most Americans have been to college. One result of this unfortunate trend is that more Americans are working two jobs to make ends meet. Also, less-educated working parents are likely to seek jobs with different work hours so that each spouse takes turns caring for the children. One demographer estimates that "split-shift parents" account for one in six married couples with children living at home.⁹

These trends are dispersing commuter traffic in all directions and at all hours. As metropolitan areas develop multiple job centers with staggered work hours, the notion of "reverse commuting" becomes meaningless. Instead of two rush hours with all cars trying to move in the same direction, planners must cope with rush hours that often last three or four hours, with traffic back up in both directions.

One employment trend that may reduce traffic congestion is an increase in jobs performed at the worker's home. Estimates of the number of telecommuters and other home-based workers vary from 20 million workers to 39 million workers in 1993.¹⁰ The Bureau of Labor Statistics (BLS), which does not count telecommuters as home-based workers, estimates that about 20 million people worked at home part- or full-time in 1991, up from 18 million in 1985. Only 9 percent of home-based workers work entirely at home, and the mean number of work hours for a home-based worker is slightly more than 9. Blacks and Hispanics are underrepresented among home-based workers, and women are overrepresented.

Discussions of home-based work are often reduced to debates about telecommuting, but BLS data show that most home workers are involved with manufacturing or services jobs. Moreover, more than one-quarter of home-based workers are self-employed, and that proportion is growing rapidly. The most effective way to encourage home-based work, therefore, is not by spending vast sums on fiber-optic links or computer networks. Small amounts invested in business incubators, and loans that allow people to start their own businesses, would take far more drivers off the streets at rush hour.

In the next century, America's labor force will be older than it is today, as the huge baby-boom generation moves through middle age. It will also be more ethnically diverse: for every one non-Hispanic white worker added to the labor force between 1990 and 2005, six Hispanic workers and three Asian workers will be added.¹¹

These changes will have mixed effects on commuting trends. Today, recent immigrants to the U.S. tend to live in larger households than do non-Hispanic whites; they have lower household incomes, on average, and they are more likely to live in one-earner families. These trends could retard growth in the number of two-car families. Yet if historical patterns are repeated, recent immigrants will pursue material rewards at least as aggressively as do native-born Americans. And one of the most reliable ways to achieve middle-class status is finding a second job—and a second car—for a spouse.

"Fringe" Drivers

Working-age Americans are by far the biggest consumers of transportation services. But the largest proportional increases in mileage driven between 1983 and 1990 occurred among the youngest drivers, aged 16 to 19. These young

⁹Jennifer McEnro, "Split-Shift Parenting," *American Demographics*, February 1991, p. 50.

¹⁰Patricia Braus, "Homework for Grownups," *American Demographics*, August 1993, p. 38.

¹¹Bureau of Labor Statistics.

drivers averaged about 3,500 more miles in 1990 than in 1983, a 91 percent gain for young women and a 62 percent gain for men.¹²

Older adults are driving more, too. Between 1983 and 1990, men aged 55 to 64 increased their average driving mileage 13 percent, even though their labor force participation rate declined. Driving mileage by women in this age group increased 33 percent, as their labor force participation increased. Among adults aged 65 and older, men registered a gain of 27 percent, and women 44 percent.¹³

Low-income people have been a steady market for buses and other forms of mass transit. But the number of low-income Americans has been growing, and the proportion of transportation claimed by mass transit has not increased. It appears that young and old Americans, who are likely to have lower incomes, are finding ways to join the SOV trend themselves.

Planners can lure low-income people back to mass transit by keeping costs low, and by promoting the low cost relative to the rising cost of using a private automobile every day. But they also must serve the large number of low-income people who are working parents with complex transportation needs, or they will lose more market share to SOV commuters.

Changing Vehicle Mix

After 44 years of steady growth, the number of passenger cars on the road in the United States began to decline in 1990. But the number of minivans, and light trucks increased rapidly. The net result is that the number of vehicles was stable in 1992, for the first time in 46 years.¹⁴

The number of vehicles is not growing because overall population growth in the U.S. has slowed to a snail's pace. The U.S. population is growing at the rate of about 1 percent a year. Moreover, the number of young adults and other first-time consumers of new cars is declining, while the number of middle-aged adults who buy replacement vehicles is increasing. Minivans and light trucks are a popular choice for middle-aged members of the "baby boom" generation because they serve a child-oriented suburban lifestyle.

One other trend in the nation's vehicle mix should be noted. As income growth has slowed or stopped in the 1990s, many families have been keeping cars longer. As a result, the average age of a car in the U.S. is increasing rapidly.

The changing mix of vehicles has negative and positive effects on transportation. Minivans and light trucks get lower gas mileage than most passenger cars, and older cars often cannot match the gas mileage of newer ones. But the increased carrying capacity of minivans may make it attractive for owners to seek ride-sharing partners who could cut their transportation costs. Transportation planners should begin programs that encourage minivan owners to take on riders by offering them tangible rewards.

WHAT PLANNERS MUST DO

Most of the demographic and geographic trends discussed in this paper work against current ridesharing and mass transit programs. A more dispersed population and job base is harder to serve with mass transit. Shift-work, erratic job schedules, smaller offices, and multiple-stop commutes make ridesharing more difficult to coordinate.

¹²El-Badry and Nance, above.

¹³Ibid.

¹⁴R. L. Polk Corporation, Dearborn, MI, Annual Vehicle Census.

Yet there is evidence that the proportion of commuters who choose SOV may be near its peak. Women's labor force participation increased at a slower rate in the 1980s than it did in the 1990s, and actually declined in 1991. Many demographers predict that the rate will increase further, but not at the dramatic pace seen in the 1970s and 1980s.

Overall mobility declines with age, and the 1990s will be a middle-aged decade. Between 1990 and 2000, the number of Americans aged 45 to 54 will increase 46 percent as the baby-boom generation enters this age group. The result will be fewer people changing addresses, longer job tenures, and more predictable daily routines in most places. Studying consumers' transportation needs as they exist now may therefore create programs that could be effective for at least a decade.

In the 1970s and 1980s, the American public ignored public policies that encouraged ridesharing and mass transit. They did this despite significant efforts by the public and private sector to promote ridesharing, and despite rapid growth in public concern about pollution. Their choices show how important private automobiles are to the psychological health and well-being of Americans. Many observers have noted that Americans see their cars as symbols of freedom and independence. But we should also recognize that cars are havens of quiet and solitude in an increasingly hectic world.

A working parent's day often starts at 5:30 A.M. It includes two hours of child care and housekeeping before school, eight hours of work, and four hours of child care and housekeeping after work. For many workers, driving to work alone is a rare opportunity to meditate in solitude, or listen to one's chosen music, or catch up with a book on tape. Rather than feeling aggravated at heavy traffic, some commuters may become more relaxed by gaining a few extra moments of peace and quiet. The truth is that their work and home lives are far more stressful than their lives in their cars.

Many Americans feel profound affection for their automobiles, and their feelings are not likely to change. For example, surveys have shown widespread public concern for environmental degradation. Seven in ten Americans describe themselves as "environmentalists." Yet only half of Americans recycle their garbage, and fewer than one-third contribute to environmental groups. When the Roper Organization asked a sample of Americans which environmentally-friendly actions they would consider taking, changing one's personal driving habits ranks dead last.¹⁵

Yet time and time again, rising public concern over a social problem foreshadows actions taken to solve that problem. Public anger over treatment of blacks built for at least a decade before the Civil Rights Act of 1964 was passed, for example. Earth Day 1970 was the peak of a wave of public concern that made possible many significant environmental reforms in the 1970s.

Rising environmental concerns in the 1990s will probably follow the same pattern, but with a twist. An increasing proportion of Americans may be willing to consider taking actions on behalf of the environment, including ridesharing. But they won't take those actions unless their consumer needs, including the need for solitude and privacy, are taken into account.

Planners who do not recognize this fact will continue to devise promotional campaigns and laws that encourage ridesharing by punishing SOV travel. Their success rates will be similar to those of the 1980s. But planners who do recognize the public's primacy have a chance to do far better. They will begin to see commuters as consumers of transportation services. Moreover, they will recognize that their competitor—SOV travel—is number one in their market, and that they are the consumer's second choice. Instead of forcing or persuading people to do things right, consumer-based transportation planners will find ways to reward people for doing the right things. Their goal will be to erode the market share of SOV travel by analyzing its weaknesses, and by devising transportation services that do a better job of meeting consumers' needs.

¹⁵Joe Schwartz and Thomas Miller, "The Earth's Best Friends," *American Demographics*, February 1991, p. 26, and unpublished data from The Roper Organization, New York, NY.

DRIVING FORCES THAT HAVE SHAPED TRANSPORTATION DEMAND MANAGEMENT

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ABSTRACT

The practice of transportation demand management is shaped by several driving forces. These include evolving government regulations, economic forces affecting employers, individual behavior, and the combination of demographics and land use. Each contributes to the strategies that have been tested and applied. Each also contributes, to the perception of transportation demand management.

Probably the most significant driving force today is the general topic of government regulations. The principal means of government influence on transportation demand now include federal and state air quality requirements, local congestion management actions, and federal and state tax rules.

Some employers have applied TDM strategies at their own sites in the absence of regulations but have done so for some clear reasons of self-interest. Similarly, most ridesharing and transit occurs because individual riders see self-interest reasons to use those modes.

Demographic and land use change have contributed to the demand management field through the increase of women in the work force, the dispersion of home and work locations, and other trends.

These driving forces are reviewed in this paper and their implications for transportation General Manager are highlighted. Demand management is likened to asset management and comparisons are made with driving forces affecting the transit and highway fields.

INTRODUCTION

With the advent of the Intermodal Surface Transportation Efficiency Act (ISTEA), the Clean Air Act Amendments (CAAA), and a spate of state and local transportation regulations, the field of transportation demand management has moved from being a field with limited, specialized interest to an institutionalized, field of practice that is also legislatively driven.

Although there are examples of transportation demand management going back decades, there was not widespread consideration of the topic until the 1970s. The energy crises of 1973-74 and 1979 plus the first Federal Clean Air Act led to many examples of planning, yet also led to relatively little in the form of actions being taken.

In this review, it is important to distinguish what was seen as conventional in the 1970s and earlier, and what is increasingly being seen as conventional today. For example, pricing of bridge tolls, parking, and transit are not new. What is new in this area is discriminatory pricing that encourages higher vehicle occupancy.

Even marketing campaigns aimed at encouraging people to share rides, conserve energy, and take other behavioral actions were not unheard of prior to the early 1970s. For example, a World War II era movie house "short" encouraged carpooling because "when you drive alone, you ride with the Fuehrer." While the clear message of this campaign was to aid in the war effort by keeping rubber available to the military, such a recurring theme of conserving in the national interest has been seen frequently in the field of transportation demand management.

Today, we consider TDM to encompass all those demand side strategies that can change one's mode of travel, time of travel, frequency of travel, and need for travel. Although some disagree, facility and service actions such as providing

a high occupancy vehicle lane or establishing a new transit route are generally seen as supply side actions and, as such, are more properly transportation systems management or transportation service strategies.

For the purposes of this review, a tight definition of TDM is not necessary. Consider TDM to encompass strategies that are intended to change one's behavior by principally working on the demand side of the supply-demand equation.

REVIEW OF DRIVING FORCES

There are four general driving forces that have shaped transportation demand management. These are regulations, economic forces affecting employers, individual behavior, and demographics plus land use. Clearly there are interactive influences between these various driving forces and one cannot easily separate these into discrete, pure influences. For example, simply trying to determine whether individual behavior drives land use or land use shapes individual behavior is not inherently resolvable. However, to understand the field and where it is headed, it is more important to understand the nature of the influences rather than the precise taxonomy or detailed input/output relationships for predicting behavior (although many have proposed such). Regulations have become the most talked about driving force and are being seen in most areas with severe traffic congestion as well as in areas that are designated as non-attainment areas for federal air quality purposes. Great hopes have been assigned to transportation demand management for addressing these congestion and air quality issues. The regulations such as those of the South Coast Air Quality Management District Regulation XV and the New Jersey Employee Commute Options Program that will induce changes in travel behavior.

ISTEA and the Clean Air Act amendments both put great store in demand management. However, few expect TDM to be "the" solution to congestion, air quality, or mobility problems. Generally, those who advocate the regulatory approach see demand management as an essential part of a broader strategy. An unanswered question is whether a regulatory approach can cause as much usage of carpooling, vanpooling, transit, alternate work hours, and other such strategies as occurred "naturally" in the market place.

This leads to consideration of two other driving forces, namely economic forces affecting employers and individual behavior. The vast majority of people who share rides, use public transportation or use one of the other strategies referred to as TDM do not do so because of some regionally established regulation, a policy that arose in a state or local plan, or due to a catchy colorful advertising campaign. They share rides or use public transportation because it makes sense to them, i.e. because it is in their self-interest to do so.

Again, it is difficult to separate the influences of federal housing and highway policies, transit investment practices, and other such items from what individual travelers would have done in the absence of those investments. However, wherever you go in the United States, the distribution of trips by trip purpose for large-scale metropolitan areas shows that transit accounts for between 2 and 6% of all commute trips, carpooling accounts for between 8 and 16% of all commute trips, vanpooling accounts for up to 3% of all commute trips, and driving alone accounts for 70 to 85% of all commute trips.

Whatever we have done as a matter of public policy across the United States at the local, regional, state, and federal areas, we have done fairly consistently. Individual behavior in response to what may appear as a crazy quilt of conditions and practices is remarkably consistent. We might do well to think more about why 15% of people in a given community or metropolitan area are carpooling than to create a catchy campaign on some new basis to get the next 15%.

Similarly, the economic forces affecting employers are fairly similar. Their work sites were designed to a uniform building code (or some slight variation of it), the site was laid out in response to a local zoning ordinance (which is generally similar to those of neighboring communities), and their working conditions and benefit packages are reasonably similar (which is to be expected in a competitive labor market).

A common sense, fundamental law of business is that employers are reluctant (and opposed) to doing anything that will increase the cost of doing business if it does not bring a more-than-offsetting increase in productivity. In this context, ridesharing and related strategies are frequently seen as "do good" programs that do not help the bottom line.

In fact, employers see the employee transportation issue as a factor in employee recruitment and retention and, in some markets, as a government regulatory issue.

There are notable and highly touted exceptions to this. These include the experience of Atlantic Richfield Company on moving to Los Angeles and instituting an extensive employee vanpool program, specialized bus service, and related actions. Many believed Atlantic Richfield did this to be a good community citizen.

Looking deeper, many of the employees Atlantic Richfield brought with them in the move from Philadelphia to Los Angeles were people unaccustomed to driving to work. ARCO also needed to recruit new employees. Fundamentally, they believed that employee recruitment and retention would be substantially better if they had a strong employee transportation program than if they did not. If they also gained respect for being a good community citizen, that was an extra added benefit. However, for each example like an Atlantic Richfield, there are many more who see no reason to change their way of doing business.

Many reviewers have held Atlantic Richfield out as an example of what an enlightened employer can do. What is overlooked is the fact that this was an employee recruitment and retention strategy involved in a large-scale, long distance corporate relocation. And the strategies put in place have continued for many years.

The literature is rich in examples of strong employee transportation programs that have been put in place for corporate relocations. With the exception of responses to regulatory programs, the literature is rather sparse in identifying employer transportation programs that have spontaneously arisen in the absence of a relocation.

For consideration of both employer behavior and individual behavior, it is important to consider the economists model of the rational man. (In light of gender enlightenment, one wonders whether economists may change to a "rational person" theory.) In considering the fundamental argument that people and organizations will do what is in their self interest (i.e. be rational), practitioners in the field have learned over time what the individual and employer are striving to be rational about. As noted for the employer, it is the cost of doing business. For the individual, in its simplest terms, it comes down to matters of time and money.

The fourth driving force concerns demographics and land use. The types, spacing, and distribution of land uses dictate where things occur and many of the needs for travel between one type of site and another. Demographics tied to lifestyles plus employer and other practices all help to shape the requirements for travel and the influences on choice of travel.

When we segregate and isolate land uses we tend to require that one travel greater distances between desired destinations than if we allowed more mixed use activities. However, we cannot necessarily blame our zoning ordinances and similar devices for the segregation of land uses and the isolation of one use from another (e.g. residential being isolated from employment centers).

The comparison between land use patterns and travel patterns in the Houston and Dallas areas is illustrative of this point. Dallas has used zoning to help arrange its land uses for many years. Until recently, Houston did not use zoning. Most of the land use pattern in Houston developed in the absence of zoning. Although the point is arguable, the appearance and distribution of land uses in the two communities are reasonably similar. The distribution of trips by purpose, distance, and frequency are reasonably similar.

Underlying all these driving forces, the potential benefits of TDM and the reasons for consideration of TDM have to do with potential reduction of private and public costs, reduction of traffic congestion, reduction of air pollution, and energy conservation.

These driving forces and underlying desired benefits are reviewed further in later sections of this paper.

TRANSPORTATION SYSTEM ISSUES

As completion of the Interstate highway system nears, there has been a limited ability to expand highway capacity. Not only were highway maintenance and rehabilitation costs increasing (thus generally decreasing the share available for new construction) but also, and more importantly, environmental issues and community disruption issues arose which effectively limited much new highway development.

Many argue that the philosophy of accommodating future travel demands by providing capacity throughout the urbanized areas and beyond was flawed from the outset. This was due to the inducement of sprawled development, the tendency to increase trip lengths, and the effect, in conjunction with zoning that isolates and segregates land uses, to encourage increased vehicle usage plus a general decrease in the effectiveness of public transportation.

With the community and environmental protests against the addition of new highways in most urbanized areas plus the very high cost of such new highways, the highways that do exist are in some metropolitan areas only a portion of the network that was planned. I am not arguing that if only the public would have let the entire network be built, there would be no problem. However, in the 1950s and in particularly in the 1960s, local governments were developing and updating their general plans in good faith reliance that actions being planned by other parties, particularly the state highway departments, would be carried out.

The Century City area is a classic example of this in Southern California. The California Legislature had in its adopted freeways and expressways system many roadways that were to be developed. These included the Beverly Hills Freeway (Route 4 running from downtown Los Angeles to Santa Monica in the area between the present Santa Monica Freeway and the Hollywood Hills) and the Beverly Glen Freeway (running in a north/south direction from the San Fernando Valley to the south paralleling the present San Diego Freeway and to the east of it).

The City of Los Angeles considered this freeway pattern and the anticipated significant freeway-to-freeway interchange, plus the accessibility this would provide throughout the metropolitan area. In good faith reliance upon the State of California, the City of Los Angeles allowed the development of a major urban center now known as Century City.

Both freeways were removed from the plan and neither was built. Century City is now a high-rise development complex housing on the order of 40,000 jobs, and stands as an area with congested streets, high parking prices, and very limited transit service. This example pointedly illustrates how different parties accommodate expected travel demand and development patterns that would shape that demand.

On a larger, more systemic basis, the Century City example has been played out in many communities. It is difficult to argue that every community's general plan development level was sized according to the highway, water, and other infrastructure, that was planned. However, most communities' plans for highway networks were not completed yet the development patterns that have been planned within many metropolitan areas are at least as extensive as were planned during the 1950s and 1960s.

The occupants of those homes and businesses have lived up to or exceeded the expectations of those planning for the communities and their highways. We have wound up with the trips but not the roadway capacity.

It is impossible to prove what would have happened had the more complete roadway networks been developed. However, the fact that vehicle travel volumes are much higher than the roadway capacities in many metropolitan areas stands as testimony to the inability to provide enough roadway capacity to avoid congestion and, in some cases, severe and long-lasting congestion. These congestion levels are among the driving forces today behind the reasons for considering transportation demand management as well as transportation systems management, added transit service, and other related strategies.

In many communities, this has come down to a summary plaintive statement of "You can't build your way out of congestion." Whether this is put in the negative because of lack of localized support for acquiring new rights-of-way

and developing new roadways or due to lack of sufficient funding to build as many new roadways as some may want, the result is the same.

In the 1970s, as one discussed transportation demand management strategies, particularly relative to new roadway alternatives, it was common to hear that one was engaging in "social engineering." By the late 1980s, there was enough general belief that substantial amounts of new roadways could not be built and that consideration of strategies to manage demand were worth considering that TDM was generally not seen as "social engineering."

Some, including the author, have argued that the evaluation of demand management strategies is nothing more than asset management. That is, if one looked at the system as a manufacturing process, one would consider the inputs, the outputs, the influences, and other aspects, and then consider what could be done to gain greater productivity from the system. This may include adding capacity. However, it is more likely that one would first consider adding a second shift (spreading the peak), finding more efficient product delivery means (increasing vehicle occupancy), using just-in-time inventory control (incident management as a close approximation), and apply pricing schemes designed to move the product more cost effectively (discounts for carpoolers, vanpoolers, and transit riders).

Left unclear, unresolved, and perhaps, unresolvable, is the question of whether any strategies can eliminate traffic congestion. One of the arguments for consideration of TDM strategies is that they are necessary in the fight against traffic congestion. There are few examples demonstrating long-term wins in the fight against traffic congestion. The best most organizations are able to conclude is that traffic congestion is "not as bad as it would have been."

There is a clear belief by the drafters of ISTEA and the Clean Air Act Amendments that further emphasis on single occupancy vehicle projects (principally, if not exclusively meaning new roadway construction) is one of the main enemies of more efficient transportation, including increased vehicle occupancies and higher transit usage. As noted before, the purpose of this paper is not to prove or disprove this point. Instead, the purpose is to observe that these are driving forces for the consideration of transportation demand management and to indicate how these driving forces may play out over time.

As pointed out in many metropolitan area plans, vehicle travel volumes have grown much faster than has roadway capacity or transit usage over the past two decades. (The supply of transit has increased over the last two decades and transit ridership has increased in absolute numbers but has declined somewhat relative to total travel.)

The overall result is a general decrease in vehicle occupancy that has been attributed to a wide variety of factors, including continued sprawl development, a relative decrease in the cost of operating a vehicle, the relatively rapid increase in the percentage of women in the work force (particularly women with the primary care responsibilities for small children), and other factors.

GOVERNMENT REQUIREMENTS

Until the early 1970s, there was little (if any) government mandate for consideration of transportation demand management. While there are interesting examples of TDM-like actions that cities and others took in the recent and distant past (e.g. banning chariots in certain parts of downtown Rome), the few instances that are known are more curiosities than a pattern of government policy.

One need only compare the 1956 Interstate Highway Act and the 1991 Intermodal Surface Transportation Efficiency Act. This author is aware of no reference in the 1956 Interstate Highway Act to managing the demand for travel.¹

¹According to Bart Hague, now with the Environmental Protection Agency and a White House staff member during the Eisenhower administration, the only policy level discussion during the development of the Interstate Highway Program that dealt with demand management even remotely concerned the potential effect of the Interstate Highway Program on suburbanization and sprawl.

ISTEA is replete with references to managing demand, transportation control measures, the priority for high-occupancy vehicle treatments over single-occupancy vehicle treatments, and so on.

With the passage of ISTEA, the federal policy emphasis moves from building plenty of capacity to accommodate travel demand to one of managing the investments that have been made and deciding on new investments by first considering ways to get more out of the existing system. This is nothing more than asset management and would come as no great shock, or mystery to corporate America.

If most businesses in the United States were asked the question of what they could do to increase their output, most would examine their current operation to see what gains and productivity they could achieve. They may add a second shift, have one of their lesser-used plants produce more product, or take some other action. Few would quickly conclude that they would have to build the second manufacturing plant or something similar. Basically, they would seek more productivity from their existing assets before they would acquire new assets.

In the transportation field (as in other areas of government involvement), the response to the need to handle more trips has generally been to build more capacity rather than wring more capacity or productivity out of what we already have. ISTEA clearly sets asset management as our fundamental priority.

As noted before, what has changed from the mid-1950s to the early 1990s is the pervasive growth of congestion and the mandate to improve air quality. Along the way, however, there have been some notable trends that have shaped federal, state, and local government treatment of transportation management.

The National Environmental Policy Act of 1970 and the Clean Air Act of 1971 both established a course that would lead to greater consideration of demand management and, over time, greater questioning of plans and projects that featured accommodation of vehicle trips, particularly single-occupancy trips.

The first federal Clean Air Act established air quality standards that needed to be met across the country. Non-attainment areas were designated and EPA was mandated to develop transportation control plans for these areas if the local governments and other responsible parties did not do so (or did not do so sufficiently). In fact, the EPA Administrator was personally liable if a non-attainment area failed to put forward an adequate plan and he, the EPA administrator, failed to establish a substitute plan capable of achieving the requisite air quality. This led to some exciting moments in federal and local relations, including one large Los Angeles Times headline that read something to the effect of "EPA to eliminate 90% of Los Angeles driving."

Although EPA did not officially adopt (or, at least, has not adopted) and enact its separate plan, the message was clear. Local areas need to plan appropriately or EPA would be forced to step in and do so. This theme is with us once again with the Clean Air Act amendments of 1991, which have been a long time in the making.

The energy shortages of 1973-74 and 1979 caused more development of specific transportation management strategies and services than did any other single requirement or incident. Many employers established corporate vanpooling programs in response to these petroleum shortages. In addition, the unreliability of the transportation system (in the face of these shortages) spurred on the development of several regional commute management organizations.

This experience helped win the passage of the federal Energy Tax Act of 1978 which, among other actions, established employer tax credits for investing in vanpooling programs and declared employer subsidies of employee vanpool rides to be tax exempt. (When the Act expired in the mid-1980s, employer provided vanpool benefits returned to a hazy tax status.)

As the 1979 energy crisis faded from the front pages, the federal government's emphasis on transportation management declined. The next wave of action was seen at the state level. States including California and Washington passed legislation supporting employer investments in employee transportation programs, establishing tax credits, and taking related actions.

Following the wave of state interests, local government consideration of transportation management strategies became more noticeable. In many cases, the local government actions were being considered because of traffic congestion far more so than because of air quality reasons. From Montgomery County, Maryland negotiated development agreements to the Pleasanton, California trip reduction ordinance, there were many variations and differences in emphasis.

What is particularly significant about ISTEA and the Clean Air Act amendments is not that they emphasize transportation management. Rather, it is that they institutionalize the treatment of transportation demand management. It has been argued that the Federal Clean Air Act and the planning regulations which have been in place for many years led one down an analytical path over the past decade or so that was the functional equivalent of the new requirements of ISTEA and the Clean Air Act amendments. However, Congress elevated this treatment to legislative mandate rather than procedural guidelines. Furthermore, Congress established this treatment in a way that gives interested parties standing in federal court to question whether the planning and decision-making process was adequate and whether it gave appropriate consideration to transportation management.

This treatment, when combined with the funding flexibility embodied in ISTEA, means that the decision of whether to pursue a single-occupant vehicle based project or one that gives preference to high-occupancy vehicles takes on even greater significance. The former sense of security or isolation of working within either a highway or transit pot of funding is no longer present. (The ability to pursue transfers of interstate highway funds to transit projects was an important predecessor of this flexibility but is not nearly as significant as the flexibility to swap funds between the various pots as presented in ISTEA.)

One of the significant issues of institutional arrangements and political science raised by ISTEA is that over the last few decades, the transportation organizations have become quite used to working out their agreements about the role of priorities for projects within the various modal pots. That is, one could argue for the Federal Aid Interstate funds and the relative priorities within a state about where to expend the Interstate funds. Similarly, the Federal Aid To Urban Systems funds presented a more complex situation wherein many local governments (and others) were recipients of FAU funds. The planning and negotiations that yielded the priorities for expenditure of Federal Aid To Urban Systems funds have evaporated. Previous accommodations and internal, local agreements no longer apply. In addition, there are new parties at the table who did not even have standing before. Not only have the rules changed but so have the players. And management of demand, in a very important change, has become one of the required elements of the new game.

Another key change in government regulation has arisen in the tax arena. As noted previously, only a few private sector firms have incorporated transportation management strategies in their employee transportation programs. And those private sector organizations that have incorporated such strategies in the absence of government regulations have generally done so for self-interest reasons (generally employee recruitment and retention and, occasionally, reduction of parking or site development costs.)

In the presence of government regulations, employer actions to apply demand management strategies are increasingly evident. However, these actions are by no means widespread. What appears to be evolving though is an increasingly consistent strategy on the part of federal, state, and local governments to include strategies in their plans and regulations which encourage higher vehicle occupancies. Certainly, ISTEA and the Clean Air Act amendments do this. State requirements for congestion management programs and employee commute options programs work towards this same objective. Local government trip reduction ordinances also work towards this end.

One of the, arguably, significant legislative changes of the past few years is the change in the federal tax rules to allow up to \$60/month worth of discounted transit passes or subsidized transit passes to be non-taxable, to allow employer provided vanpool benefits to be non-taxable, and to place a cap on the maximum value of free or discounted employee parking at \$155/month. Although the immediate effects may be small, this change adds one more significant message to emphasize that the incentives or opportunities for using one mode of travel or another should be equalized, if not tilted in favor of higher vehicle occupancies.

TOO-ROSY VIEWS OF TDM

There is a school of thought that holds the transportation demand management is a "dumping ground" used when we don't know what else to recommend. While this may appear as a harsh judgment, many who have been in this field for several years have seen numerous instances in which they believe that unrealistic expectations for the results of demand management have been assumed.

Demand management is not unique for this concern. It may be argued that the air quality plans for many metropolitan areas are based upon strategies whose implementability is not clear. Many metropolitan areas' plans call for transit and roadway investments for which funds are not available today.

While it is true that ISTEA now requires metropolitan areas' plans to be financially constrained, the nature of planning itself encourages an organization to determine what they need and then set out to find ways of accomplishing it. If all we ever did was plan for only those actions that we could absolutely and without question accomplish, our list of planned investments and actions would be very narrow. Having said this, the concern with transportation demand management goes beyond considering alternatives that would be desirable and, then, developing specific implementation strategies (including specific financing strategies). The field and the experience base do not presently allow us to reach highly defensible conclusions about, for example, the percentage of future commute trips that can be expected to use carpools, vanpools, transit, etc.

While we have travel forecasting models that include the ability to "predict" shared ride and transit usage, we are basing those "predictions" on a whole range of assumptions about future land use patterns, future behavior, and future employer practices, among other items. These travel predictions are, more appropriately, forecasts of what may happen under a given set of circumstances. They are useful for side-by-side comparisons but may not be highly reliable as forecasts for predictions in their own right.

Decision makers, in some cases, take it "on faith" that managing demands will yield appropriate and positive benefits and that these programs will have an indefinite, continuing beneficial result. At this stage, this argument is inherently unprovable and unresolvable.

This situation is akin to "The Far Side" cartoon by Gary Larson wherein two scientists are standing at a blackboard reviewing the proof of some scientific theory that ends with "and then a miracle occurs." One scientist says to the other, "I think you need to be a little bit more specific." We, in the TDM field, need to be a little more specific here.

The driving force implied here is one of belief that other strategies do not appear to be working that well and that demand management holds promise for doing much more. We need to be critical of this approach and recognize that following a fad is risky, especially in a public policy setting. If decision makers feel they bought into a "too rosy" picture of demand management's potential benefits (for whatever reasons), some may be just as willing to switch fads and, for example, decide that congestion pricing or new technology is the new "flavor of the day."

COMPARISON TO DRIVING FORCES IN OTHER FIELDS

To put the driving forces for demand management in perspective, it is useful to consider some of the driving forces for related transportation strategies. Although a discussion of driving forces is somewhat subjective and is subject to criticism as "simply conventional wisdom," there are some useful parallels.

The driving forces for public transportation are quite similar to those for transportation demand management. Fundamentally, a driving force for public transportation that is different from those for TDM concerns the mobility needs of the traveller for whom a private vehicle is not available or preferable. There is also a clearer sense that becoming dependent on a more compact urban form is a driving force for developing more effective public transportation.

While arguments for public transportation frequently include the need to improve air quality, conserve energy, and accomplish related environmental goals, most analyses of public transit alternatives do not show significant gains in these

areas. This suggests that part of the driving force for public transportation is similar to that for demand management; i.e., a belief that the results of public transportation improvements will help with achieving environmental goals even if the expected results are not forecast to be large.

Driving forces for adding new roadways tend to include the need for capacity to accommodate vehicles in areas where new development is anticipated and no significant roadway capacity presently exists. More fundamentally, the driving force for new roadway capacity tends to be the observation or belief that today's level of congestion is unacceptable and that actions to decrease reliance on private vehicle use either will not or may not eliminate sufficient congestion to make the existing system productive. The reliance on congestion management plans as a device for demonstrating or proving this theory is increasingly popular across the U.S., particularly as required by ISTEA.

WHAT HAPPENS IF DEMAND MANAGEMENT DOES NOT LEAD TO SUFFICIENT AIR QUALITY OR CONGESTION RELIEF RESULTS?

Earlier, it was suggested that TDM actions have not been analytically demonstrated to yield substantial improvements in air quality or, at least, not the level of air quality benefit that has come from changes in automotive technology in the last several years. Similarly, if TDM actions for relieving traffic congestion do not go beyond the current efforts to increase vehicle occupancies for employees of larger employers only, one can question whether the congestion benefits of TDM will be sufficient.

This line of argument begs the question of whether TDM strategies are expected to accomplish the air quality and/or congestion relief goals on their own. The answer certainly is that TDM is only one of several strategies and is not the sole basis for planned improvements. New technology, system management, and new services are each critical components of plans to achieve air quality and congestion benefits.

However, TDM is the perceived underpinning for changes in usage of transit and shared ride arrangements as well as trip avoidance or shifts out of the peak period. The driving forces encouraging each of these changes are not likely to disappear. More realistic assessments of probable results from TDM are likely to be developed. And the perceived high public cost of some solutions is likely to continue as a principal limit on substantial new capital and operations investments.

To the extent that decision-makers see TDM as a way of causing transportation-related results that do not require significant public funds and are credible, the emphasis on TDM will likely continue and, perhaps, increase. To the extent, the predictions or assumptions for TDM are not realized (whether because of resistance, inability to apply the principles broadly enough, or lack of response), other strategies may gain in popularity or reliance.

As you consider your own area's mix of transportation strategies, consider the degree of commitment to the TDM strategies and the basis for those commitments. Ask:

- To what extent is there a clean analytic basis for the expected results of TDM?
- To what extent do the plans, programs, and requirements take it "on faith" that TDM results (or the results from other strategies) will occur?
- If the air quality problem could be principally resolved through technological "fixes," would we apply TDM concepts differently from the way we are applying them now? What would happen to our plans if air quality was not a driving force for TDM strategies?
- Considering the driving forces that have shaped TDM and other strategies, what policies may evolve if TDM results prove satisfactory? What changes may arise if the TDM elements are not satisfactory?

The driving forces of regulations, economic forces, individual behavior, and demographics plus land use are not likely to disappear. Our reliance on TDM strategies will depend on whether TDM is practiced based on realistic, predictable principles and whether the interaction of supply and demand is well understood.

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.

IMPLEMENTATION ISSUES AND BARRIERS

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ABSTRACT

Transportation Demand Management, or TDM, is a set of strategies that have been implemented in many urban and suburban areas to combat problems related to traffic congestion, air pollution, and reliance on fossil fuel. TDM focuses primarily on reducing commute trips by shifting employees out of their cars and into alternatives such as ridesharing, telecommuting, and compressed work weeks.

As a result of the Federal Clean Air Act Amendments of 1990, scores of local and regional mandates, and voluntary initiatives, TDM programs are being implemented in many areas by those entities that have influence over commute trips: employers and owners/managers of commercial complexes. This paper examines TDM implementation issues and barriers from the perspective of these and other providers of TDM services to commuters. There are important issues and barriers that are outside the scope of this paper, including such areas as high-occupancy-vehicle facilities planning, land use issues, and institutional relationships. These topics are the focus of other presenters at the symposium.

Key issues include who pays for TDM programs, larger employers are impacted more than small employers, liability for implementors, challenges associated with parking pricing and financial incentives, labor relations issues, impact on business site selection, ensuring adequate alternatives and support programs, public policy issues, and the limited understanding of the effectiveness and longevity of TDM strategies.

Today's performance by the service providers will, in part, dictate how and to what extent TDM is mandated or encouraged in the future. Our understanding of the various side effects of TDM on employees, employers, and communities needs to be enhanced. A better understanding of TDM is critical to future policy making and program development. Capitalizing upon the experience and knowledge of implementors and regulators may create new opportunities.

INTRODUCTION

Transportation Demand Management, or TDM, is a set of strategies that have been implemented in many urban and suburban areas to combat problems related to traffic congestion, air pollution, and reliance on fossil fuel. TDM focuses primarily on reducing commute trips by shifting employees out of their cars and into alternatives such as ridesharing, telecommuting, and compressed work weeks.

As a result of the Federal Clean Air Act Amendments of 1990, the Intermodal Surface Transportation Efficiency Act (ISTEA), scores of local and regional mandates, and voluntary initiatives, TDM programs are being implemented in many areas by those entities that have influence over commute trips: employers and owners/managers of commercial complexes. This paper contains an examination of TDM implementation from the perspective of these providers of TDM services to commuters. Many of these implementors are new to the business of transportation, and they are discovering the challenges and opportunities resulting from TDM initiatives.

There are important issues and barriers that are outside the scope of this paper, including such areas as high-occupancy-vehicle facilities planning, land use issues, and institutional relationships. These issues are the focus of other papers presented at the conference.

CURRENT TDM IMPLEMENTATION PRACTICES

Commute trips are targeted by TDM initiatives because most commuters drive alone to work, and employment destinations offer a logical point of contact for reaching the target group. There has been a proliferation of employer-based or worksite-based TDM programs throughout the country.

Voluntary TDM programs started in the 1970's in response to the energy crises. Programs continued and grew through the 1980's to address traffic congestion problems. In the late 1980's and early 1990's, air quality became the primary focus of TDM initiatives in many areas as mandated programs emerged throughout the country. Despite the limited evidence regarding the air quality benefits that could be derived from worksite-based TDM programs, the federal Clean Air Act Amendments of 1990 set in motion widespread implementation of TDM strategies in states that do not meet federal air quality standards. Some states that meet the federal standards, including Florida and Washington, have initiated worksite-based TDM programs to mitigate the impacts of growth on their environments.

Trips are reduced by encouraging the use of alternatives to the single occupant car. Many papers and training guides are available that contain lists and definitions of TDM strategies, and this information is not repeated in this paper.

Worksite-based TDM mandates include:

1. Air quality regulations to reduce commute trips. Typical requirements include a 25% increase in the average number of employees arriving per vehicle at employment sites with more than 100 employees.
2. Site specific requirements to mitigate transportation problems resulting from expansion or new construction of facilities. Local jurisdictions are more frequently requiring TDM programs as conditions of construction and use permits.
3. Trip reduction ordinances (TROs) to reduce congestion and/or air pollution on a local and subregional level.
4. Various state and federal issue-specific laws. An example is California's "parking cash out" law that requires employers who lease parking to offer employees cash instead of free or subsidized parking.

In areas with voluntary TDM programs, objectives may be similar to those of mandated programs, absent the regulatory and enforcement infrastructure.

The service providers (implementors) of TDM and their target markets include:

1. Implementor: Employers
Target markets: Employees (especially reporting to work during the morning peak period) and customers/vendors

Baseline activities at most sites where TDM is being implemented include the following elements:

- Appoint and train a Transportation Coordinator
- Notify employees and promote their participation in commute alternatives programs
- Conduct an employee survey
- Prepare and implement a Trip Reduction Program
- Submit documents to regulatory agencies
- Keep records and monitor results of programs.

2. Implementor: Real estate developers and managers of commercial complexes
Target markets: Tenant businesses and commuters

Developers and building owners can offer TDM services to tenants, and can be especially important in complexes with numerous small employers. TDM activities for these implementors include preferential parking, parking pricing, itemization of parking costs in tenants leases, flexibility to negotiate for fewer parking spaces, ridematching, TDM information center, and staff to work personally with tenants and their employees.

3. Implementor: Ridesharing organizations
Target markets: Commuters and employers/building owners

Ridesharing organizations are usually departments in public agencies or publicly funded private companies. They implement TDM by providing services directly to commuters, such as regional ridematching, and by offering support services to employers, such as conducting employee surveys and providing training.

4. Implementor: Transportation Management Organizations
Target markets: Commuters and member companies

TMOs are partnerships of businesses that join together to address local transportation concerns. Many are created through public funding and then continued through dues collected from member businesses. TMOs offer value by implementing a variety of services for their members, thereby relieving employers from the tasks of developing and financing separate programs.

5. Implementor: Government agencies (as service providers)
Target markets: Businesses within jurisdictional boundaries

Some government agencies offer services to employers and developers within their jurisdiction. Services can include funding for certain programs (such as low interest loans for employer purchase of vanpool vehicles), advertising and promotional campaigns to generate public support, ridematching services, and consultation regarding TDM program development and implementation.

KEY ISSUES

Paying for TDM

There are no industry standards for TDM program cost allocations, in part because TDM programs are relatively new, and in part because employers don't track costs consistently. Estimates of average costs to employers range from a high of \$232 per employee per year to comply with the (San Francisco) Bay Area Air Quality Management District's Regulation 13¹ to \$40 per employee per year for selected employers in southern California.²

In 1990, the work trip accounted for 26% of all trips, and the actual number of work trips per household has remained relatively stable for the last 20 years. Household vehicle miles traveled and vehicle trips, by contrast, increased by 82% during that same period. Trips for non-work purposes are growing at a far greater rate than work trips.³

¹Applied Development Economics, *Socioeconomic Analysis of Proposed Regulation 13/Rule 1: Trip Reduction Requirements for Large Employers*, November 6, 1992.

²Commuter Transportation Services, Inc., *What Price Success? Regulation XV Trip Reduction Plans: Investment Patterns and Cost Effectiveness*, April 1992.

³U.S. General Accounting office, *Urban Transportation, Reducing Vehicle Emissions with Transportation Control Measures*, August 1993.

In regions with air quality trip reduction regulations, this begs the question of why employers are being held accountable for allocating resources to reduce employee trips. Even if objectives for trip reduction are met, the result will not be a significant reduction in total emissions from vehicle travel. Businesses are asked to contribute resources to programs for which the cost-benefit ratio isn't clear or quantifiable.

On the other hand, certain benefits that businesses may enjoy from TDM programs are frequently underestimated, contributing to an unfavorable cost-benefit ratio. These benefits may include enhancing customer service through better site accessibility and extended work hours; reducing the down time incurred when employees are stuck in traffic while making business calls; recruitment and retention benefits; increased employee productivity, and; reducing costs by reducing parking demand.

If healthy companies have difficulty justifying resources for TDM programs, companies experiencing declines in profitability or competitive standing are much less likely to authorize expenditures for TDM programs. In California where the unemployment rate is above the national average, and there is concern over the number of businesses that are relocating outside the state, policy makers have been especially interested in balancing the need for environmental protection with the need for economic stability and growth.

To improve the cost-benefit picture, some states offer tax credits and tax deductions to employers who support TDM programs. In California, qualifying companies may claim a 20% to 30% credit toward the purchase of vanpool vehicles; a tax credit to defray the cost of transit passes, and; business expense deductions for ridesharing and facility improvement programs.⁴ Some states also offer tax credits to commuters. Federal tax code does not now offer credits for commute programs. Some businesses may, however, qualify for tax deductions.

Federal tax code was amended this year to exempt from gross income an employer-provided mass transit or vanpool subsidy worth up to \$60 per month per employee.⁵ Most other incentives (e.g., travel allowances, cash prizes) are taxable as income to the employee.

Larger Employers are Affected More than Small Employers

Voluntary and mandated TDM initiatives impact large employers the most, since it is through employers that many policy makers choose to reach commuters. While the focus has been on larger employers, most people (55%) work for companies with fewer than 100 employees. Fewer than three percent (3%) of all business establishments in the U.S. employ more than 100 people, with 54% employing 1 to 4 employees.⁶ This means that most employers are not held responsible for influencing their employees' commutes, and they are not expected to invest resources into TDM programs.

Some areas have attempted to involve smaller employers through promotional initiatives focused along specific travel corridors. Other areas look to building owners and developers to offer programs that will influence the travel behavior of their tenants' employees.

While the burden for TDM falls to large employers, they also receive some benefits from their involvement. Mandates provide a level playing field for large employers because strategies that may be difficult for a single employer to undertake, such as charging employees to park, can be implemented if all employers in an area are required or encouraged to achieve similar performance measures.

⁴State of California, *Revenue and Taxation Code Sec. 17053, Sec. 23605; and Sec. 24343.5.*

⁵U.S. Internal Revenue Code, Sec. 132(f), amended 1/1/93.

⁶U.S. Department of Commerce, Economic and Statistics Administration, Bureau of the Census, *County Business Patterns*, 1990.

Another important benefit is that TDM mandates may offer opportunities for reallocating resources that would otherwise not be feasible for employers, such as reallocating funds currently used to pay for parking subsidies.

Customer access to products and services is a priority for any organization. Access includes being able to conveniently get to facilities in a reasonable amount of time. Traffic congestion, parking shortages, and lack of travel alternatives are obstacles to customer satisfaction. By employing TDM strategies, and by broadening efforts currently aimed at employees to suppliers and customers, employers may enhance accessibility, another benefit from TDM.

Whether the benefits justify the costs in any given program is a question for which there is no clear answer.

Liability

There are questions regarding the extent of employer liability when sponsoring or encouraging commute alternatives. Experts say that areas of concern are workers' compensation and claims by third parties. Despite widespread regulations requiring employers to get involved in their employees' commutes, there has not yet been a court case on either of these issues.

Commuting has generally been considered outside the course of employment, and injuries sustained during the commute are not compensated under workers' compensation laws. However, if the employment relationship is implied to continue during the commute because the employer furnished or subsidized transportation in some way, then workers' compensation may apply. An important consideration is whether the employer receives a benefit from the employees' commute choices. These factors also apply to injuries to third parties caused by employees participating in TDM programs.⁷

It is thought that employers who mandate the use of certain commute alternatives by employees will face a higher risk of liability than employers who offer a variety of choices to commuters. It is in managers' interests to ensure that TDM programs are being implemented in ways that offer minimum exposure to liability.

Advocating reasonable legislative remedies may help to address liability obstacles. The State of Illinois Revised Statutes, Chapter 95 1/2 states, "An employer shall not be liable for injuries to passengers and other persons because he provides information, incentives, or otherwise encourages his employees to participate in ridesharing arrangements."

Parking Pricing and Financial Incentives

The treatment of parking in the federal tax code allows employees to receive up to \$155 per month in parking subsidies without tax consequences.⁸

Employers are learning that charging employees for the privilege of parking is a powerful way to change travel behavior. Some employers don't realize how much money they're spending to encourage employees to drive alone to work. Free or cheap parking greatly increase solo driving; reducing or removing parking subsidies reduces solo driving.⁹ Parking pricing not only influences commuters' travel mode, but it changes the way a company allocates their transportation dollars. By charging employees to park, employers can reallocate the resources formerly used for parking and use them for TDM programs. Developers can negotiate with local planning agencies to build less parking in favor of strong travel reduction programs.

⁷Correspondence to California State Senator Tim Leslie from Deputy Legislative Counsel Sally B. McGough, July 12, 1993.

⁸U.S. Internal Revenue Code, Sec. 132(f), amended 1/1/93.

⁹Willson and Shoup, *Parking Subsidies and Travel Choices: Assessing the Evidence*, Western Regional Science Association, February 24, 1990.

Despite the proven connection between parking pricing and travel behavior, raising parking rates is one of the most controversial TDM strategies, and one of the most difficult to implement. Parking pricing can have a disproportionate impact on the lowest wage earners, and on certain socioeconomic groups. Remedies for this problem include instituting travel allowances to offset parking pricing increases, thereby turning the subsidy into cash which is put in the hands of the commuter. Another remedy that has worked successfully is to set parking rates in relation to employees' salary levels, resulting in the highest paid employees paying the highest parking rates. This solution, however, doesn't take into account employees' total household incomes, which may have more bearing on their transportation choices than their individual wages.

Labor Relations Issues

Unions have a number of concerns that relate to TDM programs. First, they want to ensure that their members don't assume the entire financial burden for TDM program implementation. Employers who raise parking fees without adding incentives or options to their employees' transportation options may face serious protests from unions and long term distrust of TDM activities. Unions also want equitable treatment of employees. Offering certain incentives and programs to some employees and not others (such as targeting employees who drive to work alone) may be counter to the principles of affected unions. Additionally, unions want to ensure that the employees they represent are not unfairly disadvantaged as a result of travel restrictions.

Offering financial incentives can be problematic for some businesses, since incentives may be viewed by collective bargaining units as negotiable benefits. Some union representatives have raised concerns about telecommuting in that it favors paying employees on the basis of performance of agreed upon objectives. This can be considered close to the concept of payment for piece-work (rather than hourly wages) which unions have opposed in some industries.

Where employees are represented by labor unions, those unions need to be involved in developing and communicating TDM programs. This added complexity may hinder an employer's ability to take short term actions that involve financial incentives, disincentives and work place/schedule changes. But it is important to point out that TDM programs can actually increase the options available to employees, and can enhance job satisfaction by easing the costs and stress associated with the commute. From this perspective, some union leaders have taken a proactive position in negotiating programs that benefit the employer and the employees.

Business Site Selection

There is anecdotal evidence from employers involved with determining where to locate or relocate their businesses regarding the role that regulatory activity plays in choosing new locations. Certainly, employers desire a "business-friendly" climate in which to operate, but it is very unlikely that TDM regulations when considered alone play a significant role in site selection.¹⁰ Public hearing testimony from businesses about TDM mandates often includes pleas for balanced policies, adequate support, and reasonable timelines. Employers object to programs that put unrealistic burdens on them, and do not want to bear sole responsibility for problems created by and exacerbated by larger populations. Burdensome TDM regulations may reflect a tendency toward an unfriendly climate in which to conduct business, and may, in that context, affect site selection.

One important aspect of site selection is the ability to decentralize operations through the use of technology. TDM offers businesses new support for programs that use *information* highways rather than *vehicle* highways. The more sophisticated such networks become, the more options employers have to reduce the need for people to report to central offices during standard daytime shifts. Opportunities are increasing for employers to join public sector partners in creating new work places that are designed for minimal travel and maximum efficiency.

Facility expansion represents an ideal time to incorporate location and design features that encourage the use of travel alternatives to the single occupant car. Proximity to transit, parking design and supply, pedestrian access, ridesharing

¹⁰Various site selection studies conducted by The Breen Consortium, Inc., McLean, VA.

staging areas, and on site services are some of the considerations that will impact behavior of all travelers to new sites in the future.

Ensuring Adequate Alternatives and Support Programs

Worksite based TDM activities need supporting programs to be effective. Specifically, support programs include enhanced transit and rail service, integrated high-occupancy-vehicle (HOV) systems, regional ridematching systems, training programs for employers, and other regional services that ensure options for travelers who are being asked to leave their cars at home.

Some communities are funding transit and rail service enhancements in conjunction with TDM initiatives, however, many are finding it difficult to devote the necessary resources to these programs. HOV systems can take years to implement due to the need for inter-jurisdictional negotiations. In the absence of supporting programs, employers are justified in their criticism that they are shouldering an unfair share of the burden.

Public Policy That Affects Implementation

Regulations, ordinances and other "command and control" strategies have become the preferred method of addressing congestion and air pollution problems by policy makers. The option of "market-based" strategies holds promise, but has yet to be tested on a regional scale. Market-based strategies are those that require travelers to pay for the cost of using the system they choose. The higher the impact is of a particular use, the higher the cost would be for that use.

Congestion pricing is an example of a market-based strategy. There are no congestion pricing projects currently in existence in the U.S., and there are only a few in operation throughout the world. One project being considered in the San Francisco Bay Area would increase tolls on the Bay Bridge (a primary east-west connector) during peak hours. Singapore's downtown area has a successful pricing scheme that requires users to pay a fee to bring a car into the densest zone during peak hours.

Obstacles to the adoption of congestion pricing include public concerns regarding the impact of such systems on low income users, technological barriers, lack of inter-jurisdictional planning, agreement on the uses for the revenue generated, and the lack of long term demonstrations of its effectiveness. The Federal Highway Administration is directing a program to fund up to five congestion pricing projects in the U.S. to help overcome this last obstacle.

Another concern relative to public policy has to do with the lack of consistency of definitions and measures used in TDM programs. Since TDM initiatives are being created simultaneously throughout the country, local jurisdictions are crafting definitions suited to their local needs. The problem with this is that employers who do business in multiple jurisdictions have numerous programs with which to become familiar. Also, obtaining comparable data between programs that use different measuring devices is difficult. The Federal Clean Air Act guidelines establish some common parameters, but every implementing state has freedom in determining exactly how employers will be required to collect and report data. Differences also impede research activities that could help us better understand the real impact and cost effectiveness of TDM programs.

Policies concerning parking requirements often run counter to TDM initiatives when local jurisdictions establish minimum amounts of parking spaces for new or expanded development. Often parking minimums do not take into account the reduced need that results from successful TDM programs (that may include parking pricing).

As evidence of TDM's growing popularity, some regions have overlapping initiatives imposed by state, regional, and local agencies. One agency concerned with congestion management may adopt TDM requirements while another agency concerned with air quality may adopt similar requirements for the same geographic area and population. The result is that employers may be affected by redundant or conflicting regulations. Addressing these problems diverts attention and limited resources away from the real issue which is to reduce demand.

Limited Understanding of the Effectiveness and Longevity of TDM Strategies

There's a lot that implementors don't know about TDM implementation. Some very good research has been performed, and more is currently underway. But findings need to be published and disseminated in a timely way to employers and others who are responsible for implementation. Today, implementors don't know how various TDM strategies complement or contradict one another; which are the most cost effective in terms of results by site and by region; how long changes that result from TDM are sustained; or what affects longevity. These gaps in knowledge can be filled through diligent research endeavors, communication of findings, and through more experience. In the meantime, implementors are using best guesses to move forward with their TDM efforts.

FUTURE IMPLICATIONS OF IMPLEMENTATION

Today's performance by implementors will, in part, dictate how and to what extent TDM is mandated in the future. There is little dispute that TDM programs can have a significant effect on site specific congestion, and that every trip reduced offers some reduction of polluting emissions and energy use. The questions arise when regional impacts are desired. Is there too much reliance on TDM as the most effective way in which to achieve the results? Is the relatively quick and inexpensive solution of TDM delaying the adoption of other measures that may be more difficult to implement, but may also be better at achieving the goals? What role can technology play?

For many in the TDM profession, TDM has been viewed as *part* of the solution to traffic and pollution problems. For some employers who are required to implement TDM programs in regions that lack sufficient support systems, it can feel as though the weight of solving regional problems is being put on their shoulders. As more transportation control measures are put into place, perceptions about TDM programs will undoubtedly change.

TDM programs involve new players in solving societal and environmental problems. Perhaps the real contribution of TDM programs is that the implementors become the avenues through which society learns new ways of planning and using its transportation resources. TDM challenges certain cultural beliefs that have been fostered by decades of automobile advertisements, highway building, and lack of integrated land use planning, namely that everyone should have the right to drive what they want wherever and whenever they want to. Polls in the San Francisco Bay Area indicate a willingness on the part of citizens to approve higher tolls on bridges during peak hours if the revenue is used to support transportation alternatives. The involvement of employers and commuters in TDM programs has raised awareness of the choices we make regarding transportation.

The involvement of new players is only one of the side effects of TDM that we don't fully understand. The manner in which each region addresses the issues listed in the previous section will also create side effects that, as yet, can't be determined. The only way to enhance our understanding is through more experience and testing, which implies the ongoing implementation of worksite-based TDM.

There is speculation that TDM initiatives may expand to affect non-work trips. These trips constitute the majority of all trips, but may be much more difficult to reduce using the same command and control approaches prevalent in work trip reduction programs. The characteristics of non-work trips are different from work trips, and the prospect of being required to reduce them is of great concern to businesses that indirectly generate trips by those seeking the businesses' services. Business alliances are already positioning market-based strategies as being more appropriate than indirect source regulations for reducing non-work trips.

The increased numbers and growing sophistication of professionals in the TDM field offers opportunities and challenges. The learning curve for TDM is short. In Los Angeles where worksite-based TDM programs have been mandated for five years, there has been a rapid change in the level of involvement and the quality of input by the regulated employer community. Because of their hands-on experience, the knowledge of the implementors can surpass the knowledge of policy makers, creating challenges for setting future policy and communicating objectives and strategies. For this reason, it is critical for all parties involved to seek the knowledge and opinions of the other stakeholders on an ongoing basis, and to respond to new findings quickly.

CONCLUSIONS

Today, TDM is focused on the reduction of work trips through programs implemented by employers or building owners. The primary reasons for TDM initiatives are to reduce congestion and air pollution. There is little proof that worksite-based programs will achieve desired regional improvements in mobility or air quality, but there is continued emphasis on these strategies because they can result in some measurable change, and they are relatively easy and inexpensive to implement.

The future of TDM depends largely on the implementors of today. As they gain experience, these implementors are discovering issues and side effects of TDM programs that were unexpected and will require thoughtful consideration and significant effort to resolve. The implementors' experience and growing sophistication is placing them in the position of knowing more about TDM than those who initiated the programs. As TDM implementors are viewed as true partners in solving transportation, air quality, and energy problems, they will offer a unique perspective and creativity to policy decisions and program development.

INTEGRATING TRAVEL DEMAND MANAGEMENT STRATEGIES

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ABSTRACT

Efforts to manage transportation demand in American metropolitan areas have in the past been very limited in scope and poorly integrated with land use and transportation policy, planning, programming, and operations. Although these efforts have frequently been quite cost-effective in reducing congestion and other effects of automobile use, their modest impacts have generally been overwhelmed by the rapid continuing growth in motor vehicle use. Most Transportation Demand Management (TDM) and Transportation System Management (TSM) strategies have had a narrow and short-term focus and have overlooked major opportunities to shape the evolution of longer-term travel demand. Even where growth management and congestion management systems have begun to influence land use policy, there has been a tendency to focus on solely or predominantly on peak period highway system performance. Such systems have given little weight to the quality and availability of transit, walking, and bicycling, or the accessibility these might offer to satisfy daily needs of residents, workers, and visitors.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990 (CAA) both give new impetus to TDM. Their successful implementation will require all metropolitan areas over 200,000 to develop effective congestion management systems (CMS) which integrate TDM into transportation planning, programming and operations and include land use management and pricing elements. Under these laws, TDM might finally realize its full potential for boosting the productivity of our transportation system investments and strengthening economic performance. However, this will require several significant changes:

- TDM must be integrated into all aspects of transportation and community planning and development, rather than being treated as an add-on to the current process.
- Local, regional and state agencies involved in transportation and land use need to be held accountable for the impacts of their actions on travel demand and reorganized to better coordinate policies and programs which can manage both short and long term demand growth.
- Much greater resources at the federal, state, regional, and local level must be devoted to transportation and land use data collection, the improvement of analytic tools and monitoring systems, and the use of new types of criteria and benchmarks for measuring transportation system performance, demand changes, and environmental and socio-economic consequences.
- TDM must encompass a broader range of strategies, including those dealing with non-work travel, non-peak period travel, short trips, emerging technologies, pricing, land use development, and urban design.

LEARNING EXPERIENCE WITH TRANSPORTATION DEMAND MANAGEMENT

Budget constraints, environmental concerns and neighborhood activism have all combined to render new roadway construction increasingly unlikely in many urban areas. All of these factors argue that the freeway building era must give way to the demand and system management era. ISTEA simply acknowledges these forces and begins the process of taking a systematic approach to urban transportation problems via the new congestion management requirement. However, prior attempts at implementing demand and system management approaches have had limited success. How have they worked and why? A look at various attempts at demand management implementation reveals much about implementation barriers.

U.S. Department of Transportation's 1975 Transportation System Management (TSM) Regulations—"Too Small to Matter?"

In the wake of the environmental and petroleum crises of the early 1970s and rising demands for federal funding of rail transit, US DOT issued regulations requiring systems management as an "element" of long range plans. "TSM" became the buzzword for the notion that "it is better to manage well what you've got than to just keep building more of it." It was a time of pause after several decades of massive highway construction across the nation. The highway revolt and gas lines had raised serious questions about national transportation policy. TSM was a banner for reform in many quarters, but soon enough became established as a label slapped on traffic signalization and a handful of small commuter assistance projects. Some in US DOT and elsewhere saw TSM as a holistic approach to transportation analysis. However, in practice the TSM Regulations failed to promote systems management as an overall approach to transportation planning and programming. Instead they merely attempted to add to existing practice by requiring metropolitan areas to address system management actions including transit, carpooling, park and ride, local traffic management and demand strategies as an element of the plan. The federal guidelines encouraged a systematic approach to the transportation system in this element of the long range plan, but gave little impetus to closer coordination of transportation and land use planning and policy or to consideration of fundamentally different alternative long-range plan options.

TSM was defined as short term in nature, leaving the long range plan to focus on unconstrained demand projection and the expansion of capacity to meet that long range demand. The regulation provided that the long range plan should include a Transportation Systems Management Element, but provided only that the "programming of TSM projects in the annual element of the Transportation Improvement Program represents a commitment for carrying out each action." In the mid term, transportation planners continued the moving bottleneck theory of dealing with congestion problems through programming capacity enhancements in the five year transportation improvement program. This "systems" approach only looked at system and demand management strategies. As a sequential add-on at the tail end of the planning and programming process, thus it was piecemeal in nature. The list of TSM activities did not include capacity enhancement, so systems management of necessity became an adjunct to the plan, not a primary focus.

The 1975 TSM regulations failed to alter transportation planning and practice in a significant way because they were an ad hoc addition to the planning process. There was no need to change institutional structures to implement the regulations, nor to significantly alter the fundamental approach used to evaluate and manage transportation programs, land use decision-making, or transportation pricing strategies. Although some local planners and activists identified more comprehensive transportation management strategies, the only elements moved forward to implementation were those which were supportive of or directly complementary to highway investment—in coordinated or computerized traffic signal systems, intersection widening to boost vehicle capacity, park-and-ride lots to make public transportation more dependent on the automobile, High Occupancy Vehicle (HOV) lanes which usually involved highway capacity expansion, low-budget voluntary ridesharing programs, and parking management programs which brought construction of public parking spaces in or near downtowns. In some communities, bicycle paths or lanes were developed, but frequently these were isolated recreational facilities of poor design which were neither maintained nor integrated into a coherent system. Measures to eliminate parking subsidies, restrict automobile use in central areas, manage land use to limit suburban sprawl were proposed but blocked by powerful political forces in all but a handful of cities.

California's Congestion Management Program (CMP)

In response to a sharp rise in traffic congestion, a recent California law has created a state Congestion Management Program. This requires designation by county level agencies of a congestion management system consisting of principal arterial roads, requires measurement of Level of Service (LOS) at specific points on that system, and requires the development of a Capital Improvement program to improve LOS at these locations as well as the consideration of demand management approaches and the implementation of trip reduction ordinances. The California CMP provides a new transportation forum for the State Department of Transportation, cities and counties and transit agencies at both elected and technical level for coordination of policies and programs. In addition, it incorporates land use and air quality considerations and elevates consideration of highway system performance to a new level.

However, the California CMP process is modally focused on Level of Service (LOS) measurements at specific points on the county's network of principal arterial roadways. This highway capacity orientated system promotes road construction and widening as the primary strategy for congestion relief. The focus on LOS at specific points in the highway system ignores overall transportation system performance. Moreover, the California system is not regionwide, but only county oriented. For example the San Francisco Bay Area consists of nine counties, between which there is a high degree of inter-county commuting. However, inter-county trips are exempted from consideration. Its many exemptions for types of trips and even for specific trip generators renders its systems analysis component severely flawed.

The California CMP guides resource allocation in three ways: projects must be on the Congestion Management Program network or significantly improve its performance to receive funding, projects must be derived from the CMP's capital improvement program, and if LOS is not improved, a deficiency plan to deal with trip generation and land use must be prepared. This linkage to resource allocation decisions is direct and provides a useful framework for congestion management programs. Unfortunately, the use of LOS as the only performance standard has resulted in Capital Improvement Programs that are almost entirely related to capacity expansion of roadways and have not included meaningful implementation of TDM programs. Despite shortcomings, both the county level congestion management agencies and the programs which they have developed will provide the foundation for the development of the congestion management program under ISTEA.

Growth Management in Montgomery County, Maryland

To help respond to the pressures of rapid population and employment growth in recent decades, Montgomery County has developed what is perhaps the most sophisticated growth and congestion management program in the US. Administered under the County's Adequate Public Facilities Ordinance (APFO), this system offers elements of a more robust multi-modal framework for integrating congestion management with land use decision-making, although it too has shortcomings. This system permits new land use development approvals in an area only if the Transportation Improvement Program will provide adequate transportation capacity, but allows a trade-off in LOS between modes. Only a modest level of peak traffic congestion is allowable in areas where people are highly dependent on the automobile for mobility. Higher levels of average highway traffic congestion are allowed where transit, walking, and bicycling provide better alternatives. Rather than measuring congestion at bottlenecks, the Montgomery County system looks at the average level of congestion across all the roads in small sub-areas of the region, giving it more of a system-level focus. Valuable methods for quantitatively assessing the average LOS for different modes which are the choices available to individual travelers have been developed by County planners, including a weighted scoring system which evaluates each of several dozen policy areas for the share of households and jobs within walking distance of transit, the average frequency of bus and rail services, the ratio of sidewalk miles to street miles, availability of bicycle and automobile parking at transit stations, and mode share for work trips and transit access trips. An extension of this approach based on rigorously evaluated peak period transit accessibility of jobs and households is under consideration for use in a total transportation LOS measure.

The Montgomery County APFO multi-modal analysis framework has stimulated increased public-private cooperation in establishing demand management programs, such as employer-based and residential-based rideshare matching, shuttle vans between suburban office campuses and Metro stations, reduction or elimination of employer-provided free parking, and employer subsidies for transit commuting. This has been particularly true in areas where funding for system capacity expansion has been unavailable to support added development approvals. However, the traditional institutional structural bias towards transportation capacity expansion at both the County and state level and the emphasis on peak-hour traffic problems have led demand-management efforts to have a short-term focus on peak-period work travel demand management. Stability of funding for even these demand management programs has been a problem. Less traditional efforts to reduce non-work, non-peak period, and shorter trip travel demand have won little or no support from financially-pressed traditional transportation and planning agencies focused on planning and building roads and operating transit services.

The Montgomery County APFO has had some success in channeling growth into more transit, pedestrian, and bicycle oriented development patterns, but has also sometimes promoted automobile-dependent sprawl. A successful

transfer of development rights program has preserved an agricultural wedge in the County. However, within the growth corridors, automobile dependent sprawl has been encouraged in part by other aspects of the APFO and by the geographically fragmented master planning process. A more traditional and overly uniform APFO intersection-level analysis of the traffic impacts of individual developments has worked against transit-oriented development and was recently modified to allow more congestion near Metro stations. "Local Area Transportation Review," focusing on intersection congestion, has promoted sprawl at the edges of the region, the flaring of arterial intersections (sometimes to 8-lanes or more), a greater use of grade separated arterial intersections, and other actions which have degraded already poor quality environments walking, bicycling, and transit use.

The linkage of the APFO to the County's land use master planning process has been limited by political resistance to the comprehensive revision of County-wide and regional master plans and zoning. A piecemeal master plan amendment process has given excessive power to NIMBY forces seeking to preserve a fast-fading "Ozzie and Harriet" suburban lifestyle in the face of growing urbanization pressures. The resulting compromises have often resulted in development at levels which guarantee enough density to cause traffic problems but not enough density and mix of uses to be truly transit, pedestrian, and bicycle friendly. As in many other metropolitan regions, zoning and growth controls are kept tight in the County's most highly transit accessible areas to limit new infill housing potential, forcing growth to the automobile-dependent metropolitan fringe. For years, political resistance at the senior level of planning agencies has prevented staff from using the county's sophisticated computer transportation models to evaluate the air pollution consequences of significant transportation pricing changes or alternative land use patterns.

ISTEA's Congestion Management System (CMS)

The new federal legislation passed in 1991 contained a requirement for six management systems, including one dealing with congestion. There are specific requirements for metropolitan areas over 200,000 in population. Under ISTEA, demand management strategies must be integrated into the transportation planning and programming process and transportation and land use interactions must be accounted for.

ISTEA recognizes the existence of an interdependent, intermodal metropolitan transportation system which affects, and is affected by, many other factors external to the transportation system itself. The management system requirement provides a means for ensuring the physical integrity of that system and for analyzing the performance of the system. The integration of congestion management and ISTEA requirements into transportation planning and programming will require continual efforts to evaluate the impact of alternative strategies to improve transportation performance, including changes in land use and urban design patterns, subsidies, and transportation pricing. These requirements cannot be satisfied by continuing business as usual approaches to transportation planning, with fixed sprawled land use forecasts, the assumption of continued automobile use subsidies, and continued neglect of pedestrian, bicycle, transit, and paratransit options. CMS must become a framework for evaluating metropolitan transportation system performance against goals and benchmarks. It must include a mix of strategies, so that capacity enhancement for highways or transit must be examined in the same context as demand management strategies.

The CMS should serve as a base for developing consensus and a mix or optimization of projects, programs and strategies that moves us beyond narrow debates about transportation and air quality to incorporate demand management strategies as an inherent part of doing business, as electric utilities did in the 1980s. Sound decision-making as part of a congestion management system and ISTEA-compliant transportation planning process will be based on evaluation of the full long-term costs and benefits of alternative investment, pricing, and development patterns, considering secondary effects and induced and latent demand.

Unfortunately, initial US DOT definitions of the new congestion management system appear to perpetuate the sequential approach to the problem and do not provide a clear linkage from the congestion management system to the investment and operational decisions made in the long range plan and short range Transportation Improvement Program (TIP). This approach will perpetuate the marginalization of demand management strategies, contrary to the intent of Congress in passing ISTEA and the CAA. The proposed ISTEA management systems regulations issued in March 1993 provided that in large urban areas the Congestion Management System must first demonstrate that demand management and operational strategies do not solve a congestion problem before proposing the addition of Single Occupant Vehicle

road lanes. This is the obverse of the fallacy of the 1975 TSM Regulations, which added the lanes by right and then iced the cake with systems management strategies. Neither approach represents a comprehensive method of managing transportation system throughput. At this time, it is unclear whether the final regulations will correct this deficiency.

The Clean Air Act Amendments of 1990

In the wake of two decades of failure to meet health standards for air quality in American cities Congress passed and President Bush signed the CAA Amendments of 1990. Roughly 150 million people living in dozens of regions are exposed to serious health threats from ozone and other pollutants. Recognizing that uncontrolled growth of motor vehicle use cancels out the benefits increasingly costly technological changes for emission reduction, the law requires steps to slow or cap the growth of vehicle miles of travel, including widespread adoption of TDM strategies in more seriously polluted cities in the 1990s. The CAA requires transportation plans and programs to contribute to annual emission reductions, mandates phased compliance with emission reduction targets, requires setting separate emission budgets for mobile and stationary sources, and promotes emission trading under these budgets. This can create incentives for new political forces to take an interest in mobile source emission reduction through TDM and other strategies if these produce tradable credits at a lower cost than equivalent stationary source emission reductions.

Under the CAA, transportation plans and programs have to conform to State Implementation Plans and their emission budgets. However, until these new budgets are established, interim period rules for transportation conformity are set by the CAA. Instead of issuing the regulations required by law, EPA issued guidance which followed the traditional approach to transportation conformity analysis and air quality planning for transportation: it was designed to affirm business-as-usual rather than to enforce a newly-toughened law. Under this guidance and draft final regulations, as many projects as possible were grandfathered or exempted from evaluation. Second, a "build/no-build" air quality analysis method was established to guarantee that long-established highway construction programs would not suffer excessive disruption, particularly when tested using the old highway planning and emission models, with their lack of policy-sensitivity and ignorance of feedback and secondary effects, such as induced, latent, and suppressed demand.

As a result, transportation plans and programs adopted to date under the CAA and ISTEA have for the most part contributed to further increases in VMT and vehicle trips per household in major metropolitan areas, rather than contributing to healthful air quality. EPA is now finalizing the transportation conformity regulations while states and MPOs struggle to catch up with the challenging requirements of demonstrating how they will attain healthy air. There no doubt that demand management strategies will be a necessary long-term element in providing clean air and healthy communities in many major American cities and suburbs. Hopefully, action by the new administration will send a more consistent message that business-as-usual will no longer suffice and that the law will be enforced.

Conventional strategies for ozone reduction, relying on VOC reduction and measures which increase vehicular capacity, are being revealed as inadequate. In many regions, new strategies are needed to curtail NO_x and other emissions, which have been ignored until now. Mobile source NO_x emissions increase, rather than decrease, in response to the failed conventional strategies for transportation-related ozone reduction. New transportation strategies need to focus particularly on reducing the number of vehicle trip starts, not just VMT reduction.

While the old approach to ozone reduction relies on models which see speed increases as beneficial, the new approach recognizes the potential for speed changes to modify demand for travel within and across modes. For example, the conventional analysis methods and strategy view traffic calming as something that would increase emissions contributing to ozone while endorsing freeway widening for HOV lanes as an emission reduction strategy. The emerging analysis methods and strategy view traffic calming for its potential to improve pedestrian, bicycle, and transit use while reducing motor vehicle trip starts and the type of vehicle chosen for ownership and use, while questioning whether HOV add-a-lane projects will produce sustainable pollution-reduction benefits. The emerging strategy considers that such HOV project may increase travel demand, especially for longer trips, and induce further low-density automobile-dependent sprawl at the fringe of metropolitan areas, leading to eventual increases in VOC, as well as short and long term increases in NO_x emissions.

LESSONS FROM PAST EXPERIENCE

Prior and ongoing attempts at implementing TDM and congestion management have foundered on six fronts, all of which can be resolved in the U.S. through careful implementation of the 1991 ISTEA legislation.

1. **Past approaches have largely been sequential, not comprehensive in their examination of ways to improve system performance.** A new approach should comprehensively examine the entire range of options including capacity enhancement in an effort to select an optimum mix of demand and supply strategies and actions for inclusion in the plan and program.
2. **Prior efforts have focused on the near term, which has not altered the fundamental approach to congestion—trying to build our way out of it.** A long term commitment to operate and manage both demand and supply on the Metropolitan Transportation System is required. Operations and management commitments and continuing support of TDM must be treated in the same way as pavement maintenance or bus replacement, as regular ongoing features of a management program for the Metropolitan Transportation System.
3. **Attempts to measure congestion have been focused at points on the road network rather than looking at the whole trip from a user perspective.** Congestion management systems should attempt to optimize travel from a system wide perspective by looking at travel corridors or subareas and at travel markets or demand sets rather than at specific bottlenecks. A broader focus will tend to weight decisions not towards optimizing vehicular *mobility*, but toward investments that increase multi-modal *accessibility* and expand the freedom to meet daily activity needs with less forced dependence on the automobile and which benefit the performance of transportation networks as a whole and the general public.
4. **Implementing agencies have traditionally been oriented toward capacity expansion.** Most state DOTs are overwhelmingly oriented to design engineering in terms of resources. New personnel with non-traditional backgrounds, including the social sciences, should be brought into these agencies to strengthen capabilities to identify and implement new and different types of strategies. In addition, implementing agencies have been biased toward capacity solutions on systems that they own. ISTEA's reliance on the Metropolitan Planning Organizations for planning and funding decisions in urban areas helps to resolve these biases as these agencies can broker among options and between competing agencies. MPOs should reach out to agencies and providers such as ridehare agencies and TMAs who have traditionally not been involved in the State DOT project planning process.
5. **Past practice has failed to link demand management options to funding and investment decisions.** This linkage is critical, as the political imperative to get credit for building new facilities is strong among elected officials. The new ISTEA legislation provides the flexibility to invest in demand management options, but there needs to be an explicit linkage between the management system requirement and the fiscal decisions if a continuing commitment to management is to emerge.
6. **Land use, urban design, and transportation pricing policies and decisions have not been considered in light of their effects on transportation demand and transportation system performance, including air quality.** ISTEA requires consideration of such factors as part of both statewide and metropolitan planning. Effective long-term demand management is highly dependent on creating ongoing integration of these factors across many different agencies and actors. This will require major efforts to reform transportation and land use decision-making structures, increase accountability of different agencies to the effects of their decisions, and improve dispute resolution mechanisms between agencies.

CRITERIA AND BENCHMARKS FOR MULTI-MODAL TRANSPORTATION SYSTEM PERFORMANCE

The integration of TDM strategies into overall transportation and land use decision processes will be most effective if methods are devised for measuring system performance that encompasses the entire multimodal metropolitan transportation system, that focuses upon the needs of the user not the facility, and that allows the evaluation of secondary, tertiary and external impacts of resource allocation decisions. Criteria must be devised for the development of

metropolitan transportation system performance evaluation measures to guide resource allocation decisions: they should be simple enough for a layperson to understand; they should be multivariate in nature as we are trying to model a complex system; they should examine system outputs rather than internal facility characteristics and they should be user oriented.

1. Cost-effectiveness should be one factor in evaluating different strategies. It should be measured over the life of the asset. Inclusion of cost-effectiveness into the ranking of projects in the Bay Area has demonstrated that inexpensive operation strategies in the system management arena have tremendously high benefits in congestion relief per dollar invested.

2. User accessibility and convenience measured in relative delay or travel time by different modes to different types of destinations could be other factors. While LOS tends only to measure a link, congestion measures which look at the entire trip in terms of time tend to better mirror the user's expectations, although these are challenging to forecast. Accessibility measures which evaluate the potential utility of alternative modes and land use patterns and pricing systems are needed to move away from a narrow modal focus and evaluate the real choices or lack of choices offered to individuals who need to meet their daily activity needs. Criteria for the acceptability of traffic delay or congestion should be related to the availability of other viable modal alternatives and should be established to promote rather than inhibit the development and use of multi-modal alternatives. Accessibility by walking, bicycling, transit, and automobile all need to be considered as elements in the total transportation level of service. The effects of changes in prices and subsidies on the use of different modes should be accounted for in developing composite accessibility measures.

3. Social and environmental impact can be measured in an normative plus-minus sense rather than an absolute sense, and a participative model can be developed here. This type of ranking is particularly effective in a public planning process that brings technicians, decision makers, the public and advisors together to evaluate alternative strategies in terms of community values and environmental impacts. Distributional impacts of current patterns and potential changes in transportation prices and subsidies and accessibility should be evaluated to inform public policy-making and participation.

POTENTIAL EFFECTIVENESS OF COMPREHENSIVE TRANSPORTATION MANAGEMENT

A number of analysts have done analyses of transportation demand management strategies for specific metropolitan areas or as part of generalized studies for US DOT or EPA. Many have concluded that there is only limited potential for demand management strategies to limit future growth of motor vehicle use unless "draconian" steps are taken. Typically, very small potentials have been identified because measures have been considered in isolation, without considering the potential for significant changes in background conditions, such as the widespread substantial hidden subsidies which now encourage Americans to use single occupant automobiles and which encourage suburban sprawl, rather than reinvestment in existing urban areas.

The Environmental Defense Fund (EDF) recently prepared a different type of analysis of the potential for demand management strategies to reduce motor vehicle use.¹ This analysis is based on a review of the literature, examination of the evolution of transportation systems and travel behavior across North America, Europe, and Japan in recent decades, and consideration of the results of several recent long-range strategic planning analyses, using policy-sensitive transportation models. Based on this review, the potential effects of a comprehensive package of demand management strategies on vehicle miles of travel (VMT) in seriously polluted major metropolitan areas have been estimated, employing judgement where rigorous modeling is not yet available for purposes of estimation.

This analysis is compared to the list of Transportation Control Measures (TCMs) evaluated by EPA and DOT. EDF believes that by means of the strategies identified in the attached tables, it will be possible for U.S. metropolitan areas to reduce their VMT to 1990 levels by the year 2000 and to further reduce VMT by 10% below 1990 levels by 2010 while accommodating continued economic and population growth. What is needed to accomplish this end are major changes in the direction of transportation pricing and investment policy, changes in the pattern of real estate development, and new approaches to the management of street space. There are no "magic bullets" which accomplish this transition, although changes in transportation pricing are the foundation of this new direction.

Context Determines Effect

The context in which transportation demand management strategies are introduced makes all the difference in their effect. Thus, it is not valid to evaluate the effectiveness of a particular measure or strategy without stating the assumed background conditions for its operation. For example, the effect of imposing new parking charges for either work or non-work trips destined to a particular area will depend on the character of the competing available choices. If public transportation is reasonably competitive with the automobile in time and cost, it may attract much greater use for trips to an area in the wake of higher parking charges. On the other hand, if public transportation is very inconvenient for travel to this area, few travelers will switch to it despite new parking charges. Indeed, the new charges may then lead some travelers to choose alternate destinations where they can get free parking, if these are convenient and available.

Evaluation of demand management strategies must include more than just factors of travel time and cost and include consideration of not only alternative destinations, but alternative times of travel, alternative modes including walking, bicycling, carpooling, and telecommuting/teleshopping, and longer-term effects on vehicle ownership and residential location decisions. Moreover, particular strategies will have different effects on different individuals and households, depending on income, household size, and the stage of the household and its members in their life-cycle.

Current Tools and Data Are Deficient

The transportation planning and analysis tools available today are incapable of considering the full range of these synergistic interactions. Conventional transportation planning models which are in widespread use are generally able to represent only a few of these relationships, and frequently only for work trips. These conventional zone-based aggregate transportation models have usually been calibrated on current conditions and are not structured to be sensitive to changes in real parking costs and subsidies, pedestrian or bicycle friendliness, relative pedestrian proximity of jobs and housing to local retail services and transit stops, the linking of trips into chained itineraries, the potential for influencing the type and number of vehicles used for different household trips, and household life-cycle factors. To encompass these factors which shape travel behavior, most of these models at best rely on crude zonal average indicators of employment density or average parking cost for work trips, average walk access time, and average household size.

Current data collection and transportation monitoring systems are inadequate to support effective TDM and congestion management systems. More investment is needed in longitudinal travel panel surveys, traffic counting and flow monitoring, and the development of inventories of transit, pedestrian, bicycle, and urban design conditions to support truly multi-modal transportation system monitoring and analysis capabilities. These are needed for both short and long range transportation planning and analysis and to evaluate the cost-effectiveness and performance of current TDM and other transportation programs.

The effects of new technologies—ranging from potential new types of vehicles (such as small, lower performance neighborhood vehicles) to new types of information and communications services (such as real-time transit passenger information systems and smart paratransit)—should be evaluated for their potential effects on travel behavior. Efforts to develop more robust and holistic analytic frameworks for travel behavior and transportation system modeling, such as neural network based microsimulation models, should be accelerated.

Meeting these needs will require the “flexing” of transportation construction funds to provide expanded resources for data collection, monitoring, evaluation, analysis, and the development of new analytic tools. ISTEA gives states and MPOs the authority to use federal funds for either construction or planning. Expanding the investment into the latter area can be a key to promoting more cost-effective investment and management strategies as well as the institutional reforms needed to integrate TDM into transportation and land use policy, programming, and operations.

New Tools Are Being Developed

Adequate analysis of the many types of demand management strategies which need to be considered in implementing the 1990 Clean Air Act (CAA) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is prompting development of new models which are sensitive to potential changes in many more types of factors. Several recent

modeling efforts have begun to develop the more holistic frameworks needed to account for these complex interrelationships, using microsimulation to evaluate decisions of individual households (rather than aggregate zones) and geographic information systems to represent the full transportation network and microscale land use pattern (rather than abstracting only major system elements and considering only macro-scale land use).

Notable are the microsimulation analyses developed by Greig Harvey of DHS on several California data sets,² the work of Ryuichi Kitamura and Resource Decision Consultants on microsimulation modeling with panel data,³ refinements of more conventional transportation models in Portland, Oregon,⁴ and Montgomery County, Maryland.⁵ Caliper Corporation has developed software tools which can support easier manipulation and analysis of comprehensive transportation networks using GIS, while longer range advanced research to simulate real-time highway systems, helpful to developing better evaluation tools for emissions analysis and traffic operations management, is proceeding at Los Alamos National Lab using supercomputers and is being advanced by other researchers such as Hani Mahasanni at the University of Texas. Robert Dial at the Volpe Center in Cambridge, Massachusetts is working on new network assignment techniques sensitive to price as well as travel time.

Some of this work has been drawn upon in estimating the potential for a combination of travel demand management strategies to reduce the growth in vehicle miles of travel (VMT) and vehicle trips from trend forecasts. However, none of this work is yet so fully developed as to provide a framework for estimating the combined effects of all of the travel demand management strategies which might be considered to be a useful and internally coherent package in a given region.

For example, Harvey's work has made a significant contribution to evaluating the potential effects of pricing system changes, but has not incorporated to date the effects of changes in pedestrian and bicycle friendliness, such as widespread application of traffic calming strategies together with encouragement of infill accessory apartments and small-scale infill neighborhood retail services in areas now lacking mixed land uses. Kitamura's work has been similarly limited thus far, but promises to soon explore these interactions. These approaches offer substantial promise for more rigorous policy-sensitive and internally consistent travel demand modeling frameworks when they are combined with microsimulation models which simulate the evolution of individual households using panel survey data, land use models which incorporate price and regulatory effects, and dynamic network simulation models which simulate individual person trips on transportation networks over the course of a full day or week.

Portland's very good conventional models, developed largely by Keith Lawton, with support from Cambridge Systematics, have been limited in considering trip chaining and more complex pricing strategies. While pedestrian friendliness factors have recently been incorporated in Portland's model, improving its ability to simulate spatial variations in travel behavior, this model refinement has been limited by significant undercounting of pedestrian and bicycle trips in the regional travel survey on which the models were estimated and new surveys, now underway, are needed to refine this model's sensitivity to alternative policies. Montgomery County's travel demand and supply models, developed largely by David Levinson, Ajay Kumar, and Michael Replogle, have also faced limitations imposed by available survey data.

In all these cases, efforts are underway by these pioneers to further push the state-of-the-art to better address shortcomings of the existing approaches to evaluating the travel behavior effects of current analysis methods. However, in the meantime, Metropolitan Planning Organizations (MPOs) and others need to estimate now the effects of various demand management and transportation investment strategies on travel demand, transportation system performance, and emissions to meet pressing deadlines under the CAA and ISTEA.

More Resources Are Needed for Transportation, Land Use, Air Quality Monitoring and Modeling

Unfortunately, there has been little spending in the past decade on transportation and land use data collection and monitoring systems, development of transportation and emissions analysis models, and training related to these. Federal guidance and support, both technical and regulatory, for transportation and emissions analysis has been very limited. MPOs, which are responsible for undertaking many new types of analysis and planning under the CAA and ISTEA, are in many cases small, understaffed, and captive to much more powerful state Departments of Transportation (DOTs).

The staff at many MPOs lack advanced training in how to undertake such analysis and struggle without appropriate models or even appropriate data to begin analysis.

Thus, many MPOs thus hire consultants or turn over analysis responsibilities to the State DOT. The support they obtain is highly variable in quality, given the shortage of appropriate data, models, and individuals who have received advanced training in travel demand analysis. Too often, deficient data and deficient models are used to produce evaluations of demand management strategies which are guaranteed to conclude that the future cannot look like anything other than an enlarged and distorted version of the recent past—i.e. “business as usual.” Political pressures on MPOs to resist changes in transportation, pricing, and land use policy frequently converge with the inherent tendency of managers and policy makers to avoid risk, thus leading to acceptance of these deficient analyses as “based on the best techniques available within the time and resources available.”

Even useful tools for transportation analysis are subject to misapplication in this process. For example, the Transportation Demand Management (TDM) Model developed Comsis has done a good job of trying to draw from conventional logit mode choice models transferable parameters which can be used to evaluate work-trip related demand management strategies for specific worksites, but this approach is limited by its sensitivity to only work trip mode choice changes. Attempts to apply this model on an area-wide basis and to extend the analysis of strategies to non-work travel through crude factors have not been very satisfactory, leading to conclusions which at times defy common sense.

The shortcomings of existing analysis tools make it essential to introduce more crude estimation techniques for assessing the relative potential of transportation demand management strategies in U.S. metropolitan areas. MPOs and state and local agencies implementing demand management strategies should certainly not limit themselves in their air quality and transportation planning to those strategies which can be rigorously quantified with poor quality models. They should instead apply themselves creatively to developing strategies which make common sense, using the best methods available to estimate the potential impacts of these strategies on emissions, and then ensure both good monitoring systems and contingency measures to evaluate effectiveness and to provide for corrective action in the event of lower than anticipated performance from TCMs.

Integrating TDM into Long Range Plans and Transportation Improvement Programs

Outputs of data collection, evaluation efforts, and multi-modal analysis are key information inputs into the planning process. The planning process must integrate performance and asset management system decisions, assigning priority to the differing classes of expenditures. The planning process develops the overall goals, policies and objectives of the multimodal system and uses the objectives to evaluate the performance data and through a simple weighting and ranking system, select strategies, programs and projects for implementation. Significant, early, and ongoing public involvement and interagency coordination are essential to the process for developing new plans and transportation improvement programs (TIPs), as well as the supporting elements which are an integral part of these—land use, urban design, pricing, and operating policies. This framework planning and programming process should aid in the effective integration of TDM into all overall transportation policy and operations.

STEPS TOWARDS COMPREHENSIVE TDM

Understanding the Limits of Traditional TDM

Recent efforts at TDM and current planning for TDM in many regions have led many to conclude that TDM will provide at best only small reductions in travel demand. A recent US General Accounting Office report which surveyed MPO officials found widespread agreement that traditional TDM measures would produce only small reductions in VMT and emissions, representing on the order of one to two years worth of current VMT growth. Why is this? Traditional TDM has focused on work trips, peak trips, and longer trips, emphasizing VMT reduction, and complemented with traditional TSM measures (such as signalization, intersection widening, etc.) which can be expected in the longer run to actually offset some of the TDM-related VMT reduction because of induced and latent demand and the degradation of the pedestrian environment. This same GAO report found widespread belief among MPO officials that pricing strategies

and non-traditional TDM measures are the most effective ways of affecting travel demand, but these have been little explored since political fear has kept them from even being evaluated in many regions.

A Comprehensive TDM Action Plan

GAO and MPOs are generally correct about the limits of traditional approaches to TDM. Efforts to reduce growth of travel demand and reverse recent trends towards sharply increased dependence on automobiles will be successful only by considering a wider range of strategies to address non-work travel, non-peak period travel, and shorter trips, and including effective transportation pricing changes. This will require coordination of the actions of many planning and operating agencies to develop truly integrated TDM strategies and programs, with measurable performance benchmarks and the assignment of appropriate responsibilities between various actors.

Overcoming Entrenched Interests

One of the reasons why there has been little experience with the broad range of effective travel demand management measures in the U.S. is that many of these strategies involve a wide range of different organizations and institutions which often do not see themselves as having anything to do with "transportation." Frequently, implementation of the less traditional TDMs requires these organizations to address new concerns which may go beyond narrowly defined local or state agency missions. Considerable challenges face MPOs and state DOTs as they work to restructure themselves for more effective implementation of ISTEA and the CAA, develop better interagency cooperation and public participation systems, and struggle to resolve sometimes bitter battles over property rights vs. broad community welfare.

Raising concerns about the long-term consequences of local government land use and site design standards will threaten strongly-cherished local autonomy in decision-making at times. However, America can no longer afford to mortgage its future mobility, economic performance, community livability, and public health so that isolationist frontier-spirited defenders of private property rights and exclusive zoning can act against the broad interests the nation, states and the millions who live in increasingly dysfunctional metropolitan areas. Effective regional implementation of ISTEA and the CAA will require providing all the actors in the system and the public with information about costs and benefits and trade-offs between different strategies for managing congestion and ensuring healthful air. This information should become the basis for establishing systems which reward contributions towards metropolitan goals and penalize actions which work against such goal attainment.

Assigning Responsibility for Results

Governance structures vary widely across the states, making it difficult to generalize about which agency, level of government, or public/private entity should be responsible for implementation of a particular element. However, this assignment of responsibility for implementation and follow-up evaluation is essential if demand management is to be timely and successful. The following discussion is intended as illustrative of what effective short-term travel demand management and mobile source emissions reduction strategies might look like for the U.S. and for a region pursuing expeditious implementation of all reasonably available TDMs.

A FEDERAL GOVERNMENT ACTION AGENDA

Several actions should be taken as soon as possible at the Federal level to support effective implementation of demand management strategies under ISTEA and the CAA:

EPA Should Adopt a Revised Transportation Conformity Regulation Consistent with the CAA

EPA should scrap its January 1993 proposed transportation conformity rule and adopt the alternative transportation conformity rule proposed in March 1993 by STAPPA/ALAPCO, the association of state and local air pollution control officials. This alternative rule, while not ideal, is far more consistent with the CAA Amendments than the EPA proposed rule. Among other features, the STAPPA rule would require annual emission reductions from transportation plans and

programs beginning in 1995, although it would not require that nonattainment areas offset emissions growth back to the 1990 level, as Congress originally intended in the CAAA.

U.S. DOT Should Immediately Issue Revised Interim Conformity Guidance

U.S. DOT should issue revised interim conformity guidance as soon as possible to require a demonstration that transportation plans and programs will produce annual emission reductions, fully offsetting the effects of growth on emissions without taking credit for fleet turnover, technology fixes such as I/M or fuel changes. This is needed to ensure that TIPs prepared as part of the 1993 conformity cycle are subject to appropriate CAA requirements consistent with the intent of Congress.

U.S. DOT Should Strengthen Management Systems, Statewide Planning, and Metropolitan Planning Regulations to Better Support CAA and ISTEA Implementation

Proposed regulations on these subjects need to set higher standards for data collection and analysis, improve coordination between planning and implementing agencies and between state and local agencies, and to strengthen the role of air pollution related agencies in transportation planning. Growth management systems should be strongly encouraged as a part of congestion management systems in nonattainment areas.

Congress Should Amend the Internal Revenue Code to Cash-Out Parking Subsidies. A simple one sentence change in the Internal Revenue Code, proposed in a recent report to the Federal Highway Administration, would make possible widespread cashing out of employer-paid parking. This change could reduce solo driving to work roughly 20%, reduce automobile travel to work by 76 billion miles per year, save 4.5 billion gallons of gasoline per year, reduce air pollution emissions, and increase tax revenues by \$1.2 billion per year, according to this recent study for FHWA.

FHWA Should Accelerate Development and Implementation of IVHS-based Road Pricing. The introduction of Intelligent Vehicle and Highway Systems (IVHS) should be tightly bundled with road pricing, emphasizing the demand management side of IVHS rather than the supply enhancement potential. Current IVHS operational tests should be modified in appropriate circumstances to demonstrate the utility of using smart cards and other technologies for imposition of trip and VMT based charges to drivers. The same technologies should be extended to enable "electronic traffic calming"—automated vehicle speed limit controls through sensors in the roads or at entrances to areas to prevent excess speeding, improve traffic safety, smooth traffic flows, and protect neighborhoods from high-speed cut-through traffic.

U.S. DOT Should Support Research and Demonstration of Traffic Calming and Non-Motorized Transportation Strategies

A major gap in U.S. DOT programs until recently has been in the area of pedestrian and bicycle transportation. Federal support for demonstration projects in this area, with appropriate investment in before and after evaluation studies, is essential to making rapid progress in implementing short-trip related TCMs which have been generally overlooked until now as air quality improvement strategies.

EPA Should Accelerate Research on Modal Emission Factors and Modeling

Widespread evidence suggests that the EPA MOBILE model is based on incorrect assumptions about real-world driving cycles and driver behavior. Incorrect decisions involving billions of dollars in investments are likely being made on the basis of these incorrect model assumptions. Private vehicle scrappage programs implemented under the emissions trading provisions of the CAA might provide a strategy for rapid testing of many more vehicles. However, EPA should complement such testing to fill other gaps and issue revised technical support information and models as soon as possible.

A STATE GOVERNMENT ACTION AGENDA

State governments have an important role to play in implementing demand management strategies. Short-term action items with the highest priority for CAA implementation related to mobile sources include:

Legislatures Should Enact Pay-As-You-Drive Automobile Insurance

PAYD insurance, currently under consideration in several state legislatures, would make drivers more sensitive to the marginal costs of using their automobiles. A \$.52/gallon insurance premium at the gasoline pump in California has been estimated to likely yield short-term reductions in VMT, fuel use, and emissions of 8%.

State DOTs Should Introduce IVHS-Based Road Pricing with HOV Take-a-Lane Strategies

Rather than adding new highway capacity in nonattainment areas, even for High Occupancy Vehicles (HOVs), State DOTs should introduce road pricing using automated smart card toll collection in conjunction with HOV take-a-lane strategies on limited access highways and selected major arterials. This kind of combined strategy can ensure efficient use of "Smart/HOV lanes" from opening day, avoiding the experience of the Santa Monica Freeway take-a-lane fiasco. Price levels charged to smart-card SOVs on the reserved lanes can be adjusted as needed over time to keep a satisfactory level of service and to boost HOV incentives. This will minimize the stimulus to latent and induced travel demand which usually accompanies highway expansion whether HOV or general SOV lanes are being added.

States Should Ensure Full Flexibility of State Transportation Resources and Give Priority to TCM Implementation

Many states still have restrictions on the flexibility of transportation funding sources which contradict the central intent of ISTEA and the requirements of the CAA for priority implementation of TCMs in nonattainment areas. In some states this will require legislative action or constitutional revisions. In most states this will require institutional restructuring and reforms. Funding for pedestrian and bicycle infrastructure projects in nonattainment areas should be substantially expanded beyond ISTEA's requirements for allocation of Surface Transportation Program funds to "Enhancements." Projects benefiting non-motorized modes—such as sidewalk and bicycle path construction, bicycle parking facilities, traffic calming measures—should comprise at least 15% of surface transportation spending in nonattainment areas to help counteract years of neglect.

Congestion Management Systems Should Incorporate Statewide Growth Management Strategies

Congestion management systems should be primarily focused on demand-side management rather than supply-side strategies. Growth management—implemented through statewide legislation, zoning changes, impact fees, and other measures—should be an integral part of these ISTEA-mandated systems. States have an important role to play in reducing damaging competition between local jurisdictions over attracting growth. In coordination with MPOs and local governments, states should develop supportive frameworks for regional and state-wide growth management, with appropriate participation and delegation of decision-making to local authorities.

AN ACTION AGENDA FOR MPOs

MPOs vary in their institutional capabilities, styles, and authority, but clearly have an important and expanding role to play in CAA and ISTEA implementation. Among the most important actions MPOs can take to forward effective implementation of the CAA and demand management are:

MPOs Should Improve Transportation Analysis and Monitoring Capabilities

Implementing CAA conformity will require difficult trade-offs between transportation pricing, investment, and management strategies related to transportation and land use, involving many different organizations, levels of government, and the private sector. More robust and policy-sensitive analysis tools are urgently needed to provide a gaming board for evaluation of alternative scenarios and strategies, as in most cases current MPO tools are quite

deficient. ISTEA funds should be flexed to support expanded investment in data collection, monitoring, analysis, and modeling tools, especially in regions with more serious air quality problems.

MPOs Should Evaluate Alternative Scenarios for Regional Development and Growth Management

MPOs should cease to use a single land use forecast for TIP and plan evaluation. Instead, alternative land use and transportation scenarios should be developed and evaluated for consideration by state and local decision-makers. Without such analysis, there will be no opportunity to consider how growth management strategies could improve air quality as a reasonably available TCM or contribute towards a congestion management program.

MPOs Should Invest in Regional Education and Marketing to Create a New Transportation Ethic

MPOs can play an important role in shaping public opinion and attitudes about transportation through education and marketing. These can influence individual driving and travel behavior choices, contributing to air quality.

A LOCAL GOVERNMENT ACTION AGENDA

Many non-traditional TCMs affect transportation and land use at the level of the neighborhood and local street and hence are best planned and implemented at the lowest possible level of government. Among the more important short-term strategies for CAA implementation related to mobile source emissions affected by local agencies are:

Local Governments Should Implement Growth Management Strategies as Part of Congestion Management

In coordination with statewide and regional programs, local governments should use zoning, urban design, site planning, permitting, and impact fee systems to promote more efficient growth patterns which will reduce, rather than increase, the number of automobile trips and VMT per capita, per household, and per job in their area. This is perhaps the most effective long-term strategy for demand management, but needs to be implemented if possible in coordination with transportation pricing strategies. Changing ordinances and regulations which discourage or bar accessory apartments from transit-served neighborhoods is a good place to start in encouraging affordable infill housing without cost to the government. Overly restrictive or improper zoning often discourages or bars housing densification and appropriate redevelopment near high transit accessibility locations. Reducing restrictions on home occupations and small neighborhood retail and service businesses can also reduce automobile dependence while creating jobs. Pedestrian and transit friendliness is enhanced by eliminating minimum building setback requirements from zoning and site planning ordinances and replacing these with maximum setback requirements. Blank walls can be prohibited in new development on certain key pedestrian streets of urban, suburban, town, and village centers. Similarly, minimum automobile parking requirements should be replaced with formula automobile parking maximums and area-wide parking caps, along with minimum bicycle parking requirements, and shower requirements at workplaces.

Local Governments Should Re-examine Transportation Investments and Pricing Policies

The largest source of highway construction expenditures not paid for by road users, but by the general public, is local governments. Local expenditures for transportation should be closely examined for their impact on travel demand and air quality and local strategies for transportation user fees should be developed to favor demand management. Parking excise taxes or other user fees, such as local automobile registration or parking fees, local gasoline taxes, and area pricing, should be used to ensure that local government general revenues do not continue to subsidize and encourage automobile use. Revenues from these new sources can be used to maintain existing roads, improve safety, and expand options for travel within the community.

Local Governments Should Develop Traffic Calming and Non-Motorized Transportation Programs

The factors that influence whether a street is pedestrian and bicycle friendly tend to be small details of street and urban design. Traffic engineers trained to promote the mobility-oriented objective of faster and more efficient traffic flow should be instructed by local officials to give attention to a new proximity and accessibility-oriented objective—promoting

a balanced transportation and growth management system, with pedestrians, bicycles, and public transportation being given priority on most streets. In areas with serious nonattainment problems, traffic calming, sidewalk and bicycle facility construction, and related measures should be a major element in local capital spending programs.

AN ACTION AGENDA FOR TRANSIT AGENCIES

Transit agencies have a role to play in CAA implementation as well. Among the most important short-term actions they can take are:

Transit Agencies Should Work with Other Agencies to Improve Non-Motorized Access to and from Transit

One of the most neglected areas for transit planning and investment is access planning. All further planned investments in park-and-ride lots should be relabeled in capital programs as "Least Cost Transit Access Improvements." These projects should include rapid examination and preliminary engineering and cost estimation for possible strategies for improving pedestrian and bicycle access to transit stops and stations, including substantial expansion of secure bicycle parking, bicycle paths, sidewalks, traffic calming, and marketing, considering the proximity of nearby jobs and residences. This evaluation of alternatives should lead to selection of the long-term least-cost strategy for expanding transit use and reducing emissions in nonattainment areas.

Transit Operators Should Improve Transit Passenger Information and Security Systems

Investments in real-time transit passenger information systems, especially for areas where services are less frequent, can make a large difference in passenger perceptions of service dependability and user-friendliness. Improved monitoring systems may aid in system security.

Transit Operators Should Improve Transit Fare Collection Systems

Introduction of more types of pre-paid fare media, particularly linked to employer-commuter subsidy programs, can improve transit attractiveness. These should be complemented by better fare integration between different transit providers.

Transit Agencies Should Encourage Paratransit Service Development

The days when one type and level of public transportation can meet every need is long gone in most communities. Market-driven paratransit services should be encouraged as supplementary and complementary to a regional transit system, rather than opposed as unfair competition.

CONCLUSION

In short, effective implementation of demand management in US transportation will come only from learning from past failures and shortcomings and seeking to reinvent institutional structures, planning methods, and the basic framework for viewing and resolving transportation issues and problems. Implementation of ISTEA and the CAA offer major new opportunities to make America's communities more livable and productive by integrating demand and supply side strategies into transportation planning and development.

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TRAVEL DEMAND MANAGEMENT AND INTELLIGENT VEHICLE-HIGHWAY SYSTEMS

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INTRODUCTION

Many metropolitan areas throughout the United States are facing serious problems related to increasing levels of traffic congestion, declining mobility, and air quality and environmental concerns. In response to these growing issues, numerous areas are focusing on better management of the overall transportation system, rather than the construction of new facilities. Travel demand management (TDM) is a pertinent technique being actively pursued in many parts of the country. Travel demand management covers a variety of actions that better manage the demand on transportation facilities by acting to shift more commuters into transit and multi-occupant vehicles and into less congested travel periods. TDM strategies focus on providing inducements to ridesharing, transit use, and peak-period travel spreading, combined with deterrents to driving alone.

Another approach being actively pursued in numerous areas is the use of a wide range of advanced technologies to better manage all aspects of the transportation system. Commonly referred to as intelligent-vehicle highway systems (IVHS), a variety of advanced technologies are being developed, tested, implemented, and operated with the common goal of improving the efficiency of the overall transportation system. More specifically, IVHS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment.

Although approaching current transportation issues from different perspectives, the use of both TDM strategies and IVHS technologies focus on improving the efficiency of the existing transportation system through better management, rather than building new capacity. Further, the use of IVHS and other advanced technologies appears to hold promise for enhancing the successful implementation of TDM strategies. Many potential applications of IVHS technologies with TDM actions are just beginning to be explored and implemented by public and private sector groups. This resource paper is intended to help foster, enhance, and expand this discussion, and to assist in bringing together the different groups involved in both IVHS and TDM. In addition, the paper generates further ideas and suggestions for operational tests, demonstration projects, and research studies to advance the integration of IVHS with TDM strategies.

To accomplish this the paper is divided into three sections following this introduction. The next section provides a brief overview of TDM strategies and IVHS technologies. The major elements of both are summarized to provide a common understanding of the depth and breath of the two approaches. This section also summarizes the different groups involved in funding, research and development, implementation, and evaluation of IVHS technologies and projects. This is followed by a discussion of techniques to utilize IVHS technologies to enhance the use of TDM actions. This section includes a review of examples of current state-of-the-art projects and discusses other potential applications. It also summarizes some of the major issues associated with the possible development of IVHS/TDM projects and approaches for addressing these concerns. The paper concludes with a summary of the major topics covered and the identification of areas where further research is needed.

OVERVIEW OF TDM AND IVHS

What Is TDM?

Travel demand management (TDM) includes a wide variety of techniques and actions aimed at managing the demand on transportation facilities by encouraging commuters to change from driving alone to using a high-occupancy vehicle

or shifting into less congested travel periods. Thus, TDM actions focus on a variety of approaches to encourage ridesharing, transit use, alternative work schedules, parking management and parking pricing, and other techniques.

Although many of these approaches are not new, increasing levels of traffic congestion and related air quality and energy concerns have resulted in major emphasis being placed on the use of TDM strategies in many urban areas. This is especially true in locations classified as air quality non-attainment areas under the 1990 Clear Air Act Amendments. These areas must meet specific requirements by established deadlines or face possible sanctions. Further, many states and cities have implemented additional regulations to increase vehicle occupancy levels and reduce single occupant vehicle use. TDM programs have become integral elements in the approaches being taken in many areas to meet these requirements.

As discussed more extensively in other resource papers, TDM strategies include a wide range of actions focusing on the use of both incentives and disincentives. TDM strategies may include expanded or new transit services, ridesharing programs, parking policies and parking pricing, flexible work hours, telecommuting, walking, bicycling, and other techniques. Incentives—such as employer paid bus passes or employee benefits for using HOVs—and disincentives—such as increasing parking rates or penalizing individuals who drive alone—may be used. Recent TDM programs are also characterized by increased private sector involvement. This may occur through the formation of Transportation Management Associations or Organizations (TMAs/TMOs), employee TDM coordinators, and joint efforts between public agencies and private businesses.

As noted in other resource papers, the experience with different TDM actions appears to be mixed. Further, the experience with many techniques is still evolving. As discussed in this paper, the use of IVHS technologies with TDM strategies appears to hold promise for making the use of high-occupancy commute modes more convenient and enhancing other TDM actions. Thus, combining the two—IVHS and TDM—may help meet the goal of improving the overall efficiency of the transportation system and may assist in meeting other environmental and societal goals.

What is IVHS?

A major focus of recent transportation research and development activities has been on a variety of technologies being examined under the general heading of intelligent vehicle-highway systems (IVHS). Intelligent vehicle-highway systems include the application of a wide range of advanced technologies that share the common goal of improving the efficiency of the overall transportation system. More specifically, IVHS technologies are directed at improving mobility and transportation productivity, enhancing safety, maximizing current transportation facilities, and enhancing the environment. These efforts are being supported by federal and state policy directives, private industry groups, university research institutions, and others.

Before discussing the wide range of technologies and potential applications of IVHS, it is first important to have an understanding of the different groups involved in funding, research and development, implementation, operation, and evaluation of IVHS. The interest in IVHS and the development of projects and operational tests has accelerated rapidly over the past few years. Numerous federal, state, and local agencies, private consultants, private industries and vendors, defense industries, university research institutes, and other groups are all actively involved. Further, the development of many IVHS technologies, products, and tests are being jointly funded and conducted by consortiums involving both public and private sector groups. In addition, numerous IVHS projects and research activities are being conducted in European countries and Japan. The major roles and activities of these different groups are briefly summarized next to help individuals involved in TDM better understand the functions of each.

U.S. Department of Transportation

The U.S. Department of Transportation (DOT) and the modal administrations—the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), and the National Highway Traffic Safety Administration (NHTSA)—are responsible for the federal IVHS program. The Intermodal Surface Transportation Efficiency Act (ISTEA) established an IVHS Program and authorized \$600 million in funding for the 6-year period (1). The Congressional appropriations have maintained a high level of funding for IVHS and the FY 94 appropriation is anticipated

to be approximately \$200 million. In addition, part of the focus of the \$70 million Rebuild America Program proposed by Congress for FY 94 focuses on the conversion of defense industry technologies to transportation and other domestic applications.

The ISTEA required that the U.S. Department of Transportation submit to Congress a strategic plan for the federal IVHS program within one year of passage of the Act. The Department's *IVHS Strategic Plan: Report to Congress (2)* contains the mission statement, goals and objectives, program organization, and program milestones for the federal IVHS program. Overall leadership and coordination for the Department's IVHS program is through the DOT IVHS Coordinating Group and the DOT IVHS Working Group. The DOT IVHS Coordinating Group is comprised of top-level representatives from the modal agencies and other federal departments. The DOT IVHS Working Group is comprised of senior-level agency staff and is responsible for coordinating programs, funding, planning, and implementation across the Department.

The FHWA has been designated the lead agency for coordinating the Department's IVHS program. In addition, FHWA is responsible for various elements of the overall program. The IVHS program within FHWA is administered through the Office of Traffic Management and IVHS. Within the FTA, IVHS-related activities are focused in the Advanced Public Transportation Systems (APTS) program in the Office of Technical Assistance and Safety. Both agencies are moving forward with funding a variety of research and development activities, early deployment planning, operational tests, and other projects. Many of these activities have been funded in response to requests for proposals issued by the different agencies. In addition, Congress has earmarked funding for specific projects through the appropriations process.

IVHS America

IVHS America is a non-profit educational and scientific association formed to plan, promote, and coordinate the development and deployment of IVHS in the United States. *IVHS America* resulted from the work of Mobility 2000, an informal assembly of interested individuals in the public and private sectors who met periodically between 1989 and 1990 to help advance IVHS. *IVHS America* is designed as a utilized Federal Advisory Committee to the U.S. Department of Transportation.

Membership in *IVHS America* is open to public and private sector groups interested in all aspects of IVHS. The structure of *IVHS America* is focused on a series of technical committees and task forces composed of voluntary members. The work of the technical committees is organized through the Coordinating Council, which in turn reports to the Board of Directors. *IVHS America* completed a *Strategic Plan for IVHS in the United States (3)* and a *Federal IVHS Program Recommendations for Fiscal Years 1994 and 1995 (4)* in 1992. Both of these documents were forwarded to the U.S. Department of Transportation. Although many of the *IVHS America* committees may address TDM-related activities, the three that are most focused on TDM are the TDM Task Force, the APTS Committee, and the Advanced Traveller Information Systems (APTS) Committee.

Private Sector Groups

A wide variety of private sector groups have been and will continue to be involved in IVHS activities. These include transportation consulting firms, automobile manufacturers, electronic companies, communication-related business, other technology firms and vendors, and defense industries. Recent interest at the federal level, as evident in the Rebuild America Program, has focused on the potential conversion of defense industry products to transportation and other domestic uses.

State and Local Governments and Agencies

Many State departments of transportation (DOTs) have become actively involved in IVHS activities and projects. For example, state DOTs in California, Texas, Minnesota, Colorado, Washington, Florida, and Virginia are developing, implementing, operating, and evaluating different IVHS technologies and projects. Local governments and agencies are

also involved in IVHS activities in many areas. These include transit agencies—such as those in Houston, Ann Arbor, Minneapolis-St. Paul, and the San Francisco area—and local units of government.

Universities and University Research Institutes

A number of universities and university-based research institutes have been actively involved in a wide range of IVHS activities. Universities are currently playing important roles in many of the IVHS operational tests, demonstration projects, and research and development activities. The FHWA recently selected three schools—Texas A&M University, the University of Michigan, and Virginia Polytechnic Institute and State University—through a competitive process as IVHS Centers of Excellence. In addition, a number of universities in California, the University of Minnesota—which was given funding for IVHS through ISTEA—and other schools will continue to be actively involved in many IVHS projects.

IVHS Technology Classifications

Two different classification schemes are being used to describe IVHS technologies. The first divides IVHS into six broad categories focusing on general applications. The second focuses on IVHS technologies from a user perspective. Both approaches are briefly summarized next.

The six general categories used to describe IVHS technologies are advanced traffic management systems (ATMS), advanced traveler information systems (ATIS), advanced public transportation systems (APTS), advanced vehicle control systems (AVCS), commercial vehicle operations (CVO), and advanced rural transportation services (ARTS). There is overlap among the categories and many technologies within each are in the research and development stage. A brief description of each of the six categories is provided below.

- Advanced Traffic Management Systems (ATMS) - development and operation of advanced transportation surveillance and monitoring systems to provide detection, communications, and control functions in major travel corridors.
- Advanced Traveler Information Systems (ATIS) - provision of pre-trip and in-vehicle information to motorists on current traffic and other conditions and real-time guidance on route information.
- Advanced Public Transportation Systems (APTS) - use of advanced technology to improve the delivery of transit services and enhance the cost-effective and efficient provision of these services.
- Advanced Vehicle Control Systems (AVCS) - use of advanced technologies to enhance vehicle control and operation, thus providing a “Smart Vehicle.”
- Commercial Vehicle Operations (CVO) - utilization of IVHS technologies to improve the efficiencies and effectiveness of commercial vehicles.
- Advanced Rural Transportation Services (ARTS) - improve the safety and efficiency of the rural transportation system through the use of advanced technologies.

The second approach to defining IVHS technologies focuses on describing the different services from a users perspective. This approach is being used in the development of the *National IVHS Program Plan*. This plan, which is being developed by the United States Department of Transportation and *IVHS America*, will identify the near-term program for IVHS development and deployment. The 27 user services highlighted in this plan are summarized next.

- Pre-trip travel information
- Enroute driver information
- Enroute transit information
- Traveler services information

- Route guidance
- Ride matching and reservations
- Incident management
- Travel demand management
- Traffic control
- Electronic payment services
- Commercial vehicle preclearance
- Automated roadside safety inspections
- Commercial vehicle administrative processes
- Onboard safety monitoring
- Commercial fleet management
- Public transportation management
- Personalized public transit
- Emergency notification and personal security
- Public travel security
- Emergency vehicle management
- Longitudinal collision avoidance
- Lateral collision avoidance
- Intersection crash warning and control
- Vision enhancement for crash avoidance
- Impairment alert
- Pre-crash restraint deployment
- Fully automated vehicle operation

Detailed user service plans are being developed for each of these areas. These plans include a description of the operational concepts, possible technologies, potential costs and benefits, the roles of different groups, milestones and activities, and related projects. The user service plans will form a major focus for directing and coordinating the development of IVHS projects and activities. A number of these user services focus specifically on features that are directly related to or are supportive of TDM actions. First, travel demand management is one of the user services. This user service focuses on the application of a wide range of technologies to enhance TDM actions, including mode change support services, HOV facility management and control, parking management and control, congestion pricing, and air pollution and emission detection (5). Further, other user services, such as those oriented toward pre-trip travel information, enroute driver and transit information, ride matching and reservations, electronic payment services, personalized public transit, and public travel security, all support TDM strategies. Thus, as discussed more extensively in the next section, there appears to be numerous opportunities to utilize advanced technologies to enhance TDM actions.

COMBINING IVHS AND TDM

This section discusses the potential of combining IVHS technologies and TDM strategies to better manage commute travel in congested areas. The use of IVHS and other advanced technologies appears to offer numerous opportunities to enhance the successful implementation of TDM actions. This section reviews the general concept of combining IVHS and TDM, examines current and planned projects, and identifies other potential applications.

The Concept of Combining IVHS and TDM

Advanced technologies can be used in numerous ways to enhance the implementation, operation, management, and evaluation of TDM actions. First, IVHS technologies can be used to provide pre-trip and enroute real-time information to commuters on traffic conditions, transit alternatives, weather, and other elements to help individuals select the most appropriate travel mode and to encourage greater utilization of high-occupancy vehicles. Second, the application of advanced technologies can enhance the convenience and ease of use for all types of HOVs. Third, IVHS technologies can be used to help manage and enforce TDM strategies related to HOV use, parking, and congestion pricing. Finally, a wide range of advanced technologies is enhancing the potential for telecommuting.

The provision of real-time information on traffic conditions and transit alternatives to individuals in their home and work place represents an important step in making commuters more aware of both current conditions and the options available to them. In order to influence commuters to change from driving alone to using some form of high-occupancy vehicles, this information needs to be provided in advance of the first mode selection. Thus, as discussed under the examples of current projects, some operational tests are focusing on the provision of real-time traffic and transit information to individuals in their home and work place to allow commuters to make more informed decisions regarding their travel and mode choices. The real-time traffic and transit information may be obtained and coordinated through the use of advanced traffic management systems (ATMS), automatic vehicle identification (AVI), automatic vehicle location (AVL), and other advanced technologies. The information could be provided to individuals through the use of touch-tone telephones, cellular or pocket telephones, television, microcomputers, and videotex terminals. Ensuring that the information provided is accurate and timely appears to be critical to continued use by individuals (6).

The application of IVHS technologies can also make using all HOV modes more convenient and attractive to commuters. For example, fare payment methods can be simplified and made more convenient through the use of *Smart Cards* and other automatic fare payment methods. These techniques focus on the use of pre-paid fare media ranging from a relatively simple pass to a more advanced programmable memory chip card. Further, *Smart Cards* could be used to provide integrated fare payment among different transit modes in an area. In addition, *Smart Cards* could be expanded into multi-purpose cards linking transit, parking facilities—including the ability to charge lower rates for carpools and vanpools—and other services such as banking and credit card purchases. *Smart Cards* could also be used by businesses to help track the use of HOVs by employees as part of incentive programs or to charge more for the use of parking for drive alone commuters. Other IVHS technologies could be used to provide real-time carpool matching capabilities, enhanced guaranteed ride home programs, and other techniques to make the use of all high-occupancy vehicles more convenient.

IVHS technologies may also be appropriate to assist with the management, operation, and enforcement TDM actions related to HOV facilities, parking management, and congestion pricing. A wide range of advanced technologies, including AVI tags, *Smart Cards*, remote sensing, and other devices may be used to help operate and enforce various TDM strategies. For example, AVI tags are currently in use on a number of toll facilities throughout the country to provide electronic toll collection. Individuals purchase AVI tags which are encoded with a prepaid toll value. The AVI tags, which are usually located on the front windshield, are read by receivers at special toll plazas, allowing vehicles to pass through the plaza without stopping. This approach is currently being used with buses equipped with electronic tags on the Route 495 HOV lane on the approach to the Lincoln Tunnel in New York City. The potential for other applications using IVHS technologies to better manage and enforce TDM actions are discussed more extensively later in this paper.

Finally, advanced technologies are being used to enhance the use of telecommuting. Advances in telephone, fax, video conferencing, and other technologies are allowing increasing numbers of workers to spend one or more days a week working at home or at a remote job site. Although the exact number of telecommuters is not known, it appears that the use of telecommuting is increasing. In addition to the TDM benefits of removing trips from the roadway system, telecommuting offers businesses the potential to realize savings in real estate costs. For example, AT&T estimates that it has saved approximately \$24 million in real estate costs through telecommuting programs since 1992 (7).

Current and Planned Examples

There are a number of projects throughout the country in different phases of planning and implementation that focus on the use of IVHS and other advanced technologies to enhance TDM actions. Examples of a few projects currently moving forward throughout the country that combine different aspects of IVHS and TDM are briefly summarized in this section. The projects described are intended to provide an indication of the variety of applications currently being considered. Projects in Houston, the Bellevue-Seattle area, the San Francisco-Bay area and other parts of California, the Minneapolis-St. Paul area, and Dallas are briefly highlighted next.

Houston Smart Commuter IVHS Operational Test

The Houston *Smart Commuter* IVHS Operational Test is examining the potential for gaining more efficient use of major travel corridors through greater utilization of high-occupancy commute modes, shifts in travel routes, and changes in travel time through the application of innovative approaches using advanced technologies. The operational test is based on the hypothesis that commuters who have quick and easy access to relevant, accurate, and up-to-date information on existing traffic conditions, bus routes, bus schedules, how to use the bus, and instant ridesharing services in their home and work place will be more likely to use public transportation and other high-occupancy commute modes. The travel time savings and travel time reliability offered by the Houston HOV lanes provide further incentives for changing travel modes. In addition, individuals may alter their travel time or route based on this information.

The Houston *Smart Commuter* IVHS Operational test has been developed and is being implemented through the joint efforts of the Texas Department of Transportation (TxDOT), the Metropolitan Transit Authority of Harris County (Houston METRO), the Federal Transit Administration (FTA), the Federal Highway Administration (FHWA), and the Texas Transportation Institute (TTI), a part of The Texas A&M University System. The first phase of the operational test is currently moving forward.

The *Smart Commuter* IVHS Operational Test includes two different, but compatible, components. Both components are intended to make better use of the Houston HOV facilities, which have been developed and funded as multi-agency projects. The bus component focuses on the traditional suburban-to-downtown travel market in the I-45 North corridor. This element focuses on encouraging a mode shift from driving alone to using the bus, changing travel times, and shifting travel routes. These changes in travel decisions will result from the provision of current traffic and transit information to individuals in their home and work place through state-of-the-art videotex and telephone technologies.

The second component focuses on the suburban-to-suburban travel market in the I-10 West corridor to the Post Oak/Galleria area. This corridor, which is more difficult to serve with traditional regular-route bus service, provides the opportunity to test the use of a comprehensive employer-based carpool matching service. This system will include the ability to provide real-time carpool matches and is structured to encourage a mode shift from driving alone to carpooling and also to encourage an increase from 2 to 3 person carpools.

The two components of the *Smart Commuter* IVHS Operational Test, the advanced traffic and transit information system in the I-45 North corridor and the comprehensive employer based instant rideshare matching service in the I-10 West corridor, are being implemented and evaluated over a five-year period. The *Smart Commuter* Operational Test represents the first major demonstration of the use of IVHS technologies to encourage an increase in average vehicle occupancy. It provides an opportunity to test the ability to collect, process, and transmit current traffic and transit information and instant rideshare matching services to individuals in their home and work place through a variety of advanced technologies. The *Smart Commuter* Operational Test also provides an opportunity for highway and transit interests to work together to better manage the overall transportation system through the innovative application of IVHS technologies, enhanced information, and improved services (8).

Bellevue Smart Traveler

This project is testing the use of cellular telephones and voice mail to help facilitate the formation of carpools in the Bellevue, Washington area. An operational test is planned to demonstrate the use of dynamic ride matching through the use of mobile communications. The first phase of the project developed a set of information-based services for ridesharing. The second phase is focusing on testing a prototype computer-based interactive commuter information center in a downtown Bellevue office building. It is anticipated that individuals—both those who currently carpool and those who currently drive alone—will register to participate in the project. Both groups will be provided with cellular telephones and access to electronic voice mail (9, 10).

Minneapolis - St. Paul *TravLink*

The *TravLink* project represents one element of the larger *Minnesota Guidestar* program, which is a multifaceted IVHS program in Minnesota. The *TravLink* program is being developed and implemented through the joint efforts of the Minnesota Department of Transportation (MnDOT), the University of Minnesota (U of M), the Regional Transit Board (RTB), the Metropolitan Transit Commission (MTC), and the Federal Highway Administration (FHWA).

A major component of the *TravLink* project focuses on the provision of transit and traffic information to transit users and carpoolers in the I-394 corridor. This is a radial route corridor linking the western suburbs to downtown Minneapolis. The corridor contains a freeway HOV lane, park-and-ride lots, and transit stations. The HOV lanes, which include segments of both concurrent flow and reversible, barrier separated lanes, are connected to three major parking garages on the edge of downtown Minneapolis. The parking garages contain bus waiting and transfer areas and provide reduced parking rates for carpoolers and vanpoolers using the I-394 HOV lanes.

The *TravLink* project will attempt to increase the use of high-occupancy commute modes in the corridor through the provision of transit and traffic information to individuals at home, at work, and at major transit terminals. In addition, transit users at transit stations along the corridor and at the transit terminals in the parking garages will be provided with real-time information on bus arrival and departure times (11).

San Francisco Bay Area

A number of projects are moving forward in the San Francisco Bay area focusing on improving access to transit information and integrating fare payment among multiple transit providers. One project is examining the potential to coordinate the provision of transit information among all providers in the region. Currently, different services have their own information numbers. This may require a potential transit user to call multiple providers in order to obtain the desired information. A study was conducted to examine different approaches to providing one common information number. The results of this study are being examined and it is anticipated that a decision will be made to select and implement one approach (13).

Transit systems in the San Francisco area are also considering coordinating fare collection through the use of a common fare prepayment method. The *Translink* project currently involves the Metropolitan Transit Commission (MTC), Central Contra Costa County Transit (CCCT), and Bay Area Rapid Transit (BART). The use of a stored value fare card, which could be upgraded at a later point to a *Smart Card* is anticipated. Additional providers are also expected to be added in the future (14).

California *Smart Traveler*

The California *Smart Traveler* contains numerous advanced public transportation system (APTS) elements as part of the California Department of Transportation's (Caltrans) overall IVHS program. The California *Smart Traveler* project focuses on the design, testing, and evaluation of a variety of IVHS technologies to transit, paratransit, and ridesharing. The first phase of the project included the evaluation of potential test sites and technologies. Five sites have been identified for the actual implementation and evaluation of operational tests. It is anticipated that these will involve a partnership between public and private sector groups (9, 10).

Dallas HOV Monitoring and Enforcement

A research study is being conducted in Dallas examining the potential use of IVHS technologies to enhance the monitoring and enforcement of the vehicle occupancy requirements on the East R. L. Thorton Freeway HOV lane. The project is being conducted jointly by the Texas Transportation Institute, Dallas Area Rapid Transit (DART), FHWA, and DTA. The intent of the study is to assess the applicability of various automated enforcement technologies and to test the use of the most promising alternative on the East R. L. Thorton HOV lane. It is hoped that the use of advanced technologies can reduce enforcement costs and police exposure to traffic and weather. Technologies currently being examined for possible use include AVI tags, imaging systems, and infrared applications (12).

Other Potential Applications

The projects described previously provide an indication of a few applications of IVHS technologies focusing on TDM related actions. In addition to these projects, other activities are being conducted around the country which focus on related types of applications and other approaches combining IVHS and TDM. Further, there appears to be a great deal of potential for other applications of IVHS technologies to enhance TDM actions. A few suggestions for additional research, operational tests, and demonstration projects are provided in this section.

- **Real-Time Transit and Traffic Information.** Although there are a few projects focusing on the provision of real-time traffic and transit information to individuals in their home and work place, additional projects testing other technologies appear appropriate. Combining real-time transit information on the status of buses, obtained through AVL systems, with real-time traffic data from ATMS and providing both to individuals in different locations through numerous technologies could be considered.
- **TDM Multi-Purpose *Smart Cards*.** A series of operational tests could be conducted focusing on the use of multi-purpose *Smart Cards* for TDM programs. These operational tests would develop, implement, and evaluate the use of *Smart Cards* for transit use, HOV and SOV parking, and other commute modes. The cards could be used to both pay for and access the different modes and for organizations to track use of these modes by employees. Multiple tests using different approaches, different sizes and types of businesses, and alternatives combinations of incentives and disincentives could be explored.
- **HOV Toll Pricing.** Currently preferential pricing for HOVs is provided at some toll facilities in the United States. The use of AVI tags provides the opportunity to greatly enhance and expand the use of HOV discounts and HOV preferential treatment at toll plazas. Operational tests could be conducted to test and evaluate the use of HOV pricing strategies and preferential treatments with toll roads, bridges, and tunnels in this country.
- **Enhanced Ridesharing.** Rideshare matching software has improved significantly over the last 5 years. The potential exists to combine this software with GIS and other technologies to greatly enhance response time for ridematching services and provide real-time matches. A few operational tests are currently focusing on this area, but more projects appear appropriate.
- **HOV Facility Monitoring and Enforcement.** The results of the Dallas project described previously should provide a good deal of information on possible IVHS technologies to enhance the monitoring and enforcement of HOV facilities. Additional operational tests and projects could be developed in this area.
- **Telecommuting.** Rapid advances in communications technology are making telecommuting more easy and more wide spread. Additional projects testing different approaches to telecommuting, as well as monitoring and evaluating existing programs, appears appropriate.
- **Air Pollution and Emission Detection.** IVHS technologies could be used to identify air quality hot spots and air pollution violations on a real-time basis. Projects could be developed to first identify actions to be taken in response to these situations and then to implement the recommend projects when air quality incidents occur.

Potential Issues Associated with Integrating IVHS and TDM

A number of issues may emerge as projects and operational tests combining IVHS and TDM are planned, implemented, operated, and evaluated. Although technology problems may emerge—especially those relating to testing new products and approaches—it appears that most of the concerns will focus on institutional and organizational issues.

Individually, both TDM and IVHS projects usually involve a diverse group of individuals and organizations from the public and private sectors. Projects which combine the two will require that even more diverse groups work together. Further, to date, individuals in the TDM and IVHS areas have not worked together on many projects, and thus may not be aware of the other area. Thus, building a strong working relationship between the different groups, which includes

an understanding of the roles, responsibilities, strengths, and weakness of each group, will be critical to advance projects integrating IVHS and TDM.

CONCLUSION

This paper has presented a discussion of the potential for greater integration of IVHS technologies with TDM actions to better manage the demand on transportation facilities in congested areas. It has presented a brief overview of TDM strategies and IVHS technologies, identified the different groups involved in IVHS, discussed the concept of integrating IVHS and TDM, and illustrated a few examples of current projects. Further, suggestions for additional demonstrations and projects were identified.

The current projects and possible applications outlined in this paper provide a strong indication of the potential benefits the use of a wide range of IVHS technologies may have on the successful implementation of TDM actions. As noted in this paper, additional research projects, operational tests, and full deployment are needed to help advance the state-of-the-art in integrating IVHS and TDM. This paper has helped foster, expand, and enhance the discussion of greater integration of IVHS and TDM and has assisted in furthering activities focused on this area.

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IMPACT OF TELECOMMUNICATIONS TECHNOLOGY, INCLUDING TELEWORK AND TELECOMMUTING, ON TRAVEL DEMAND AND TRAVEL DEMAND MANAGEMENT IN THE NEXT DECADE

E. M. Risse and Linda T. Risse and Jon Williams

INTRODUCTION

This is an abridgement of a copywritten paper, by E. M. and Linda T. Risse of Synergy Planning, Inc. The complete 47-paper will be available at the November 15-16 TDM Symposium in Rosslyn, Virginia. As well, brief summaries of three other publications on telecommuting have been included as an appendix to this abridgement.

The Risse's paper addresses the impact of telecommunications technology on travel demand and travel demand management in the next decade. There are two primary, interrelated issues considered:

- Indirect Impact
Telecommunications technology has a fundamental impact on regional pattern and density of land-use, and, thus, trip origins and destinations.
- Direct Impact
Telecommunications technology may be applied to replace the commute to work (and other travel needs), and thus overcome transportation system deficiencies or locational disadvantages.

An important vocabulary distinction is that between telework, and telecommuting. Telework is a broad category that describes moving work to people via telecommunications, instead of moving people to work. Telework would thus include home-based businesses employing telecommunications, and teleconferencing. Telecommuting has a narrower meaning: replacing the trip from a home to a traditional workplace with telecommunications some or all of the time. Telecommuting is thus a kind of telework.

SURVEY OF CURRENT AND FUTURE TELECOMMUNICATIONS TECHNOLOGIES

When considering the travel demand and TDM impacts of telecommunications technology, one must guard against becoming fascinated by the promise of individual technology applications or being oversold by those promoting technology. It is technology implementation that impacts travel demand. Over the past two decades, it has primarily been the economic, social and physical context that has governed the adoption of technology that impacts travel demand and TDM, rather than the availability of new telecommunications technologies.

Telecommunications technology can be divided into two broad categories:

- Terminal hardware and software: what the terminal operator uses
- Network hardware and software: what connects terminals together

Network and connection technology is what directly substitutes for travel. Terminal technology controls what users do and therefore whether there is a reason to travel. Network technology improvements do not require a user interface and so do not have the same cultural inertia and lag time as terminal equipment.

Before examining these two broad categories of technology, there are two important contextual points to make. First, the medium of the future is digital transmission. What Marconi and Bell invented were analog systems. Digital transmissions employ the binary language that is the communications medium of central processing units of computers.

While both analog and digital transmissions travel at the speed of light, the chief benefit of digital transmission systems is in capacity, which is orders of magnitude greater than analog.

The second fundamental contextual issue is that the terminal of the future is a merger of the telephone, the television and the computer. The capacity of the digital network will make available for every work, service and entertainment application an integration of the information processing and presentation potential of these three technologies. This merger and its application is called telematics.

TECHNOLOGY ADVANCES: TERMINAL HARDWARE AND SOFTWARE

Technological advances have decreased terminal costs, even as power has increased, and size has decreased. Further innovation will increase power and bring down the cost even more, but the size of those parts of a device that interface with a human body cannot be reduced beyond a convenient threshold that may have been already overshot by some notebook and palm-top computers. In fact, the new advances in terminal equipment of importance to transportation will be in applications—the range of useful or entertaining activities that the equipment can perform. Following are some specific applications technologies that have a high potential to impact travel demand.

1. Virtual Reality
2. Teleconferencing Audio and Video and Software and Equipment
3. Groupware
4. Locating Services
5. Caller Identification
6. Personal Communications Services (PCS)

TECHNOLOGY ADVANCES: NETWORK HARDWARE AND SOFTWARE

There are currently hundreds of networks that are “long distance” or interregional. Some are owned by users, some are leased by users, and others are available for a fee to a selected group or the general public. Interregional networks are fiber-optic cable, microwave and satellite, in addition to wire.

There are many thousands of regional networks. They are owned by the “local” telephone companies (wire and cellular), by cable TV companies, and by a range of public and private organizations that provide service to themselves or clients. Most important is a new breed of networks called Metropolitan Area Networks (MANS). MANS are being set up by Competitive Access Providers (CAPS), as well as by traditional wire and cellular telephone companies. CAPS plus the competition among wire, cellular and cable companies are predicted to make regional and subregional systems as competitive as “long distance” carriers before the 90s are over.

Of particular importance to the pattern and density of land use is access via modem over local phone lines to the major commercial on network services, e.g., CompuServe, Prodigy, GENie. These consumer services allow individuals to access many of the connectivity services and information formerly only available to corporate and agency networks.

To tie the networks, terminals and connections together, there is strong political support to create a National Electronic Super Highway. While many electronic communications networks already exist, it is clear that a “system” of electronic superhighways will move information faster. If one can believe the promotion for the National Electronic Super Highway by the private sector and the media coverage, most of the content will be entertainment. To facilitate the creation of the Electronic Super Highway, there is pressure to create, as a national policy, fiber optic cable “to the home.” This means that the entire telecommunications cornucopia will be at every telephone jack in every home.

There are a range of connection technologies that will facilitate access to networks and services, without full installation of fiber optics all the way to the user. One, ISDN (integrated services digital network), despite early promise, has been little used. There are now less complicated technologies that will enhance the capacity of standard

local wire phone circuits and transfer high volumes of digital information. By acronym, these include ATM, SMDS, B-ISDN, and ADSL.

Another connection technology of importance is the direct satellite link. Although costly, this can provide immediate, high-band-width digital capacity, and is useful where the need justifies the expense.

FACTORS INFLUENCING IMPLEMENTATION OF TELECOMMUNICATIONS TECHNOLOGIES

There are some fundamental social, economic and physical factors that have influenced and will continue to influence the implementation of telecommunications technology. In turn, the nature of travel demand will be changed by these socio-economic factors and the telecommunications developments that they trigger. This will have a direct bearing on the type of travel demand management measures needed in future.

There is now underway a global change in the way that work is done. Specialization of work and organized markets first emerged in neolithic agricultural and trading communities. From that time until the Renaissance, human economic activity was done at or close to the residence of the worker. The second significant pattern of human economic activity was created by the Industrial Revolution, which made necessary an agglomerated workforce located in close proximity to others working on the same task. This urbanized almost all non-agricultural economic activity. Telework, moving work to people by telecommunications, instead of moving people to work, represents a third, fundamentally different way that work is being carried out.

Telecommunications and telework have made concentrations of office jobs viable in locations separated from the central cores of our industrial centers. Jobs were moved closer to where people live and shop, and farther from where others doing related tasks were located. This created the so-called "Edge Cities." New locations for work are now moving outward from Edge Cities, with technology allowing even further dispersion in the location of work.

The need to be competitive is the primary cause of the fundamental changes that are restructuring the workplace. U.S. enterprises have been striving to become more efficient and effective to keep up with European Community and Pacific Rim competitors. Whatever else the future holds, it will be more competitive.

The need to be competitive, as well as the recent downturn in the economy, has created three trends in the workplace that impact and will be impacted by telework and telecommunications.

1. More efficient office layouts
2. The move to cheaper office space
3. Fewer traditional office space users

As a result of these trends, there are dramatic changes in the potential use of existing structures, and thus tremendous changes in transportation demand. For example, currently a building with 200,000 square feet of space could have 800 employees going to work there every day. In five years, there could be 1,600 people working from that space with only 400 people there on a given day.

Changes, in addition to the need to be more competitive, which are driving organizational restructuring include:

1. Demographics of the persons entering the workforce between now and 2010.
2. Deterioration of the transportation infrastructure.
3. Growing child or elder-care responsibilities of members of the workforce, coupled with the mushrooming cost of this care.

4. The 1990 Clean Air Act Amendments that will either substantially raise the cost of doing business, or cause organizations to relocate outside of non-attainment areas.
5. The 1990 Americans with Disabilities Act and other new workplace regulations that raise the cost of doing business in existing structures.

TELECOMMUNICATIONS IMPACT ON TRAVEL

Telework Impacts on Pattern and Density of Land Use

Telework involves moving work to people via telecommunications, rather than moving people to work. Most of the research to date exploring telework's impact on transportation has focused on reducing peak period demand via one aspect of telework-telecommuting. Telecommuting involves employees who use electronic communication as a substitute for the traditional commute to work.

The broad category of telework has had, and will continue to have a much more profound impact on transportation system performance than peak period transportation/telecommunications trade-offs from telecommuting. Well over 50% of the total office workforce has relocated in the past 20 years to "Edge Cities" and more recently to even more widely-scattered sites. What has moved are primarily organic components of private and public organizations. These moves were driven by economic factors, but many could only have taken place because of applications of telecommunications technology. Telecommunications has thus enabled a development pattern frequently called "sprawl."

With respect to work at home, Link Resources, a New York based research firm, states that the number of people over 18 years old in the United States who have full- or part-time home-based businesses or who work at home full or part time as company employees increased to 41.1 million in 1993, up 5.4% from 1992. This includes telecommuters. The current 41.1 million homeworkers is 32.4% of the total workforce. This number is forecasted to reach 50 million by 1996.

Telecommuting Replacement of Commuting Travel

Telecommunications technology may be applied to replace the daily journey to work to overcome transportation system dysfunctions and locational disadvantage, and in the process change transportation demand. This is telecommuting.

According to Link, there are currently 7.6 million telecommuters in the United States, up 15.2% from the 6.6 million reported in their 1992 survey. 7.6 million telecommuters is 6% of the total U.S. workforce. Of this 7.6 million, Link reports that 5.12 million are pure corporate telecommuters, up 22% from 1992. These "pure" telecommuters are regular salaried employees doing job-related work at home during normal business hours. The others are contract workers.

Beyond the overall numbers, there is very little good data on telecommuting. Most of what there is pertains to large firms, although Link Resources reports that 77% of all telecommuters come from firms with under 100 employees.

It is easy to oversell telecommuting, and also easy to parody it. In fact, telecommuting may not have a significant impact on total vehicle miles traveled, or on total vehicle trips at the national level. Telecommuting, however, can have a significant impact on travel in a specific subregion or corridor suffering from transportation and clean-air dysfunctions. The validity of this approach was shown by the traffic mitigation program implemented in Los Angeles during the 1984 Olympics. Telecommuting should thus be carefully considered as a TDM tool in congestion management and air quality planning.

CONCLUSION

Telework and Travel Demand

The contemporary transportation system has created job, housing and trading opportunities in dispersed locations. The use of these dispersed opportunities has been facilitated by telecommunications technology. The resulting widely scattered regional pattern of land use cannot be supported by the current transportation system. We have now reached a point where it is clear that prosperous economic activity and a sustainable environment cannot be maintained in a dispersed urban form if we move people to their work the way we have in the past.

Telework and Telecommuting are not the solution, but they can be a bridge to the future; they can assist us in retaining our economic viability while we:

- Rebuild our urban areas,
- Recreate a rational balance between intensive and extensive uses of land, and
- Establish a sustainable relationship between land-use pattern and density, and the transportation system that supports it.

Telework Center Strategies

We are only now beginning to look at ways to spend transportation construction dollars to cut demand, rather than expand capacity. Using the flexible-funding features of the Intermodal Surface Transportation Efficiency Act, we can explore ways to provide access via telecommunications, instead of adding more transportation capacity at ever greater cost. This must be done in a way that creates supportable pattern and density of land use. For example, there is no public payback for putting telework centers into office buildings surrounded by parking lots and thus insulated from human needs by asphalt. Once the car is the easiest way to get to work, and a car is needed to do anything in addition to getting to work, low density super sprawl occurs. Therefore, there should be a public strategy to locate telework centers within walking distances of services, and to encourage center workers to live in communities.

Data Needs

There is a need for more, better and/or different data before we can fully address the telecommunications impact on travel demand. Information on land-use is particularly important.

Current transportation models typically input "land-use data" from municipal government. These are projections of future development activity, often derived by applying a formula to construction activity "in the pipeline." Like any extrapolation, these data may be unreliable, but they also are based on changes in the amount of particular uses of land (demolitions and new construction) and not on changes in the use of existing structures. Therefore, although there are major changes taking place in the market that will have profound impact on regional transportation systems, the current modeling processes will not reflect these changes.

Telecommunications and Telework Research and Policy

For years, federal and state transportation agencies have been conditioned to deal with pattern and density of land use:

- As a given,
- As driven by free market choices, and/or
- As driven by municipal decisions,

or for other reasons beyond the purview of transportation research, planning and review. The staffs of the regional Metropolitan Planning Organizations (MPOs) have been foreclosed from considering these issues.

Much of the current dysfunction in the transportation system stems from a pattern and density of land-use created in part by transportation facilities and telecommunication technology.

On the other hand, telecommunication technology provides enterprises, institutions and citizens an alternative to the dysfunctional transportation system infrastructure. If allowed to go unchecked, however, individual optimization and self-interest will further exacerbate a sprawling land use pattern, making it impossible to provide a functional transportation system at a cost that society can afford in time or money. This makes it imperative to conduct far more research on the impact of telecommunication technology on travel demand, and to incorporate the relevant information into travel demand forecasting models.

The 1990 Federal Clean Air Act Amendments, the Intermodal Surface Transportation Efficiency Act and federal economic growth policies will accelerate policies and actions to substitute telecommunications services for travel demand. If widespread application of telecommunications and telework are to be encouraged, we should first understand their impact on travel demand.

DISCUSSION OF THREE PUBLICATIONS ON TRANSPORTATION IMPACTS OF TELECOMMUTING

1. Patricia L. Mokhterian, "Telecommuting: What's the Payoff?," ACCESS, Research at the University of California Transportation Center, (Spring 1993).

Telecommuting is defined as "working from home, or a location close to home, instead of travelling to a conventional work location." Telecommuting has become an item on the policy agendas of public agencies as a possible way to reduce travel, energy consumption, and automotive emissions, while also providing human resource and economic development benefits. Telecommuting has been introduced for government employees in California and Washington state, and the federal government has begun a pilot program for its employees.

While telecommuting should, in theory, reduce travel, it is possible that a person working at home might have increased non-work travel. It is also possible that telecommuters would be more likely to drive alone on the days that they commuted to work, rather than carpool or use transit. Another possibility is that telecommuters might move to a home farther from work, since they need to commute to work less often, and this could result in increased VMT.

Empirical studies, notably from the California and Puget Sound demonstration project have shed light on the transportation impacts of telecommuting. Findings include:

- Total VMT, including non-work travel, decreased on telecommuting days.
- There was no aggregate increase in non-commute travel.
- Reductions in emissions and fuel use were proportional to reductions in VMT.

These studies appear to confirm that telecommuting reduces travel in specific, small-scale settings. Some have found these findings to be inconclusive, as they are based on small, non-representative samples. For example, telecommuters studied so far have substantially longer trip lengths than the average.

A clear research need is to learn more about why people will or will not choose to telecommute. This will allow better policy formulation, and a clearer understanding of what level of telecommuting might be achieved in future. We also need to learn more about long-term impacts on residential and job locations.

2. Daniel B. Rathbone, "Telecommuting in the United States," Transportation in the ISTEA Era, Issue Papers for the ITE 1993 International Conference, Orlando, Florida.

A survey of the known telecommuting programs in the U.S. was conducted, with 16 organizations responding. There was also an analysis of which occupations are suitable for telecommuting. From this the following is concluded:

- Survey respondents reported that telecommuting has a number of non-transportation benefits, e.g., increased employee productivity and job satisfaction.
- For a single employer, a 25% reduction of peak period vehicle trips is possible; at a subarea level, a 10% reduction is possible; and at the regional level, a 5% reduction is possible.
- For traffic impact studies, a 20% reduction of home-to-work vehicle trips attracted by new development is recommended, provided that there is a binding agreement for the implementation of a telecommuting program.
- Metropolitan Planning Organizations can play an important role by disseminating information about telecommuting. Documentation should be developed to support their future activities.

3. US Department of Transportation, Transportation Implications of Telecommuting (April 1993)

This 104 page report surveys the current state of knowledge on the topic of future impacts of telecommuting on transportation, the environment and energy use. Following are, verbatim, the principal conclusions of the report:

- Telecommuting is now practiced by approximately 2 million workers and could reach 7.5 to 15 million within a decade.
- Estimates of the future level and impacts of telecommuting are highly uncertain.
- Telecommuting has the potential to provide significant transportation-related public benefits in this decade.
- The actual amount and impact of telecommuting in any particular region will depend strongly on the local transportation environment and travel demand measures.
- The congestion and air quality improvements potentially attainable through telecommuting could be substantially diminished if telecommuters removed from the highways are replaced by the emergence of latent travel demand.
- Direct energy, air quality, safety, and time benefits of telecommuting will be increased as the degree of congestion is reduced.
- Telecommuting could stimulate urban sprawl and have other adverse impacts on land use and public transportation.
- Factors which will impact the rate of growth of telecommuting include uncertainty of benefits for employers and the considerable time and effort inherently required to bring about major changes in workstyles and ways of doing business.
- Telecommunication services and equipment are adequate for most current telecommuting, but high-bandwidth capabilities will be needed in the future and would be beneficial now.
- Government agencies can play a significant role in facilitating and encouraging telecommuting.
- Telecommuting can be an effective tool for travel demand management, but cannot be mandated.
- Continuing research is needed to clarify telecommuting costs, benefits, and future impacts.

APPENDIX A—LISTING OF TDM STRATEGIES AND RESEARCH NEEDS

The following 42 strategies and research topics were discussed and rated at the closing session using the Perception Analyzer. A 100 point rating scale was used to measure the importance of each strategy and research need, with 0 = not important and 100 = very important. These have been grouped by high priority projects—those with ratings of 75 and above—and medium priority projects—those with ratings between 50 and 74.

MARKET AND CONSTITUENCY DEVELOPMENT

High Priority

- Develop realistic TDM goals and objectives using market analysis which incorporates the benefits of air quality, energy, economic development, productivity, quality of life, and congestion.
- Develop an outreach, planning, and program development strategy which includes:
 - Involving key stakeholders.
 - Nurturing champions.
 - Creating a credible comprehensive consensus program.
 - Teaching engineers and planners to integrate TDM into their work.
 - Creating communications between planners and practitioners through workshops, cross-training, and other activities.
- Educate public officials on the benefits of TDM.

Medium Priority

- Evaluate TDM as a contributor to transportation synergy, rather than as an isolated transportation component.
- Develop training and education programs at all levels.
- Identify and incorporate innovative market research techniques to increase consumer acceptance and use of alternatives to single-occupant vehicles.
- Create a marketing campaign to focus on the competition—single-occupancy vehicles and public acceptance of TDM through mass media and other marketing techniques.
- Conduct better and more complete market research.
- Initiate a continuous and coordinated communications program to encourage the use of alternatives to single-occupant vehicles.
- Create federal and state offices of advocacy for TDM.

LEGISLATIVE AND POLICY

High Priority

- Increase the flexibility of funding provided for ISTEA.
- Review existing tax policies to support the realignment of tax programs and strategies.
- Develop land use policies that encourage transit friendly markets.
- Realign the tax strategy to encourage effective TDM.
- Establish level playing field for moving toward full cost pricing for single-occupant vehicle driving and subsidize travel behavior that improves the environment and reduces congestion.
- Incorporate pricing as part of future TDM.

Medium Priority

- Advocate increased and flexible funding to ensure innovative programs.
- Promote policies and regulations that are performance-based and identify and remove regulatory barriers to TDM.
- Set TDM friendly parking strategies as a top priority.
- Expand the eligibility of TDM strategies for ISTEA and standardize the requirements for the use of ISTEA funds.
- Develop performance-based regulations that are sensitive to site variations rather than being prescriptive.
- Double the U.S. Department of Transportation's budget and ensure adequate staffing for TDM research and information dissemination.
- Evaluate all transportation policies against ISTEA objectives.
- Institute area-wide travel allowance.

PLANNING, IMPLEMENTATION, AND EVALUATION

High Priority

- Incorporate TDM strategies into the transportation, air quality, and land use planning process.
- Perform reasonable and defensible evaluations of the impacts of applied TDM strategies.
- Develop guidelines on TDM effectiveness, applicability, implementation, funding, and monitoring, including the development of a comprehensive TDM manual.
- Research, inventory, evaluate and disseminate information on programs, services, and techniques which affect TDM results.
- Develop and implement a TDM research and evaluation program.

Medium Priority

- Integrate TDM into the planning process through the Congestion Management Systems (CMS).
- Create better modeling tools that will measure the impact of TDM.
- Identify impact of non-commute trips on congestion and air quality and conduct demonstration projects.
- Conduct demonstration projects aimed at TDM for non-commute trips.
- Develop trip reduction manual based on comprehensive evaluation programs.
- Provide an adequate time frame for implementation of TDM requirements.
- Develop comprehensive area-wide plans using TDM strategies.
- Encourage federal government funding for the development of state of the art rideshare match system.

INSTITUTIONAL/ORGANIZATIONAL DEVELOPMENT

High Priority

- Develop broad based coalition of public and private interests to advocate the implementation of TDM strategies.

Medium Priority

- Pursue opportunistic public/private partnerships.
- Recognize differences in organizational and institutional needs and objectives.

OPERATIONAL AND TECHNOLOGICAL DEVELOPMENT

- Expand the effectiveness of TDM by assessing available and potential technologies and market based strategies.
- Develop outreach programs to encourage the application of IVHS to facilitate TDM program development.

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