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Foreword

Since 1990, the Task Force on Transportation Demand Management under the chairmanship of Michael D. Meyer has provided a focus and a forum within the Transportation Research Board on transportation demand management (TDM) and sought to promote a better understanding of the demand management concept within the transportation profession. As part of their activities, the task force has sponsored or cosponsored a number of sessions at the TRB Annual Meeting. The papers in this Record are from TDM-related sessions at the 1992 Annual Meeting and cover a wide variety of topics related to TDM. The topics include experience with, and effectiveness of, alternative TDM measures; impacts of road and parking pricing on travel behavior; and the role for transportation management associations. The papers are sponsored by the Committees on Ridesharing and on Paratransit and by the Task Force on Transportation Demand Management.

Whether the reader is interested in the practical application of TDM measures or in the research needed for the development of road and congestion pricing, this Record will provide valuable information and insight.

Transportation Demand Management: A Cautious Look

JEFFREY M. ZUPAN

Transportation demand management (TMD) strategies are discussed with an emphasis on some of the barriers to their success, particularly in the New York region. Coverage of TDM strategies is not exhaustive, but focuses on major strategies, such as alternative work hours, pooling, parking management, pricing, and land use. A methodology to select the potentially most effective TDM strategies is also presented.

The increase in congestion on the nation's roads over the past 20 years is well documented. As suburban areas developed and spread, the road network expanded as well, accommodating the increased demand for automobile travel. The cost of highway construction has become increasingly expensive, awareness of environmental impacts has grown, and opposition from neighbors to highway expansion has mounted. The result is that in many situations it is no longer possible to merely build one's way out of traffic congestion.

One reaction to this problem has been to search for transportation systems management (TSM) solutions, intended to increase the transportation supply with a minimum of construction. These relatively low-cost, low-environmental-impact measures are to provide more capacity on the road network or divert automobile users to transit, and include such measures as left-turn lanes, park-and-ride lots for transit, improved transit services, and preferential lanes for high-occupancy vehicles.

In the past few years, increasing attention has been paid to complementary measures that can reduce the demand on the road network by changing the choices made by drivers. These measures are collectively known as transportation demand management (TDM).

A further motivation to explore such measures comes with the Federal Clean Air Act Amendments of 1990 (CAAA), which mandates the use of a variety of TSM and TDM strategies, collectively called transportation control measures (TCMs), to reduce vehicle miles of travel and to increase passenger car occupancy in areas with poor air quality.

Against this backdrop, the New York Metropolitan Transportation Council (NYMTC) asked Regional Plan Association (RPA) to explore the use of TDM strategies in three highway corridors in their region, which covers New York City and five suburban counties. Corridors selected were Interstate 278 on Staten Island (the Staten Island Expressway), the Jericho Turnpike/Veterans Memorial Highway in the Long Island counties of Nassau and Suffolk, and Interstates 684 and 287 in Westchester County. The full report is available from RPA (*1*).

In many ways the motivation to explore TDM strategies in the New York region is no different from that in other parts of the country. Yet New York is unique in its density, the extent of its transit system, the duration of its peak periods of congestion, and perhaps in the willingness of its citizens to tolerate delay and inconvenience. The density of the region's core and inner ring of counties indicates many employers and, combined with diversity of industries, makes it more difficult to enlist all the employers in implementing TDM strategies.

TDM strategies will be discussed using the analysis of the three highway corridors in the New York region, with an emphasis on some of the barriers to TDM success. Coverage of TDM strategies will not be exhaustive, but will focus on major strategies, such as alternative work hours, pooling, parking management, pricing, and land use. A methodology to select the most effective TDM strategies is also presented.

ALTERNATIVE WORK SCHEDULES

An obvious means of reducing peak-hour congestion is to spread the peak. This can be done if employers are more flexible with their employees' working hours. However, such programs must be carefully considered to avoid internal inefficiencies, coordination problems, and lack of employee supervision. Care must also be taken because these programs may be incompatible with some other TDM approaches; for example, the probability of forming a carpool may shrink significantly if workers are not keeping the same hours.

There are a number of way of altering schedules. The option of working staggered hours requires employees to start and end work at different times and can have a pronounced effect on peak congestion, particularly at large sites with one employer. Flextime or variable-time programs form another option. The employee is required to be at work during a core period, say, 9:00 a.m. to 3:00 p.m., and can fulfill other obligations before or after those hours. In the New York region, many employers may need to participate for there to be a measurable effect, but the shift of employees to earlier or later hours may merely keep them in an equally congested part of the peak. The analysis performed in the NYMTC region is instructive. The analysis assumed that only workers commuting in single-occupant vehicles (SOVs) working at sites with over 100 employees would be subject to shifts of work times. This is consistent with the CAAA, which requires employers with over 100 employees at one site to consider such measures in their plan. This reduces the pool of potential

Regional Plan Association, 1211 Sixth Avenue, New York, N.Y. 10036-8703.

drivers by at least half in the three corridors studied. On the Staten Island Expressway it was found that 49 percent of the target SOVs would have to shift by 1 hr or more in the morning peak period to bring conditions to borderline Level of Service D and E. On Interstate 684 in Westchester County, 41 percent of the peak-30-min SOVs would need to move 1 hr earlier and the same number 1 hr later, with the second-highest-30-min peak moving SOVs 1 hr earlier. In the Long Island highway corridor studied, the hours adjoining the peak were also beyond Level of Service D, making a shift by an hour inadequate to relieve traffic sufficiently.

To be effective beyond a local area, alternative work schedules require broad application. If there are dozens or even hundreds of employers in an area, agreement on the institution of alternative hours programs that could relieve congestion in an entire corridor would be difficult without a coordinator.

Another option is to institute a 4-day work week, with different employees off on different days of the week and working longer hours on their work days. Most employees would prefer Mondays or Fridays off, limiting the effectiveness of this approach. Four-day work weeks also pose a problem unique to areas where transit use is high, as in the New York region. If such a work week were available to employees who use transit, then weekday ridership on transit by those employees would be reduced 20 percent. Given the high fixed costs of transit, widespread use of the 4-day work week could be financially disastrous to transit systems. Much of the downturn in transit use after World War II can be traced to the abandonment of the 6-day work week.

With the advent of the personal computer telecommuting has gained acceptance. Over time, an increasing number of workers may not need to leave their home or neighborhood to travel to work. Whereas some estimates of the impact of telecommuting have been made, how it affects congestion remains uncertain. The application of telecommuting may come sooner to the New York region than elsewhere because of the difficult commute and the concentration of service, publishing, communications and information-sharing industries in the region. The danger to public transit is similar to the one posed by the 4-day work week, namely a reduction in transit ridership without the ability to trim costs proportionately.

RIDESHARING

Carpooling is perhaps the most widely considered TDM. The idea is clear: consolidate drivers of SOVs into fewer vehicles and congestion will be reduced. Carpools can be informal, formed by a group of individuals acting on their own, or they can be formal, formed deliberately by a public agency such as a state department of transportation, by one employer, or by an agency such as a transportation management association (TMA) that coordinates the activities of many employers. The driver and the automobile can be alternated to adjust expenses, and the participants are thereby able to reduce the cost of driving alone.

Carpooling is limited to those whose schedules are rigid and who have relatively long trips. In a recent survey by Beaton et al. in another paper in this Record, SOVs were found to have a median trip length of 15 mi and ridesharers, 38 mi. Relatively long trips are most efficient for carpooling because the time spent gathering the participants in one vehicle is small compared with the length of the trip. Most important, carpools require participants who have the same work schedule each day and are prepared to stick to it. If work schedules change because of unexpected overtime, having transit as a backup is necessary. After all, a carpool is essentially a public transit service with a frequency of one trip per day.

Carpoolers do not have the flexibility of running errands before and after work or during lunchtime, and having a car for daytime emergencies at home. Some employers have provided shuttle services to restaurants in suburban settings when a walk to lunch is not possible, but with limited success. Some employers also provide a guaranteed ride home in emergencies. Finally, carpools will only remain intact if participants are compatible.

State departments of transportation and county governments have actively sought to match potential carpoolers by computer. In an effort to create carpools, names, telephone numbers, home and work locations, work schedules, and personal characteristics (e.g., smoker/nonsmoker) have been amassed by advertising in local newspapers or by contacting large employers to survey their employees. Keeping files current is a problem because of residential and job turnover. If the average household moves once in 5 years, in a carpool of four persons one will change trip origin once every 2½ years. Job changes increase the frequency in which carpoolers turn over. Most of these efforts have had limited success because of the high cost of keeping files current and of follow up (*2*). Large employers are more successful in following up because potential carpoolers working at the same site are more likely to share rides, to know each other, to have a common employer, and to feel company pressure if the employer actively supports the carpool program. Other employer actions to encourage carpooling, such as the guaranteed ride home or preferential parking for carpools, have been tried. The effectiveness of the guaranteed ride home is difficult to measure, but it appears to have marginal use (*3*). The most successful method of employer-generated carpooling is a continuing, highly visible, well-staffed program. For employers to make that commitment they must believe that the costs will reap direct benefit.

In the case of vanpools, the vehicle is larger and holds a dozen or more persons. The van is provided by the employer or a vanpool brokerage agency, which provides insurance. Participants pay a monthly fee either to the brokerage agency or to the employer, who sometimes does not charge the full cost. In most cases one person is designated the driver, and that person, as compensation, has the use of the van on weekends.

The advantages and disadvantages of carpools also apply to vanpools. The cost to the individual is lower, but flexibility is sacrificed. Because of the large number of employees that must be collected, vanpools work best over distances of at least 20 mi. The large number of people involved in a vanpool makes compatibility less important but does not take care of the need for park-and-ride lots, because the most efficient way to arrange for morning pickups is to do it at one location. Vanpools, because they only work well for long distances, are not widely used. For example, in the suburban corridor of Route 1 in Mercer and Middlesex counties, New Jersey, only

four pockets of residential concentrations generated enough travel for vanpools. The need for park-and-ride lots could conflict with badly needed parking for transit. Care must be taken to sort out park-and-ride capital investment priorities.

For the same reasons, subscription bus service or buspooling is even more limited. Typically, employers guarantee to cover a bus operator's costs, plus profit, and gather enough employees to participate to cover the expenses at a monthly fare attractive enough to attract solo drivers. The participants must join for a month or more to pay their share of the costs. The same benefits and limitations apply as described for carpools and vanpools. The need for park-and-ride lots is greater, but the importance of compatibility disappears. In rapidly growing corridors, subscription buses may eventually add trips and become regular route services.

Encouraging carpools and vanpools is somewhat different in the New York region than elsewhere. For example, only 15 percent of work trips to the Manhattan central business district (CBD) are made currently in automobiles. If encouragement is given to pooling to the CBD, it is more likely that the poolers will be drawn from public transit.

In low-density areas and for reverse commuting, especially from the lower-income areas of the region, the concept of pooling, with its lower costs, might be an important part of the transportation system. Many factors lower the possibility of pooling and suggest that high participation rates for pooling will be needed to relieve congestion substantially. An analysis of three roadway corridors in the New York region calculated that 38 to 90 percent of drivers of SOVs would need to form four-person carpools to bring the highway level of service to D. The market for carpooling is small because of the following factors:

1. Some of the vehicles on the road are trucks, which generate disproportionate congestion and are not carpool material.
2. Some vehicles already have many occupants.
3. Some vehicles carry people not destined for work and are inappropriate for pooling.
4. Some vehicles are passing through, not heading for an employment area.
5. Some SOVs transport sales people not destined for the same daily employment location.
6. Those who form carpools do not take all their vehicles off the road, because a vehicle is needed for the carpool itself.
7. Carpool formation is particularly difficult if large numbers of employees do not work at the same site; in the three corridors studied, 64 to 78 percent of the employees worked at sites with under 100 employees.

PARKING MANAGEMENT

Free parking provided by employers is a tremendous incentive to drive alone. Even in city centers where scarcity of land creates the market for parking charges, employers often pay the cost, which is seen as a business tax deduction by employers and a tax-free fringe benefit by the employee. Evidence (*4*) suggests that parking pricing is the most effective TDM strategy, although it remains difficult to assess since other strategies have usually been instituted at the same time, obscuring the impacts. Using preferential parking close to office buildings for carpools and vanpools is an approach, but having drivers of SOVs pay for parking while poolers do not is more effective. One approach is to pay every employee a transportation benefit while charging for parking at the site. The employees who pool, walk, bike, or use transit keep the benefit, whereas the employee who drives alone pays a modest fee. Those who cannot pool because of their job schedules would have a legitimate complaint. Free employee parking as an untaxed benefit remains the problem. Fairness will only come with a change in the tax code.

Limiting the number of parking spaces provided by the employer would be more effective (*5,6*). The ratio of parking spaces to office floor space, known as the parking ratio, has traditionally been set in suburban developments at four spaces per 1,000 ft^2 of office floor space, reflecting the assumptions that the average employee occupies 250 ft^2 and that one parking space is needed for each employee. These ratios are out of date because the average office space per employee has risen. Zoning must reflect this to avoid incentives for drivers of SOVs. Moreover, the use of nonofficial spaces needs to be strongly discouraged so that the number of spaces is not artificially expanded. Tailoring these parking ratios to the amount and availability of public transportation, with lower ratios where transit is widely available, could be an effective means of controlling unnecessary driving. Research in this area would be helpful.

Mandated parking ratios of four spaces per 1,000 ft^2 of floor space, particularly in suburban locations, are out of date. Financial institutions still look for this ratio and favor developers who use it. Data are needed to make the case that lower ratios are now good business in suburban settings. This suburban thinking can even pervade urban thinking. The city of Newark, with more transit service than any location in the New York region other than New York City, was for some time trying to require the same high 4:1,000 ratio.

PREFERENTIAL TREATMENT FOR HIGH-OCCUPANCY VEHICLES

Giving high-occupancy vehicles (HOVs) the advantage over SOVs on congested roadways is another category of TDM. HOV lanes can be very effective if enough HOVs use them. Otherwise, public pressure will mount to remove them, as drivers of SOVs find themselves stuck in traffic while a parallel lane appears to be underused. Another problem is enforcement; unless there is diligent enforcement, SOVs not physically separated will slip into the HOV lane, reducing its effectiveness. To prevent this, portable lane dividers can be inserted in the pavement daily, but that greatly increases the cost of operation.

Preferential treatment for HOVs can take many forms. The simplest is a reserved lane on an urban street for buses, and possibly for carpools and vanpools. SOVs are only permitted in the lane to make turns. Because the curb lane is used, agreements must be made with merchants concerned with losing street parking for their customers. On major arterial roads reserved lanes are often made using an extra lane or shoulder for short segments.

An HOV lane on a limited-access highway must contend with the problem of weaving created by the need to reach the lane from the entrance ramps or the need to reach exits. This is a serious problem if ramps are closely spaced. If the HOV lane is taken from mixed traffic, the possibility that the mixed traffic lanes will be backed up and block the entrance to the HOV must be examined beforehand.

A contraflow lane is an HOV lane taken from the traffic flowing in the opposite direction. This can be done if the lane removed does not cause traffic congestion in the minor-flow direction. Great care must be taken to minimize the danger of head-on collisions. Driver training is important and limits the vehicles to buses. Contraflow lanes work best if the volume of HOV traffic is sufficient to be self-enforcing. The exclusive bus lane on the approach to the Lincoln Tunnel is the best example of such a facility. Contraflow lanes to be used in each direction for morning and afternoon peaks can be made with reversible lanes. New designs have been devised to improve the feasibility of such a facility (*7*).

HOV lanes can be constructed as separate facilities adjacent to existing or new highways. If exclusively for buses, these facilities are known as busways. They are very expensive but eliminate the safety and enforcement problems and do not reduce the capacity for mixed traffic.

HOV measures require careful analysis and education of the driving public. Before such measures are endorsed, it must be certain that the HOV lane will have enough vehicles to gain and keep political support. Such estimates cannot be based on wishful thinking regarding the shift of riders to pooling or transit. Moreover, careful analysis is needed to ensure that excessive weaving to and from exits and upstream gridlock will not occur.

"Dual-dual" limited-access highways provide a special opportunity to segregate HOVs from SOVs. This is now planned for a segment of the New Jersey Turnpike. Urban street HOV lanes must be presented to merchants on the basis of bringing more shoppers downtown. Contraflow HOV lanes must have large enough HOV volumes to be self-enforcing, and there must be a well-thought-through plan to handle lane breakdowns. Finally, once implemented, HOV lanes must be continually enforced.

CONGESTION PRICING

The increasing scarcity of roadway space, the difficulty and undesirability of expanding that space, and the need for transportation funding are leading to greater attention to congestion pricing. The basic principle is that where and when a commodity is most scarce, its use should be curbed through increased prices that lower the demand for that commodity in that place and time. In the case of roadways, higher fees could be imposed during peak hours and on portions of a roadway network that are the most congested. Higher fees for SOVs might also be incorporated. Congestion pricing has the potential to

1. Reduce the need for new highway capacity,
2. Improve air quality,
3. Relieve peak traffic congestion,
4. Increase the use of high-occupancy vehicles,
5. Reduce automobile use in highly congested urban environments,
6. Raise revenue for much needed transportation improvements, and
7. Establish a rational pricing system following sound economic principles.

Resistance to paying more, especially if the goods have been free until now, is the biggest problem to overcome; how to collect the fee has been the technical stumbling block. Where tolls are in place (already a crude form of congestion pricing), the problem is somewhat simplified. If tolls are to vary by time of day (or day of the week), the greatest problem appears to be disputes that might occur between the driver and the toll-taker about the time of changeover to or from a higher toll. This operational issue is now eased by the use of electronic toll and traffic management (ETTM) capabilities using prepaid toll media. Such a technology is now being tested by the Port Authority and the New Jersey Turnpike Authority in the New York region and elsewhere (*8*). Congestion pricing might also be tried on the currently free East River bridges leading to Manhattan, where the imposition of tolls is being considered, coupled with ETTM. Eventually, its use at locations other than at river crossings or current toll barriers would make a comprehensive system of congestion pricing possible in the New York area.

The upcoming challenge will be to set charges high enough to influence travel yet in a way that is consistent and equitable throughout the region. Moreover, mechanisms to evaluate and choose how to spend the funds, and of ensuring accountability of those expenditures, will need to be established to provide the public with assurances that the funds will be wisely spent. In the absence of these assurances, public acceptance, a prerequisite for congestion pricing, will not occur.

A serious examination of congestion pricing in the region would require a sophisticated analysis. Alternate pricing schedules by time of day, day of week, vehicle occupancy, vehicle type (automobile, small truck, tractor-trailer) would need to be tested. The impacts on traffic congestion and of potential revenue would be estimated for each pricing plan tested.

First, base data would need to be assembled on the use of the highway network in the region by time of day, vehicle occupancy, and vehicle classification. A base would be established from which changes resulting from pricing scenarios on traffic and revenue could be calculated.

Next, price elasticities would need to be estimated. The likelihood of shifts of traffic, not only to different time periods, but also to different modes (transit) would have to be considered, as well as the elimination of some traffic. For each pricing scenario a series of impacts would need to be determined, including vehicle hours of delay reduced, distribution of vehicle miles traveled at varying levels of service, emission reductions, and revenue gained and lost by type of user (SOV, carpooler, truck).

Most important, an assessment of the barriers to implementation would be required, including legal, institutional, and public acceptance. On the basis of that assessment, a plan would be prepared providing the next steps to implementation of congestion pricing if the study results indicate the value of this approach. This plan would need to outline a public information and outreach program. Such a program to study

congestion pricing under the auspices of the RPA is now under consideration by the transportation agencies in the New York region.

LAND USE AND ZONING

The density, location, and type of developed land determine how people will travel. Much needs to be done to make it more likely that the choice of public transportation or driving in a pool will be made. Residential and employment densities above certain levels are necessary to support public transit. No attempt will be made to review these findings in detail; they are available elsewhere (*9*). Residential densities of above five dwellings per net acre, corresponding to gross densities of at least 3,000 people/mi^2, are the minimum needed to support public transit. If residential developments are located near existing transit routes, their potential to dampen SOV travel increases. Nonresidential densities are equally important. The clustering of economic activities in a downtown core area of at least 5 million ft^2 is necessary to support minimum bus service. Express buses require closer to 20 million ft^2. Activities clustered near train stations in such central areas are similarly critical to improving transit's market share. In recent years developments have been built well below these thresholds.

Higher residential densities as a way of encouraging transit use must contend with the housing preferences of the region's households. Although most Americans (and most New Yorkers) appear to prefer lower-density housing, this does not mean that everyone does. The aging of the population, smaller household size, two-worker households, and the general trend away from the traditional family unit all suggest the need for new housing types. Moreover, many people equate higher-density housing with older, less attractive housing. Zoning mechanisms to cluster higher-density housing near transit stops suitable for a wide range of people are an unmet challenge.

Larger and more compact employment locations near transit are also needed. Employment locations must take advantage of the confluence of many transit lines to widen their source of commuters. Employees' personal preferences play a smaller role here than they do in residential developments. Yet, whether the area is residential or not, the issue is municipal zoning. The ratable chase, intended to keep local property tax rates as low as possible, encourages "clean" office buildings and low-density housing to minimize school costs. Mechanisms need to be developed to enable zoning to occur across municipal boundaries and take advantage of the existing transit infrastructure. Otherwise automobile-oriented development and the ensuing traffic congestion will remain, or become, the norm.

The designs of new developments have provided for the automobile driver and ignored the needs of transit riders, bicyclists, and pedestrians. This was dramatically shown by a recent analysis of over 250 designs submitted to the International City Design Competition: only 12 percent of the designs provided transit-friendly features (*10*). To remedy these shortcomings and make transit a more realistic option, buildings could be clustered to make it possible for a bus to serve more people with one stop, bus stops could be closer to building entrances with sharply reduced building setbacks, sidewalks could connect buildings with bus stops, bus shelters and bus stop signs could be provided, and pull-offs for buses could be designed into the roadway system. Bicycle lockers and shower facilities could also be required. Present local zoning does not mandate such steps. Model local zoning ordinances need to be developed and followed to put these transit-friendly concepts into zoning regulations. With these regulations in place, drivers clogging the highways of the region could begin to shift toward transit, bicycling, and walking. Transit-friendly designs require a model zoning ordinance if they are to take hold in the New York region. The Department of Transportation should take the lead in presenting one to each municipality that complains of a traffic problem created or exacerbated by automobile-oriented zoning. It is in DOT's interest, because new highways are more expensive than good design.

Mixed-use development is a land use concept that might have an important role in reducing trip making and therefore highway congestion. The idea is to provide both home and work sites within the same complex. With shortened trips, opportunities are made for more nonmechanized travel such as bicycling and walking. Most workers would live in the same development. The MSM Regional Council in Princeton recently sponsored a study that indicated that mixed-use development, other TDM measures, and location of growth to more urban settings could reduce traffic generated by the incremental growth by over 50 percent (*11*). These estimates are based on an extensive peer review process, and further research to determine empirical impacts is needed.

Pedestrian pockets, or transit opportunity districts, are designed almost from scratch to encourage transit, biking, and walking (*12*). To determine whether such designs could preclude the need for additional highway capacity, 1000 Friends of Oregon is sponsoring a study, Land Use/Transportation/Air Quality (LUTRAQ), to apply these principles to a fast-growing area in Portland.

Growth management is a more ambitious land use strategy to limit congestion. A number of jurisdictions around the country have tied development approvals to the provision of adequate facilities, including transportation. Developer impact fees have been established in some cases to provide funding for the construction of transportation facilities.

RESEARCH NEEDS

It is clear that much more work needs to be done to understand the effectiveness of TDM strategies. A recent Transportation Research Circular (*13*) on research problems in the area highlights a number of important avenues to pursue. These include research on pricing and parking, the relevance of free parking to development potential, TDM effectiveness measured through formal evaluations, impacts of variable work hours on transit and HOV use, assessment of transportation management associations, and the relationship between ridesharing and employer size.

WHO MUST TAKE THE LEAD IN TDM?

Table 1 shows many TDM strategies and those likely to have a lead role in each. Whereas many agencies and institutions

TABLE 1 TDM: WHO DOES WHAT?

TDM Strategy	Actions Required By:
Alternative work schedules	Employer, TMA
staggered	
flex	
4 day	
telecommuting	Employer, Improved technology
Carpools	
informal	Individuals
formal	Employer, TMA, county or state
Vanpools	As above, van brokerage companies
Subscription bus	Employer, TMA, county, transit operator
Parking management	
preferential parking	Employer
parking pricing	Employer
parking ratios	County or municipality, developer
park and ride	County or state, transit operator
Preferential road treatments	DOT, road authority, municipality
Congestion pricing	DOT, toll road authority
Transit	
transitchek	Transit brokerage agency, transit operator, employer
employer subsidized transit	Employer, transit operator, TMA
employer sponsored transit	Employer, transit operator, TMA
transit coordinator	Employer, transit operator, TMA
Land Use and Zoning	
higher densities	Municipality
transit-friendly design	Municipality, DOT
mixed use development	Municipality, county
growth management	County and state
Trip Reduction Ordinances	Municipality
Transportation Management Associations	Employers, state, county

play a role, the most frequently noted is the employer. Employers must see that TDM strategies are in their self-interest or there is little chance for success. Many levels of government are also represented.

There is a question whether the municipalities have enough economic self-interest to create change. The toughest municipal actions would be changing development and zoning. The role of the TMA is the hardest to define. TMAs could be involved in almost every strategy. Yet, because they are funded primarily by the private sector, they may be limited in what they can do, which explains their spotty success.

EVALUATING TDM STRATEGIES

A fully systematic and comprehensive process to evaluate the effectiveness of TDM strategies is not available. The closest to it are recent studies by Comsis Corporation (*14*) commissioned by the Federal Highway Administration (1990) and a study by K. T. Analytics for the former Urban Mass Transportation Administration (now the Federal Transit Administration) (*4*). The Comsis study compiled data from 11 TDM programs around the country. The biggest difficulty encountered was the absence of before-and-after data on traffic counts, or vehicle occupancies, making it impossible to determine any changes in congestion that could be attributed to the TDM strategies. The presence of other factors, and the variability of traffic counts from day to day, compounded the problem. However, it was possible to devise an index, vehicle trips per 100 travelers, and estimate its change. Many useful insights were drawn:

1. Locally targeted strategies could relieve congestion in spot locations such as entrances to developments, but their impact on wider congestion problems was difficult to measure and thought to be small;
2. Areawide TDM programs, rather than those covering specific companies or with narrowly drawn geography, have the most potential for congestion relief;
3. Establishment of performance objectives, rather than a prescription of specific actions, inspired greater innovation and success;
4. Voluntary actions were much less likely to lead to success than mandated actions;
5. Economic self-interest inspired successful actions;

TABLE 2 TDM SOLUTIONS

Strategy	Area Suitability	Travel Impacts				TDM Costs			TDM Acceptance				Ease of Implementation Index
		SOV Reduction	*Peak Trip Reduction*	*VMT Reduction*	*Transit Impact*	*Employee Cost*	*Employer Cost*	*Public Capital Cost*	*Employee*	*Employer*	*Municipal*	*Political*	
Alternate Work Schedules													
Staggered	U,S	none	high	none	none	same	higher	none	high	low	high	high	3
Flex–time	U,S	negative	high	negative	negative	same	higher	none	high	low	high	high	4
4 day week	U,S	medium	medium	high	highly neg	lower	unknown	none	medium	low	high	medium	3
Telecommuting	U,S	positive	positive	positive	highly neg	lower	unknown	none	unknown	unknown	high	medium	unknown
Carpools	S	high	medium	medium	negative	lower	varies	none	low	medium	high	high	3
Vanpools	S	medium	low	low	negative	lower	higher	none	low	low	high	high	2
Subscription Buses	S	low	low	low	positive	lower	higher	none	low	low	high	medium	2
Parking Management													
Preferential Pkng	S	low	low	low	none	same	higher	none	low	low	high	high	2
Parking pricing	U,S	medium	medium	medium	low	higher	same	none	negative	low	negative	negative	1
Parking ratios	U,S	medium	medium	medium	positive	same	lower	none	negative	unknown	negative	negative	2
Park – Rides	U,S	medium	medium	medium	positive	varies	n.a.	higher	medium	medium	varies	high	4
Preferential HOV lanes	U,S	medium	medium	medium	positive	same	n.a.	higher	varies	varies	high	varies	4
Congestion Pricing	U,S	medium	high	medium	positive	varies	n.a.	lower	low	low	unknown	negative	unknown
Transit													
Transitchek	U,S	medium	medium	medium	medium	lower	same	none	high	medium	high	high	5
Employer sponsored	U,S	low	low	low	low	varies	higher	none	medium	low	high	high	4
Employer subsidized	U,S	low	low	low	low	varies	higher	none	medium	low	high	high	5
Land Use – Zoning													
Higher densities	S	medium	medium	high	high	n.a.	varies	lower	n.a.	n.a	negative	negative	2
Transit – Friendly Design	S	medium	medium	medium	medium	same	same	lower	medium	low	varies	positive	4
Mixed Use Development	S	unknown	unknown	medium	unknown	lower	unknown	lower	unknown	unknown	varies	positive	4
Growth management	S	unknown	unknown	unknown	unknown	same	unknown	lower	unknown	unknown	varies	varies	3
Trip Reduction Ordinances	S	high	high	high	low/medium	varies	higher	n.a.	low	negative	varies	varies	4
Transportation Mgmt Assoc	U,S	varies	varies	varies	unknown	same	higher	n.a.	n.a.	varies	n.a.	positive	n.a.

Suitability index U – Urban Areas S – Suburban Areas N A not applicable
Ease of Implementation Index 1 (difficult) to 5 (easy) N A not applicable

6. Realistic alternatives to the SOV must be present for changes to occur; and
7. No legal areawide mechanisms have yet been devised in the absence of success through voluntary actions.

Similarly, Pratt (*15*) concludes that

> . . . for success, TDM must include carrots, sticks and employer participation; traffic reduction for tough TDM programs in the suburbs may be around 10 percent; successful traffic mitigation with travel demand management alone is unlikely; a 10 percent improvement in efficiency is worthwhile; TDM won't solve all our problems; and it is a viable partner in the overall traffic mitigation toll kit.

WHICH STRATEGIES TO USE?

In Table 2 an attempt is made to characterize various features and impacts of the strategies that have been discussed. It must be understood that these characterizations are difficult to make and represent one person's best guess from a careful reading of the literature, which often does not inform these judgments. First, the suitability of a strategy for urban or suburban areas is given, "U" indicating urban and "S" suburban. For strategies that are likely to affect traditional transit negatively, only suburban locations are indicated as suitable. The characterizations of travel impacts are high, medium, and low corresponding to greater than 10 percent, 2 to 10 percent, and less than 2 percent, respectively. If the direction of the impact is known but the magnitude cannot even be guessed, a positive or negative indication is given. Employee commuting costs and employer costs are described as higher or lower or the same in most cases. The acceptance criteria reflect the projected reaction to a strategy. If the reaction depends on the specific situation, "varies" is indicated. Finally, an overall rating of ease of implementation is provided, with 5 a high score and 1 the low score. Although no answer is intended with this matrix, some tentative conclusions are suggested by grouping the strategies in the following categories:

1. Strategies that have a positive impact on congestion, no major negative impact, and are generally acceptable: Strategies falling in this category for both urban and suburban locations are staggered work hours, flextime, park-and-ride lots, HOV lanes (although acceptance will vary), and "transitchek." Strategies appropriate to suburban areas include only carpools, vanpools, transit-friendly designs, and trip reduction ordinances (acceptance will vary here too). This group of strategies should be actively pursued in most instances.
2. Strategies that reduce congestion, have little negative impact on transit, but do not have wide acceptance: For both urban and suburban locations this group includes parking pricing, parking ratios, congestion pricing, and higher densities in suburban locations. Resistance to paying more, to restrictions of choice, and to prescriptive local land uses will need to be lessened if these strategies are to become effective means of reducing congestion.
3. Strategies with little impact on congestion, little negative impact on transit, and are generally acceptable: These strategies, which include subscription buses, preferential parking, and employer-sponsored and employer-subsidized transit services, may have a place in particular situations, do not represent a major strategy to reduce congestion, and should be recognized for their limitations.
4. Strategies that will reduce congestion, are generally acceptable, but will negatively affect transit: Four-day work weeks and telecommuting are in this category. These two strategies are likely to gain popularity independent of specific public policies, and the impacts on transit will need to be closely monitored.
5. Strategies for which too little is known or which are too difficult to assess to determine their value in reducing congestion: Mixed-use developments, growth management, and TMAs are in this category.

SUMMARY AND CONCLUSIONS

Much of the discussion about TDM in recent years has pointed out that none of these actions by themselves can solve traffic congestion problems. Even the full range of TDM strategies can only be partly successful in reducing congestion. In the long run, a conscious effort to reduce automobile dependence by clustering new development and providing incentives to shift existing developments to make transit, walking, and biking more reasonable choices for more people will be needed to prevent traffic congestion from reaching intolerable levels. The evidence presented indicates that a major public purpose would need to be understood by most citizens before voluntary actions could approach the needed traffic reductions. This is not to suggest that the most promising of TDM measures should not be pursued, and pursued vigorously.

The convenience, privacy, independence, and flexibility provided by the single-occupant automobile is difficult to match. Traffic congestion, a concern to many and a topic of daily conversation, has not yet proven to be a deterrent for most people to choose another option. The price of driving is not unreasonable for most commuters, and the willingness to raise that price to attack air pollution, energy shortages, and traffic congestion has been absent.

In a democratic society, the idea of artificially affecting individual choices for the greater good is not an easy concept to put in place. And without a clear and present danger as motivation, TDM may become just another transportation acronym.

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Abridgment

Public-Private Partnership in Transportation Demand Management

BILL LEGG

Transportation providers have used several strategies to encourage ridesharing. A new approach is described that involves convincing employer chief executive officers to provide employees with rideshare incentives. In Seattle the Commuter Challenge program has asked employers to "Take the Challenge," become Pacesetters, and develop rideshare programs for their employees. In addition, this program has provided a forum in which transportation providers and employers have been able to discuss transportation issues. The program is composed of representatives from transportation providers who work side by side with the Economic Development Council of King County (EDC), which represents over 800 businesses. Since the beginning of the program in 1989, 98 major employers representing over 270,000 employees in the Seattle area have become Pacesetters. Four forums have been held to discuss transportation issues with employers.

The Commuter Challenge program, a public-private cooperative effort, began as a public awareness program driven by the idea that employers can influence their employees' commuting habits by providing incentives to rideshare. Commuter Challenge differed from previous rideshare marketing efforts within the Puget Sound region in that it targeted chief executive officers (CEOs).

The program was developed in 1989 when King County invited other public agencies to launch a commuter campaign. The Economic Development Council of Seattle and King County (EDC), a private, nonprofit organization, agreed to lead the effort because of its commitment to a sound economy and the valuable role a vital transportation system plays in the economy. The EDC, whose membership is composed of both public- and private-sector agencies and businesses, provided a neutral setting in which to join these two groups and focus on transportation problems.

The commuter campaign was based on the knowledge that employers can influence commuter behavior. The campaign developers recognized that the ability of the EDC's president and board of directors to reach decision makers in organizations throughout King County was the key to securing employer commitments to new or enhanced rideshare incentives for employees.

The 1989 campaign's goal was to reduce the number of single-occupant drivers in King County. The campaign objectives were to (*a*) create public awareness of transportation modes and (*b*) demonstrate a public-private commitment to relieving traffic congestion. The EDC began with a list of target employers with 50 or more employees who had resisted efforts by local transportation agencies to have them provide rideshare incentives for their employees.

The EDC gave a breakfast for targeted CEOs to outline the campaign and challenge them to make pledge commitments. Twenty-one employers agreed to provide new or enhanced rideshare incentives and were called Pacesetters. Metro customer service representatives (CSRs) then contacted the pledged employers to develop tailored transportation programs for each.

Employers were asked to appoint an employee transportation coordinator, post and distribute commuting options information, give on-site promotional events, and offer flextime. Because the first phase of the program had no criteria for qualifying Pacesetters, some employers were accepted into the program on the premise that they would consider these actions.

The results of the 1989 campaign were a measure of its success: 21 employers joined the campaign, pledging new or enhanced rideshare incentives for their collective 200,000 employees. The success paved the way for the program's extension beyond 1989.

CURRENT PROGRAM

The second phase of the Commuter Challenge program began in May 1990 when King County, Metro, the Washington State Department of Transportation (WSDOT), and the city of Seattle pledged support to continue the program under the direction of the EDC through June 30, 1992. The program is run by a manager housed at the EDC and on loan from Metro's sales and promotion staff.

A program task force composed of representatives from all the program sponsors adopted the following goals:

- Goal 1—The Pacesetter Program: increase employer commitment to provide employee incentives to reducing single-occupancy commuting.
- Goal 2—The Outreach Program: increase business community awareness of specific, long-term transportation issues by disseminating information and create a mechanism that invites businesses to tell transportation providers about potential transportation solutions.

The program task force, chaired by the EDC president, meets monthly. In addition, the following committees, staffed by program sponsor members, work to accomplish the program goals:

Washington State Department of Transportation, 4507 University Way, N.E., Suite 204, Seattle, Wash. 98105.

- Recognition Committee: recommends, develops, and implements recognition for Pacesetter activities.
- Evaluation Committee: works to evaluate the effectiveness of the Commuter Challenge program.
- Farsighted Committee: recommends, develops, and implements plans for achieving Goal 2 and the long-term direction of Commuter Challenge.
- Sponsors Committee: chaired by the EDC president, this committee seeks program funding sponsors.

Additional committees and ad hoc groups have been formed to address issues and programs as needed.

PACESETTER PROGRAM

Pacesetters

The primary activity of Commuter Challenge has been to enroll more Pacesetters. Since the beginning of the program's second phase, 77 additional employers have become Pacesetters. As of March 1992 these 98 Pacesetters represented over 270,000 employees in King County.

The incentives for an employer to become a Pacesetter are as follows:

- Pacesetters are profiled as community leaders through public recognition,
- Employees' car expenses and commuting-related stress are reduced,
- Employers are benefited because transportation programs can reduce parking expenses, increase employee morale, improve employee retention, and facilitate extended operating hours and better equipment use, and
- Washington State is helped to meet federal air quality standards and ease traffic congestion.

To become a Pacesetter, an employer with a rideshare program agrees to improve the program; one without a program pledges to perform at least three of the following actions:

- Provide a minimum $5.00 rideshare subsidy,
- Appoint an employee transportation coordinator,
- Distribute and post transit information,
- Regularly provide employee newsletter information on commuting options,
- Become a member of a professional rideshare organization,
- Sponsor annual on-site rideshare promotions,
- Develop an alternative work hours policy or participate in the state telecommuting demonstration project,
- Operate a parking management program,
- Guarantee rides home to transit users and carpoolers in the event of unforeseen problems, and
- Allow 15- to 30-min work schedule flexibility for commuters.

The Commuter Challenge program is flexible and encourages employers to create additional, perhaps unique, incentives for their employees.

The primary method for recruiting Pacesetters is to invite targeted CEOs to hear other employers describe successful employee transportation programs. As a follow-up to each breakfast meeting, the Commuter Challenge manager and a Metro CSR visit each attending employer to discuss development of a transportation program. Four breakfast meetings have been attended by employers from downtown Seattle and outlying suburban areas. On average, each breakfast meeting has attracted 40 persons representing 35 employers. Through March 1992, 60 of these employers or 43 percent of the employers represented at the breakfasts have become Pacesetters. An additional 8 employers, representing 6 percent of the breakfast attenders, are working with Metro CSRs and will eventually become Pacesetters. Some of the Pacesetters and the major rideshare incentives they provide are given in Table 1.

Pacesetter Recognition

Public recognition is important to Pacesetters. Employers like to be recognized in the community and among their peers as contributors to community solutions. Commuter Challenge has developed a comprehensive recognition program. Program activities include the following:

- Metro bus tunnel opening—Pacesetters were recognized for their efforts during this ceremony dedicating Seattle's underground bus tunnel.
- Oil Smart Wednesday—Commuter Challenge participated in this program, which encouraged workers to rideshare for five consecutive Wednesdays. The promotion received widespread local publicity, and Pacesetters were honored for their long-term commitment to employee transportation programs.
- The *All Street Journal*—Commuter Challenge helped produce this comprehensive transportation-alternatives guide for employees, 205,000 copies of which were distributed free within four Puget Sound counties. Pacesetters were highlighted in this book, and some Pacesetter employees were spotlighted to exemplify commuting options.
- Ads in business publications—Commuter Challenge placed ads recognizing employers in business journals, including the regional edition of *Wall Street Journal*, *CEO Magazine*, and *Puget Sound Business Journal*.
- Bimonthly newsletter—The EDC's bimonthly newsletter, *The Catalyst*, reaches over 800 employers in King County. The Commuter Challenge program supplements this newsletter with a two-page insert. Supplement articles address current transportation issues. Each issue highlights new Pacesetters.

Pacesetter Survey

In February 1991 the Evaluation Committee conducted a phone survey. The nonscientific survey targeted managers in the Pacesetter organizations to gather their perspectives of the Commuter Challenge program and to solicit suggestions and perceived problems. At that time there were 42 Pacesetters; 39 participated in the survey. Survey results include the following:

TABLE 1 SELECTED PACESETTER ORGANIZATIONS AND MAJOR TYPES OF RIDESHARE INCENTIVES OFFERED TO THEIR EMPLOYEES

Organization Type and Organization	Distribute Rideshare Information	Employee Rideshare Coordinator	Flex-time Program	Guaranteed Ride Home Program	Parking Management Program	Rideshare Promotion Activities	Transit Subsidy	Vanpool Subsidy
FINANCIAL								
Dean Witter	✓	✓					✓	✓
Security Pacific Bank	×	×					✓	✓
GOVERNMENT								
City of Kirkland	×	×		✓	✓	×	✓	✓
WA State Dept. of Ecology	✓	✓				✓		
HEALTHCARE								
Pacific Medical Center	×	×			✓	✓	×	×
INFORMATION TECHNOLOGY								
Attachmate Corporation	✓	✓		×	×	✓	✓	✓
US WEST New Vector	✓	✓	✓	✓	✓	✓	✓	✓
MANUFACTURING								
Chiyoda International	✓	✓					✓	✓
The Boeing Company	×	×		✓	×	×	✓	✓
PROFESSIONAL SERVICES								
Bogle & Gates	✓	✓		×	×	✓	×	×
Entranco Engineers	✓	✓			✓	✓	✓	✓
RETAIL								
Nordstrom	✓	✓				✓		
Trick & Murray	✓	✓				✓	✓	✓
UTILITY								
Washington Energy	✓	×		✓	✓	✓		

✓: A rideshare incentive offered to the organization's employees since the organization became a Pacesetter.
×: A rideshare incentive offered to the organization's employees prior to the organization becoming a Pacesetter.

- Many Pacesetters offered more rideshare incentives than they had originally agreed to when they joined the program.
- Over one-third indicated that the main benefit of being a Pacesetter was helping the community.
- About 20 percent of the Pacesetters believed that participation in the program made employees feel better about their workplace. Nearly all of the Pacesetters said that the rideshare incentives provided employees economic benefit and convenience.
- Two-thirds of the Pacesetters indicated that the program had increased their awareness of transportation issues. Eighty percent believed that awareness of transportation issues among other members of the business community had increased.
- Two-thirds of those responding felt their involvement had permitted them to provide input to transit agencies about transportation problems.
- One-third said that both the program and the Pacesetters needed more visibility; eight Pacesetters felt the program should work harder to attract additional Pacesetters.

THE OUTREACH PROGRAM

Commuter Challenge's Farsighted Committee focuses on the program's second goal, the Outreach Program. A survey conducted by the EDC revealed that transportation issues are in the forefront of the business community's concerns; traffic congestion affects personnel mobility and the transport of goods and services (*1*). Before Commuter Challenge, no mechanism existed to permit ongoing discussion between transportation providers and employers. The EDC's connection to CEOs helped make an environment to fill this need, hence the program's focus in this area.

The Farsighted Committee's objective is to identify existing and new means of facilitating communication between transportation providers and the private sector on regional transportation issues. Initial efforts at achieving this have focused on a Washington State transportation demand management (TDM) law that will take effect in 1992.

Four significant TDM activities have been undertaken to fulfill the committee's goals.

1. EDC quarterly luncheon: At this meeting, Duane Berentson, Washington State Secretary of Transportation, and Dick Watson, Washington State Energy Office Director, spoke to the EDC members and guests on pending TDM legislation.
2. Sponsorship of TDM forum: This breakfast forum for area employers provided up-to-date information on the state's new TDM law. The forum

- Familiarized employers with TDM techniques,
- Informed them of the basics of the law, and
- Explained the process and schedule for determining the details.

3. TDM employer focus groups: In October 1991 Commuter Challenge sponsored two focus groups for area private-sector employers to hear their impressions of upcoming employer TDM requirements. The major concern revealed in these sessions was that employers were not fairly represented in the drafting of the TDM requirements.
4. TDM workshops: As a result of the focus groups, the Commuter Challenge sponsored a workshop to organize employers to effectively participate in the development of the TDM requirements. From this workshop, employers formed three working groups to represent the three elements of the TDM legislation, measurement methods; model ordinance; and parking, model programs, and training. These working groups, aided by technical resource people from the State Energy Office and WSDOT, are providing direct input to the state task force that is developing the law's requirements.

PROGRAM FUTURE

The long-term future of Commuter Challenge depends on continued receipt of operating funds from its sponsors. A long-range plan for the program is now under development. The following will be included in this plan:

- Increase sponsorship—Other suburban communities will be given the opportunity to join the program. Sponsors may also include members of the private sector who would donate funds or services to the program.
- Pacesetter activities—Washington State's new TDM law will make employer rideshare programs a requirement rather than a voluntary commitment. In this new environment, Commuter Challenge is pursuing a work plan to refocus its Pacesetter activities. This new focus will provide recognition of exemplary employer programs and will work toward encouraging smaller, non-TDM effected employers to take the challenge and establish rideshare programs.
- Outreach Program—The primary focus of the program is expansion of the number of transportation issues addressed and development of a more positive public/private environment for discussing these issues.

SUMMARY

The Pacesetter program has raised the region's employers' awareness of congestion problems and has begun to foster a commitment among them to find and implement solutions. The program task force has attempted to balance the need to keep the Commuter Challenge program visible to the general public with the need to focus most of its efforts on delivering the rideshare message to CEOs.

The Pacesetters survey showed that the program is on track but also needs improvement. 1992 will present an opportunity to focus on improvements and continue this successful example of public and private sector cooperation to address the region's transportation problems.

TDM, as well as other important transportation issues, will require tremendous work and cooperation between the public and private sector. With the guidance and contacts of the EDC and the current multiagency cooperative approach, the Commuter Challenge program is in a unique position to play a major role in joining public agencies and the private sector to address these issues.

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Abridgment

Lessons for Transportation Demand Management from Utility Industry Demand-Side Management

RUTH L. STEINER

Electric utility industry demand-side management (DSM) is compared with transportation demand management (TDM) to make recommendations about the implementation of TDM. The regulatory environment of these two sectors and the types of demand-side measures are described. Finally, lessons for TDM are identified. The following conclusions are reached about TDM based on DSM. (*a*) Congestion pricing gives proper price signals to move people out of automobiles. Political barriers and equity considerations will make implementation difficult. (*b*) Many people hope for a technological fix for poor air quality and transportation congestion. The use of technology may be more successful in the long-term. (*c*) For TDM efforts to be meaningful, they need to be implemented in all communities in a region and simultaneously address the multiple reasons for their implementation: air quality, congestion, energy, and land use. This is not easy, because of different agendas and organizational cultures of agencies, political alignments, competing interests, and parochial concerns of local communities. TDM needs to be implemented uniformly throughout a region, balance the short-term and long-term implementation goals and constraints, and address congestion outside the commute periods.

In response to increases in energy prices and to infrastructure and environmental concerns in the 1970s, environmentalists and other activists recommended that decisions about new infrastructure be based on a least-cost planning process. The traditional method of creating additional supply to meet increased demand would be replaced by a process whereby the cost of new supplies would be compared with the cost of freeing up existing capacity through more efficient management of demand. During the past decade, least-cost planning, with a focus on demand-side management (DSM), has come to be accepted in the utility industry (*1*). In contrast, transportation demand measures have been implemented for a small number of employers or along a single corridor in a region (*2*). The Clean Air Act Amendments of 1990 and a variety of other state and federal legislation have once again focused attention on transportation demand management (TDM).

The purpose of this paper is to identify lessons from the implementation of utility industry DSM for TDM. The types of demand-side management measures are outlined and compared. The organization of these two regulated sectors is compared. Finally, lessons for TDM based on the implementation of DSM are identified.

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TYPES OF DEMAND-SIDE MEASURE

The nature of the demand-side measures differs between the two sectors because of the nature of demand. The utility industry uses a mix of generators to meet their needs. The most efficient generators are used for the base load, less efficient generating capacity is used for the intermediate load, and peaking generators start quickly and are the most expensive to operate. In contrast, there is a limit to the capacity of major roadways. If a driver enters the freeway when it is at capacity, he or she encounters congestion and delays in getting to his or her destination. Transportation agencies cannot expand capacity in the same way that utility companies can dispatch additional peaking capacity.

Gellings (*3*) identifies five methods of managing the demand for utility generation: peak clipping, valley filling, load shifting, strategic conservation, and flexible load shape. Peak clipping is designed to reduce demand for the more expensive peaking capacity. Valley filling entails building demand during off-peak periods to make use of generating facilities for longer periods of time. Load shifting is a combination of peak clipping and valley filling that shifts loads from peak to off-peak periods. Strategic measures, such as conservation, appliance efficiency, and improvements in industrial processes, reduce end-use consumption and demand for electricity. Other characteristics of electricity, mostly reliability, are traded for discounted electric rates when demand is reduced through a flexible load shape.

Ferguson (*4*) outlines five methods of controlling the demand for transportation facilities: trip generation, trip distribution, mode choice, spatial route selection, and temporal route selection. Demand management through trip generation focuses on the elimination (e.g., through the use of telecommunications) of specific activities associated with trip making and trip making associated with specific activities. TDM through trip distribution focuses on shifting trips from more congested to less congested areas. When planners focus TDM efforts on mode choice, they attempt to shift trips from lower-occupancy modes of travel (usually solo driving) to a higher-occupancy mode. Spatial route selection shifts trips from a more to a less congested route. Demand management through temporal route selection shifts trips from a more to a less congested time period.

The demand management strategies can be summarized in three categories based on how they reduce demand: load management, trade-off in quality of service, and strategic demand reduction (see Table 1).

TABLE 1 DEMAND MANAGEMENT MEASURES CATEGORIZED BY GOAL AND TYPE

Demand Side Management (DSM)	Transportation Demand Management (TDM)
Load Management: Decrease the Variation in the Level of Activity	
Peak Clipping Valley Filling Load Shifting	Temporal Route Selection
Tradeoff in Quality of Service: reduce reliability of service in exchange for other benefits	
Flexible Load Shape	Trip Distribution Spatial Route Selection Mode Choice
Strategic Demand Reduction: reduce end use energy consumption or level of activity	
Strategic Conservation	Trip Generation Mode Choice

Load management strategies attempt to decrease the variation in the level of activity and do not attempt to prevent the use of the infrastructure; they merely attempt to change the time during which it occurs.

Trade-off in quality of service includes demand management activities that reduce reliability in exchange for other benefits such as lower costs for electricity and possibly less congestion for drivers. In transportation, these trade-offs involve changes in trip distribution and spatial route selection. For some people, mode shifts involve trade-offs in quality of service.

Strategic demand reduction occurs through reducing end-use consumption in the electricity sector and through measures affecting trip generation and mode choice for transportation services. In other words, the overall level of activity is reduced while the same activities continue.

The predominant demand-side strategy is different between industries. Electric utilities encourage customers to use electricity at different times of the day by offering price incentives and thus manage the load. TDM efforts have emphasized changes in mode or time of travel, or both (*4*). Most efforts have focused on work trips because they are characterized by the lowest automobile occupancy and the most significant congestion (*2*).

COMPARISON OF TDM AND DSM

A comparison of the nature of regulation, pricing, the use of technology, and nature of the demand-side management presents a sharp contrast (see Table 2). Utility industry DSM is regulated in a formal quasi-judicial proceeding with few participants. TDM is implemented largely at the local and regional levels. Decisions about transportation expenditures are made at the federal, state, and regional levels; decisions about the location of various land uses are made locally. DSM measures have a broad focus; they address the energy use by all classes of customers at all times of the day and year. TDM efforts have focused on work trips concentrated in space and time. There has been a less explicit comparison of transportation demand to supply. Utility customers pay through their utility rates for investments in both DSM measures and gen-

TABLE 2 COMPARISON OF TRANSPORTATION AND UTILITY REGULATION AND IMPLEMENTATION OF DEMAND-SIDE MEASURES

Utility Regulation and Demand-Side Management (DSM)	Transportation Regulation and Transportation Demand Management (TDM)
Regulatory Environment	
Formal quasi-judicial proceedings before state and federal regulatory commissions; relatively few participants in decision-making	Decisions are made at the federal, state and local level; large number of participants in uncoordinated decision-making processes
Use of Pricing as a Part of Regulation	
Coordinated demand related pricing (e.g., time of day, seasonal and interruptible rates); facilities financed directly through rates paid by customers; beginning to internalize the cost of externalities associated with electricity production	Fractured pricing structure (e.g. gas taxed at federal and state level, tolls collected on a few highways without obvious relationship to demand, inconsistent parking prices); facilities financed indirectly through gas taxes
Focus of Demand-Side Management Activities	
Broad, considers demand patterns of all categories of customers; compares supply-side and demand-side measures	narrow, responding to shortage of capacity in area and focussing on periods of highest usage (usually commute trips); demand-side not explicitly compared to supply-side measures
Use of Technology	
wide range of end-uses (e.g., light bulbs, sensor switches, appliance efficiency)	focussed on supply-side (e.g. automatic vehicle identification, integrated vehicle highway system) and automobile (e.g., improved catalytic converters, fuel injection)

erating facilities. Transportation infrastructure has been funded from a wide variety of taxes. Pricing as a part of TDM measures has been less pervasive, less consistently imposed, and less sensitive to the level of demand. Finally, utilities used technology in a variety of applications (e.g., industrial motors, appliances, and light bulbs) to improve energy efficiency, whereas the use of technology for TDM has been limited.

LESSONS FOR TDM

This comparison suggests some lessons for the implementation of TDM based on the implementation of DSM measures. Many have suggested that improvement in technology may provide solutions to transportation problems. Clearly, technological solutions have decreased energy consumption and automobile emissions and have improved the flow of traffic. Further reductions in automobile pollution will require changes in catalytic converters, engines, or fuels. Additional technological changes may make highway systems operate more efficiently, but these will not reduce the congestion from too many vehicles on the highway.

Pricing Strategies

Many transportation planners and policy analysts suggest that TDM, especially mode shifts and trip generation, would be more effectively implemented if the cost of driving were higher. Lessons from DSM suggest that pricing is important in reducing demand. However, increases in price are more complicated, but not impossible, in the context of TDM. There has been great political resistance to increases in the price of gasoline. The use of congestion pricing has received a more favorable response because it is seen as a fair way of allocating a scarce resource, the highway capacity.

Although congestion pricing can be easily implemented technically, it may not lead to the desired reductions because commuter traffic demand appears to be highly price inelastic. Studies indicate that commuters are willing to pay tolls as high as 25 cents/mi to save time (*5*).

The use of congestion pricing assumes that the occurrences of congestion are predictable. Although congestion associated with commute trips can be predicted, all occurrences of congestion cannot be predicted. It seems clear that congestion prices should be charged for predictably timed commute trips; it is less clear whether a charge should be made for other trips when the highways are congested. If there is no charge during noncommute periods of congestion, what is the message being sent to drivers about the meaning of congestion pricing?

Congestion pricing will not be effective if it is not coordinated with other transportation and pricing policies. If congestion pricing is implemented and transit alternatives to various locations are not improved, workers will only see increased costs without improvements in transportation service. In addition, the effect of congestion pricing could be neutralized by employer-provided transportation or parking allowances (*5*).

Finally, congestion pricing should be implemented throughout a region, or it may induce employers to move to parts of the region in which it is not being implemented. Participating communities may be at a disadvantage relative to nonparticipating neighboring communities, because congestion pricing may raise the cost of doing business in parts of a region.

Coordination of Regional Land Use, Transportation, and Air Quality

Difficulty in the use of congestion pricing is a symptom of the larger problem of implementing TDM: the fragmented regulation of regional transportation and the multiple reasons for the implementation of TDM. This fragmentation has led some to conclude that land use and transportation should be coordinated at the regional level to reduce associated environmental problems. These proposals assume that regional control over land use and transportation could lead to a better balance of jobs and housing, with a resulting decrease in travel, congestion, energy use, and air pollution. Some form of regional tax sharing to eliminate the need for communities to attract business to increase their tax base is often included.

Regulation of land use and transportation at the regional level can be difficult because of different institutional backgrounds, political origins, and sources of funding of existing agencies. Each agency has its own organizational mission, its own governing body, and its own means of communicating and coordinating its activities with communities, the state, and the region. Any attempt to merge these activities will require major organizational change, separate funding, and the means to bring together the diverse concerns of communities that have competed with each other for the same development projects.

Balancing Short-Term and Long-Term Goals

The final lesson for DSM is the need to consider the broader perspective in implementing demand-side measures. It is unclear whether TDM is being implemented as a short-term solution to a short-term problem or as a long-term solution to a long-term problem.

In the past load management and changes in mode choice have been the focus to reduce congestion during commute periods. The number of trips that can be switched to carpools and vanpools is about one-fourth the commute trips (*6*). In the long-term, temporal route selection can only occur where a less congested period exists.

In the short term the number of trips must be reduced and the timing of trips changed. Noncommute trips must be the focus, because congestion already exists during nonpeak periods and on trips to major nonwork destinations (e.g., sports and entertainment centers, airports, and regional shopping centers).

In the long term new technology can be applied, activities redistributed, and the distribution of trips changed so people can combine or eliminate trips. In both the short and the long term, change is needed in the way both cities and daily activities are organized. The short-term solutions must be implemented without compromising long-term goals.

Finally, a comprehensive strategy to evaluate the future of supply and demand throughout a region must be developed. This broader view would compare the supply of transportation

with the demand and consider the costs of congestion, air pollution, depletion of oil resources, expansion of the highway system, and decrease in quality of life versus better planning, taxation, and other behavioral responses that would reduce reliance on the automobile. Such an approach should be an integrated process leading to a least-cost planning of the transportation system.

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Developing Transportation Demand Management Packages Using Transportation Surveys: Case Study

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The goal of most transportation demand management (TDM) programs is the reduction of single-occupant-vehicle (SOV) use. The selection and packaging of TDM measures are critical in devising and implementing an effective program. The basis for the selection process can come from specialized transportation surveys. One such survey administered at the U.S. Department of Transportation (DOT) headquarters in Washington, D.C., is reported. The survey was distributed to 11,568 DOT employees, with a response rate of 41 percent. Only 16 percent of respondents commute by SOV. The Washington, D.C., core average is nearly 31 percent. DOT has excellent rideshare participation, with an overall occupancy of 1.89 employees per automobile. Several attitudinal questions were asked to investigate possible mode shifts if the headquarters were relocated near Union Station. DOT employees consider discounted transit passes and increased parking costs strong incentives to change modes of travel. It is anticipated that a combination of transit subsidies, rideshare programs, and flexible work schedules will be considered for the possible consolidation of DOT.

A critical objective of transportation demand management (TDM) programs both locally and regionally is the reduction of single-occupant-vehicle (SOV) use. A shift in mode choice from SOVs and a reduction in peak-hour vehicle trips are the major goals of most TDM programs. It was recently reported that suburban centers with mandatory TDM programs had considerably higher ridesharing than similar centers without required programs (*1*,*2*). Research has found that SOV use could be as much as 10 percent lower in areas with transportation management ordinances (*2*,*3*). The critical issues in devising a TDM program for a specific area are the selection and packaging of various management measures. Data on travel characteristics must be assessed before a TDM program is implemented. Travel information can come from many sources, including transportation surveys. Special employee transportation surveys are a tool to analyze which TDM measures to include in an overall management program. One such survey was administered at the U.S. Department of Transportation (DOT) headquarters in Washington, D.C. DOT is currently evaluating the relocation of most of its headquarters employees to a consolidated site in Washington, D.C. The employee transportation survey was distributed to existing DOT personnel to identify effective TDM measures.

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DOT currently employs 11,568 persons in three separate locations in Washington, D.C. It is anticipated that 8,252 employees will be relocated to one building near Union Station. To fulfill the requirements of the study, an evaluation of future transportation, traffic, and parking conditions with the consolidation project is required. The consolidation alone would bring over 8,000 additional jobs to the Union Station area. To mitigate the potential traffic impacts of the proposed action, packages of TDM measures are being tested. A preferred package will be selected and implemented when the development project to consolidate DOT employees is complete. The transportation survey and its use in TDM development are reported here. The following information is included:

- Comparison of travel characteristics for DOT employees and average regional measures for metropolitan Washington, D.C.,
- Evaluation of potential travel characteristics of DOT employees, and
- Processes for formulating TDM packages using attitudinal and other questionnaire responses.

Few DOT employees currently travel to work in SOVs. Even with the strong ridesharing and mass transit use at the existing buildings, additional aggressive TDM programs will be needed to reduce the traffic and parking impacts of the proposed action.

The Consolidation Employee Transportation Survey was distributed in March 1991 to all 11 operating administrations in DOT. Completed surveys were returned by 4,735 of the 11,568 employees. This is a response rate of 41 percent. Only 11 percent of employees actually live within the District of Columbia. Most live in the suburban areas surrounding Washington, D.C.

Figure 1 indicates the location of residences of DOT employees. Many options are available to DOT employees for the work commute. These include personal automobile, Metrorail, commuter rail, Metrobus, suburban bus, paratransit, bicycles, and walking.

Ample opportunity for ridesharing exists for employees in their commute to the current and future DOT headquarters sites. TDM strategies must be developed to encourage mode shifts to effectively use existing and programmed modes of travel.

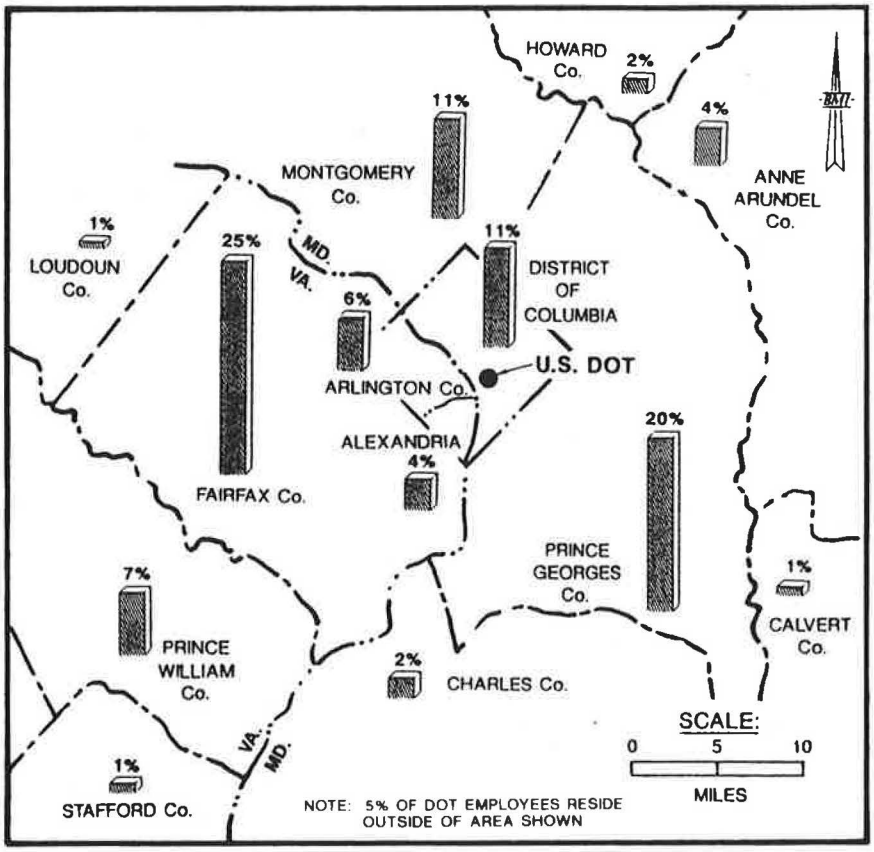

FIGURE 1 Residence of DOT employees.

As part of a study of such a consolidation, an employee survey was used to formulate the effectiveness of TDM strategies. The general goals of the TDM program are to reduce vehicular traffic and parking demand at the consolidation site.

EXISTING TRAVEL CHARACTERISTICS

Before strategies for reducing personal automobile trips could be established, an understanding of existing travel characteristics was needed. These characteristics were defined through the responses to the employee transportation survey. The average one-way commute distance to work for DOT employees was found to be 21 mi for all travel modes. The average one-way commute time was approximately 45 min. The reported minimum and maximum commute distances and times were 1 and 170 mi and 5 and 180 min, respectively. Table 1 indicates the one-way commute times and distances for DOT employee trips to and from work. The employee-commute times and distances are slightly greater than the metropolitan area average. These will be checked with networks and employee locations through traffic assignment procedures.

The primary mode of travel to work for employees is indicated in Figure 2. Over 50 percent of respondents listed carpool and vanpool as the primary mode of travel. Public bus and rail were used by 28 percent of respondents. Only 16 percent travel to work by SOV. In addition, the occupancy of personal automobiles was calculated to be 1.89 employees per vehicle. The peak period of trips was from 6:30 to 8:30 a.m., when 86 percent of employees arrive at work.

TABLE 1 COMMUTE TIMES AND DISTANCES FOR DOT EMPLOYEES

Commute Time			Commute Distance		
One-Way Commute Time	Number of Responses	Percent of Responses	One-Way Commute Distance	Number of Responses	Percent of Responses
1-10 minutes	100	2.1%	1-5 miles	358	7.6%
11-20 minutes	443	9.4%	6-10 miles	736	15.5%
21-30 minutes	840	17.7%	11-15 miles	754	15.9%
31-40 minutes	790	16.7%	16-20 miles	723	15.3%
41-50 minutes	1,148	24.2%	21-25 miles	483	10.2%
51-60 minutes	755	15.9%	26-30 miles	457	9.6%
61-70 minutes	197	4.2%	31-40 miles	481	10.2%
71-80 minutes	254	5.4%	41-50 miles	164	3.5%
81-90 minutes	133	2.8%	51-60 miles	68	1.4%
91+ minutes	75	1.6%	61+ miles	86	1.8%
No Response	0	0.0%	No Response	425	9.0%
Total	4,735	100%	Total	4,735	100%

Source: March-April, 1991 survey conducted by DOT of its Washington, D.C. employees.

The regional travel characteristics for 1985 were compiled by the Metropolitan Washington Council of Governments (*4*). The data indicate that approximately 40 percent of trips to the Washington, D.C., core area are by transit. DOT employees use transit less than the regional average. The regional automobile occupancy to the core area is approximately 1.41

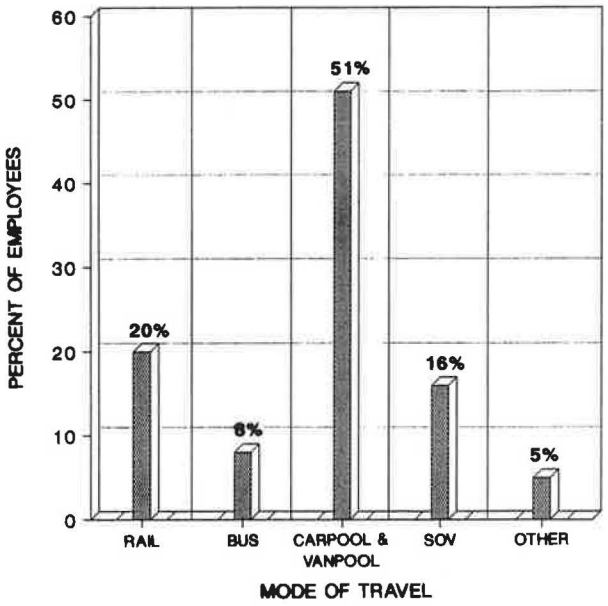

FIGURE 2 Existing mode choice of DOT employees.

persons per vehicle (*6*). The automobile occupancy for DOT is 1.89 employees per vehicle. Preferred parking in DOT garages is reserved for carpool and vanpool vehicles only.

Apparently the preferred parking incentive greatly influences the employee mode choice. Other mode-choice comparisons were sought. Data for numerous suburban activity centers have been reported in recent publications. Mode-choice attributes of office centers in California with TDM ordinances and office centers in various states without TDM requirements were reported (*1*,*2*). The research pointed to the effectiveness of TDM ordinances through a comparison of these centers. It was reported that the Silver Spring, Maryland, Metro Center (SSMC), located on a rail line with excellent mass transit opportunities, had a strong TDM program. The program includes discounted transit fare, flex time policies, and parking controls (*6*). Table 2 gives a comparison of the DOT; Washington, D.C., core; SSMC; and other recently reported mode-choice characteristics. As indicated, the DOT headquarters currently has excellent rideshare participation. The TDM program being developed for the planned relocation should augment the already effective trip reduction strategies in place at DOT.

FUTURE TRAVEL CHARACTERISTICS

The environmental studies associated with the proposed DOT consolidation are focusing on sites near Union Station. Union Station is several blocks north of the U.S. Capitol near the intersection of Massachusetts Avenue and North Capitol Street. Union Station is a multimodal hub with the following public transportation opportunities:

- Amtrak—heavy rail service along the eastern seaboard;
- MARC—commuter rail service to and from Baltimore, Maryland, and Harpers Ferry, West Virginia;
- Virginia Railway Express—commuter rail service to and from Fredericksburg and Manassas, Virginia;
- Metrorail—Washington, D.C., metropolitan subway system;
- Metrobus—regional service feeding Metrorail and providing sole service in other areas;
- Commuter bus—several carriers providing service from suburban Maryland; and
- Bicycle and pedestrian access.

If the consolidation takes place at Union Station, changes in employee mode choice are expected. In the transportation survey, employees were asked to anticipate their mode choice if the proposed action occurs. A map of the Union Station area was provided with the survey, and it was assumed that the respondents were aware of the mode-choice opportunities available. Figure 3 gives a comparison of existing and anticipated mode choice of DOT employees. Significant increases in rail use are expected. The mode shift to rail transit was from personal automobile use. The anticipated reduction in carpool or vanpool participation will reduce the overall automobile occupancy rates. The reported future automobile occupancy was calculated to be approximately 1.75 employees per vehicle, which is still 25 percent higher than the core average. The responses for future mode choice were without knowledge or consideration of TDM programs beyond the existing conditions. It is anticipated that transit and rideshare use could be even higher than reported because additional TDM measures will be implemented. TDM measures related

TABLE 2 DOT MODE-CHOICE COMPARISON WITH OTHER LOCATIONS

Mode of Travel	California Suburban Employment Centers With TDM (1)	Suburban Office Centers Without TDM (1)	Silver Spring Metro Center (SSMC) (5)	Washington D.C. Core Average (3)	U.S. DOT Headquarters
Drive Alone	83%	92%	28%	31%	16%
Car/Vanpool	11%	7%	28%	29%	51%
Metrorail	na	na	11%	27%	17%
Commuter Rail	na	na	10%	1%	3%
All Transit	4%	1%	39%	40%	28%
Other	2%	na	5%	na	5%
Auto Occupancy	na	na	1.41	1.41	1.89

na - not available

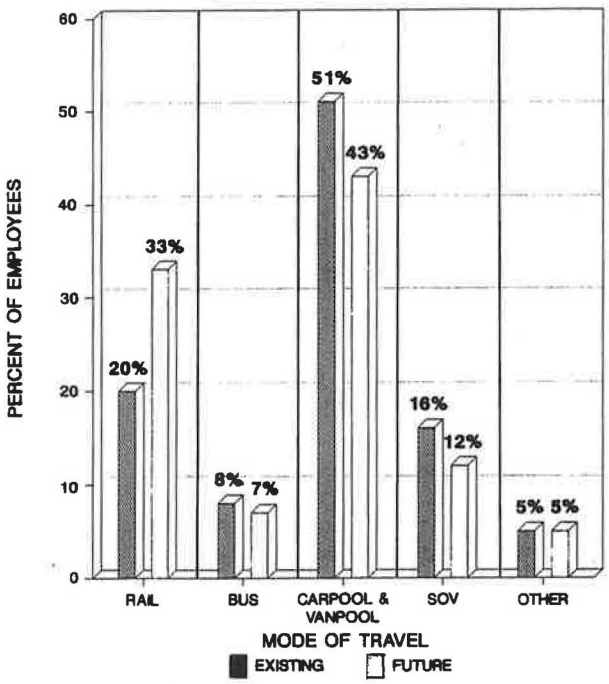

FIGURE 3 Existing and future mode choice of DOT employees.

to parking management may serve as incentives to an increased number of persons per vehicle. Parking supply and pricing policies would offer other incentives.

ATTITUDINAL RESPONSES

The responses to several attitudinal questions were used to screen TDM measures and help identify those measures that would further reduce SOVs. DOT employees responded "very likely," "somewhat likely," or "not at all likely" to the following questions:

- "If you presently drive alone, carpool, or vanpool, how likely would you be to take public transportation to DOT given the following incentives?"
- "If you presently drive alone, how likely would you be to join a carpool or vanpool to DOT given the following incentives?"

The incentives and responses are summarized in Table 3.

The discounted sale of transit passes was considered to be a strong incentive for changing modes. Whereas it was not possible to test actual dollar amounts of discount, it is reasonable to assume that the respondents would expect discounts of 25 to 50 percent in total fare cost. These discount rates have been effectively applied in the SSMC project (*6*). It was found that most employees at DOT are older, have been employed longer, and did not respond to enhanced day-care services as an incentive to change modes. This incentive is typically mentioned by younger workers as improving their likelihood to rideshare. Approximately 50 percent of respondents said that they would be very likely or somewhat likely

TABLE 3 SUMMARY OF ATTITUDINAL QUESTIONS

Question 1. If you presently drive alone, carpool or vanpool, how likely would you be to take public transportation to DOT given the following incentives?

Incentive	Very Likely	Somewhat likely	Not at all likely	Total Responses
a. Discount bus or rail passes sold in your building.	26%	36%	38%	3,057
b. Shifting work hours to better coincide with transit schedules.	18%	26%	56%	3,014
c. Enhanced day care services provided.	6%	6%	88%	2,925
d. Emergency ride home services.	22%	28%	50%	3,000
e. Parking prices at commercial parking garage rates.	20%	27%	53%	2,977
f. Convenient information on available public transportation.	12%	28%	60%	2,987

Question 2. If you presently drive alone, how likely would you be to join a carpool or vanpool to DOT given the following incentives?

Incentive	Very likely	Somewhat likely	Not at all likely	Total Responses
a. An improved Ridematch service with personalized assistance and identified pick-up locations.	18%	30%	52%	727
b. Shifting work hours to meet the schedule of a convenient carpool or vanpool.	20%	26%	54%	719
c. Enhanced day care services.	7%	6%	87%	690
d. Emergency ride home services.	19%	25%	56%	713
e. Parking prices at commercial parking garage rates.	17%	27%	56%	711

to change modes of travel if a guaranteed ride home was available for emergency situations. Surprisingly, however, 12 percent of respondents who currently drive reported that they would change to transit if convenient information on public transportation was available. Approximately 17 percent of SOV respondents reported that they would rideshare if the charge for parking was at commercial garage rates. Presumably many of these employees currently find on-street parking. Another promising incentive was the ability to shift work schedules to accommodate ridesharing arrangements. Approximately 46 percent of persons using SOVs reported that they would be very or somewhat likely to shift modes if their work schedules were more flexible.

It is important to recognize that these responses are strictly attitudes and do not reflect actual mode shifts. Research has been conducted on the subject of behavioral intent and actual behavior. In the survey presented here, respondents provided behavioral intent. It is up to researchers and engineers to evaluate the reasonableness of the responses concerning future mode choice and the influences of TDM programs. Previous research has suggested that predictions of future behavior are more successful when the respondents to a survey have had experience directly related to the proposed action (*7*). It was also found that if a respondent currently uses a form of public transit, the response to a future transit ridership inquiry will likely be accurate. This research also found that the responses to questions about the demand for a particular mode of transit with which the respondent has had experience should be more reliable than the responses for a new mode (*8*). The DOT employees currently use mass transit to a great extent and are familiar with the regional transit system. No

TABLE 4 DESCRIPTION OF TDM ACTION GROUPS

TDM Action Group	General Description
1. Increase Transit	Includes numerous programs and strategies for increasing transit usage; therefore, reducing reliance on personal autos.
2. Increase Carpool	Includes numerous elements which strive to increase ridesharing of current SOV users.
3. Increase Walk and Bicycle	Includes enhancements to ped/bike networks and adds convenience facilities for potential users.
4. Improve Paratransit and Goods Movement	Includes measures to better link major transit facilities with the ultimate destinations. Includes measures to regulate, control, and improve the movement of goods through an area.
5. Restricted Traffic	Includes partial or full restrictions of SOVs or autos in specified regions or corridors.
6. Pricing Measures	Includes programs which use the pricing of various travel elements to encourage or discourage the use of certain modes.
7. Parking Management	Includes the control of parking supply and fares to influence the selection of travel modes.

new modes of transit are expected in the future; therefore, DOT employees were responding on the basis of existing transit systems that will be available at the new headquarters site. The responses to future mode-choice and attitudinal questions are reasonable in light of the behavioral research cited.

FORMULATION OF TDM PACKAGES

Because of the large employee population and multimodal nature of the proposed site, a broad range of TDM measures was identified. Table 4 provides general descriptions of major TDM action groups identified for the DOT project.

While packages of TDM measures were being developed, evaluations of the interrelationships between individual measures and groups of measures were conducted. An example of this initial screening process is provided in Figure 4. This represents an extension of earlier work conducted for FHWA and UMTA by Bellomo. Each measure is screened to determine which TDM measures assist, which are independent, and which are counterproductive when packaged together.

This discussion provides, as examples, several interpretations of the interrelationships between the TDM measures specified in Figure 4. Increased carpooling is listed as independent of increased walking and bicycling. The potential market areas for each of these modes occur at vastly different travel distances from the destination. Carpooling becomes desirable at distances greater than 15 mi; walking and bicycling occur within distances of less than 5 mi. Another interrelationship example is the use of automobile-restricted zones (ARZs), which tend to increase transit use because cars are prohibited. However, ARZs are counterproductive in encouraging the formation of car or vanpools. Finally, parking management by limiting supply, time-restricted access, vehicle-restricted access, and pricing measures tends to increase the use of transit and ridesharing. Controls on parking are structured to discourage the use of SOVs.

In the process of evaluating TDM measures and formulating packages, the following concerns must be considered:

- What is the overall effectiveness of the measures or packages in reducing SOV travel and increasing ridesharing, bicycling, and walking?
- What departmental, legal, and financial obstacles must be addressed and what problems might arise from obtaining federal and local policy changes to implement the TDM package?
- Will employees and the public accept the TDM packages that might include changes in life-style, travel behavior, and commuting costs?

An overall goal for the TDM should be established. The measure of effectiveness (MOE) for the DOT headquarters project is likely to be one or more of the following:

- Reduced single-occupant vehicle trips,
- Reduced parking space requirements,
- Reduced vehicle trips,
- Increased vehicle occupancy, or
- Reduced peak-hour vehicle trips.

The TDM will have general objectives of reducing parking demand, limiting traffic impacts, and minimizing noise impacts on the adjacent residential communities. A transportation coordinator and staff will be assigned to implement the TDM programs. The TDM packages are still being developed, but the following programs and measures are likely to be recommended for the DOT project:

- Transit subsidy program to promote Metrorail, commuter rail, and bus use;
- Bulletin board and transportation and commuter office to disseminate rideshare information;
- Computerized carpool and vanpool matchlist data base;
- Parking controls in DOT garage to encourage high-occupancy vehicles (HOV) and discourage violation of occupancy requirements;
- Telecommuting and flexible hour work schedule programs; and

ACTION GROUPS

ACTION GROUPS	2.Increase Carpool	3.Increase Walk & Bicycle	4.Improve Paratransit and Goods Movement	5.Restricted Traffic	6.Pricing Measures	7.Parking Management
1.Increase Transit	C	A	A	A	A	A
2.Increase Carpool		I	I	C	A	A
3.Increase Walk & Bicycle			I	A	I	I
4.Improve Paratransit and Goods Movement				C	I	I
5.Restricted Traffic					C	C
6.Pricing Measures						A

Legend:

A - Action Groups assist each other in reducing vehicle trips.
I - Action Groups are independent of each other in reducing vehicle trips.
C - Action Groups are counterproductive to each other in reducing vehicle trips.

FIGURE 4 Interrelationships between TDM measures.

- Provision or extension, or both, of HOV lanes for peak traffic periods.

DOT headquarters is in a central business district with a wealth of ridesharing opportunities. No one TDM measure would be sufficient to satisfy the vehicle trip reduction goals. In complex transportation situations, packages of TDM measures are needed to achieve the specified goals. DOT employees at the future headquarters location will decide between heavy and light rail, bus, paratransit, and various personal automobile arrangements for the commute trips. DOT employees currently reside in the metropolitan Washington, D.C., region with access to different transportation systems. Discouraging SOV travel requires an integrated program, including incentives and disincentives.

Besides the traffic, transportation, and parking issues addressed by the TDM programs, other factors will be considered. The MOEs must be broadened to include visual quality, pedestrian orientation, relationship to cultural activities, environmental concerns, and socioeconomic effects.

SUMMARY

Formulation and testing of TDM actions require innovative work. Transportation surveys of employees can be quite useful in developing TDM packages and in evaluating their potential effectiveness.

A transportation survey that was distributed to 11,568 DOT employees in Washington, D.C., is reported. The survey was needed to obtain mode-choice, travel characteristics, and socioeconomic and other information to assist in the environmental studies and TDM programming of the proposed relocation and consolidation of the DOT headquarters. A response rate of 41 percent was achieved, with 4,735 completed surveys returned. It was found that only 16 percent of the respondents currently arrive by SOV to DOT headquarters compared with a Washington, D.C., core average of 31 percent (*4*). The average personal automobile occupancy was calculated to be 1.89 employees per vehicle, which is higher than the Washington, D.C., core average of approximately 1.41 (*5*). Nearly 28 percent of employees currently use a form of public transportation to travel to work. On the basis of the survey, public transportation use would increase to 40 percent of employees if a DOT relocation near Union Station takes place. DOT employees consider the sale of discounted transit passes and increased parking costs as strong incentives to changing modes of travel.

The preferred TDM measures will be packaged and evaluated by qualitative and quantitative MOEs. A range of transportation, socioeconomic, and environmental objectives must be considered in establishing a TDM program. The interrelationships between measures must be understood and accounted for to ensure that an effective TDM package is developed. It is expected that a combination of transit subsidies, carpool and vanpool programs, and flexible work schedules will be instituted for the DOT consolidation.

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Case Study on Impact of 4/40 Compressed Workweek Program on Trip Reduction

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The compressed workweek is often promoted as a transportation demand management (TDM) strategy. It is assumed that employees who work fewer days per week will make fewer trips per week, thus reducing demand on transportation infrastructure. A before-and-after case study by Commuter Transportation Services, Inc., examines the effects of this strategy on travel behavior by analyzing travel logs completed by employees at a Los Angeles County worksite before and after the implementation of a 4/40 compressed workweek schedule (four 10-hr days a week). Results show that employees actually made more trips on their compressed workweek day off than they did on any other day. However, employees made fewer trips per week and traveled fewer miles than when working a traditional 5/40 schedule (five 8-hr days per week). In addition, the trips made on the day off are short errands and were usually made during nonpeak periods, late morning or early afternoon. Further, the findings show that a larger percentage of the trips were being made without a return home between trips, indicating a reduction in the number of cold starts. The study concludes that a 4/40 compressed workweek program can reduce the average number of vehicle miles traveled (VMT) and thus can reduce levels of mobile source pollutants entering the atmosphere. The average reduction in VMT per week for respondents of this study, 46 mi, is equal to a $850 annual savings in user costs and an average reduction of 2,300 lb of carbon dioxide and pollutants.

Transportation demand management (TDM) strategies are designed to increase the efficiency of existing transportation infrastructure by reducing travel demand and traffic congestion during peak travel periods. In Southern California, many transportation professionals are promoting the use of TDM strategies to reduce vehicle emission levels and air pollution in the Los Angeles Basin. TDM strategies include ridesharing, telecommuting, variable work hours, and compressed workweek programs.

In a compressed workweek program, the length of the traditional 8-hr workday is increased, allowing employees to reduce the number of days worked per week. Employees working compressed schedules report to work fewer days per week and are presumed to make fewer trips per week.

Except for the 1980 Denver Regional Council of Government experiment (*1*), there has been little research to determine what employees do with their additional days off. The Denver experiment evaluated both the 4/40 and 9/80 compressed workweek programs of over 7,000 federal employees in the Denver area. Particular attention was given to quantifying the indirect impacts of the modified schedules on weekly household travel patterns.

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This case study parallels the Denver study and was designed to determine whether the compressed workweek program reduces total weekly trips and total weekly distances, or both, thus reducing congestion and pollution.

To understand the effects of a compressed workweek schedule on employee travel behavior, Commuter Transportation Services, Inc., (CTS) surveyed a group of employees working a traditional 5/40 schedule and surveyed the same employees after they began working a compressed 4/40 schedule. The research was conducted at the Los Angeles County Department of Public Works (DPW), a major employer in the San Gabriel Valley in Southern California. The site was chosen for the following reasons:

1. There was an opportunity to conduct before-and-after surveys,
2. A large employee population participated in the compressed workweek program, and
3. There were considerable cooperation and support from DPW management.

On September 5, 1990, DPW implemented a 4/40 program that involved 1,600 employees at the Alhambra headquarters worksite. The 1,600 employees work four 10-hr workdays each week and the building closes on Fridays.

CTS conducted a survey 2 weeks before the implementation of the program and 6 months afterward (Figure 1). The surveys were distributed to the same sample group and included a 1-week travel log (Figure 2) designed to record details of employee trips each day of the week. Experience with past surveys indicated that a response rate of 50 percent could be expected. Thus, for 100 "after" surveys to be completed by respondents who also returned a "before" survey, 300 of the 1,600 employees were randomly selected to participate in the study. (The sample group was chosen through a computer program that randomly selected 300 employees from the pool of all employees who were scheduled to be on the 4/40 compressed workweek program.)

There was concern in DPW that hardships might arise following the radical change in work schedule. There was particular concern that the 4/40 schedule might cause problems for employees with childcare needs. The survey was therefore designed to gather information about how the 4/40 schedule would affect such employees.

The effect of the compressed workweek on trip generation and travel behavior is considered by examining the following:

- Employee's day-off trips,
- Number of trips,

Trip #1
Time: ____:____ am/pm (please circle one)
Origin: (please circle one)

1	Home	1	Home
2	Work	2	Work
3	Different work site	3	Different work site
4	School for children	4	School for children
5	Child care/dependent care	5	Child care/dependent care
6	Restaurant	6	Restaurant
7	Shopping	7	Shopping
8	Post Office	8	Post Office
9	Bank	9	Bank
10	Medical	10	Medical
11	Recreation	11	Recreation
12	Visit friend or relative	12	Visit friend or relative
13	Personal business	13	Personal business

How did you traveled: (please circle one)

A	Drove alone
B	Carpooled
C	Took the public bus
D	Bicycled
E	Walked
F	Other

Distance traveled: _____ miles Time traveled: _____ minutes
Did you travel by freeway? Yes No

Trip #2
Time: ____:____ am/pm (please circle one)
Origin: (please circle one)

1	Home	1	Home
2	Work	2	Work
3	Different work site	3	Different work site
4	School for children	4	School for children
5	Child care/dependent care	5	Child care/dependent care
6	Restaurant	6	Restaurant
7	Shopping	7	Shopping
8	Post Office	8	Post Office
9	Bank	9	Bank
10	Medical	10	Medical
11	Recreation	11	Recreation
12	Visit friend or relative	12	Visit friend or relative
13	Personal business	13	Personal business

How did you traveled: (please circle one)

A	Drove alone
B	Carpooled
C	Took the public bus
D	Bicycled
E	Walked
F	Other

Distance traveled: _____ miles Time traveled: _____ minutes
Did you travel by freeway? Yes No

Trip #3
Time: ____:____ am/pm (please circle one)
Origin: (please circle one)

1	Home	1	Home
2	Work	2	Work
3	Different work site	3	Different work site
4	School for children	4	School for children
5	Child care/dependent care	5	Child care/dependent care
6	Restaurant	6	Restaurant
7	Shopping	7	Shopping
8	Post Office	8	Post Office
9	Bank	9	Bank
10	Medical	10	Medical
11	Recreation	11	Recreation
12	Visit friend or relative	12	Visit friend or relative
13	Personal business	13	Personal business

How did you traveled: (please circle one)

A	Drove alone
B	Carpooled
C	Took the public bus
D	Bicycled
E	Walked
F	Other

Distance traveled: _____ miles Time traveled: _____ minutes
Did you travel by freeway? Yes No

FIGURE 1 Day 1 of travel log included with preimplementation survey of Los Angeles County Department of Public Works employees.

- Freeway trips,
- Length (distance and time) of trips,
- Time of day during which errand trips are made,
- Mode split, and
- Factors affecting the number of trips.

RESPONDENT PROFILE

Of the 300 employees surveyed, 158 responded to the first survey and 139 to the second survey. Of the 139 who returned the second survey, 108 completed both surveys.

Tests indicate that there is no significant difference between the two surveys, at the 95 percent confidence level, in the respondent's gender, number of persons per household, and number of cars per household.

Number of Cars and Household Size

There is some correlation between the number of cars per household and the number of persons per household. In the first and second surveys, the number of cars in a household increased in relation to the size of the household.

Results also indicate that most respondents had access to a car and, thus, the number of cars per household should have had a negligible effect on the number of trips made per respondent.

Type of Childcare

One of the aims of this study was to gather information on how the 4/40 schedule would affect those employees with childcare needs. Only 20 respondents (13 percent) to the first survey and 23 respondents (17 percent) to the second survey said that they currently had children in childcare. However, a test for "difference in proportion" indicated that there was no significant difference, at the 95 percent confidence level, between the number of respondents with childcare needs in the first survey and that in the second survey.

Of those respondents who had childcare needs, approximately half indicated that their children are cared for at home. Thus, the actual number of respondents using childcare outside the home is so small that conclusions regarding the effect of the 4/40 program on persons with childcare needs cannot be determined.

SURVEY RESULTS

Employee's Day-Off Trips

After the implementation of the 4/40 program, there was an increase in the number of trips made for shopping, medical or personal business, recreation, school for children, and visits to bank and post office on Fridays (see Table 1). This indicates that the respondents are using the day off for errands or personal needs. It is interesting to note that the percentage of all trips destined for home on the day off decreased from that on an ordinary Friday, indicating that a greater per-

THE DEPARTMENT OF PUBLIC WORKS FOLLOW-UP SURVEY

To help evaluate the effects of the 4/40 Compressed Work Week Program, we would like to ask you to complete the following survey and travel log.

Please answer all questions pertaining to you. All responses are confidential and will be used for planning purposes only.

---

1. At what time do you normally begin work?

   ___:___ am/pm (please circle one)

2. At what time do you normally leave from work at the end of the day?

   ___:___ am/pm (please circle one)

ANSWER QUESTION 3 ONLY IF YOU CARPOOOL WITH LESS THAN 4 PEOPLE AT LEAST 3 TIMES A WEEK, OTHERWISE SKIP TO QUESTION 4.

3. With whom do you usually carpool: (Circle all that apply.)

   a. Household members
   b. Non-household relatives
   c. Co-workers
   d. Friends, neighbors
   e. Other (please specify) _____

4. Indicate whether you are:

   a. Male
   b. Female

5. How many people live in your household?

   _____ number of people in household

6. How many cars do you have in your household?

   a. None
   b. 1
   c. 2
   d. 3 or more

ANSWER QUESTION 7 AND 8 ONLY IF YOU ARE LIVING WITH CHILDREN WHO ARE UNDER 6 YEARS OLD AND NOT ENROLLED IN SCHOOL.

7. What type(s) of child care are you providing the children?

   a. Household member (including live-in sitter) at your home
   b. Non-household relative, friend or sitter at your home
   c. Relative, friend or sitter at their home
   d. Child care facility
   e. Other (please specify) _____

8. How often do <u>you</u> take your child to the child care facility or to a sitter not at your home?

   a. Never or only in case of an emergency
   b. Once a week
   c. Two to three times a week
   d. More than four times a week

FIGURE 2 Follow-up survey of DPW employees.

centage of trips are being made consecutively rather than with the respondent returning home between trips.

Although the proportion of work trips as a percentage of all trips on Friday decreased from the first to the second survey, the proportion of work trips almost doubled for each workday (Monday through Thursday). In the first survey, the proportion of errand-running trips decreased; thus, in relation to all trips, work trips constituted a larger percentage.

In addition, these work trips are not commute trips to work because the percentage of trips to home decreased significantly. Instead, the increased percentage and number of trips to work can be accounted for by trips made during the workday when the respondents returned to work from, for example, lunch or an errand. The respondents to the second survey who work a 10-hr day were probably more inclined to leave the worksite during the day than respondents working an 8-hr day. Thus, the increased work trips are most likely accounted for by short trips made as the employees returned from errands instead of by an increased number of commute trips made from home to work.

TABLE 1 PERCENTAGE OF TRIPS TO DESTINATION

DESTINATION	FRIDAY PRE PERCENT (%)	FRIDAY POST PERCENT (%)	FRIDAY PERCENT POINT CHANGE	WEEK PRE PERCENT (%)	WEEK POST PERCENT (%)	WEEK PERCENT POINT CHANGE
HOME	34.1	25.0	- 9.1	36.1	25.8	+10.4
WORK	26.5	1.6	- 24.9	21.3	27.3	- 6.0
DIFFERENT WORK	4.7	0.9	- 3.8	4.1	8.0	- 3.9
SCHOOL FOR KIDS	0.9	9.3	+ 8.4	0.8	2.7	- 1.9
CHILDCARE	2.3	0.7	- 1.6	2.0	2.2	- 0.2
RESTAURANT	7.9	8.1	+ 0.3	5.9	4.8	+ 1.2
SHOPPING	6.3	15.7	+ 9.4	8.5	8.0	+ 0.5
POST OFFICE	0.3	2.1	+ 1.8	0.5	0.6	- 0.1
BANK	1.0	2.6	+ 1.6	0.9	0.9	- 0.0
MEDICAL	1.4	5.5	+ 4.1	0.7	1.6	- 0.9
RECREATION	4.9	8.1	+ 3.2	5.1	3.7	+ 1.4
FRIEND/RELATIVE	5.2	8.1	+ 2.9	6.4	6.8	- 0.4
PERSONAL BUSINESS	4.5	12.2	+ 7.7	7.5	7.7	- 0.2

Number of Trips

The results of the second survey indicate that the average number of trips made per respondent on the compressed workweek day off (Friday) exceeded the average number of trips made on any other day (Figure 3, Table 2). Although more trips are made on the day off than on any other day, the average total number of weekly trips made by respondents to the second survey decreased by 9 percent. This would indicate that, although more trips are being made per person on Friday, the increase is more than compensated for by a reduction in the number of trips being made on all other days (Table 2). This indicates that non-work-related trips are either eliminated or redistributed from workdays to the day off.

Freeway Trips

The proportion of trips taken on the freeway, noted in the first survey, was 39 percent; however, according to the second survey, only 34 percent of all trips were on the freeway, a reduction of 5 percent (Table 3). On Friday, however, there was a reduction of 13 percent in the percentage of trips made on the freeway, indicating that a larger percentage of day-off trips were local trips. The destination analysis confirms this hypothesis because there was an increase in the percentage of errand-running trips made on Friday (assuming that errands are accomplished locally).

Length (Distance and Time) of Trips

Although the average number of trips made on the day off exceeded the average number made on an ordinary workday, the average trip distance traveled on the day off was less than that on the ordinary workday. This is primarily because the trips were short personal errands instead of the traditionally longer commute trip to work.

The average distance for a trip, following the introduction of the 4/40 schedule, was reduced by 19 percent (Figure 4). Shorter average trip distances noted in the second survey could also explain why fewer freeway trips were made, because short trips are more likely to be made on surface streets.

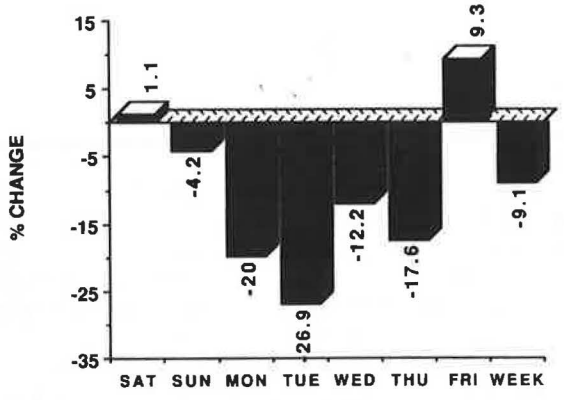

FIGURE 3 Average number of trips per respondent.

Distance Traveled

Sunday showed the greatest reduction in average distance traveled per respondent (61 percent), followed by Friday (39 percent). However, the average distance traveled on Saturday increased by 10 percent (Figure 5).

These figures indicate that trip destinations were redistributed. Whereas errand trips previously made during the workday were redistributed to Fridays, longer recreational trips previously made on both Saturdays and Sundays were made on Saturdays. Sundays then became a day to relax and stay at home.

Total Weekly Distance Traveled

The average weekly distance traveled by respondents decreased by 46 mi, a 17 percent reduction (Table 3). The Den-

TABLE 2 AVERAGE NUMBER OF TRIPS PER RESPONDENT BY DAY

DAY	PRE TOTAL TRIPS	PRE TRIPS PER RESPONDENT	POST TOTAL TRIPS	POST TRIPS PER RESPONDENT	PERCENTAGE CHANGE (%)
SAT	515	458	3.26	3.29	+ 1.1
SUN	488	412	3.09	2.96	- 4.2
MON	562	412	3.56	2.96	- 20.0
TUE	606	420	3.84	3.02	- 26.9
WED	556	436	3.52	3.14	- 12.2
THU	571	427	3.61	3.07	- 17.6
FRI	574	557	3.63	4.01	+ 9.3
WEEK	3872	3122	24.51	22.46	- 9.1

TABLE 3 AVERAGE DISTANCE TRAVELED PER RESPONDENT

DAY	PRE DISTANCE	POST DISTANCE	PERCENT CHANGE (%)
SAT	43.85	48.76	+10.1
SUN	44.22	27.41	- 61.3
MON	40.77	37.31	- 9.3
TUE	45.36	39.17	- 15.8
WED	41.01	41.64	+ 1.5
THU	49.47	38.63	- 28.1
FRI	52.68	38.01	- 38.6
WEEK	317.36	270.93	- 17.1

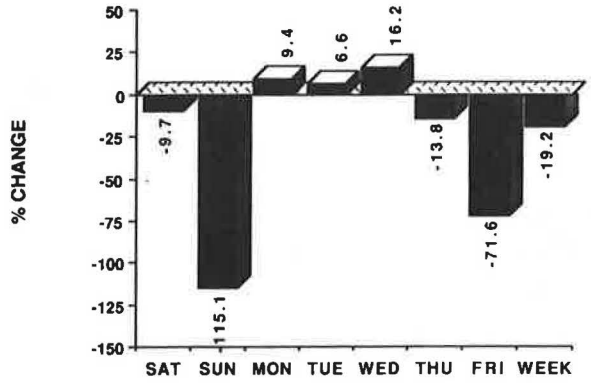

FIGURE 4 Average distance per trip.

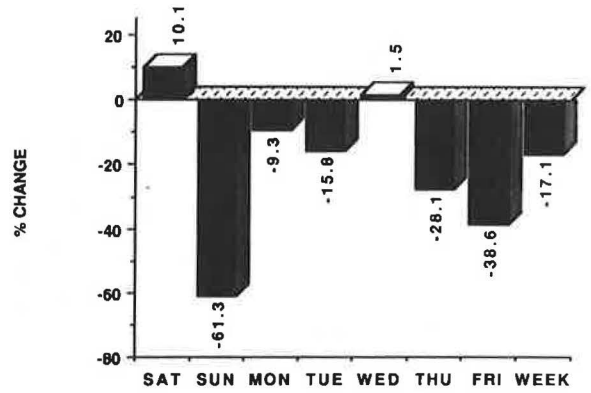

FIGURE 5 Average distance traveled per respondent.

ver Regional Council of Governments study also concluded that the introduction of the compressed workweek resulted in an average reduction in weekly distance traveled. The study found that the average weekly distance traveled per respondent decreased by 49 household vehicle miles per week, an 18 percent reduction (1).

The reduction in total weekly distance traveled is primarily equal to the reduction in vehicle miles traveled on Sunday and Friday.

Travel Time per Trip

For the week as a whole there was no significant change in the average travel time per trip. More profound changes can be seen when the days are compared individually instead of when they are compared at the aggregate weekly level. The average time per trip on Sunday and Friday of the second survey was significantly lower than that in the first survey (50 and 53 percent reductions, respectively), whereas the average time per trip for all the other days increased by 6 to 18 percent.

These figures support the hypothesis that the respondents working a 4/40 schedule made shorter trips on their days off than they did on a working Friday. In addition, on the 4/40 workdays (Monday through Thursday) the employees made fewer short errand trips; thus, the average trip time on working days was higher because the longer commute trips to and from work constituted a greater proportion of all trips.

Travel Time per Week

The total weekly travel time per respondent was reduced by 5 min or 6 percent. On a daily basis, Sunday showed the greatest percentage of reduction in total travel time per respondent (20 percent), followed by Friday (17 percent).

Whereas travel time per trip did not change, total travel time per week decreased. This is again because of the reduction in the number of total trips made.

Time of Day Errand and Work Trips Made

In both the first and second surveys, most Saturday and Sunday trips were made between 10:00 a.m. and 3:00 p.m. There was an overall increase in the percentage of trips made in mid-morning and late afternoon and a decrease in the percentage of trips made in the early morning and late evening.

Workdays (Monday through Thursday) showed an increase in the percentage of trips made between 5:00 and 7:00 a.m. and 5:00 and 7:00 p.m. as well as trips made around lunchtime. The morning and evening trips are assumed to be commute trips made to and from work, whereas the noontime trips are either errand or lunch trips made from work. On the whole, in the first survey fewer errand trips were noted between Monday and Thursday and the errand trips that were made on workdays were made during the day rather than after work. The increased percentage of trips made around lunchtime accounts for the increased percentage of trips destined for work, as noted. On Friday, the compressed workweek day off, there was a reduction in the percentage of trips made before 8:00 a.m. and after 3:00 p.m., shifting errand trips out of peak hours.

In the first survey, 94 percent of respondents began work between 7:00 and 9:00 a.m. and were evenly distributed throughout the 2-hr period. In the second survey, however, 96 percent began work between 6:30 and 7:30 a.m. Thus the time parameters within which employees began work changed from 2 hrs, 7:00 to 9:00 a.m., to 1 hr, 6:30 to 7:30 a.m. The time parameters within which the majority of respondents left the worksite also narrowed considerably.

These reduced time parameters are explained by the increased length of the workday. The employees responding to the second survey were working 10-hr days instead of 8-hr days and thus had less control over the hours they arrived at and left work. An effect of these narrowed parameters could be increased congestion between 6:30 and 7:00 a.m. and 5:30 and 6:00 p.m. around the site on Monday through Thursday.

Mode Split

The drive-alone rate for the week noted in the first survey and second survey did not change, remaining at 60 percent. The carpool rate for the week did not change either (Figure 6, Table 4).

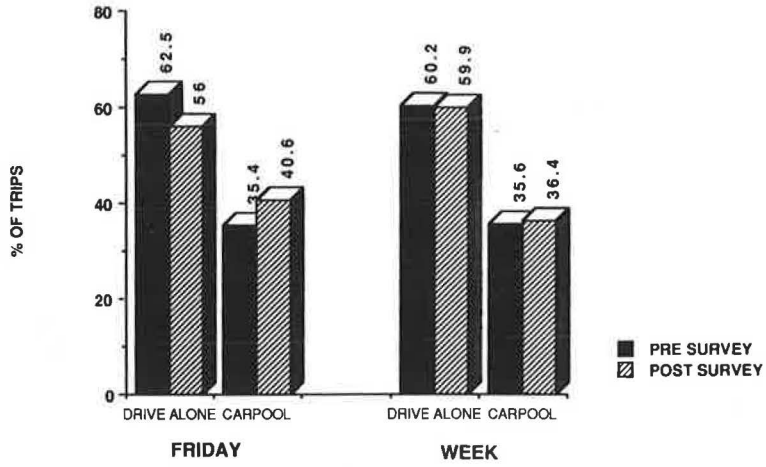

FIGURE 6 Travel mode.

These findings are similar to those in the Denver study. The results of the Denver study indicated that the compressed workweek had little effect on mode split, specifically on the drive-alone rate (*1*).

On Friday, however, the drive-alone rate was reduced by 7 percent and the carpool rate increased by 5 percent. These figures show some indication that day-off trips were more likely to be made with a carpool partner.

The percentage of respondents indicating "not applicable" when asked with whom they normally carpool decreased from the first survey to the second survey, from 80 to 70 percent, implying that there was a 10 percent increase in the number of respondents who made trips with a carpool partner (Figure 7). There was also an increase in the percentage of respondents who carpooled with a coworker. The percentage of respondents who indicated that their carpool partner was a coworker more than doubled, from 7 to 15 percent. These figures indicate that a significant proportion of the new carpoolers are carpooling with coworkers. This makes sense because employees working a 10-hr day are more likely to find a carpool partner with a similar schedule among coworkers.

Factors Affecting Number of Trips

Household Size

The households with five or more persons formed too small a sample in both surveys to make accurate observations regarding the trip behavior of members of larger households. The average number of trips person for the week was greatest for persons with four household members in both the first survey (27) and in the second survey (24). Households with one and three members made approximately the same number of trips in the first survey (22 and 21, respectively). Following the implementation of the compressed workweek, the average number of trips decreased for each of the household sizes. However, in the second survey, respondents with one member reduced their trips by a larger percentage (15 percent) than did those with two or four members (12 and 13 percent, respectively).

It appears that respondents with responsibilities to other household members are less likely to reduce the number of trips made in a week than respondents living alone.

TABLE 4 TRAVEL MODE AS A PERCENTAGE OF TRIPS BY DAY

MODE	PRE PERCENT (%)	POST PERCENT (%)	PERCENT POINT CHANGE (%)
FRIDAY			
DRIVE ALONE	62.5%	56.0%	- 6.5%
CARPOOL	35.4%	40.6%	+ 5.2%
TRANSIT	0.0%	0.2%	+ 0.2%
BIKE	0.0%	0.0%	- 0.0%
WALK	1.1%	2.1%	+ 1.0%
OTHER	0.9%	1.1%	+ 0.2%
WEEK			
DRIVE ALONE	60.2%	59.9%	- 0.4%
CARPOOL	35.6%	36.4%	+ 0.9%
TRANSIT	0.2%	0.5%	+ 0.3%
BIKE	0.5%	0.0%	- 0.5%
WALK	2.0%	1.7%	- 0.3%
OTHER	1.5%	1.5%	+ 0.0%

Cars per Household

The number of cars per household did not seem to significantly affect the average number of trips made on any day as found in the first or second survey.

Trips Made by Respondents with Childcare Needs

There were few respondents with childcare needs and accurate conclusions about the effects of the new schedule on respondents with such needs cannot be drawn. The data indicate that respondents with childcare needs made more trips per week than did the general population. However, following the implementation of the compressed workweek schedule, the average number of trips decreased by a greater percentage (13 percent) for those with childcare needs than it did for the population as a whole (9 percent).

CONCLUSION

The implementation of the 4/40 compressed workweek schedule at the study site affected employees' travel behavior. The survey results indicate that the respondents made more trips

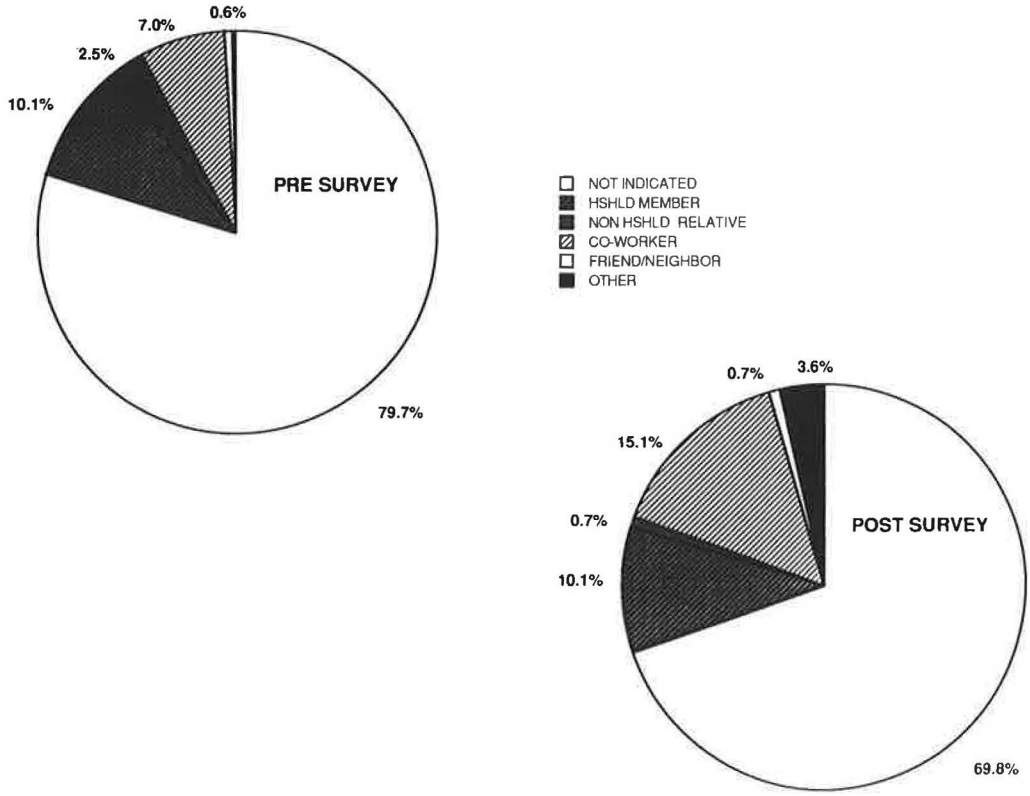

FIGURE 7 Carpool partner.

on their days off than on any other day but that these extra trips were compensated for by a reduction in the number of trips made on the remaining days of the week. Fewer trips were made per week after the implementation of the new schedule. Trips that were made, however, were shorter than those made before the 4/40 workweek was implemented; thus, there was a reduction in the average total distance traveled per respondent.

It appears that employees use the compressed workweek day off to run short errands, go shopping, or visit friends, activities that were previously conducted on Saturday. Saturday becomes a day for recreation rather than an errand-running day. The employees now have an extra weekend day, Sunday, which is used for relaxation. The results of the second survey indicated that the number of trips made and the length of trip were reduced in both distance and time, shorter trips were made on Friday, and more, slightly longer trips were made on Saturday.

Respondents arrive earlier at work and leave later, although the commute trips remain within peak travel periods. The arrival and departure time parameters are reduced; therefore, more people enter and leave the worksite at approximately the same times. Although congestion around the site may be more severe on Monday through Thursday, the respondents are making fewer trips before and after work, running errands during the workday or on their day off. On weekdays, errand trips are made at lunchtime, and on the day off most trips are also made in the middle of the day. Errand trips shifted from peak travel periods to off peak periods, thereby reducing the number of noncommute trips made during peak traffic volumes.

More day-off trips were made consecutively, resulting in a reduction in average distance traveled and in the number of pollutant-generating cold starts. The average distance traveled for the week decreased by 46 mi per respondent; the average time spent traveling decreased only slightly. This indicates that in reducing congestion and pollution, the savings may not be as great as it initially appeared: the time vehicles are actually on the road did not decrease significantly, in spite of the reduction in distance traveled.

The 46-mi weekly reduction represents nearly 2,300 mi, 81 lb of pollutants, 2,185 lb of carbon dioxide, 114 gal of fuel, and $851 in user costs per person annually. [Pollutant, carbon dioxide, and fuel use factor data are from Division of New Technology, Materials and Research, California Department of Transportation. User cost data are from the American Automobile Association (1991).]

According to the second survey, fewer trips were taken on the freeway and more trips were taken on surface streets where fuel consumption and automobile emissions are higher than for trips made on the freeway. However, fewer trips on the freeway can help reduce freeway congestion and associated increased levels of pollution. When traffic on the freeways is congested, freeway travel would not reduce automobile emissions and mileage per gallon.

On the basis of the findings of this study, it is concluded that the 4/40 compressed workweek program is an effective strategy to reduce vehicle trips and vehicle miles traveled. It is hoped that additional research into the compressed workweek as a TDM strategy will be encouraged.

Three areas in which further research is needed are (a) change in trip destinations, (b) travel mode of work and non-

work trips, and (c) the effect of the compressed workweek on productivity, morale, and absenteeism.

The survey design for this study did not draw information from the respondent about changes in trip destination: did the respondent shop at a market close to home or to work? The survey design also did not analyze the commute-to-work travel mode. Each trip was recorded individually and not aggregated into contiguous trips. For example, a carpool trip to work would be recorded as two trips: a drive-alone trip from home to visit a friend or relative and a carpool trip from visited friend to work. This type of information would be especially useful for air quality management trip reduction plans.

Because of the scope of this project, the effect of the 4/40 compressed workweek on employee productivity was not measured. However, a previous study found that 67 percent of 4/40 schedule participants and 57 percent of 9/80 schedule participants reported improved productivity (2). More data on the effects of compressed workweeks on productivity, absenteeism, and morale are needed to determine whether a compressed workweek program will be approved by management.

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Abridgment

Free and Paid Commuter Parking in the Washington, D.C., Region

JON WILLIAMS

Parking is an important determinant of modal use. Appropriate parking policies require good background information on the subject. For these reasons, the Metropolitan Washington Council of Governments studied the average market rates being charged in the Washington, D.C., region for commuter parking, the number of employees who either pay for parking or receive a free space, and the total dollar value of both paid and free parking. Research techniques included a parking rate survey, telephone surveys of employers, and estimates of total commuters and automobiles from regional planning data bases.

Parking at the workplace is one of the most important determinants of how commuters will travel to work. Where parking is abundant and free, employees will most often drive to work alone. Where parking is scarce and expensive, they are far more likely to travel by transit, vanpools, carpools, or bicycle. Public policy and private practice with respect to parking can thus have a major impact on the number of cars on the road, traffic congestion, air quality, and energy conservation.

To make informed decisions about parking, there must be a basis of current information on the subject. For the Washington, D.C., region in 1990, the Metropolitan Washington Council of Governments (COG) studied the average market rate being charged at different locations, the number of employees who either pay for parking or receive a free space, and the total dollar value of paid and free parking.

The study (*1*) was conducted over a 6-month period beginning in January 1990. Parking rates were collected from operators of private and public parking throughout the region, and average daily and monthly rates were determined for local areas. A sample survey of private employers was conducted to estimate the number of employees being given free parking, discounted parking, and market-rate parking. Federal facilities were studied to enumerate cars parked and pricing practices. Finally, the number of cars parked was derived from regional travel models. Estimates were then made of how many commuters pay to park and how much they pay and of how many commuters receive free parking and the value of that benefit.

PARKING PRICES

With respect to parking prices, it was found that employee parking in the region is divided into the three major types described as follows:

National Capital Region Transportation Planning Board, Metropolitan Washington Council of Governments, 777 North Capitol Street, Suite 300, Washington, D.C. 20002–4201.

1. **Pervasive parking charges**: In some areas, all nonfederal employees pay for parking unless employers have made a decision to subsidize employee parking. The pervasive charge areas have the form of a traditional downtown business district with high-density development, signalized intersections, and extensive pedestrian facilities, including ubiquitous sidewalks and signalized crosswalks. On-street parking is metered, mostly for the short term, and most blocks have one or more off-street, for-pay parking facilities. Pervasive parking charges are found only in the downtown business district of the District of Columbia and Arlington, Virginia, and in the business districts of Alexandria, Virginia, and Bethesda and Silver Spring, Maryland.
2. **Scattered parking charges:** A pattern of scattered parking charges was found outside the pervasive parking areas. This type of parking is sometimes charged for, but only in occasional high-density locations. Typically, development patterns vary from clusters of high-rise office buildings to single-story commercial strips. Pedestrian facilities are generally poor, with breaks in the sidewalk network and few safe crossings of major roads. On the basis of anecdotal information, it is believed that where there are parking charges, they are levied on building visitors, and not employees.
3. **Free parking**: In the rest of the region, parking is abundant and free, with occasional nominal charges of $1.50 a day or less. Employment is organized in strip developments, low-density business districts, and campus-style office parks. Pedestrian facilities vary from poor to none.

Figure 1 shows the location of areas with pervasive parking charges. This includes a contiguous central business area comprising downtown D.C. and Georgetown, as well as Rosslyn, Crystal City, and Ballston in Virginia. Outlying areas with pervasive charges are downtown Alexandria, Bethesda, and Silver Spring. On the basis of monthly contract rates, the average daily out-of-pocket cost of parking ranged from $4.40 to $7.50 in downtown D.C. The average daily cost was $4.60 in Rosslyn, $2.60 in Crystal City, $3.80 to $4.60 in Alexandria, $3.00 to $3.50 in Bethesda, and $3.00 in Silver Spring.

Employment densities and transit usage correlate well with parking cost. Virtually all areas with pervasive parking charges have more than 10,000 jobs per square mile. With respect to transit use, there is complete correspondence between those areas with parking charges and commuter transit use greater than 10 percent.

EMPLOYER-SUBSIDIZED PARKING

Where pervasive parking charges exist, many commuters do not pay for their daily parking because their employer gives

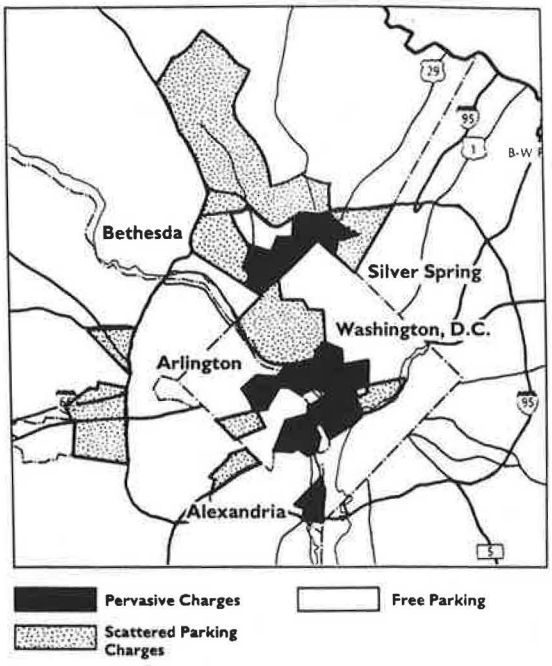

FIGURE 1 Commuter parking price areas.

them a parking space as an employee benefit. The economic reasons for offering such benefits are clear, even in an area where parking spaces cost over $150 a month. There are two ways that an employer might provide an extra $2,000 to a typical employee working in downtown Washington. The first is through a salary increase:

• Employee take-home pay	$2,000
• Taxes, social security, etc.	1,810
• Employment contribution	590
• Total cost to employer	$4,400

The second is by providing a free parking place to the employee, assuming a monthly cost of $167. The total cost to the employer is $2,000, and the employee receives a parking space worth $2,000 annually, with no tax or social security liability.

There are other factors that influence employers to provide free parking:

1. An employee with a parking place may be better able to work extra hours.
2. Increases in an employee's salary increase the base against which future cost-of-living adjustments and merit raises are applied. An added fringe benefit such as free parking does not increase the base.
3. Nonsalary benefits such as free parking are easier to cut than salary.

Faced with these facts, many employers naturally elect to provide free parking to their employees, even where land is valuable and parking is costly.

The extent to which employers provided their employees with free parking in 1990 was studied by an employer survey that focused on areas with pervasive parking charges, since employee parking is generally abundant and free elsewhere. Table 1 shows an estimate of free parking, discounted parking, and full-rate parking at employment sites throughout the region.

Referring to Table 1, in the central business district, 38 percent of those who drive to work receive free parking and 62 percent pay full or discounted rates. In the outlying business districts, 67 percent park free. For the region as a whole, 82 percent of commuters park free and 18 percent pay to park.

TOTAL VALUE OF PAID AND SUBSIDIZED PARKING

The daily amount that commuters pay for their parking at work was estimated for federal and nonfederal facilities. In total, about $1,000,000 daily is paid by Washington area commuters for parking at work. This is about $240 million annually.

Parking that is given to employees as a benefit has a dollar value too, and this has been estimated using the average daily parking rate in the neighborhood of each employer that subsidizes parking. For the Washington region, approximately $1,000,000 worth of free or discounted parking is provided daily by employers as an employee fringe benefit. This is

TABLE 1 TOTAL DAILY COMMUTER AUTOMOBILES PARKED IN THE WASHINGTON METROPOLITAN REGION

	AREA TYPE				
	PERVASIVE PRICING		SCATTERED PRICING	NO PRICING	TOTALS
	Central Business District	Outlying Business District			
FREE PARKING	118,000 (38%)	37,400 (67%)	161,600*	623,300	940,300 (82%)
DISCOUNTED PARKING	49,000 (16%)	16,500 (29%)	0	0	65,500 (5%)
FULL RATE PARKING	144,000 (46%)	2,100 (4%)	0	0	146,100 (13%)
TOTALS	311,000 (100%)	56,000 (100%)	161,600	623,300	1,151,900 (100%)

*Parking appears to be free for employees in the scattered price areas.

about $240 million annually. About 70 percent of this is provided by nonfederal employers.

Subsidies are given only in those cases in which the employee would clearly have to pay for parking except for the employer's intervention. There is another kind of employer parking subsidy, one that occurs even in suburban areas in which all parking is free. This is the cost associated with building and maintaining parking facilities. Parking structures typically cost between $10,000 to $15,000 a space to build, and at-grade parking may run $5,000 a space, depending on the cost of land. A new 300-space parking garage could thus cost up to $4.5 million to build, with maintenance and operating costs of about $90,000 annually.

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Transportation Management Associations: Organization, Implementation, and Evaluation

ERIK FERGUSON, CATHERINE ROSS, AND MICHAEL MEYER

A national evaluation of transportation management associations (TMAs) was performed. Of 110 TMAs contacted, 64 responded (58 percent). Over two-thirds of all responding TMAs were formed as recently as 1988 or thereafter and almost half were located in the state of California. Most TMAs are organized as private, not-for-profit corporations. The majority of TMA board members represent private firms, and most TMA corporate members are drawn from the private sector. Yet less than half of all TMA revenues came from private sources in 1991, and this proportion is expected to increase to no more than two-thirds in 1995. TMAs typically experience difficulty in recruiting private-sector representatives to serve on their boards, to become full-fledged corporate members, or even to contribute cash or in-kind services to the TMA. TMA goals and objectives typically include a strong emphasis on the implementation of travel demand management (TDM) strategies, almost equal emphasis on reducing traffic congestion and air pollution, much less interest in economic development issues, and very weak support for the promotion or financing of transportation infrastructure improvements. TMA services are often modest in scope, with the greatest emphasis typically being placed on the provision of information to employees and assistance to employers in the promotion of TDM alternatives. Guaranteed-ride-home programs are common among TMAs, but telecommuting and child care facilities have not caught on to quite the same extent. In spite of mounting evidence about the effectiveness of parking management strategies, they have been avoided by most TMAs. It might thus seem that TMAs would not be very successful in changing travel behavior on a large scale. TMA evaluations are undertaken infrequently. Even when TMA assessments are complete, the results often are not granted wide circulation. This suggests that measured changes in travel behavior associated with TMAs probably are slight. On the basis of these findings, it is suggested that TMAs must gain far greater support and acceptance from the private sector and may need to pursue more aggressive TDM strategies if they are to become more successful in any quantifiable sense.

Transportation management associations (TMAs), sometimes also called transportation management organizations (TMOs), are innovative institutional arrangements. TMAs usually take the form of public-private partnerships, often with a strong emphasis on private-sector participation. Their primary mission is usually the adoption and implementation of various types of travel demand management (TDM) strategies, often aimed specifically at reducing traffic congestion, enhancing air quality, or promoting economic development opportunities. TMAs occasionally may promote transportation infrastructure improvements as well.

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DATA AND RESEARCH METHODOLOGY

Until a few years ago, only a handful of TMAs were operating in the United States. The most appropriate means of evaluating TMAs under these circumstances was to use the familiar case method (*1*). As of February 1991, we had identified 110 TMAs nationally as being in the process of formation, organized but not yet operating, or partially or fully operating (*2*). With this small but rapidly growing population of TMAs to draw upon, it is now possible to conduct a broad-based comparative analysis of TMA activities in different parts of the country.

Most previous TMA evaluation efforts were fairly limited in scope. There have been a few detailed case studies of individual TMAs (*3–5*) and some comparative analyses within specific regions (*6,7*). Jackson et al. identified 54 TMAs nationally using the 1989 *TMA Directory*, published by the Association for Commuter Transportation, and surveyed 37 of these in 1990 (*8,9*). Dunphy and Lin identified 72 operating or organizing TMAs nationally between 1986 and 1990, but limited their detailed case study treatment to those located in three regions—Washington, D.C.–Baltimore, Northern California, and Southern California (*10*). Diggins and Schreffler in another paper in this Record identify 56 TMAs in the state of California in late 1990 and survey 38 of them.

Of the 110 TMAs that we identified, 65 were located in the state of California alone, 9 more than Diggins and Schreffler had identified less than 6 months before. We mailed a 12-page national TMA survey to the executive directors of all 110 of these TMAs in April 1991. The survey was composed of 25 questions, which requested more than 250 separate pieces of information on various aspects of TMA initiation, organization, financing, operations, and evaluation. As of September 30, 1991, a total of 64 TMA mail surveys had been received, yielding an overall survey response rate of 58 percent. Given the level of detail requested in this survey, that is a highly satisfactory response rate. Responses were received from 31 of the 65 California TMAs (48 percent) and 33 of the 45 TMAs in other states (73 percent). It appeared that older, more mature TMAs were more likely to respond to the survey. Several surveys were returned unanswered, often by TMAs indicating that they were still in the very earliest stages of formation. Most completed surveys listed the TMA executive director as the respondent, though other staff may have assisted them in filling out portions of the survey. The information presented in this paper is based on an analysis of these

64 responses to the national TMA mail survey. In addition to the executive director mail survey, short-form TMA board member mail surveys were conducted simultaneously. A total of 109 TMA board member mail surveys were returned, representing 32 of the 64 responding TMAs.

STATUS AND MARKETS

Many TMAs are still in the process of formation. Nonetheless, a few have been around for 5 or even 10 years and have thus taken on some of the characteristics of maturity. As Figure 1 shows, over two-thirds of all responding TMAs were formed in 1988–1991. Overall, TMAs may be characterized as predominantly private institutions, usually located in rapidly growing suburban areas, with relatively small budgets and staffs to deal with the ambitious scope of local problems that they report facing.

Overall, 68 percent of responding TMAs were partially or completely operational at the time the survey was completed, and 27 percent were still in the early or late stages of formation. In general, it appears that TMAs take about a year to get organized and another year to begin providing services. Most TMAs formed in 1989 or previously were completely operational, whereas those formed in the last 12–18 months were much less likely to be in any position to provide services (Figure 2). As shown by Diggins and Schreffler elsewhere in

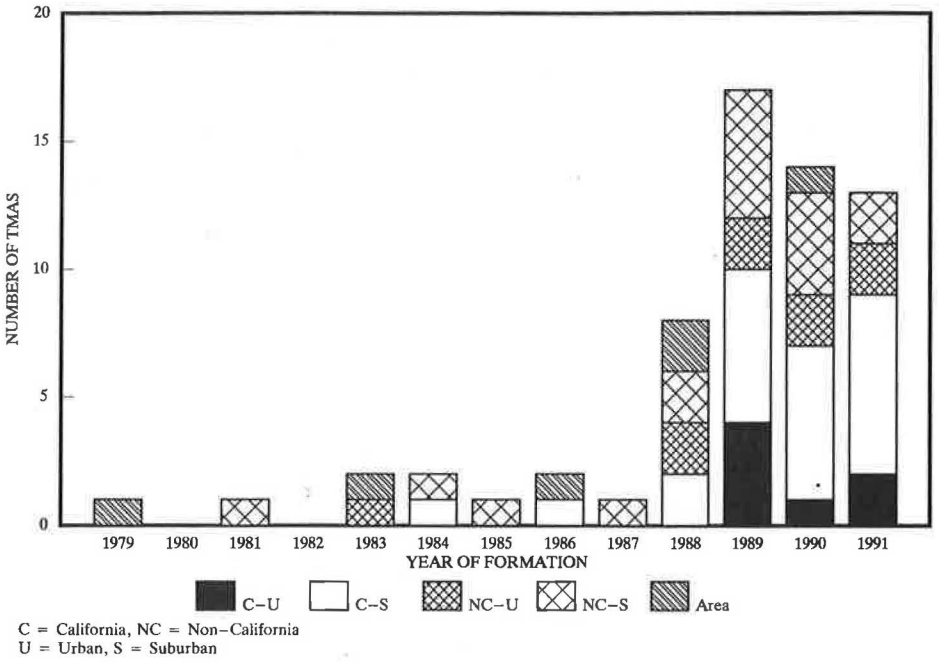

FIGURE 1 Number of TMAs by year of formation and geographic location.

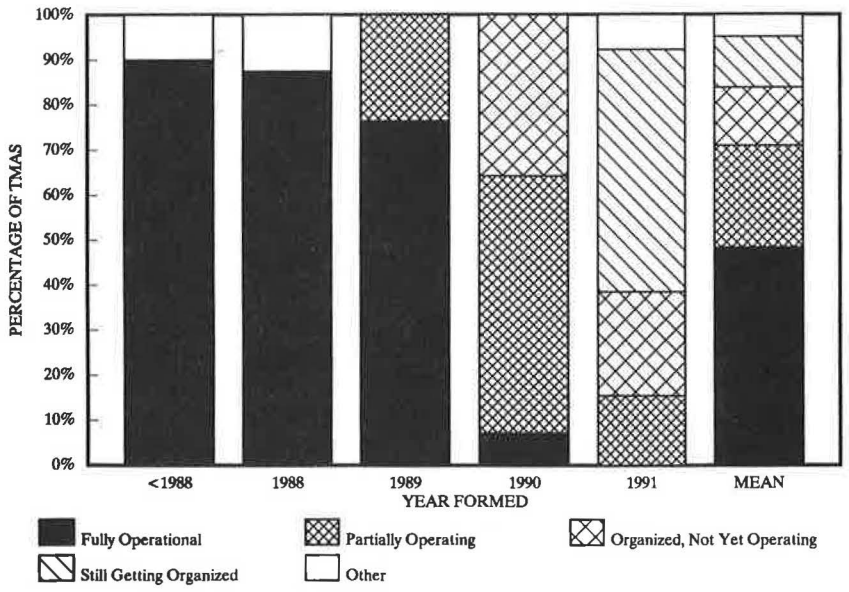

FIGURE 2 TMA operational status by year of formation.

this Record, only 40 percent of California TMAs were fully operational as recently as 1990. California TMAs are somewhat younger and apparently less developed than TMAs in other states, even though the first TMA in the nation, the El Segundo Employers Association, was founded in Southern California in 1981.

TMA market area size varies considerably from one TMA to another, from as little as half a square mile to as much as 500 mi^2. Included within a typical TMA's market area are about 15 developers, 550 landowners, 1,500 employers, and over 50,000 employees. These figures are representative of typical emerging suburban employment activity centers or groups of such centers. The density of development of TMA market areas varies considerably by location, building occupancy, and percentage of land vacant, but it is generally quite low. Because of low development densities, whether permanent or transitional in nature, there can be a high level of dependence on the automobile for transportation. If transportation infrastructure improvements lag behind, this may contribute to increasing traffic congestion as suburban land development proceeds apace. Most TMAs are located in the suburbs, usually in large, rapidly growing suburban activity centers. A few TMAs have been formed in central cities, including downtown areas, but these are still outnumbered by suburban TMAs.

INSTITUTIONAL FACTORS

Initiation

TMAs most often are created by local actors to deal with local problems. Private employers and developers are identified most frequently as key agents in the formation of TMAs, followed by municipal governments, private landowners, regional ridesharing agencies, and local chambers of commerce (Table 1). State and federal agencies are cited much less commonly as being important in TMA initiation. When asked to identify the single most important person, firm, or agency involved in TMA initiation, executive directors most often mention a specific individual by name (18 percent), followed by cities or counties (18 percent), the regional metropolitan planning organization (MPO) (11 percent), chambers of commerce (11 percent), and private developers (11 percent). Local chambers of commerce and regional MPOs are identified rather infrequently as being important in TMA initiation, but when involved, are often listed as the key agent. Private employers rarely fill this role.

TABLE 1 RELATIVE IMPORTANCE OF TMA INITIATORS

Type of Initiator	Not Important	Somewhat Important	Very Important	Greatest Importance
Private Sector				
Employers	15	13	32	40
Developers	23	12	28	37
Land owners	52	12	17	20
Local COC	50	8	18	23
Other private	76	3	10	10
Local Agencies				
City governments	32	27	28	13
Ridesharing agencies	38	17	23	12
Transit agencies	57	18	20	5
County governments	55	22	13	10
Regional governments	65	13	8	13
State and Federal Agencies				
State DOT	47	12	27	15
FTA	65	15	8	12
Other state agencies	77	7	10	7
Other federal agencies	92	3	5	0

Percentage of TMAs. All rows sum to 100%.

Leadership

Most TMA executive directors (86 percent) report having a board of directors as their executive policy decision-making body to which they are responsible. The average TMA board has about 14 members, including 12 voting and 2 nonvoting members. On average, eight TMA board members are from private, for-profit firms; three are from private, not-for-profit firms; and three represent public agencies. Over half (54%) of all TMA executive directors sit on their own board. Virtually all board members from private, for-profit firms (97 percent) vote on board matters. The percentage of board members with full voting rights is lower for private, not-for-profit firms (85 percent), public agencies (62 percent), and executive directors (28 percent).

In a separate survey, TMA board members reported the following:

- Main reason for joining TMA board: The most common reasons included addressing local transportation problems, representing the interests of their own organization, assisting in the establishment of the TMA, and serving as a liaison between the TMA and another organization.
- Main contribution to TMA activities: The most common contributions included needed leadership skills, time or money, specific types of expertise, and assistance with public relations.
- Main obstacles to TMA implementation: These obstacles often included getting the TMA up and running, recruiting new TMA members, raising funds to operate the TMA, and increasing public awareness of TMA activities.

Corporate Membership and Dues

Most TMAs (77 percent) have some kind of corporate membership program. The typical TMA has about 26 corporate members, including averages of 19 private, for-profit firms; 4 private, not-for-profit firms; and 3 public agencies. Most corporate TMA members (87 percent) join voluntarily because of the services provided directly by the TMA. The remainder of corporate TMA members are mandatory members, usually as a result of compliance with local trip reduction ordinances or specific provisions of building occupancy permits and rental or lease agreements. Of those TMAs with corporate membership programs, most (82 percent) charge dues. Membership dues generally are assessed per employee for employers, per square foot for developers, and per acre for landowners. The emphasis of most TMA dues programs seems to be on employers, to whom (or to whose employees) most TMA services presumably are directed. Miscellaneous TMA membership categories include local governments and public agencies, transit providers and transportation firms,

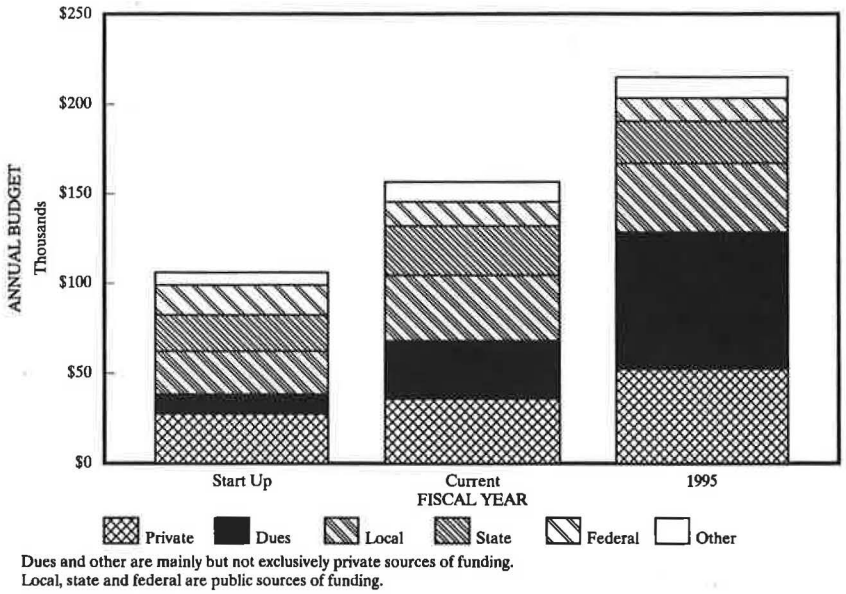

FIGURE 3 TMA annual budgets by source of funding and fiscal year.

individuals, and chambers of commerce. These groups usually are placed into special dues categories, often paying a flat membership fee.

Many TMA employer membership dues rates are actually a combination of a flat fee per firm and a marginal fee per employee, for example, a flat fee of $350 plus $2 per employee above 25 employees. Dues rates vary widely from one TMA to another and also may vary considerably for firms of different sizes within individual TMA market areas. The average cost of TMA membership ranges from a net of less than $1 per employee to $15 or more per employee per year. In most cases, larger employers pay more per firm than smaller employers but often far less on a per-employee basis. There is less variability in membership dues rates for firms with 100 to 1,000 employees, which apparently make up the principal target market for most TMAs (Table 2).

TMAs may be most useful in serving the needs of small employers within large employment activity centers, that is, those employers too small to develop cost-effective TDM programs on their own. However, current TMA pricing policies clearly favor larger firms over smaller ones. The result could be rather perverse if such pricing encouraged the participation of larger firms, which are capable of developing and implementing their own internal TDM programs, and discouraged smaller firms from participating. Larger firms might actually accomplish less in terms of TDM implementation by participating in the TMA than they would on their own initiative.

TABLE 2 TMA MEMBERSHIP DUES PER FIRM BY FIRM SIZE

Firm Size	Minimum	Maximum	Average	Standard Deviation	Average Per Employee
10 employees	5	2,500	303	486	30.32
50	25	2,500	450	481	9.01
100	50	2,500	599	513	5.99
500	250	5,000	1,914	1,417	3.83
1,000	350	10,000	2,819	2,533	2.82
10,000	350	100,000	12,513	26,768	1.30

FINANCING

Budget

The average TMA has a start-up budget of about $100,000, a current fiscal year budget of over $150,000, and hopes to have a 1995 annual budget of more than $200,000 (Figure 3). In the early years of TMA development, developers typically make the largest private-sector contributions and county governments generally make the largest public-sector contributions. State and federal funds usually take the form of seed grants to fund start-up costs for new TMAs; these funds are not expected to continue past a couple of years for most TMAs. Anticipated growth areas for additional TMA funding by the year 1995 include private employers, membership dues, and other, mainly fee-for-service programs. The most rapid growth in TMA funding is anticipated to occur in the area of membership dues revenues, which have increased rapidly from about $11,000 at start-up to $32,000 in the current fiscal year, and are expected to double again to $69,000 in 1995.

Staffing

The average TMA has 2.7 employees, 1.7 of whom (62 percent) work full time; the remaining 1.0 (38 percent) is part-time. The TMA staff of 2.7 is split among executive director (0.92 person), other professional and managerial staff (0.77 person), and clerical, secretarial, and other support staff (0.98 person). Three-fourths of all executive directors (75 percent) and over two-thirds of all other professional and managerial staff (73 percent) work full time for the TMA. Most TMA clerical and support staff are employed on a part-time basis.

GOALS AND OBJECTIVES

Given the modest financial resources of most TMAs, one might expect rather limited goals and objectives to be the rule

rather than the exception. Similarly, the kinds of services offered by TMAs on such limited budgets should be equally modest. In fact, TMA goals and objectives are often quite ambitious. TMAs generally are not overly specific in quantifying targets for attainment, however, unless operating under the aegis of local or regional trip reduction ordinances. The most important goals of TMAs include implementing TDM strategies, reducing traffic-related problems, promoting economic development, and increasing the capacity of the transportation system (Table 3).

- Demand management: The most important TMA objectives often include the implementation of specific TDM strategies, such as the promotion of ridesharing and transit use, or provision of TDM services to employers and employees. Parking management has been shown to be perhaps the most effective TDM strategy (*12–13*). Unfortunately, parking management was the least important TDM objective of many TMAs.
- Traffic mitigation: Next in importance as a TMA goal is the mitigation of traffic problems. First and foremost among these is the reduction of local and regional traffic congestion, followed by reduced local and regional air pollution, compliance with local trip reduction ordinances and regional air quality regulations, and energy conservation. The single most popular TMA goal was reducing local traffic congestion, which surpassed any single TDM objective.

TABLE 3 RELATIVE IMPORTANCE OF TMA GOALS AND OBJECTIVES

Goals and Objectives	Not Important	Somewhat Important	Very Important	Greatest Importance
Transportation Demand Management				
Promote increased ridesharing	7	14	36	43
Provide transport services to employees	9	16	40	36
Provide transport services to employers	9	21	40	31
Promote greater transit ridership	21	16	35	29
Retain or recruit employees	21	31	38	10
Better manage parking demand	35	19	24	22
Mitigation of Traffic Problems				
Reduce local traffic congestion	3	10	38	48
Reduce regional traffic congestion	10	14	41	35
Reduce local air pollution	19	17	34	29
Reduce regional air pollution	21	29	21	29
Comply with trip reduction ordinances	45	10	14	31
Comply with air quality requirements	35	26	12	28
Help conserve energy	31	53	14	2
Land Use/Economic Development				
Allow more office development	33	26	26	16
Allow more commercial development	31	33	21	16
Promote local economic development	21	30	41	9
Improve image of business community	17	45	29	9
Allow higher density development	33	38	21	9
Promote regional economic development	36	33	24	7
Promote regional jobs/housing balance	47	31	14	9
Allow more retail development	53	24	17	5
Increase local land values	55	31	12	2
Allow more industrial development	67	19	10	3
Allow more residential development	74	16	9	2
Promote more affordable housing	81	10	7	2
Transportation Supply Enhancement				
Promote local transit improvements	28	21	33	19
Promote new regional transit facilities	45	22	22	10
Promote local street improvements	47	26	21	7
Promote new regional highway facilities	57	22	16	5
Help finance regional transit facilities	74	14	9	3
Help finance local transit improvements	76	12	7	5
Help finance local street improvements	81	12	5	2
Help finance regional highway facilities	83	10	7	0

Percentage of TMAs. All rows sum to 100%.

- Economic development: Somewhat less important to the typical TMA are land use and economic development. Of these, allowing more commercial and office development ranked highest, followed by the promotion of local economic development and development of higher density. Promotion of greater regional jobs/housing balance was ranked in the middle, and promoting more affordable housing was last among all land use and economic development objectives.
- Supply enhancement: Transportation supply enhancement is the least favored of all TMA goals. TMAs rated the promotion of transportation supply enhancements moderately high, whereas financing such improvements was given a very low priority. TMAs favor local and regional transit improvements slightly over local street and regional highway improvements.

PRODUCTS AND SERVICES

TMAs were asked if they offered or brokered any or all of 40 different types of TDM products and services. Offering a service implied that the TMA was responsible for all or most aspects of its provision. Brokering a service implied that the TMA only referred the products or services to other qualified service providers. There appeared to be some disagreement or confusion among TMAs concerning this distinction, which is readily apparent from the results. This may have been a survey design problem, a survey response problem, or both. Because of this ambiguity, the results reported here should be treated with some caution.

The most common types of TDM products and services offered by TMAs include information and assistance, program operations, alternative work schedules, and convenience incentives (Table 4). Less frequently offered TMA products and services include financial incentives, facilities improve-

TABLE 4 FREQUENTLY OFFERED TMA PRODUCTS AND SERVICES

Type of Service[1]	Offering[2]	Direct[3]
Information and Assistance		
Car/vanpool matching information	96	70
Transit route information	88	81
Computerized matching assistance	83	70
Transit scheduling information	77	65
Personalized matching assistance	73	83
Professional transportation coordinators	67	69
New hire orientation meetings	54	73
Program Operations		
Guaranteed ride home programs	71	77
Vanpool programs	63	50
Buspool programs	38	33
Fleet-pool programs	19	44
Alternative Work Schedules		
Flexible work hours	56	48
Staggered work shifts	52	44
Adjustable hours for ridesharing	46	50
Compressed work weeks	46	41
Convenience Incentives		
Carpool preferential parking	58	54
Vanpool preferential parking	58	50
On-site transit pass sales	50	71
Shuttle buses for midday use	46	36
Fleet vehicles for midday use	29	43

[1] Multiple responses possible.
[2] Percentage of all TMAs.
[3] Percentage of those TMAs offering service.

ments, telecommunications (as a substitute for travel), and on-site services (Table 5).

Information and Assistance

A high percentage of responding TMAs provide carpool and vanpool information, transit route and scheduling information, computerized and personalized carpool and vanpool matching assistance, professional transportation coordinators, and new-hire orientations. These services, if available, usually are provided directly by the TMA. These types of services are similar to those long favored by traditional ridesharing and transit agencies.

Alternative Work Schedules

About half of all TMAs offer scheduling of flexible work hours, staggered work shifts, and compressed work weeks, as well as adjustable hours for ridesharers. Use of alternative work schedules may conflict with promotion of alternative mode choices (*13*). It is helpful that many TMAs are attempting to obviate this problem by linking the two.

Convenience Incentives

Convenience incentives are somewhat less common. Nonetheless, carpool and vanpool preferential parking is available at over half of all TMA sites. Half of all TMAs offer on-site transit pass sales and almost half have shuttle buses available for midday use. These types of incentives are quite common among employer TDM programs, but have not been shown to be very effective in the past (*14*).

TABLE 5 LESS COMMON TMA PRODUCTS AND SERVICES

Type of Service[1]	Offering[2]	Direct[3]
Financial Incentives		
Prizes/awards for ridesharers	44	76
Vanpool subsidies	40	53
Transit subsidies	35	47
Carpool subsidies	33	31
Discount parking for carpoolers	21	20
Discount parking for vanpoolers	19	22
No free parking for drive alone	13	17
Facilities		
Transit facilities	33	25
Bicycle facilities	33	38
Traffic facilities	31	33
Pedestrian facilities	27	39
Highway facilities	23	27
Telecommunications		
Telecommuting	33	31
Teleconferencing	17	25
Teleshopping	17	25
On-site Services		
Child care facilities	19	56
Restaurants/cafeterias	15	57
Automatic tellers	10	20
Dry cleaners	8	50

[1] Multiple responses possible.
[2] Percentage of all TMAs.
[3] Percentage of those TMAs offering service.

Program Operations

Perhaps the most innovative aspect of TMA services is the strong commitment being shown to guaranteed-ride-home programs, which are offered quite frequently, often directly by the TMA itself. Vanpool programs are also fairly common, though many of these are brokered, as is to be expected.

Financial Incentives

Financial incentives are used quite sparingly by most TMAs. The most common of these are prizes and awards for ridesharers, followed by vanpool, transit, and carpool cash subsidies. Discount parking for carpoolers and vanpoolers is rarely available. Elimination of free parking for employees who drive alone is the least common of all financial incentives. Lack of financial incentives may be due to employer rather than TMA priorities, but is still unfortunate, given that parking pricing has been shown to be one of the most consistently effective strategies for increasing the level of ridesharing and transit use, even in suburban activity centers (*15*).

Telecommunications as Substitute for Travel

About one-third of TMAs promote telecommuting as an alternative to driving alone. Teleconferencing and teleshopping are far less common. TMA telecommunications-related services tend to be brokered rather than directly provided.

On-Site Services

On-site services are offered only rarely, though almost one in five TMAs does provide access to or information about child care services and facilities.

Facilities Improvements

Facilities for transit, bicycles, local traffic, pedestrians, and regional highway access are provided by very few TMAs. The majority of these TMA products are brokered.

PERFORMANCE MONITORING AND EVALUATION

Given the ambitious goals that TMAs have set for themselves and the length of time that some of them have had to implement their TDM programs, one might reasonably expect TMAs to collect and analyze transportation impact data. Unfortunately, this is far from the case (*16*). TMA evaluative self-assessments are rare (*2*). Those that are conducted often do not include any information on measured changes in travel behavior associated with TDM program implementation (*8*).

Performance Monitoring

Most TMAs agree that performance monitoring and evaluation are important considerations and that measured changes

TABLE 6 TMA EVALUATION CRITERIA

Appropriate Evaluation Criteria[1]	% TMAs Supporting
Changes in employee mode of travel	89
Changes in the number of vehicle trips made	81
Changes in the supply of transportation services	58
Changes in the number of person trips made	45
Changes in the supply of transportation facilities	40
Changes in employee time of travel	34
Changes in the location of activities	23
Other changes	8

[1] Multiple responses possible.

TABLE 7 EXPECTED AND DESIRED FREQUENCY OF TMA EVALUATIONS

Frequency[1]	Under Current Budget	Under Ideal Circumstances
Never	29	20
Less than every three years	16	8
Once every two or three years	31	27
Once a year	24	45

[1] Percentage of TMAs. Both columns sum to 100%.

in travel behavior can and should be used to gauge their individual success (Table 6). Changes in employee mode of travel and the number of vehicle trips attracted to the site are far and away the most commonly accepted measures of TMA performance, followed by changes in the supply of transportation services. Less than half of all responding TMAs consider any other performance measures as relevant.

Evaluation

Given the fairly general agreement on the importance of quantifiable TMA performance measures, it is somewhat surprising that 54 percent of all TMAs have never undertaken any type of evaluation. Of those that have undertaken evaluation studies, 69 percent have engaged third parties to provide objective evaluation results, and 31 percent have conducted only in-house performance reviews. The third-party evaluator most commonly relied on by TMAs is a government agency charged with monitoring a public grant or contract, usually as required by law rather than under the initiative of the TMA. Only 19 percent of TMAs engaged in evaluation activities had actually completed their assessments at the time of the survey. Under current budget constraints, almost one-fourth of the responding TMAs believe that they will be able to conduct full-scale third-party evaluations of their performance every year or, barring that, every 2 or 3 years (31 percent). Still, one in three TMAs believes that third-party evaluations can never be done under current budget conditions. One in five TMAs considers that evaluations are never needed, even under ideal circumstances (Table 7). The fact remains that even those TMAs that have completed third-party evaluations appear to be reluctant to share the results with outside parties such as our research team.

CONCLUSIONS

TMAs were first created in the early 1980s, most often to assist concerned private-sector individuals and firms to better manage travel demand. Most such efforts were made in rapidly expanding suburban employment activity centers. TMAs have recently become more popular and more geographically widespread, with the number of TMAs identified at the national level increasing from just over 50 in 1988 to well over 100 by 1991. Most TMAs are organized as private, not-for-profit corporations, and most are initiated primarily through activities of the private sector. Most TMA board members represent private interests, and most corporate TMA members are drawn from the private sector. Nonetheless, difficulty in recruiting new corporate members and generating secured sources of financial support and other commitments from the private sector are among the most common complaints of TMA board members and executive directors alike.

TMAs have ambitious goals and objectives. They tend to focus on demand management rather than on supply enhancement as a means to reduce traffic congestion and air pollution, or to increase the size and density of commercial and office development in suburban activity centers, or to achieve both of those goals. Toward these ends, TMAs often rely on fairly traditional forms of persuasion, such as the provision of information and assistance to employees interested in alternatives to driving alone, rather than on parking pricing and supply control measures. TMA evaluation efforts generally have been limited in scope, and often have not been widely distributed, even when undertaken. This is perhaps understandable, given the limited resources and the types of strategies most often employed by TMAs in efforts to modify travel behavior.

The survey revealed several areas in which TMAs can improve their performance, including the following:

- Private-sector participation: Identify strategies for increasing private-sector participation in TMA financing and operations and expand corporate membership dues programs on the basis of the provision of valued services.
- Program implementation: TMA members and staff need to be better informed about the potential effectiveness of parking management, road pricing, and ridesharing and transit subsidy programs that have been shown to be effective, even in suburban operating environments.
- Performance monitoring and evaluation: More effort should be directed toward serious TMA evaluation, including the production of quantifiable estimates of changes in travel behavior associated with the operation of TMA programs and services and their costs.

With more stable financing and improved services, TMAs may have greater success in reducing traffic congestion and air pollution within their market areas (*17*). Without these improvements, however, examples of measurable changes in travel behavior associated with TMAs will remain difficult if not impossible to find. To demonstrate their effectiveness, TMAs will need to devote more resources to evaluation efforts. When asked to identify their top three implementation priorities for the next 3 years, TMAs focused overwhelmingly on the provision of additional transit and ridesharing services (Table 8). Shuttle bus services are particularly popular at the moment as new TMA initiatives. Other top priorities include

TABLE 8 TOP THREE TMA IMPLEMENTATION PRIORITIES

Priority	First[1]	Second	Third	Average
Provide more ridesharing services	23	23	11	19
Increase education/marketing efforts	9	15	17	14
Implement new transit services	7	15	13	12
Provide more convenience incentives	14	11	9	11
Increase funding/revenues/staffing levels	5	11	11	9
Provide other new services	5	6	13	8
Achieve regulatory compliance	9	2	11	7
Increase corporate membership	13	4	4	7
Implement new alternative work schedules	2	4	4	3
Adopt new parking management strategies	5	4	0	3
Conduct evaluation studies	2	2	4	3
Implement highway improvements	2	2	2	2
Implement bicycle improvements	2	2	0	1
Other priorities	2	0	2	1

[1] All columns sum to 100%.

additional education and marketing efforts, and increased funding and staffing. Compliance with regulatory measures, increased membership, and parking management are mentioned less often as top priorities. Changing employee travel behavior and evaluating the effectiveness of overall TMA programs was rated highly as a priority by only a handful of TMAs. These priorities may need to change if TMAs are to become able to demonstrate their effectiveness in any statistical sense.

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Assessing the Effectiveness of Transportation Control Measures: Use of Stated Preference Models To Project Mode Split for Work Trips

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Five policies used to increase the level of ridesharing among employees of a large New Jersey firm are evaluated using stated preference techniques. The work shows that performance measures for policies such as guaranteed ride home, parking fee, rideshare coupon, and flexible starting times can be recovered through the administration of a stated choice instrument. The derived estimates of performance effectiveness are sensitive to both the local conditions and the constraints experienced by employees as well as to the unique opportunities brought to the program by the employer. A mix of the guaranteed-ride-home program, a rideshare coordinator and rideshare-matching program, a $0.75 per day parking fee, and a rideshare coupon of $1.00 to each participant combined with an average of 15 min lost time ridesharing is projected to meet the Clean Air Act's 25 percent increase in average vehicle occupancy. At the same time, this mix of transportation control measures will distribute the costs and benefits of the combined program across all employees and generate revenue to offset the program costs.

Major changes in commuting behavior face the drivers in at least eight of America's metropolitan areas. In order for states to avoid federal sanctions, the Clean Air Act Amendments of 1990 will require employers to reduce their employees' vehicle trips or increase their employees' vehicle occupancy rates. Employers must prepare plans indicating the effectiveness of the measures they take. This paper presents a method by which employers and transportation planning agencies can determine the effectiveness of transportation control measures (TCMs) proposed for use in compliance with the act. On the basis of an empirical study made in northern New Jersey, a set of performance estimates is reported for several TCMs.

Sixteen TCMs are currently available under the statute for use in meeting an employer's goals. The list includes parking fees, availability of third-party vanpools, transportation allowances, and changes in work hours. In theory, when each of these measures is implemented in the appropriate fashion, commuting behavior will change such that there will be less reliance on the single-occupant vehicle than is currently the case.

To date, little is known regarding the performance of TCMs. Evidence comes from several case studies of existing transportation management programs. These studies (*1,2*) provide important insights into the aggregate properties of selected subsets of TCMs. Aggregate changes in driving behavior over time can be inferred from these studies. However, they do not show if or how local constraints will alter TCM effectiveness, how various combinations of measures will alter commuting behavior, or how different segments of the commuting public will respond to the TCMs.

Like any proposed new product or service on the market, the use of TCMs by the driving public must be evaluated indirectly. Only after a significant track record has been compiled on each TCM will a set of conclusive performance ratings be available. During the interim, the effectiveness of TCMs can be evaluated through methods taken from marketing and psychology (*3*) and from the economics of revealed preferences (*4*). The synthesis of these ideas has produced a method known collectively as the stated preference approach to discrete choice analysis (*5*).

STATED PREFERENCE

Initial research on stated preference (SP) was done in the United States and is exemplified by the work of a group led by Kocur (*6*). With the advent of cheap gasoline, research in the use of SP shifted. This approach is now used extensively in the United Kingdom, on the Continent, and in Australia. Its uses include the projection of market demands for major events such as cultural expositions (*7*) and modal shifts conditioned by new policy or transportation improvement programs (*8*). The U.K. Department of Transport's value-of-time studies showed SP to be accurate and stable relative to existing revealed preference research (*9*). British rail has an extensive inventory of SP studies, which have been used to project ridership changes linked with changes in quality of service (*10*) and to examine new local rail service (*8*). SP has been used to explore the demand for intermodal services (*11*) and the value of parking services (*12*); Euronett has used it to examine the impact of intelligent highway systems and toll rings on transportation policy in Norway (*13*).

SP is a branch of disaggregate or individual-based experimental research that seeks to explain discrete choices made by individual decision makers in the face of hypothetical but realistic constraints and opportunities. Its theoretical and sta-

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tistical foundations are based in the field of revealed preference (*4*). SP consists of a set of data generation procedures and supporting theory. In the case at hand, the data consist of individual choices in hypothetical travel situations represented by a set of alternative travel modes; each alternative is defined in terms of values assigned to cost and level-of-service attributes. The theoretical model used to estimate the attractiveness of each attribute associated with an alternative mode is random utility theory combined with the multinomial logit choice process (*14*).

The design of an SP study is a three-step process: (a) identification of the target population and appropriate sampling procedures, (b) preparation of the data generation instruments, and (c) selection of the survey administration method.

Identification of Target Population

The first step is the most important. Transport decisions are known to be affected by type of trip; social characteristics of the trip makers; home, work, and infrastructure constraints; and the attributes of the trip mode. Careful attention to this step ensures a valid inference from the sample to the target population. If segments of the population are hypothesized to have distinct systematic utility functions, provisions can be established to sample from each of the population's subsets (*15*).

Preparation and Testing of Data Generation Instruments

The preparation and testing of the survey instrument place the researchers in direct contact with the target population. Focus groups are often utilized to identify those properties of the commute that are of greatest importance to drivers as well as the constraints facing the commuters. The type and magnitude of these constraints determine the attributes for each alternative and set the range of values to be used for each attribute in the SP model.

Each decision maker selected for the SP experiment completes a number of SP tasks. It is common for a respondent to evaluate from 9 to 27 separate choice tasks consisting of a set of two or more commuting alternatives. Each alternative possesses a set of attributes through which each alternative is recognized by the traveler. Finally, each attribute is assigned a value; these values allow the traveler to combine the partial utilities into a summary value for the alternatives.

The decision maker must examine a sufficient number of choice tasks such that estimates of the marginal utility weights for each attribute can be recovered from the multinomial logit model. When a utility function is hypothesized to contain all of the attributes as well as all forms of interaction among the variables, a full-factorial model results. When the goal is to recover all possible direct and indirect impacts on a commuter's utility function, all combinations of the attributes' values must be evaluated by the decision maker. In a study with seven attributes, each with three value levels, the total number of choice tasks each respondent would be required to examine is $3^7 = 2487$. It is unlikely that many respondents would be willing to examine this many choices. The experience gained from numerous transport-related SP studies indicates that the results derived from choice sets that exclude consideration of interaction among the attributes are reasonable. Consequently, most choice sets used in transport studies are main-effects orthogonal fractional-factorial designs (*6*). In the case of the seven attributes with three value levels per attribute example, 18 choice sets are needed to recover the coefficients from a main-effects-only design in which all interaction effects are assumed to be negligible.

The final element in the design of the SP instrument is the selection of the form of the dependent variable. Three types of dependent variable are commonly found in the SP literature: the nominal variable indicating a discrete choice, the ordered categorical or ranking dependent variable, and the rating variable (*16*). The rating and ranking forms of the dependent variable are found in many early studies (*6*). Both rating and ranking alternatives place great burdens on respondents; evidence exists that shows that heteroscedastic disturbances occur in ranking exercises (*17*). The simple choice process, represented in the binomial discrete choice form of the dependent variable, is favored by those seeking to reduce respondent fatigue. The term *stated choice* is now being used to identify the explicit use of the choice-dependent variable. In general, the discrete form of the dependent variable is appropriate for use in intermodal demand forecasting studies. The term *stated preference* is linked directly with the ranking and rating scales and is most appropriately used in intramodal studies in which an evaluation of quality-of-service variables is required.

Selection of Survey Administration Method

The final component in the SP study is the selection of the administration technique. Here, the researcher must trade off the costs and relative precision of the several methods that can be employed to administer the survey instrument (*18*). The most popular survey technique continues to be the self-completion mail-back instrument; when resources are available, the face-to-face interview is often preferred with the caveat that affirmation bias—the tendency in respondents to detect and affirm the perceived views of the interviewer—can influence the results (*19*). Recently, researchers have employed computer-aided and computer-designed and computer-administered instruments (*20*). Little in the way of comparative analysis is available to guide in the selection of a specific administration technique.

APPLICATION OF SP TO EVALUATION OF TCM PERFORMANCE

In this section, an SP model is estimated for the mode-choice decision related to the journey to work. Performance measures are estimated for five classes of TCMs: preferential parking, parking costs, guaranteed ride home (GRH) program, rideshare adjustments, and flex-time programs. Each of these TCMs can be implemented by individual corporations independent of the actions of public agencies and transit companies. Of greatest interest is the ability of each TCM to increase the average vehicle occupancy (AVO) level for an employment site. The site chosen to perform the SP experi-

ment is located in the Hackensack Meadowlands of northern New Jersey. This is an area of severe nonattainment for the ozone air quality standard. Employers in the area will be required to demonstrate a 25 percent increase in their AVOs.

The test site is the corporate headquarters of the Matsushita Electric Corporation of America (MECA), which is the largest single employer in the Meadowlands. At the time of the study, MECA employed 1,948 individuals.

The SP study had two data generation components: an employee transportation survey and a stated choice experiment. The first component was administered to all MECA employees. The survey instrument was designed to collect socioeconomic, demographic, and attitudinal information, and required the name of the respondent to be placed on the document. The second survey consisted of two versions of a stated choice instrument. All instruments used in this study are available on request from the authors.

Preparation of Stated Choice Survey Instrument

The survey instrument developed for the MECA study evolved over a 3-month period. During its early design stage, two focus groups were held at the MECA site. These meetings brought the researchers in contact with the concerns and impressions of clerical, professional, and administrative employees, on which the first draft of the survey instrument was based. The draft instrument was then presented to a technical advisory group consisting of professional transportation planners and administrators working in the area.

The stated choice instrument was designed to support two commuting alternatives: the single-occupant vehicle (SOV) and ridesharing. The focus groups showed that alternatives such as public transit, park-and-ride facilities, and shuttle buses had little applicability to the majority of the employees. They were therefore excluded from the list of alternatives. Retaining the binomial choice problem has the advantage of simplicity over more complex multinomial designs. Before the SP experiment was carried out, a pilot test was made of the draft version.

Choice Set Design

The concept underlying the execution of the stated choice experiment is relatively simple. The researcher presents the respondent with a set of information-processing tasks. Each task requires the respondent to examine two commuting alternatives: SOV and ridesharing. The respondent must make a decision on the basis of the design values assigned to the attributes of each alternative. The MECA study required each employee in the sample to examine and make 16 choices.

The 16 choice tasks were constructed to form an orthogonal fractional-factorial research design (*21*), the use of which permits the marginal utility of each attribute to be estimated independently of the remaining attributes. As a practical matter, orthogonality of the design is less important to the successful estimation of the model than is the reasonableness of the trade-offs (*15*). The trade-offs built into each task must be accepted by the respondent as a potential situation worthy of serious consideration. A small amount of intercorrelation inevitably enters the model either through design considerations or through post-survey review of the raw data. The former includes the removal of choice sets presenting the respondent with no reasonable trade-offs, whereas the latter involves either the removal of completed choices that contradict revealed or observed behavior or the effective removal of choice tasks through the selective refusal of a respondent to indicate a choice.

Specification of Utility Functions

From the point of view of the SP experiment, the attributes and their values provide the information for the respondent to distinguish one alternative from another. From the point of view of the logit model, the attributes are the independent variables used to specify the utility functions. The logit model requires that variables representing the attributes and the socioeconomic characteristics be assigned to each alternative's utility function. Each commuting policy's attributes represent characteristics of the journey to work that can be altered by the employer. The remaining characteristics are used to account for systematic variation in choice behavior resulting from social and demographic characteristics of the respondents.

The attributes used to define the SOV alternative are preferential parking, parking charges, and flexible starting hours. Parking space allocation ranges from the current first-come, first-served practice to the assignment of the SOV driver to a parking space on the periphery of the parking facility. Under extreme conditions, parking at the fringe of the facility can require the employee to make a 10-min exposed walk to get to work, but under normal conditions, the walk takes 3 min. The second attribute is parking cost. A fee schedule was presented to employees ranging from free parking to $7/day parking. There are six steps in the parking charge schedule; however, no employee examines more than three parking charge values in any choice set. This was done in order to keep the number of choice tasks required of the employee at a minimum. The final attribute linked with the SOV alternative is the starting hours. Although both alternatives were assigned the same starting time, the research interest centered on the impact that more flexible or staggered starting times would have on mode-choice behavior. Starting times were allowed to range from 8:00 to 10:00 a.m.; current starting time is 9:00 a.m. For the purpose of model specification, socioeconomic characteristics are also assigned to the SOV.

According to the stated choice instrument, all TCMs used to promote ridesharing are implemented with the aid of a permanently assigned transportation coordinator and an up-to-date rideshare-matching program. The alternative specific variables representing the ridesharing alternative include independent parking space allocation, parking charge, the time required to pick up riders, the GRH program, and rideshare adjustment. The two values given to the parking space allocation attribute are preferential parking and parking on a first-come, first-served basis. Parking charge is also entered as an attribute for the ridesharing alternative; however, it is held constant at a value of $0.00 per space per day. The opportunity cost of ridesharing in time required to pick up riders is included, with values ranging from 0 to 45 min. Two incentives are also included as attributes. First, a GRH program is de-

TABLE 1 ATTRIBUTES AND CONTEXT VARIABLES TESTED FOR USE AS ARGUMENTS IN JOURNEY-TO-WORK UTILITY FUNCTIONS FOR MECA EMPLOYEES (*22*)

Attributes	Utility Function	Sample Mean or Design Values	Remarks
Design Variables			
Starting time	SOV	8:00, 8:30, 9:00, 10:00 (a.m.)	
Parking charge	SOV	$0.00, 0.50, 2.00, 3.00, 7.00	
Extra time to pick up rider	RS	0, 5, 10, 15, 25, 45 (minutes)	
Guaranteed ride home program	RS	yes, no	
Rideshare coupon	RS	$0.00, 0.25, 0.50, 1.00, 1.25, 3.50	
Socioeconomic Variables		Mean of sample	
Age	SOV	36 years	
Male	SOV	52%	
Spouse	SOV	54.9%	
Spouse at home	SOV	15.3%	
Commuting distance	SOV	15 miles	
Congestion	SOV	34%	Percent of index commuting time wasted due to congestion
Clerical	SOV	19.5%	
Administration	SOV	29.6%	
Professional	SOV	35.0%	
Home constraints that will prevent ridesharing	SOV	23.3%	
Unlikely to commute index	SOV	6.25	Seven level index where 7=unlikely
Pleasantness index	SOV	4.07	Seven level index where 7=pleasant
Week of survey	SOV	Started during 27th week, ended in 37th week of 1991	
Household size	SOV	3.2 persons	
Automobiles/household	SOV	1.56	
Walk time from parking space to work	SOV	2.4 minutes	

fined as a free service that is given to the certified ridesharing employee. It provides a ride home when a home or office emergency arises; when a supervisor requires an employee to stay late, the GRH also applies. The GRH attribute is specified in the model as a nominal variable (available/not available). In future research the performance characteristics of the GRH program must also be modeled. The final attribute specific to the ridesharing alternative is ridesharing adjustment. This consists of a coupon given to each member of a certified ridesharing team and refundable at face value when presented at the corporate cafeteria. Its value ranges from $0.00 to $3.50 per day. As in the case of the parking charge attribute where six values were presented to the sample as a whole, each respondent examined three values per attribute.

The complete set of individual characteristics and design attributes is shown in Table 1 (*22*). The first set of attributes is the design variables that represent the commuting scenarios. The second set identifies the social and economic variables available for use in the model. The social and economic context variables represent characteristics that change the propensity to use the SOV by subgroups of employees. The focus groups indicated that men and older persons have a relatively high propensity to stay with their SOV commute. Household size was presented as a characteristic that could represent competition for scarce transportation resources; therefore, household size as well as variables representing the number of drivers and cars in the household were included in the model as surrogates for budget constraint. Focus group meetings showed that clerical employees living in households where more persons have driver's licenses than there are cars are likely to be positively disposed to ridesharing.

Attitudes expressed in the employee transportation survey were also used as predictors of commuting choice. The existence of home constraints, such as children to take to school or elderly parents to take to a treatment center, will increase the threshold at which the costs and incentives would bring a driver into the ridesharing category. Similarly, a predisposition not to rideshare or to have ridesharing viewed as relatively unimportant will reduce the observed utility in ridesharing. On the other hand, the perception that ridesharing is pleasant will add to the utility of the option.

The final two context variables used in the commuter choice model represent the attributes of the link between home and office. Distance to work represents the cost of time involved in the travel. The distance variable was transformed using several operators; the transformation that best showed its impact on driving choice was the natural logarithm. Congestion is measured as the percent of the total travel time perceived by the employee to have been spent in congestion. This attribute of the trip is used to represent the discomfort associated with stop-and-go driving. The transformation that best represents perceived congestion with commuting choice

is exponentiation to the base (e). The last variable entered into the logit model is the week during which the SP survey was completed by the employee. Since the first surveys were returned in early August and the final surveys in late October, the weather and traffic situation will vary and may influence the commuting decision.

Survey Administration

The data-generating process consisted of two temporally separated survey instruments. The employee transportation survey was distributed to all 1,948 employees working at the Hackensack Meadowlands facility during June 1991. The company's mail facility was used to distribute and collect the surveys. The package contained a self-addressed return envelope, a cover letter from the firm's vice president, and the survey. Of the 1,948 surveys, 762 were returned, giving an overall response rate of 39 percent. However, 12 surveys were returned without the respondent's name; these were discarded, leaving 750 usable surveys and a net response rate of 38.5 percent. The respondent's name was essential for the commuter choice study. This is the identifier that links the socioeconomic characteristics of the respondent with his or her stated choices. Without these characteristics, the statistical estimators for the commuting attributes become unstable and the possibility of bias is likely (*15*).

The 750 usable surveys were coded and a random sample of 300 employees, exclusive of general managers or higher-level employees, was selected for administration of the stated choice instrument, which began during the first week of August and ended in October 1991. The surveys were distributed in groups of 50.

The SP experiment was administered to the respondents through a mail-back technique guided by the Total Design Method (*23*). Each packet of experiments consisted of an individually addressed, large envelope containing a cover letter from the principal investigator on university stationery, the 16 SP tasks, an explanatory note reminding the respondents of the issue being explored and their previous cooperation, a glossary of terms, and a return envelope. The 16 choice tasks were identified through randomly chosen sequences of uppercase letters; the sequence in which the respondents saw each task was randomized. A follow-up thank-you letter was sent to respondents 1 week after they received the experiment.

CHARACTERISTICS OF MECA WORK FORCE

The employee transportation survey provided data that permit a broad description of the MECA work force. Table 1 shows the average or median value for the variables used in the experiment. Most of the MECA employees are in management, administration, or professional positions (60 percent), another 20 percent have clerical jobs, and the rest are technical or service workers. As is common throughout the region, most MECA employees drive alone to work (89.1 percent); for these drivers the median time spent driving to and from work is 35 min, and their median distance from home to office is 15 mi. Ridesharing, defined as commuting with more than one person but not in public mass transportation, is found in 8.4 percent of the work force. Ridesharing that does occur at MECA is strongly related to commuting distance. For ridesharers, the median distance to work is 38 mi, and the median trip time is 60 min.

Economic status of the employee is represented by several variables: job category, working spouse, and number of cars per person in the household. In order to keep response rates as high as possible, household income was not included in the questionnaire. The lowest income category included in the survey is clerical. This group of employees is more likely to consist of women than is the total work force, is younger than average, and is less likely to have a spouse.

ESTIMATION OF LOGIT COEFFICIENTS

Two data bases were combined for the estimation of the logit stated choice equation. From the set of completed and returned stated choice experiments, each employee contributed up to 16 commuting-choice observations. From the employee transportation survey, employees also reported their socioeconomic characteristics and attitudes toward ridesharing. The two data sets were merged and input into the Alogit linear logit program (*24*).

Given that only two commuting alternatives are available to the MECA commuters, a binomial logit model was estimated. In a search for the best-fitting set of utility functions, the data base was sectioned by job category, and logit models were constructed for each section. Similarly, interval-level variables such as parking charge, congestion, and commuting distance for the journey to work were transformed into quadratic, logarithmic, and exponential functional forms and tested for the form that would best reproduce the shape of the utility function. Partitioning the data base into a subset of clerical workers and the residual set of professional, administrative, and technical workers offered the most promise; however, the number of observations in the clerical subset was too small to effectively span the remaining number of socioeconomic variables thought necessary for inclusion in its utility function. As a result, adjustments for the unique disposition of clerical workers toward commuting options are built into the reported logit equation.

The final equation reported in this paper required five iterations to converge to a stable set of estimates. The initial value of the likelihood function was -831.78, the final value was -592.13, and the rho-squared term was reported to be 0.29. Using the Hensher criteria for inclusion of variables in the final equation, only those socioeconomic variables whose coefficients have the theoretically correct sign and are statistically significant at the 0.05 level were retained in the model (*25*). A similar criterion was used for the design variables.

Table 2 gives the coefficients of the MECA employees' commuter choice logit model (*22*). The data show that the binomial logit model applied to the commuting-choice behavior of MECA employees returns a set of coefficients that agree with the theoretical expectations derived from utility maximization. The design variables will be examined first. The SOV option was evaluated through the use of parking charges and variation in the starting time of the headquarters facility. An increase in parking charges reduces the utility

TABLE 2 UTILITY COEFFICIENTS ESTIMATED FOR TWO JOURNEY-TO-WORK ALTERNATIVES, SOVs, AND RIDESHARING, FOR MECA EMPLOYEES BELOW GENERAL MANAGER GRADE, AUGUST 1991 (*22*)

Attributes	Drive Alone	Rideshare
Employee age	0.022 (3.17) **	
Unlikely to rideshare index	0.20 (3.5)	
Ridesharing is pleasant index	-0.14 (2.9)	
Trip length (natural log)	-0.35 (3.6)	
Drivers licenses per car (clerical employee households)	-0.50 (6.3)	
Date experiment held (week in 1991)	0.064 (4.9)	
Parking cost	-1.065 (9.4)	
Parking cost squared	0.074 (4.9)	
Flextime (early arrival in hours before 9:00 a.m.)	0.31 (1.4)	
Time lost ridesharing		-0.033 (5.8)
Guaranteed ride home		1.33 (9.0)
Rideshare coupon		0.85 (3.0)
Rideshare coupon squared		-0.15 (2.1)

*Analysis is based on 1,200 observations.

**"T" Ratio displayed in parentheses. The flexible starting time estimators are not significant at the 0.05 level, however, they are reported in order to bring more information to bear on their use as TCM.

associated with the journey to work, whereas a shift in the starting time 1 hr earlier than the current 9:00 a.m. increases the utility of the drive-alone option.

The ridesharing option was evaluated through the use of the GRH program, the added time it takes to pick up riders, and the value of the rideshare coupon. The GRH program produces positive utility for the rideshare alternative. Similarly, the rideshare coupon is also a stimulus to ridesharing; however, the additional time consumed linking the rideshare team together acts to discourage ridesharing. The GRH program was described to employees without any time loss or discomfort relative to the SOV option. Therefore, its coefficient must be treated as unconstrained and biased toward a positive response to ridesharing.

The signs of the coefficients representing the socioeconomic variables point to subsets within the employee work force at which efforts to encourage ridesharing at MECA should be targeted. The general categories of employees most willing to try ridesharing are those who are younger and those who are a part of the clerical staff. In particular, clerical employees who are members of households in which the number of driver's licenses exceeds the number of cars also have a strong predisposition toward the ridesharing option.

Those employees who find ridesharing to be a pleasant experience are also more likely to rideshare than those who have found it unpleasant. On the other hand, those employees who expressed a strong likelihood to drive alone, as shown in the employee transportation survey, consistently favor the SOV option in the stated choice experiments. It is interesting to note that the statement made in June that home- or work-related mobility needs would prevent them from ridesharing was not a significant indicator of stated choice behavior.

Forecasting Selection Probabilities

The direct output of the logit model is a set of selection probabilities for the commuting alternatives. The transformation of the selection probabilities into the percent change in AVO is direct. A data matrix consisting of employees by socioeconomic variable and the attributes for the commuter options is constructed. The values of the attributes are fixed for each scenario and combined with the values of the socioeconomic variables obtained from each individual in the sample. The utility function derived for each alternative is used to calculate the probability of ridesharing and driving alone. The probability of using a given alternative for the sample as a whole is taken to be the average of each individual's selection probability.

Forecasts of AVO using the unconstrained GRH program attribute will produce unrealistically high values similar to values acquired through a stated intentions survey (*8*). In order to counter this tendency, an adjustment factor related to the expected lost time experienced when using the GRH program was developed. The factor is based on the assumption that the disutility of time lost in the daily ridesharing experience is the same as the disutility experienced waiting for the GRH. For each observation where GRH is provided

the employee, 30 min of lost time is assumed to occur. The marginal disutility of ridesharing is computed for the 30 min lost, and the unconstrained marginal utility for the GRH is reduced by the disutility of time lost.

AVO levels were calculated by taking the ratio of the number of employees who arrive at MECA to the number of cars that bring them to MECA and park in the MECA parking lot (Equation 1). The number of employees arriving at the site is fixed by the size of the sample and by the current employment level. The number of vehicles entering the parking lot with employees is the sum of the SOVs and the vehicles used for ridesharing. The model does not predict the number of employees to arrive in each vehicle used in ridesharing. Since calculation of the AVO requires this value, it is assumed to be the current average number of employees entering the MECA parking lot in a ridesharing vehicle, which was determined from the employee transportation survey made in June 1991 to be 2.2.

$$AVO = E/V \quad (1)$$

where E is the number of employees employed at MECA, and V is the number of vehicles used to bring MECA employees to work and park in the MECA parking lot.

$$V = P(\text{SOV}) * E * a + P(\text{RS}) * E * b \quad (2)$$

where

a = 1/(1 employee/vehicle),
b = 1/(2.2 employees/vehicle),
P(SOV) = average selection probability for employees to choose the SOV alternative,
P(RS) = average selection probability for employees to choose to rideshare, and
$*$ = notation used for multiplication.

TCM Levels Needed To Meet Clean Air Act Standard

The set of outcome indicators most relevant to evaluating performance shows the values of one or more of the TCMs needed to generate a percentage change in AVO. Table 3 shows the percentage change in AVO given combinations of three measures: parking charge, rideshare coupon, and the adjusted GRH program. The reader must be reminded that the behavior projected in Table 3 is predicated upon the existence of a transportation coordinator and an up-to-date rideshare-matching program. The upper half of the table describes the joint effect of parking charges and rideshare coupons on the relative change in AVO. At zero parking change, none of the possible values of the rideshare coupon will generate the required 25 percent change in AVO. In contrast, a $2.00 parking charge with no rideshare coupon will produce the required change in AVO.

The lower half of Table 3 shows the joint effects of the GRH program adjusted for 30 min of lost time, combined with parking charges and rideshare coupons. Given the GRH program, the 25 percent increase in AVO is achieved at lower values of parking charges and rideshare coupons. A parking charge of approximately $1.50 now generates the required change in AVO, as does a $1.00 parking fee and rideshare coupon.

Once the set of TCMs that produce the 25 percent change in AVO is determined, the final mix of costs and incentives must be derived from a cash-flow analysis of the program.

TABLE 3 PROJECTED PERCENT CHANGES IN AVERAGE VEHICLE OCCUPANCY LEVELS FOR THREE TCMs (*22*)

NO GUARANTEED RIDE HOME PROGRAM

		Parking Charge			
		$0	$1	$2	$3
Rideshare Coupon	$0	0%	10.4	25.3	41.4
	$1	6.6	22.5	41.6	58.9
	$2	12.1	31.0	51.6	67.7
	$3	13.7	33.6	54.5	70.0

GUARANTEED RIDE HOME PROGRAM

		Parking Charge			
		$0	$1	$2	$3
Rideshare Coupon	$0	2.8%	15.5	32.7	49.5
	$1	10.9	29.4	49.8	66.5
	$2	17.5	38.8	59.6	74.5
	$3	19.3	41.4	61.9	76.5

*Each mode choice scenario contains a 15 minute time loss for ridesharing over the driving alone option and a starting time of 9:00 a.m.

Total costs include the salary of the transportation coordinator, matching program, and incentives. The revenues are essentially those derived from parking fees and subsidies given by the firm.

CONCLUSIONS

Estimates of the performance of TCMs can be recovered through the use of stated preference techniques. In a practical application of SP, employees of a large firm in northern New Jersey were able to respond to a hypothetical set of commuting situations in a fashion that is both realistic to professionals in the area and consistent with hypotheses derived from utility theory. The results show that the traffic reduction plan of a firm or agency can be evaluated on the basis of their employees' stated commuting behavior.

In its empirical application in northern New Jersey, a combination of a GRH program, a $1.00 ridesharing coupon, and a $0.75 daily parking charge for the SOV commuter generates the 25 percent increase in AVO required by the Clean Air Act and distributes the costs and benefits throughout the firm's employees. In reality, this must be viewed as an upper bound for the assessment of performance. Not only must the firm enact the $0.75 parking fee and $1.00 rideshare reward, but the rideshare coordinating and matching programs must also link all individuals who said they were willing to rideshare under these conditions, and the distribution of willing rideshare drivers and riders on average must perceive this time lost ridesharing to be 15 min per trip.

As a general method for exploring policy issues of mode or route choice, SP appears to be a valuable addition to the widely used class of discrete choice analysis developed under the theory of revealed preference. It can also be seen as a method for assessing nonmarket demand for many classes of public goods such as quality-of-service characteristics of public transit, recreational and park improvements, as well as airport expansions and improvements.

FUTURE WORK

Future testing is still needed. The instrument developed for the MECA study did not define the GRH program by its performance attributes: time, comfort, security, and convenience. The range of values assigned to the rideshare coupon does not reach the levels required to shift the commuting decisions of many respondents. The value range should be extended beyond the $3.50 per person per day. New TCMs, such as the availability of a day-trip vehicle for company use, should be considered, as should shuttle buses linked to local shopping centers and transportation terminals.

The results from the MECA study must be compared with similar studies performed both within the region and beyond, with firms having similar and different distributions of employee categories, and with firms in a broad range of industrial categories and locations within metropolitan areas.

Future research must also be performed to construct and validate new forms of survey administration. The pilot study required two separate approaches to the firm and its employees. Although remaining as unobtrusive as possible, the researchers still posed a distraction to management and labor. It was initially intended that 150 employees would be called at the work site and interviewed personally using a combined employee transportation survey and stated choice instrument. Discussions with management suggested that such a procedure would be difficult to implement under current conditions. A two-stage, mail-back procedure was chosen instead. Unfortunately, the use of mail-back techniques for the administration of the instruments does nothing to protect the results from nonresponse bias. New techniques being tested at the Institute for Transportation Studies at Leeds University in the United Kingdom are integrating stated preference with the hand-held microcomputer and offer the promise of new breakthroughs in sample selection and survey administration. These techniques should be studied by the U.S. Department of Transportation.

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Status Report on Transportation Management Association Development in California

LORI DIGGINS AND ERIC N. SCHREFFLER

The results of a research project commissioned by the California Department of Transportation (Caltrans) to explore development of transportation management associations (TMAs) in California are presented. Through a TMA survey and a series of workshops, several characteristics of California TMAs are identified: geographic distribution, funding, activities, and stage of development; impetus for TMA formation; and organizational and technical areas in which TMAs need assistance. The role of a Caltrans TMA formation funding program in TMA development was also examined. Recent experience with TMAs following the implementation of a statewide TMA assistance program and changes by Caltrans to the grant program are also recounted.

In late 1990, there were 56 transportation management associations (TMAs) in California, 75 percent of which were in Southern California. Most were initiated after 1988, the year the state funding program began. TMAs were divided into three stages of development: exploration (37 percent), formation (27 percent), and operation (36 percent). Most of the services provided by TMAs were of an informational or promotional nature. Services that directly offered commute alternatives were provided only by the most mature TMAs.

TMA formation was largely prompted by the existence of a transportation-related problem or trip reduction regulations. The availability of grant funds, although not a reason for TMA formation, did contribute to the timing.

TMAs needed advice with many aspects of their development and operation. Primary needs included data collection and analysis (exploration stage); business organization, membership development, and financial management (formation stage); and service planning and evaluation (operation stage).

In December 1988, the California Department of Transportation (Caltrans) initiated the Transportation Management Association Formation Grant Program with funding from the Federal Highway Administration. During the next 2 years, Caltrans awarded 43 TMA grants to 40 groups for a total of over $2.4 million. The intent of the grants was to provide seed funding to support TMA start-up; this funding was to be matched by private funds.

In fall 1990, Caltrans commissioned a research project to explore three aspects of TMA development in California: the current status of TMAs in California—their locations, funding experience, activities, and stage of development; the factors that led to TMA formation; and organizational and technical areas in which TMAs need and desire future assistance. Much of this paper is excerpted from the final report of that assessment project (*1*).

Following completion of the research project, Caltrans modified the grant program and implemented a new statewide program administered by COMSIS Corporation of one-on-one assistance to TMAs. This paper also draws on recent experience with TMAs following these changes.

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DATA COLLECTION

To assess the current status of California TMAs, the project collected background information on the 56 TMAs in existence in fall 1990. Information was obtained through numerous sources, but key insights were gained directly from TMAs through surveys and TMA workshops held in five locations around the state. Both TMAs funded by Caltrans under the grant program and those that had not received Caltrans grants were included in the assessment.

Of the 56 TMAs then operating in California, 45 provided information by completing the survey form, attending one of the workshops, or both. The comprehensive survey, which was mailed to all TMAs and collected at the workshops, was completed by 38 TMAs. It gathered information on

- Development and operations activities being undertaken,
- Primary impetus for TMA formation,
- Funding sources and amounts,
- Current and past assistance needs during different stages of development,
- Role of the grant program in TMA formation,
- Indicators of potential locations for TMA development,
- TMAs' future vision of themselves, and
- Perceived results to date.

Five 1-day workshops also were held to augment information received through the survey. The workshops were held regionally, for Los Angeles–Ventura County, Orange County–Inland Empire, Sacramento–Central Valley, San Diego, and San Francisco. Workshop participants included managers and board members from 35 TMAs, Caltrans representatives, representatives of regional planning and ridesharing agencies, and other groups involved with TMA development in California. During the morning session of the workshops, the participants discussed descriptive information on each of the TMAs present, local conditions that led to their formation, the role of the Caltrans grant program in TMA development,

and information on existing sources of assistance and the role of other agencies. The afternoon discussion focused on identifying problems specific to TMAs and needs for further assistance.

Discussion during the workshops was recorded by the consultant and used with the survey data to develop a profile of TMA development in California, identify the primary reasons for TMA development, and identify assistance needed by TMAs.

PROFILE OF TMAs IN CALIFORNIA

Through the survey and workshops, information was collected on six characteristics:

- Distribution within California,
- Funding sources,
- Distribution by geographic focus (service area land use type),
- Distribution by development stage,
- Typical activities, and
- Impetus for TMA formation.

Distribution Within California

The data showed that in late 1990, TMAs were distributed throughout the state, but were clustered in five urbanized areas: (a) South Coast Basin (Los Angeles, San Bernadino, and Riverside Counties) and Ventura County, (b) Orange County, (c) San Diego County, (d) San Francisco Bay Area, and (e) Sacramento–Central Valley.

As shown in Figure 1, 42 of the TMAs were in Southern California. Los Angeles County led the state in TMAs, with 15, primarily located in dense employment areas such as Pasadena, Century City, and downtown Los Angeles. One was located in San Bernadino County and three others were located in Ventura County. Orange County was the base for 12 TMAs, most located in or near the I-405 corridor. The 11 TMAs in San Diego County were distributed throughout the county, but except for one downtown area TMA, others in San Diego have emerged in newly developing areas north of the city and along the I-15 corridor.

Fourteen TMAs were located in Northern California: six in the San Francisco Bay area, five in the Sacramento area, and three in other Northern California areas. The six San Francisco TMAs were evenly divided among downtown San Francisco, the east Bay, and other suburban counties. In Sacramento, one TMA was located downtown; the others were located in high-growth corridors and suburban activity centers.

Funding Sources

TMA funding sources and amounts varied. Over 70 percent of the TMAs that participated in the study cited Caltrans as a funding source. Most indicated that they had been awarded $60,000 from Caltrans, the grant limit in a 50-50 matching program. Sixteen percent mentioned having received grants

FIGURE 1 Geographic distribution of California TMAs.

from the former Urban Mass Transportation Administration (UMTA) (now the Federal Transit Administration), in amounts ranging from $45,000 to $1.2 million total for the life of the grant (up to 3 years). Another 16 percent had received funds ranging from $3,000 to $280,000 from other public groups such as cities, counties, and rideshare agencies.

Most TMAs (63 percent) also indicated that they were funded in part by membership dues consisting of from $4,000 to $300,000, and nearly half (47 percent) had private in-kind contributions of $400 to $100,000. Finally, other sources, such as developer fees and donations from chambers of commerce, were reported by 21 percent of TMAs, in amounts from $15,000 to $350,000.

Distribution by Geographic Focus

TMAs were also characterized in the study by their geographic focus, that is, the type of development or land use in their service area. They were grouped into four categories:

- Existing suburban,
- New suburban,
- CBD (downtown), and
- Other.

Existing Suburban

Over half (30) of the TMAs in California in late 1990 were located in existing (developed) suburban areas. These TMAs served existing non-CBD activity centers, usually dense em-

ployment areas with existing transportation problems. They were formed primarily to provide centralized, coordinated services to current employers, to assist employers to develop and implement in-house transportation demand management (TDM) programs, and to address localized transportation-related problems.

New Suburban

Twelve of the California TMAs served new suburban areas and emerging commercial or residential developments. Developers were typically the catalysts in TMA formation, because there were no employers or residents yet. TMA formation was often seen as a mechanism to mitigate traffic or air quality impacts of planned development. In some cases, developers were required by agreements negotiated with localities to mitigate trips to the site or in the area, and a TMA was initiated to assist in this effort.

The preponderance of suburban TMAs in California, 75 percent of the total, is not surprising given that much of the recent employment growth in California, as in many areas of the United States, has occurred outside downtown centers. It could also point, however, to a possible lack of transportation services and facilities in suburban settings as compared with downtown areas. Downtowns often have organizations, services, facilities, and programs to support transportation, as well as a history of greater awareness and acceptance of commuting options by employers and employees.

CBD (Downtown)

Six of the California TMAs (11 percent) were located in central business districts (CBDs) or downtown areas. They served CBDs in San Diego, Glendale, Los Angeles, Pasadena, San Francisco, and Sacramento. TMAs located in downtowns worked with employers, but often also worked with managers of the multi-tenant buildings frequently found in downtowns. CBD TMAs more often focused on transit promotion and parking management than did suburban TMAs, because of typically better access to transit and lower availability of free employee parking in the CBD. They also promoted accessibility to and within downtown for employers and merchants.

Other

The remaining eight of the 56 California TMAs served other areas, neither in suburban centers or downtown. This category included TMAs that serve entire regions, corridors, or industries. Regional TMAs often played a significant role in areawide transportation planning and advocacy and a lesser role in local service delivery. Corridor TMAs tended to focus on development along a particular transportation corridor or were formed to mitigate impacts of highway reconstruction. Industry TMAs served a single type of employer, such as hospitals, within a region or area, and often developed services and programs unique to employers and employees in that industry.

Distribution by Development Stage

The fourth characteristic examined was stage of development, that is, how far from TMA initiation to maturity was the TMA. TMAs were divided into three development stage categories that correspond to the stages Caltrans has defined in its TMA grant program: exploration, formation, and operation.

Exploration

The exploration stage represented a study effort that determined the feasibility of and need for forming a TMA and the conditions under which it would be formed. The effort might have considered the appropriateness of a TMA compared with another organizational form to address transportation problems, but most often exploration simply examined whether a TMA made sense at the time.

TMAs in this stage were also developing their core group of supporters and beginning to define problems and solutions. In some cases, they were pursuing formation tasks, such as drafting bylaws and developing a work plan, although operating funds had not been secured and TMA formation was not certain. Twenty-one (37 percent) of the TMAs in California were in the exploration stage.

Formation

The formation stage answered the questions, "Now that we want to be a TMA, what will we look like and what will we do? How will the TMA be structured and what services will be provided?" Fifteen California TMAs (27 percent) fell into this development stage. During this stage, a TMA expanded its support beyond the core group and planned services. Formation tasks included hiring staff, adopting a legal status, establishing an office, and so on. As with exploratory TMAs, the line between formation and the next development stage, operation, was often ill defined. TMAs in formation often were also undertaking operational activities such as initiating a few services, but the primary focus was on formation tasks.

Operation

The remaining 20 TMAs (36 percent) fell into the operation stage, which included two categories of activities—administration and service delivery. Administration refers to the efforts needed to maintain membership and funding and activities related to running the TMA office and serving the Board of Directors. Service delivery refers to provision of services such as rideshare matching to members' employees. This stage was characterized by a maturation of the organization; development of stable, ongoing, private funding from membership sources; and a track record of service delivery.

The combination of four geographic area types and three development stages resulted in 12 distinct types of TMAs. They include, for example, TMAs located in downtowns in the formation stage of development, existing suburban TMAs in the operation stage, and new suburban TMAs in the ex-

ploratory stage. The 56 California TMAs were divided into the 12 categories as shown in the matrix in Table 1.

Several points have already been highlighted about the geographic distribution of TMAs, but the matrix suggests several other observations. First, TMAs were not evenly distributed over the three development stages; only about one-fourth of TMAs were in the formation stage, whereas the balance were evenly divided between exploration (infancy) and operation (maturity). The unequal distribution of TMAs by development stage could be the result of noncontinuous TMA initiation, that is, more TMAs having been initiated at certain times than others, or of differences in the rates of growth of different TMAs. Probably both are partial explanations.

Table 2 shows the distribution of TMAs by year of initiation and 1990 stage of development. Of the 56 TMAs, 15 (27 percent) were in existence, even if only in embryonic form, before 1989. Twenty-one (38 percent) were started in 1989, and the balance, 20 (36 percent), were started in 1990. The percent distribution of pre-1989, 1989, and 1990 start-ups is roughly the same as the distribution of TMAs in the operation, formation, and exploration stages in late 1990. Also, as Table 2 shows, most TMAs in the operation stage had been started before 1989, most formation TMAs in 1989, and most exploration TMAs in 1990. This would also suggest that 12 to 24 months is required for a TMA to reach the operational stage.

Because only five TMAs were operating in California in 1987, it is noteworthy that 20 were operating in late 1990. Thus, 15 TMAs were able to move to operation from an earlier stage. It is possible that the presence of trip reduction regulation, increased awareness of and interest in TMAs as a mechanism for TDM implementation, and the increased availability of public seed funding contributed to this progress.

A second observation from Table 1 is that, except for the existing suburban category, the overall distribution of TMAs by stage of development does not hold in individual geographic categories. In the new suburban category, for example, exploration TMAs account for 50 percent compared with the overall average of 37 percent. This could suggest a recent interest in transportation demand management (TDM) on the part of developers, the typical catalysts for new suburban TMAs, perhaps because of increased application of transportation-related development conditions by planning and zoning agencies. Alternatively, it could suggest that the time needed to move from exploration to formation is greater in areas where mobility problems do not yet exist.

Also, in the "other" TMA category, the number of formation TMAs is higher than would be expected from the averages and the number of operating TMAs is lower. This might suggest that it is more difficult to develop a TMA in one of these settings or it might signal increased recent interest in developing TMAs in nontraditional areas.

TABLE 1 DEVELOPMENT STAGE BY TMA GEOGRAPHIC TYPE

	Geographic Area Type				
Devel. Stage	Existing Suburban	New Suburban	CBD	Other	Total
Exploration	11	6	1	3	21 (37%)
Formation	7	2	3	3	15 (27%)
Operation	12	4	2	2	20 (36%)
Total	30 (54%)	12 (21%)	6 (11%)	8 (14%)	56 (100%)

In June 1990, in its fourth cycle of grant awards, Caltrans awarded 18 TMA grants, one for TMA formation and 17 for exploration (see section entitled "Recent Experience"). Of these grants, nine (50 percent) were awarded to groups in existing suburban areas, three (17 percent) to groups in new suburban areas, five (28 percent) to CBD groups, and one (5 percent) to an "other" group. Although grants to suburban groups still outnumbered those to nonsuburban groups, the percentage of TMA grants awarded to CBD groups more than doubled in this recent award cycle, whereas the percentages in all other categories declined from the past average. Most of the CBD groups were, however, in either suburban CBDs near major metropolitan areas or in the CBDs of smaller towns.

Typical Activities

The survey also explored the typical activities of TMAs at different stages of development. The activities differed by the development stage of the TMA, but nearly all TMAs undertook or were planning to undertake the following activities during their development:

- Problem definition,
- Establishment of organizational status and structure,
- Membership development and relations,
- Service delivery, and
- Planning and evaluation.

Problem Definition

Seventy-nine percent of TMA survey respondents had completed the problem definition task. Most generalized their problem as "traffic congestion" or "mobility constraints," however, rather than citing specific, localized, and tangible problems. Of the respondents, 82 percent had secured the commitment of the core steering group, but only 58 percent had reached a consensus on the problem.

The dilemma of fostering commitment among the members without first forming a consensus on an only generally defined problem was an issue for many TMAs. Consensus on a specific problem is extremely important, because without a common understanding of the nature and source of the problem, it is difficult to develop services that will be effective and offer real benefits to members.

Organizational Status and Structure

Organizational status was broadly defined to mean the structure and independent status of the TMA. Nearly 70 percent

TABLE 2 CALIFORNIA TMAs: FALL 1990 DEVELOPMENT STAGE BY YEAR OF INITIATION

	Development Stage			
Year	Exploration	Formation	Operation	Total
Pre 1989	1 (1.7%)	2 (3.6%)	**12 (21.4%)**	15 (26.7%)
1989	5 (8.9%)	**9 (16.1%)**	7 (12.5%)	21 (37.5%)
1990	**15 (26.8%)**	4 (7.1%)	1 (1.7%)	20 (35.7%)
Total	21 (37.5%)	15 (26.8%)	20 (35.7%)	56 (100%)

had decided on their legal status, but only 58 percent had determined their tax status (for-profit status or type of not-for-profit status). This is probably because TMAs first decide whether to be independent or part of an existing group, and then, if having decided to be an independent corporation, explore the appropriate tax status.

Eighty percent of the TMAs polled had established a place of business. Two-thirds had formed a Board of Directors; the remaining one-third were in the process of board formation.

Membership Development and Relations

About half of the TMAs had completed three tasks related to membership development: member identification, development of employer or employee data bases, and preparation of a membership recruitment plan. In the early stages of development, TMAs often have a fluid membership, but even TMAs in the operation stage can experience considerable turnover from year to year. The number of members ranged from 1 for a developer-initiated TMA in a new suburban area to almost 100 for a CBD TMA. Membership of 10 to 20 was average.

Member and board relations were also explored in the TMA workshops. Several TMAs noted difficulty in getting firm commitment and even direction from the board. Boards were seen as a valuable resource, but many TMAs found it difficult to get members to deliver on promised assistance.

Service Delivery

TMAs were asked to check the services they offered or planned to offer in the future. The most frequently cited services offered (mentioned by over one-third) were

- Member information services (55 percent),
- Rideshare promotion and fairs (53 percent),
- ETC network coordination (47 percent),
- Government relations and advocacy (47 percent),
- Input to local planning process (42 percent),
- Ridematching (42 percent),
- Transit pass sales and distribution (39 percent),
- Trip reduction plan preparation (39 percent),
- Employee surveys and analysis (39 percent), and
- Vanpool formation (34 percent).

The most frequently mentioned services being planned were

- Shuttles (39 percent),
- Guaranteed-ride-home programs (36 percent),
- Vanpool formation (34 percent),
- Parking management (34 percent),
- Vanpool leasing (32 percent), and
- Child care–transportation link (32 percent).

Services now offered were largely of an informational or promotional nature. Only ridematching and vanpool formation directly offered commuting alternatives. The other services were primarily targeted at employer members or involved general information exchange with commuters. They were aimed at educating commuters and employers rather than offering actual commute alternatives.

The major conclusion from the services that are planned is that they tended to be more tangible services oriented toward directly providing commute alternatives or affecting commuting, as through parking management or child care. These services, which usually have the greatest effect on commuter behavior and trip reduction, were primarily implemented by TMAs well into the formation and operation stages. The likely reason for the differences between existing and planned services is that informational and promotional services were far easier and less costly to implement than services such as shuttles or vanpool programs and less controversial to implement than parking management.

Planning and Evaluation

About 50 percent of formation TMAs had completed work and marketing plans, and another 30 to 40 percent were working on them. Of those in the operation stage, approximately 60 percent reported having a work plan. The fact that not all TMAs, particularly in the operation stage, have prepared a work plan is significant, because a work plan is an important activity guide. Also, both Caltrans and UMTA [now the Federal Transit Administration (FTA)], funders to many TMAs, require their grantees to develop work plans.

Fewer TMAs reported monitoring and evaluation as activities, particularly in the earlier development stages. Only 24 percent of TMAs in the formation stage had a program evaluation plan. But of operational TMAs, 55 percent were implementing program evaluation and 32 percent were evaluating services. The relatively low level of service evaluation could be due to the fact that many TMAs have not fully implemented services or that program evaluation (what the TMA is doing) might be seen as a higher priority than service evaluation (how effective the services are).

Impetus for TMA Formation

The project also examined the impetus for TMA formation, that is, what the conditions were that led to the TMAs' being formed. This information was gathered to help in predicting when, how, and where future TMAs might be expected to form.

Information gathered both in the workshops and through the surveys suggested two primary reasons for formation of the California TMAs. One was to respond to a specific or general transportation-related problem. Problems such as traffic congestion and labor market accessibility were mentioned as contributing to their formation by over one-half of the TMAs. In some cases, the TMA was formed by employers interested in "doing something" about traffic.

The second reason was to respond to traffic or air quality regulations. Regulations such as the South Coast Basin's Regulation XV on air quality and local developer traffic mitigation agreements were mentioned by about half of the survey respondents as a factor in the TMA's formation. Many of these TMAs said that although a problem also existed, the regulatory environment spurred the TMA's development.

A factor mentioned by TMAs as contributing to their development was the availability of public-sector grants for TMA start-up. It was not cited as a reason for forming a TMA, but was mentioned by some TMAs as influencing the timing of their initiation. In most cases, survey respondents said that their TMA would have been formed without the grant, but probably not as soon or as quickly.

The responses of some TMAs also indicated that grants from the public sector influenced the choice of a TMA over another organizational form to address local transportation problems. If grants were available "to form TMAs," some groups that might have addressed transportation problems through a chamber of commerce, ETC network, or other organization might have decided to form a TMA instead.

These results suggest that new TMAs are likely to form in areas of rapid employment growth, primarily suburban centers, where transportation services and facilities are not adequate to accommodate the growth. The results also point to locations in which local or state regulations require employers or developers to reduce vehicle trips. Recent legislation points toward a growing trend among state and local governments to mandate trip reduction requirements for employers and developers. If development growth continues to create congestion problems, trip reduction legislation is passed in other locations, and governments reinforce the choice of a TMA as a TDM mechanism, there will likely be more demand for TMA formation.

ASSISTANCE NEEDED BY TMAs

A substantial part of both the TMA surveys and workshops was devoted to identifying the assistance needs of TMAs in each of the three stages of development. TMAs cited two primary needs: financial assistance and one-on-one information assistance.

Financial Assistance

TMAs stated a desire to have public funding beyond the start-up or "seed" period. Some also mentioned the desire for funding to support the initiation or testing of specific services or to support functions that benefitted the public as well as the private sector. Most TMAs have problems with raising private-sector funds and establishing a continuing revenue stream. TMAs are often undercapitalized and operate on a shoestring. The quest for funding preoccupies the attention of many TMA managers, especially during the formation stage. But even TMAs that have been in existence for several years report not feeling secure about their continued funding.

Information Assistance

In the survey TMAs were asked to indicate specific organizational and technical areas in which they currently needed assistance. TMAs that had completed an activity were asked if they would have liked assistance with that activity in the past. The results were organized by the three development stages mentioned earlier.

Exploration Stage

Data collection and analysis were the highest priorities of TMA managers who completed the TMA survey. Two-thirds of TMAs surveyed need or have needed assistance in this area. Having made the decision to pursue the exploration of a TMA, fledgling groups required assistance to develop data needed to assess conditions in their areas, define problems, and identify feasible solutions. TMAs also needed help in working with potential members to build consensus on both the problem and potential solutions. The survey revealed that member identification and commitment of a core group were the second and third priorities of TMA managers.

Formation Stage

The primary thrust of assistance needed by TMAs in the formation stage was in setting up a business. Much of the TMA staff came to their jobs with little experience in forming a new enterprise, and new staff were often overwhelmed by the many challenges they encountered. Based on information from the workshops and surveys, formation TMAs also needed assistance with program evaluation, development of work plans, membership recruitment, and financial planning.

Operation Stage

In the operation stage of TMA development, assistance needs focused on administration and service delivery. The highest priority among survey respondents was planning for financial stability. Concern for financial self-sufficiency continued to preoccupy staff attention. TMAs also needed help identifying and selling benefits to members. At this point it is essential that return on investment be documented to maintain member interest and attract new members. Program monitoring and evaluation were mentioned as the greatest need by survey respondents.

Another area of assistance needed by operation-stage TMAs was service delivery. Most TMAs come into existence to provide services that make it easier for members to meet trip reduction mandates or operate in-house programs that are best provided centrally. TMAs must determine what these services should be and deliver them. Most TMA staff required assistance in assessing the demand for services, developing performance specifications, and initiating services.

RECENT EXPERIENCE

The TMA assessment project was not intended to evaluate the effectiveness of individual TMAs nor to determine whether the concept was worthy of continued funding and attention. It was intended, however, to provide recommendations to Caltrans on changes or additions to the TMA Formation Grant Program that would enhance the success of TMAs as TDM implementation mechanisms. Caltrans chose not to implement all of the recommendations, but did implement many. Several concerned the provision of technical assistance to TMAs. Others involved changes in the funding guidelines. These changes are discussed herein.

Caltrans Fourth-Cycle Grant Process

On the basis of the recommendations of the TMA Assessment Report, Caltrans has made several significant changes in its TMA grant program. Of the grants awarded during fiscal years 1988 through 1990, nearly all were one-for-one matching grants of $60,000 for TMA formation, although a $15,000 feasibility grant was also an option. The discussions in the workshops suggested, however, that some of the grantees applied for formation grants even though they were actually only in the feasibility stage. Thus, some formation grantees were still conducting exploration tasks. This perhaps resulted in their being less secure and less well-developed at the end of the formation funding period than expected.

In spring 1991, Caltrans announced the fourth cycle of the TMA grant program, that is, the fourth announcement of solicitation for applications for new TMA grants. In the fourth-cycle guidelines, Caltrans cited "several ways in which the TMA Development Grant program could better assist in the (TMA) development process:

- Assist TMAs in clearly defining the problems which they, as organizations, are to address.
- Assist in developing a solid business organization to support the TMA prior to its initial operation.
- Assist the TMA in designing saleable and effective transportation demand management services."

Each of these areas was identified in the assessment project as a potential stumbling block for new TMAs. The research suggested that some TMAs were experiencing development problems because of premature formation, poor definition of problems or solutions, or lack of sound structural organization.

Therefore, for the fourth cycle, successful completion of a distinct feasibility step is now a prerequisite to award of a formation grant, in a two-part award. The first part is a $15,000 exploration grant (no match required) to be used to identify the conditions under which the TMA would form and to assess the appropriateness of a TMA to address the area's problems. In the feasibility study, expected to be completed within 6 months, grantees define their service areas, identify the existing and projected transportation problems and potential TDM strategies, and estimate business community support for the TMA and TDM strategies.

If the exploration study concludes that the TMA is an appropriate organization to address the issues and grantees have accumulated at least $15,000 in private cash contributions for TMA support, they may apply for the second part of the award, the formation grant. The formation grant, $60,000 with one-for-one match by the TMA, is seed funding intended to give the grantee time to establish a TMA structure and establish initial TMA services.

Nineteen grants (17 feasibility and 2 formation) were awarded in the fourth cycle. The changes to the funding program encourage groups interested in forming TMAs seriously to assess their potential markets and services and develop a consensus on the problem and the role of a TMA in addressing that problem during the exploration stage. This exploration will put them in a stronger position to undertake formation tasks if TMA feasibility is determined. Some of the exploration studies funded in the fourth cycle may lead to the award of TMA formation grants, and others could result in decisions by groups to form ETC networks, regional public-private advisory councils, or other groups to address transportation issues. With this new focus, Caltrans expects to continue to foster TMA development in California, but also to enhance their prospects for longevity by supporting new TMAs in several critical initial tasks.

TMA Assistance Program

A second recommendation, recently implemented, was for development of a program of one-on-one assistance to TMAs. In March 1991, Caltrans announced the availability of a new program, the TMA Assistance Program, designed to provide management and technical assistance to California TMAs.

The program, which is administered by COMSIS, consists of two assistance elements. The first is management consulting assistance. In this element, TMA staff request assistance on specific topics and a one-on-one meeting is scheduled with one of the six TMA advisors on the consulting team. Nearly all the TMAs surveyed said that they would benefit from assistance with a TMA expert or advisor, preferably in a one-on-one format rather than in group workshops. In the meeting, the TMA advisor helps the TMA develop solutions tailored to its stated immediate need, but also identifies other areas in which the TMA could benefit from the experience of the advising team.

The second element is "quick response" assistance. This is assistance that is available on a limited but ongoing basis to help with brief, easily answered questions. It can be used at any time, but it is envisioned primarily as follow-up to the in-depth management consulting assistance. The advantage of a TMA's meeting first with one of the advisors is that the advisor would then be familiar with unique aspects of the TMA and its operation and could answer future questions with little or no additional research.

Assistance Requested

As of November 1991, 23 TMAs had requested assistance. Most of the requests came from newer TMAs, primarily those initiated since 1989. Only one TMA that existed before 1989 had requested assistance, but the director of that TMA was new to the position. Requested topics have ranged widely. The most common requests have been as follows:

Description	*No. of Requests*
Membership development	15
Membership dues structures	10
Program and service evaluation	9
Development of TDM or TMA services	9
Data collection and analysis	7
Work plan development	7
Board relations and participation	7
Financial planning	7
Shuttle service development	4

Although it is difficult to draw firm conclusions about the TMAs that have requested assistance, there are commonalities, some quite encouraging to the long-term future of TMAs,

but other less so. The large number of requests for assistance with membership development suggests that membership recruitment is difficult for many TMAs. Many TMA managers report finding this task more time-consuming and less rewarding than they had expected. Persuading employers of the benefits of the TMA seems to be easier in areas with employer or developer trip reduction requirements, but far from easy even there. Many managers did not realize how much salesmanship they would need in their positions. Recognizing this need to persuade, many have asked for assistance in measuring their successes (evaluation) to document TMA benefits to members.

TMAs do seem to be well aware of the need to provide desirable, effective services to attract new members and keep existing members. Both new and mature TMAs have stressed their desire to be up and running with services as quickly as possible, and nearly all have asked for assistance on one or more service-related topics.

There is a danger in the rush to provide services, however. Although many TMAs have completed a baseline survey of commute patterns in the area and others have asked for assistance in this task, few have done any significant market analysis of what services their constituents need or want. This is due in part to constrained resources; TMAs do not have either the money or the time to conduct the full range of market research studies needed. There is a growing awareness among TMAs that they must tailor services to their areas, but too many still choose services and model many aspects of their programs on what other TMAs do.

For some services, such as rideshare matching, this might be appropriate, but TMAs are possibly spending valuable resources to provide services that are not the most effective or that their members do not consider worthwhile at the expense of other, more valuable services. The strong interest in shuttle services is a case in point. Four of the requestors have asked for information on shuttle services despite the cautions of transportation professionals that most shuttles, especially those in suburban areas, fail.

An interesting request that has come from seven TMAs concerns staff interaction with the Board of Directors. It is interesting particularly because it has come from both start-up and more mature TMAs. Most of these TMAs have asked for ideas on ways to involve their Boards of Directors more deeply in membership recruitment and long-term planning, but several also are interested in rejuvenating their boards' enthusiasm for TMA activities. An increasing focus on board participation in strategic planning is especially encouraging, because it indicates that some TMAs are thinking beyond day-to-day crisis management and taking time to develop a future vision of the TMA and an action plan to achieve its goals.

Interest in guidance on how to reach financial self-sufficiency has also been common. Several TMAs have asked for help in pricing their services at an appropriate level, that is, high enough to cover the costs of providing the services and generate adequate revenue for TMA operation but low enough to attract a large number of members. This is a delicate balancing act, and over one-third of the TMAs have asked for assistance in developing a member dues or fee structure. Other TMAs have asked for information or ideas on other potential sources of ongoing funding and assistance with financial planning.

Planned Assistance Additions

The assistance program will soon be adding business training for TMAs as a complement to the organizational and technical assistance now provided. Many TMA managers, especially those with TMAs in the formation stage, cited the need for assistance in establishing and running a business. TMA staffs are usually small, and few managers bring a business background to the TMA. This training, which will be available to all TMA managers in California through the University of Southern California Entrepreneurial Services Program, will teach a business approach to TMA management. It will focus on strategic business development, the process of developing and marketing new services, and financial management.

A soon-to-be-implemented change to the assistance program will be its extension to fourth cycle grantees. It was clear from the assessment research that problem definition, development of mission and goals, and consensus building were important early tasks overlooked by many TMAs. Recent contact with existing TMAs has further confirmed the impression of this omission. As a result, assistance will now be offered to the steering committees of recent TMA feasibility grants to help them address these issues early in the TMA exploration process. This assistance is expected to lead to more realistic exploration studies and development of more solidly founded TMAs.

Caltrans' TMA Assistance Program will continue to evolve to meet TMAs' needs. The assistance is tailored to each request and follow-up is provided to ensure that the assistance is responsive. Written guidance materials also are being developed in response to specific requests, and these materials will be available to other TMAs in the future. As more TMAs are formed, through future Caltrans funding cycles and the natural development of TMAs, the program will need to evolve with these changes.

FINDINGS AND CONCLUSIONS

The research undertaken for the TMA Assessment Project and presented in this paper suggests several notable conclusions about the status of TMAs in California that likely apply to TMA development in other locations as well.

TMA Development Stages and Critical Developmental Issues

TMAs pass through three distinct stages from inception to maturity and face specific challenges in each stage:

1. The first stage, exploration, represents a study effort of the feasibility of a TMA to address the area's problems. The primary challenges during this stage are defining specific, tangible problems and developing member consensus on both problems and solutions.
2. The second stage, formation, involves the establishment of an organization structure and identification of appropriate TDM strategies. During this stage, TMAs must develop secure funding sources and effective services that are perceived as valuable to members and potential members.

3. The third stage, operation, is characterized by financial self-sufficiency and a track record of service delivery. In this stage, the TMA challenges are to maintain member interest beyond the initial core support and to document benefits and successes.

Length of Development Period

TMAs differ in the speed of their development, but 18 to 24 months seems to be the average time required to progress from exploration to operation. Movement to operation is enhanced if the exploration stage includes a thorough identification of the problems to be addressed and development of consensus on both problems and solutions.

Reasons for TMA Formation

TMAs reported two primary reasons for formation: to address a transportation-related problem and to respond to traffic or air quality regulations.

This suggests that new TMAs are likely to form in areas with rapid employment growth and insufficient transportation systems and services. The results also point to TMA development in areas where employers and developers are required to reduce vehicle trips. Although not cited as a reason for formation of a TMA, the availability of grants for TMA start-up was mentioned as contributing to the timing of formation.

Funding

TMAs draw funding from a variety of public and private sources, but most are undercapitalized and operate on a shoestring, particularly during the early stages. Even TMAs in the operation stage report concerns over financial self-sufficiency.

Services

TMAs typically begin to develop services during the formation stage, but actually implement few until the operation stage. Initial TMA services are frequently informational in nature, such as rideshare promotion, but offer few tangible alternatives to commuters. As the TMA matures, its services are generally broadened to include services, such as vanpool leasing and guaranteed-ride-home programs, that can more directly affect commuting behavior.

Evaluation

Few TMAs now actively monitor or evaluate their services. This could be due to the fact that many have not fully implemented services, or that program evaluation (what the TMA is doing) is seen as a higher priority than service evaluation (effectiveness of services). The absence of evaluation data makes it difficult to determine how effective TMAs are as TDM implementation mechanisms, either individually or as a group.

Assistance Needs

TMAs report needing assistance on a wide variety of topics related to TMA operation and service planning and delivery. Primary assistance needs vary by stage of development:

- Exploration stage: data collection and analysis, problem definition and consensus building, member identification.
- Formation stage: business start-up, program evaluation, member recruitment, and financial planning.
- Operation stage: service development, service monitoring, financial planning, and board and member relations.

Research Needed

The TMA Assessment Project identified many of the characteristics of current TMAs, that is, what TMAs are and do. Little is known, however, of the effectiveness or cost-effectiveness of TMAs as mechanisms for TDM implementation—whether what TMAs do improves area mobility or reduces trips in an area. This is due in large part to the absence of data on TMAs' impact on trip-making patterns or on transportation decision-making processes that can lead to increased commute options.

Interest in determining TMAs' effectiveness is increasing, however, as both public and private groups demand to know if the resources they allocate to TMAs are well spent. A thorough evaluation of the results achieved by existing TMAs is greatly needed. Many of the findings noted in this paper suggest that TMAs require several years of growth before they are fully operational and before they should be expected to produce trip reduction results. A point in TMA development is now being reached, however, when TMAs are both numerous and mature enough for a rigorous study of their effectiveness to be contemplated. TMAs, their members and other funders, and many other public and private groups would benefit from such research.

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Transportation Management Associations and Privatization

CATHERINE ROSS, ERIK FERGUSON, AND MICHAEL MEYER

The role of transportation management associations (TMAs) within the broader context of privatization is examined and their potential for the delivery of innovative, less expensive, and responsive service is evaluated. Findings support their further development and suggest that federal, state, and local governments consider strategies to encourage their formation. The results reported here are based on information collected in a survey of TMAs and previous research findings. A survey of Executive Directors and Boards of Directors of 110 TMAs was conducted in 1991 with a 55 percent response rate. The benefits of privatization are examined from both a historical and a contemporary perspective, focusing on recent government initiatives to enhance the role of the private sector. Although TMAs were initially formed almost a decade ago, there has been little evaluation; in fact, more than 50 percent of existing TMAs have not conducted an assessment.

Transportation management associations (TMAs) represent an opportunity to merge the public and private sectors in a manner that is potentially innovative, less expensive, responsive to local needs, and comprehensive. Governments have a long history of cooperation with the private sector for a wide variety of services. Recently, there has been a call for increased involvement by the private sector in the provision of mass transit, because privatization potentially reduces costs and increases efficiency. There are many methods by which governments can privatize some of their transportation services, and transportation management associations (TMAs) are one of the most innovative and uncomplicated ways for the private sector to provide transit on a relatively small scale. In this paper TMAs are examined within the context of privatization and their potential for innovative, less expensive, and responsive service is evaluated. Findings suggest that federal, state, and local governments should consider investing in strategies that will encourage the formation of TMAs. There is continuing need for objective, analytic assessment of TMAs; more than 50 percent of existing TMAs have never conducted an evaluation. The results reported here are based on information collected in a survey of TMAs and previous research findings. The survey of Executive Directors and Boards of Directors of 110 TMAs was conducted in 1991 with a 55 percent response rate.

HISTORY OF PRIVATIZATION OF TRANSPORTATION SERVICES

From the beginning of organized transportation, private operators were involved in service delivery. A private operator is anyone who owns a mode of transportation or a person or firm whose business it is to make a profit by transporting people or goods. By the end of the 19th century, cities had granted electric streetcar franchises to private operators, and developers often funded the construction of these lines to increase the value of outlying properties. Until the early part of this century, all roads were state-owned or privately owned, with no assistance for planning, engineering, construction, or maintenance. With the creation of the Bureau of Public Roads in 1916 and the Federal-Aid Highway Act of 1934, the federal government substantially increased its role in the provision of transportation services.

All of the nation's available resources were consumed during World War II, and operators attempted to maintain existing service while meeting the great demand for new services. In 1944 private transit operators carried over 23 million passengers, the largest number of transit passengers ever (*1*). In that same year, Congress passed the Federal-Aid Highway Act of 1944, which chronicled the ever-increasing role of the federal government in the provision of transportation services. This act authorized federal-aid highway funding up to 45 percent for primary roads, 30 percent for secondary systems, and 25 percent for an urban extension of primary and secondary roads. Buses were the preferred method of public transportation, and bus systems operated under the same franchise system that governed their predecessors, the streetcars.

After the war ended, transit ridership decreased by the same rate at which it had increased during the war. Ridership dropped from about 17 billion passenger-trips in 1950 to fewer than 9 billion passenger-trips in 1961 (*2*). People bought automobiles at record rates and moved to the suburbs. Transit operators found themselves in financial trouble during this period because of long-deferred maintenance and labor demands. Public transit authorities were created, and they operated the financially strapped businesses in many cities. The earliest notable ones are the Chicago Transit Authority and the Metropolitan Transit Authority of Boston, created in 1947, and the New York City Transit Authority, created in 1955 (*1*). Because of market failures, the role of the private provider of transportation services decreased during the next decades, except those in air and water transportation.

In 1964 Congress enacted the Urban Mass Transportation Act providing federal grants to cities for the purchase of local transit companies. By 1980 the public sector owned and operated 92 percent of all bus and rail transportation in the country (*2*). During this time, ridership continued to decrease, and operating deficits grew. In 1974 the federal government authorized subsidies for local transit authorities, but these subsidies failed to reverse the trends. Federal, state, and local

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subsidies for public transit rose from $132 million in 1970 to over $5 billion in 1983. Ridership, on the other hand, remained at about 6 billion passenger-trips a year during the same period (*3*).

As the demand for federal assistance grew, the government's ability to provide that assistance decreased. During the Reagan Administration the privatization of many services, including transportation, was considered an effective way to generate revenue and lower costs. The logic behind this is that through the privatization of transportation services, competition for services increases. Increased competition potentially increases efficiency and reduces costs (*4*). The public transportation marketplace would change as a result of competitive forces, rather than through public regulation. Studies have shown that private-operator labor costs are about half of public-operator labor costs (*5*). Governments could benefit by selling their physical assets and shifting the money to other programs. To achieve a greater level of private participation in the transportation marketplace, the U.S. Department of Transportation attempted to remove barriers in the operation and financing of transportation services.

In 1984 the former Urban Mass Transportation Administration (now the Federal Transit Administration) issued a Policy on Private Participation in the Urban Mass Transportation Program. This policy provided guidelines for compliance with several sections of the Urban Mass Transportation Act (*1*). Section 3(e) prohibited unfair competition with private providers by publicly subsidized operators. Section 8(e) required maximum participation of the private sector in the planning of public transportation services. The Surface Transportation Assistance Act of 1982, which added Section 9, established procedures for involving the private sector in the development of the Transportation Improvement Program (TIP) as a condition for federal funding (*1*). This policy calls for the early involvement of private providers in the development of new transit services and for their maximum feasible participation in the provision of such services. The policy identifies the principal criteria used by UMTA to determine if recipients have complied with the statutes. UMTA requires the transit agency to consult private providers when it develops plans for new or restructured services.

In addition, transit agencies must consider private carriers for the provision of new or restructured services, and they must also use a true comparison of cost when comparing publicly provided service with that of private providers (*1*). This policy represents a major departure from past federal policy toward public transportation operators. Previously, public operators had virtually monopolized federal funds for transit facilities, equipment and service. With the enactment of this policy, transit agencies needed to consider private-sector operators as competitors for the provision of transportation services (*1*). Local transit agencies began to implement the policy almost immediately. By 1988, 35 percent of local transit agencies had contracted out at least a portion of their service to private providers (*6*). Public transit agencies are also exploring other ways to involve the private sector in the provision of public transportation, such as impact fees and TMAs.

In this decade, cities and states face unprecedented budget crises, the transportation infrastructure is deteriorating, and the administration wants to reduce funding. State and local governments are proposing tax increases and service reductions in response to shrinking budgets. In this environment, the privatization of transportation services can be a viable alternative to service reductions and increases in taxes. In March 1991, the New York City Council's Economic Development Committee heard testimony concerning the sale of LaGuardia and Kennedy airports. The sale would bring an estimated $1 billion to the city of New York, along with millions in tax revenues (*7*). This kind of approach, in which the public sector sells facilities and then contracts with the purchasing authority, is representative of another aspect of privatization.

There is, however, a major federal obstacle that attenuates the feasibility of privatization of transportation services. Most local governments finance their infrastructure projects in part with federal grants from agencies other than UMTA. In return for these grants, the federal government requires local governments to sign detailed grant agreements, many of which discourage privatization. In one case, the proposed sale of the Albany, New York, airport was prohibited by the Federal Aviation Administration (FAA) because of FAA's interpretation of the grant agreement (*7*).

In 1988 every federal agency adopted the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments. These guidelines permit local and state governments to terminate a federal grant unilaterally for any reason. Before 1988, the law required that both parties agree to the termination. In the event of a termination, the grantee must negotiate a settlement for the outstanding grant obligations, either directly with the granting agency or, if the agency is uncooperative, with the Justice Department (*7*). With these guidelines, local governments can take steps to investigate the privatization of transportation or other services.

PRIVATIZATION OF PUBLIC SERVICES

Privatization of a public service is the direct and voluntary involvement of the private sector in the planning, funding, delivery, operation, and ownership of a traditionally public service (*8*). There are three categories of privatization: private-sector choice, financing, and production of a service; public-sector choice and financing with private-sector production of the service; or deregulation of private firms that provide a service (*9*). In the first category the public sector transfers all responsibility for a service to individual consumers. These consumers first select the level of service that they desire and then purchase that service from private suppliers. Government involvement is minimal. In the second category of privatization, the public and private sectors are both active in the provision of services. Consumers collectively select and pay for the amount and type of service desired through the government. The government then contracts with private firms to produce the desired quantity and type of service. The third category occurs when governments reduce or eliminate the restrictions imposed on private firms that provide individually selected services.

The private sector finances and produces traditional public services and has been increasing its involvement. Private companies across the nation are already experimenting with new opportunities. In Pittsburgh, Pennsylvania, the developer of

an office complex near Three Rivers Stadium plans to provide a peoplemover service that would connect the project to the city's light rail transit system. The developer will contribute to the financing and construction of the peoplemover. Additional funds will come from parking revenue at Three Rivers Stadium and advertising, and the system will operate without charging fares. The capital costs of this project will be 30 to 50 percent below public construction costs, and operating costs will be less than half of a public agency's operating costs (*10*). In Chicago, Illinois, about a dozen private companies operate fleets of subscription buses that connect the downtown with the suburbs. Passengers subscribe to the service on a monthly basis. The system competes directly with the city's commuter rail line and operates as a charter bus service to avoid the quagmire of route and price regulation (*11*). Just outside of Dallas, Texas, in the planned city of Las Colinas, developers and property purchasers are funding an automated system designed to link all of the major urban centers of the new community (*8*). In Tysons Corner, Virginia, area businessmen responded to the inadequacy of public transit by forming the Tysons Transportation Association (TTA), one of the country's first TMAs. TTA installed and currently operates a vanpool system for employees of member businesses, and the revenue necessary to maintain the system is generated through fare collection (*12*).

The private sector produces publicly selected and financed goods in three ways. First, the private sector can produce intermediate goods, such as vehicles and computers, that the government uses to supply the final service. The private sector may also produce services, such as maintenance or accounting, that the government must buy in order to carry out its operations. Finally, private producers can provide the final services, such as education, police and fire protection, and transportation, that are consumed directly by the public (*9*). The provision of the final service itself is usually the objective of privatization.

Governments throughout the country are contracting with private companies for the provision of final services. In New Jersey private carriers operate 35 percent of the state's commuter bus transportation (*13*). In Las Vegas, Nevada, the city government recently awarded a contract for the provision of a new transit service. Under the terms of the agreement, the city provides the right-of-way for the system, and the private company finances, builds, owns, and operates the system (*8*). Johnson County, Kansas, a suburban county of Kansas City, Missouri, contracted its commuter bus service to a private provider because of dissatisfaction with the service provided by the public transit agency in Kansas City. Under the terms of the contract, the government requires the provider to paint and maintain its vehicles to county standards. The government has also imposed certain performance standards on the service (*14*). One major barrier to contracting out is Section 13(c) of the Urban Mass Transportation Act of 1964, which provides public-sector transit employees with extensive protection against any federally supported activity that may threaten their jobs. Unions may use this provision to block attempts to contract services out. Contracting also suffers from a lack of visibility, and many private operators do not take advantage of the opportunity to bid on contracts.

The third and final type of privatization involves the relaxing or lifting of restrictions that the government can impose on private providers of transit services. These regulations often prevent smaller private firms from entering the market. For example, many cities restrict the number of taxis that can operate in the city, even though taxis may be an economical alternative to public transit in low-density residential neighborhoods. Studies indicate that in areas where government deregulates entry into the taxi market, the quality of the service improves. Free entry results in shorter waits and better integration with local bus and rail systems (*3*).

Another private transit alternative that suffers from heavy government regulation is the jitney. A jitney is a small van or station wagon that carries a small number of passengers along a semifixed route on a regular basis. Jitneys were popular in this country in the early part of this century, but cities eventually banned them through the efforts of trolley operators, who claimed that they were unlicensed and cut into their rush-hour profits. Jitneys are quite popular in developing nations because they are relatively inexpensive; in fact, they operate illegally in many cities in the United States because of the demand by lower-income groups. San Diego, California, legalized jitneys in the early part of the 1980s, and by 1983 they carried 12,000 passengers a week at fares that were significantly less than those charged by taxis (*3*).

Government regulation can also work against vanpools and commuter buses. The courts usually consider these services to be public carriers; therefore, these services are subjected to the same route and fare regulations that govern public transit. As mentioned earlier, the subscription bus service in Chicago can remain in business only because it operates as a charter bus service. Recently, several states have exempted employer-sponsored vanpools from regulation, and Tennessee even allows private bus service without regulation in specially designated "citizen transportation areas" (*3*).

Governments desire privatization because it can be a way to reduce public costs. In looking at the cost savings accrued through privatization, the argument is that government producers have no incentive to hold down production costs, whereas private producers who contract with the government do. The lower the cost incurred by the firm in satisfying the contract, the greater the profit will be for the firm. Competition among potential private suppliers for a contract (for a limited period, after which the government can change contractors) will result in the lowest possible cost for the specified level of service (*9*). The following quote summarizes the argument:

> Competitive bidding by profit-maximizing firms for a well-specified output guarantees that the product will be produced at the lowest cost. The absence of competition and profit incentives in the public sector is not likely to result in cost optimization. (*15*)

Three potential sources of lower production costs for private firms are lower labor costs and better management, more research and development, and faster innovation of the results. Lower labor costs result either from lower wages, which implies that the government pays inflated wages for a given skill, or from less labor input, which suggests that the government either employs too many workers or uses inefficient production methods (*9*). A private firm is more flexible than a public transit agency. Private operators may try out different approaches more quickly, whereas government tends to adhere to the current approach because change often creates

substantial political difficulties for local officials. Better management or experimentation and innovation with different production methods may be the reason for lower production costs and fewer workers. In addition, private firms may use retained earnings to finance research or to purchase new capital equipment, which lowers unit production costs. Government may not allocate tax revenues to those purposes as easily because there are many competing demands for a share of a government's budget (*9*). Clearly, these are characteristics that should be applied in public service delivery.

TRANSPORTATION MANAGEMENT ASSOCIATIONS

TMAs are one form of privatization of public transit; they are also known as transportation management organizations (TMOs). They are public-private partnerships with a strong emphasis on private-sector participation. Many TMAs form as a response to the problem of traffic congestion in suburban areas (*16*). Other reasons for the formation of a TMA include the promotion of economic development and the improvement of air quality. Today there are 110 TMAs in various stages of development across the country. Most of these organizations started up within the last 3 years, although the first TMAs were initially formed almost a decade ago.

Structure of TMAs

TMAs have an overwhelming private-sector composition and orientation (Table 1). The average TMA consists of about 30 member organizations, 22 (73 percent) of which are private, for-profit firms. Another six (20 percent) of the member firms are private, nonprofit groups, and two member organizations (7 percent) are public agencies. Corporate membership is usually voluntary, and each member often pays membership dues. This money could be considered public money spent by the private sector. Additional sources of revenue include contributions from developers and local government and fees collected from the users of certain services. A Board of Directors governs the overwhelming majority of TMAs (82 percent). The average board consists of about 14 members, 12 of whom (86 percent) are allowed a vote. In most cases, the board appoints an Executive Director to administer the TMA. On average, eight board members (57 percent) represent private, for-profit firms. Private, not-for-profit organizations and public agencies have three representatives (21 percent) apiece.

TABLE 1 STRUCTURE OF TMAs

Characteristic	No.	Percent
Average size	30	—
Member organizations		
Private		
For profit	—	73
Nonprofit	—	20
Public agencies	—	7
Governed by Board of Directors	—	82
Private for profit	—	57
Private nonprofit	—	21
Average Board size	14	

Almost all private, for-profit board members may vote, but members representing other interests receive that privilege less frequently. When surveyed, board members cited the following reasons for joining the TMA board: to address local transportation problems, to represent their organization directly, to assist in the establishment of the TMA, to serve as a liaison between the TMA and other organizations, or all of those reasons (Ferguson et al., unpublished data).

The most common goals of TMAs are the implementation of travel demand strategies, such as ridesharing and transit use, and the reduction of congestion and pollution. TMAs typically include information on carpools and public transit scheduling, guaranteed rides home, and vanpools. In addition to these services, several TMAs also operate as advocates in local politics. The members of TMAs often have considerable influence with local government, and the TMA can organize this influence into a significant lobbying unit. TMAs have also negotiated with local public transit agencies for route adjustments that better serve the needs of the community (*17*).

Examples of TMAs include, among many others, the Woodlands, a mixed-use development outside Houston, Texas. Here the developer provides a vanpool to residents of the community because public transit does not service the area. The Hacienda Business Park in Contra Costa County, California, developed a program that focused first on the promotion of ridesharing. In later stages the program will expand to include flexible work hours and shuttles to public transit stations. The El Segundo Employers Association in Los Angeles, California, was formed to address transportation problems at Los Angeles International Airport (LAX). The association is responsible for the implementation of reversible lanes at the airport, a carpool and vanpool program, a flexible-work-hours program, and the provision of a bike path (*18*).

TMAs are not being effectively monitored. In fact only 19 percent have participated in any kind of an evaluation and therefore it is difficult to ascertain the magnitude of their impact on privatization:

Status of Evaluation	*Percent*
Evaluated	19
Not evaluated	54
Planned evaluation	
Yearly	24
2–3 years	31
Never	20

Privatization and TMAs

The provision of mass transit services presents both the public and private sectors with two potential roles: service sponsor and service provider. A service sponsor decides what services to provide and their characteristics, such as routes, schedules, and fares. The service sponsor arranges for provision of the service. The sponsor's role is essentially one of policy making, planning, and facilitation. The service operator, on the other hand, actually produces the service—operates and maintains the vehicles, hires the drivers, and so on. There is no reason why sponsor and operator must be the same organization, and in many public services different groups play each role (*5*). In traditional mass transit, the government is both sponsor and operator. Most discussions of privatization focus on the

private sector as service provider, with the government maintaining its role as sponsor. For example, the government may contract out its bus routes but at the same time may impose certain performance standards through the contract. The public sector remains the sponsor of the service and retains control over the amount and quality of transit service provided (*5*). A good example of the two roles exists in New York City, where private firms provide about 15 percent of the local transit service. However, local-service bus firms, which also provide some express bus service, have exclusive rights to the routes they operate. The government, however, still regulates fares and other service features (*5*). This type of privatization, with government as service sponsor and the private sector as service provider, presents several potential obstacles:

- Transit managers tend to view privatization of transit services unfavorably.
- Transit labor unions are almost always opposed to contracting.
- When subsidy sources are dedicated exclusively, as is often the case for large transit agencies, transit policy makers may lack the incentive to support contracting.
- The service quality of private operators may be below public agency standards, creating dissatisfaction on the part of the sponsor and the patrons.
- Finding a suitable private provider may be problematic, and maintaining a competitive environment may be difficult.
- Although the monetary savings may be impressive in percentages, the dollar amounts may not be enough to warrant contracting (*19*).

With TMAs, the discussion of privatization acquires a slightly different perspective. In this case government is neither service sponsor nor service provider. The TMA is formed by its members' volition, and they decide what services to offer and either provide those services directly or contract them out. The TMA is almost always the service sponsor and frequently the service provider as well. The role of the government is that of advisor.

As a result of this difference in roles, some of the aforementioned obstacles to privatization may no longer apply. The government does not have to find a suitable private provider, and competition is irrelevant because profit is not a major motivation for most TMAs, as indicated by the goals and objectives mentioned earlier. TMAs form in response to shortcomings in the public transit system and provide services that currently do not exist. As a result, labor unions and transit managers may argue in favor of the public provision of those services, but the initiation of new services does not threaten jobs or subsidies. The problem of the quality of service should take care of itself. If users are dissatisfied with the service, they will stop using it. The purpose of the TMA is to encourage alternatives to automobile commuting. The quality of the service must be such that these alternatives are attractive to potential users.

With the new definition of roles comes a new set of potential barriers. The creation of a TMA depends almost entirely on private-sector initiative. The private sector decides that the area needs a TMA, and the private sector can dissolve the TMA at any time. Even if some business leaders do organize a TMA, membership is voluntary, and not all businesses in the area served must belong. The government must identify strategies that encourage the formation and the perpetuation of TMAs, as well as policies that encourage businesses to join.

The government can encourage the formation of TMAs by making them mandatory. There are several tools that the government can use to accomplish this objective. Localities may enact trip reduction ordinances, which force businesses to investigate methods by which the number of trips to and from their locations may be reduced. Government may also tie the formation of a TMA to the granting of building occupancy permits and the approval of rezoning requests. The government may also, for budgetary reasons, not be able to extend transit services to a new development. Because accessibility and convenience are important to both employees and customers, the firms in the project may want to provide some transit services of their own. Developers can also require membership in the TMA as part of the lease agreement.

There are also several incentives that government can offer. For example, because many TMAs attempt to link an area with existing public transit lines, the public sector can offer discounted passes for TMA members. The local government can also offer property tax breaks for businesses that join a TMA. Developers who agree to help start up a TMA in their lease agreements could be exempted from paying certain impact fees.

CONCLUSIONS

TMAs are but one technique that governments can use to privatize transit services. These associations have several features that appeal to the public sector: they require relatively little public money, and they offer a degree of flexibility in the provision of service that large public transit agencies lack. TMAs also indicate a willingness among developers and business leaders to assume some of the responsibility of meeting the transportation demand that their operations generate. In addition to these benefits, governments should be aware of the following characteristics:

- TMAs are formed mainly through the initiative of the private sector. Governments may have limited ability to require TMAs, but the most important role of government is that of advisor and coordinator. Governments need to explore incentives that will lead to the formation and continuation of TMAs.
- TMAs serve private-sector interests. The majority of voting members on the average TMA board represent private, for-profit firms. Governments must insist on the consideration of public concerns.
- The service area of a TMA is usually quite small as compared with those of public transit agencies. TMAs often serve only the needs of a specific service activity area within the community. Governments should explore ways to expand the scale of TMA operations.

TMAs are an innovative mechanism for the privatization of transit services, and governments should examine their potential in meeting local transit demands and develop creative support mechanisms.

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Road and Parking Pricing: Issues and Research Needs

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Road and parking pricing are of increasing interest to transportation and air quality planners as ways to reduce automobile use and traffic with its associated pollution. Three road and parking pricing concepts are examined. The issues of effectiveness, feasibility, legality, acceptance, and implementation are evaluated on the basis of experience and research to date. In road pricing, key issues include public acceptability, legal impediments with respect to pricing of federally aided facilities, legislative requirements concerning enforcement, administration of large-scale permit distribution or automatic vehicle identification (AVI) systems, and institutional requirements pertaining to administration, enforcement, and revenue distribution. Parking pricing issues relate to the extent of pricing (public or private parking facilities or both), the legal and administrative implications of taxing the providers or users of parking, how employer policies interact with parking pricing to influence employee automobile use and mode choice, and the question of enforcing pricing permit schemes on private property. Specific research and assessment needed to address the issues are suggested, and roles for local, state, and federal agencies in carrying out the research agenda are identified.

Three broad road and parking pricing strategies may reduce congestion and improve air quality in urban areas. Pricing may focus on

- Major facilities, including freeways and highways in a region or leading to and from large activity centers and downtowns;
- Areawide networks, including surface streets in a congested zone;
- Areawide parking, including parking facilities in a zone.

ROAD AND PARKING PRICING OPTIONS

Facility Parking

In facility pricing, road users would be charged on the basis of their use of congested highway facilities. A congestion pricing program could cover a large portion of the highway network or could confine charges only to selected freeway segments or facilities in a travel corridor. The required charges for highway use could be assessed automatically by mounting electronic licenses on the affected vehicles. The charges would be made at pricing points along a facility through electronic roadside interrogators. This technology, dubbed automatic vehicle identification (AVI), has been tested successfully in controlled pilot projects. It promises an effective way of implementing road pricing, although many questions about its application in the United States remain unanswered.

One major problem with AVI is how to accommodate occasional road users who may not have electronic licenses. For these infrequent users, supplementary licenses would be necessary, making it more costly to enforce and administer the program. If all vehicles were equipped with AVI (perhaps for theft prevention, collection of travel data, or general vehicle identification and registration), this problem of the occasional user would be solved.

The alternative to AVI is to require the affected vehicles to prepurchase and display supplementary windshield permits (daily, weekly, or monthly). The administrative and enforcement problems for this option are likely to be more difficult compared with those for AVI, because it would require retail distribution systems and manual or photographic monitoring of moving vehicles for proper use at freeway ramps and intersections.

Areawide Pricing

In the areawide pricing alternative, vehicles entering an area from surface streets or freeway exit ramps would pay a special price or charge. Larger or smaller areas could be designated as priced areas. Clearly, larger benefits would be realized if pricing was applied to all areas with significant congestion.

It would not be appropriate from the efficiency standpoint to price an entire region, simply because not all areas in a region are congested. However, to guard against the disadvantage to competitive businesses and development in priced areas, more than just a few areas within the region would need to be considered for pricing (possibly most major activity centers).

As with facility pricing, electronic licenses could be used to automatically charge the affected vehicles at roadside pricing points equipped with electronic interrogators. Again, there is the problem of AVI's accommodating occasional users. Alternatively, supplementary licenses could be required for all vehicles entering the designated priced areas. The use of supplementary licenses for areawide pricing application might not be as problematic as their use for freeway pricing. In area pricing, monitoring would be required for vehicles moving much slower than in corridor applications. Such area pricing has been used in Singapore, although many questions remain for U.S. application, particularly if many drivers try to subvert the system.

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Parking Pricing

The areawide road pricing just described would collect charges from all vehicles entering designated areas at certain times of the day. Such a program would use supplementary licenses (windshield stickers) or electronic licenses and require monitoring of moving vehicles as they enter the priced area.

Another areawide pricing alternative is to charge all parked vehicles in the designated areas at given times. This would require charges for vehicles parked in all private and public spaces (on and off street) within an area. Such a policy would cover all traffic but through traffic. Thus, although it would not be as effective as the areawide pricing policy, it would still affect a large number of vehicles. Parking prices would be much easier to enforce because moving vehicles would not have to be monitored.

In an areawide parking pricing program, the affected vehicles would be required to purchase and display a special parking permit (available at retail outlets in daily, weekly, or monthly designations). Daily and hourly areawide parking permits are in use in several U.S. and European cities. Thus, a parking permit approach should be feasible.

Significant reductions in travel are possible with this policy, particularly if major employment and other activity centers in a region are covered. The analysis of impacts of such policies is difficult, because those facing parking charges may spill over outside the priced area and into surrounding residential and retail spaces. Careful design of area boundaries and parking regulations in adjoining areas would be needed to reduce such unintended consequences. Heavy and widespread employer subsidies for employee parking also would defeat the program.

ISSUES

There are many unanswered questions about the three pricing concepts. Although they promise to reduce congestion and generate revenues for transportation alternatives, general issues arise around

- Public acceptability, including concerns about right to travel, paying for roads twice through pricing and gasoline taxes, and the quality of alternative modes or facilities for those not wanting to pay;
- Possible legal impediments, at least with respect to the pricing of federally aided facilities;
- Legislative requirements to facilitate enforcement and to permit demonstration on federally aided facilities;
- Need for a large-scale distribution system for permits or AVI, possibly involving both government and retail outlets; and
- Requirements for new organizations to apply and enforce congestion pricing and new roles for existing institutions with respect to collection and distribution of revenues.

Specific issues surrounding each pricing alternative are discussed in the following sections.

Facility Pricing

Section 129, Title 23, of the U.S. Code effectively bans toll roads on federal-aid facilities. In the past, only special exemptions have allowed states to use federal funds to construct toll bridges, tunnels, and approaches to federal-aid highways. In these exceptions, states agreed to discontinue tolls upon retirement of bond indebtedness unless Congress passed legislation waiving the requirement. Congress has granted exceptions and allowed toll collections to continue after bonds are paid off, but also required the state to repay the federal investment. The state of Delaware has paid back the federal portion of some toll roads. In Maine, the federal portion was forgiven. However, forgiveness is very rare and is allowed only for unusual circumstances such as for worn-out facilities.

Under the Intermodal Surface Transportation Efficiency Act of 1991, tolls on federal-aid facilities are permitted to a much greater degree than in the past. Permitted types of work are initial construction of toll facilities (except for Interstate facilities), so-called 4R work on toll facilities, reconstruction or replacement of free bridges or tunnels and conversion to toll facilities, reconstruction of free highways (except Interstate roads) to convert them to toll roads, and preliminary studies to determine the feasibility of any of the above work. The act also allows congestion pricing strategies (e.g., higher tolls in the peak than off peak or higher tolls for solo drivers versus carpoolers) under a pilot program. Five projects are allowed, up to three on the Interstate system.

Of course, federal-aid restraints on pricing do not apply to new private toll roads. For example, in 1990 California Governor Deukmejian approved four private toll road projects under the provisions of AB 680. Two of these projects may provide opportunities for congestion pricing. They are the 11.2-mi extension of the Orange Freeway (Route 57) along the Santa Ana River channel and an extension of the high-occupancy-vehicle (HOV) lanes in the median of the Riverside Freeway (Route 91) in Orange County. The other projects are in northern California and in southeast San Diego County.

An important issue in private toll road projects is how project sponsors might be encouraged or required to implement congestion pricing. For example, in the case of California legislation AB 680, the California Department of Transportation (Caltrans) is not authorized to set or regulate toll schedules for these projects. The only requirement of the legislation with respect to tolls is that "toll revenues be applied to payment of the private entity's capital outlay costs for the project, the costs associated with operations, toll collection, and administration of the facility, reimbursement to the state for the costs of maintenance and police services, and a reasonable return on investment . . . [and that] any excess toll revenue be applied to any indebtedness incurred by the private entity with respect to the project or be paid into the State Highway Account." Of course, nothing prevents Caltrans from negotiating for congestion pricing in project agreements with the private project sponsors.

Some states may have legislation authorizing state regulation of tolls on private facilities. Such legislation may allow state agencies to require congestion pricing on private toll facilities. For example, California Streets and Highways Code

Division 17, Chapter 3, 30800, gives the state certain rights in the approval of toll facilities. In particular, Caltrans "has exclusive jurisdiction . . . and may grant franchises, privileges or licenses for the construction of toll bridges, toll roads and toll ferries . . . situated wholly or in part within the State." Furthermore, Section 30802 indicates that the state may "fix the toll rates" of any such toll agency or entity and regulate what amounts are kept (30805) and the disposition of the funds (30808). Several authorities are authorized by Section 30802 (e.g., Gold Rush Parkway, El Dorado County Tunnel), with specific language authorizing tolls, bonding, acquisition, and operation authority.

Enforcement of pricing is a key issue on private toll roads, especially who would carry out the enforcement. In the California example, AB 680 allows the state to provide police services at cost. Section 143 refers to "agreements for maintenance and police services entered into pursuant to this section. . . ." Consequently, because the California Highway Patrol is authorized to issue citations on state-owned facilities, there is no need for the private toll road sponsors to obtain special legislation to enforce against toll evasion. However, in other states, there may be a need for such legislation.

Another enforcement issue applying to both private and public toll facilities is whether the driver or owner is liable for evading the toll. Under many state laws, drivers and not owners are liable for evading tolls. This provision presents two enforcement options: (a) enforcers must be available and ready at or near pricing points and apprehend drivers at the time of violation, and (*b*) enforcers must rely on photographs of vehicles and drivers as well as on a mail citation system. The first option requires enforcement resources and the logistics of pursuing and stopping a driver. The second option entails complex legal procedures relying on vehicle registration. If the vehicle is not registered, there is no way to locate and cite the driver.

The enforcement complexities involved in the aspect of the second option in which photographs of violators are used are illustrated by the following example. Pasadena, California, uses photo radar at 57 locations to enforce against speeding (the technology also is used in Cambell, Danville, and Roseville, California). A camera takes pictures of vehicles and drivers traveling over the speed limit as indicated by radar. The city then mails the owners of speeding vehicles a request for pay. The request is not a legally binding instrument, since under state law the city cannot issue such instruments to vehicle owners without evidence that the owner was the driver of the speeding vehicle. Many vehicle owners pay the fine indicated in the request, in spite of the fact that it is not binding. According to police staff (Sergeant Gray, Pasadena Police, unpublished data, telephone interview, November 28, 1990), the city obtains an 84 percent compliance rate on requests to pay. However, if a notice is not paid, the city then obtains from the California Department of Motor Vehicles (DMV) a facsimile of the owner's driver license. If the picture on the license matches the photo radar picture the city then issues a legally binding *summons* against the driver. However, if there is no match (meaning that someone other than the owner was driving), the city cannot issue a summons. Of course, if the vehicle is not registered, police cannot initiate the enforcement process.

Clearly, enforcement procedures would be greatly simplified by legislation that makes the registered owner liable for moving violations or toll evasion on toll roads. The city of New York recently obtained state legislation making the vehicle owner liable for moving violations, except for cases involving a stolen vehicle. This legislation may provide a starting model for consideration.

Areawide Pricing

Perhaps the foremost issue with areawide pricing is effectiveness. Areawide pricing for an activity center may not relieve much congestion on the region's freeway system, where the congestion may also be severe. To achieve significant reductions in freeway congestion, several major areas in the region may require pricing. It may be difficult to gain acceptance for such an extensive approach.

The main implementation issues surrounding areawide pricing are the mechanism for pricing and its enforcement. In an areawide approach such as that implemented in Singapore, vehicles are required to display a permit or carry an electronic tag that is recognized by a roadside electronic device. Either could be required for entry into a priced zone. Two key issues include how users of the priced zone acquire permits or tags and how enforcement might be carried out.

Experience in the United States and overseas suggests that permits for areawide pricing programs might be sold effectively through local retail and government establishments. However, there has been no experience with regional sales and distribution. For example, in Santa Cruz County, California, areawide parking permits allowing visitors to park along 3 mi of coastline are sold through retailers and roving vans. In Eugene, Oregon, retailers sell city parking permits to commuters for daily, weekly, and monthly parking privileges in residential and retail areas around the University of Oregon. In Cork, Ireland, and in several cities in Israel, retailers and post offices sell permits for parking on the street. Permit sale volumes are substantial, because the programs regulate on-street parking over large areas. In essence, the permits serve the same function as parking meters, except that the meter is on the vehicle instead of on the street. In short, experience suggests that it should be possible to distribute permits to both regular and infrequent users through local retail outlets, at least for localized programs.

The other implementation issue is enforcing areawide pricing. In Singapore for many years, two dozen enforcers stationed at 22 entry points successfully monitored vehicles without permits. Now cameras are used to take pictures of license plates for later citation. Revenues from citations in Singapore have more than offset enforcement program costs. In Hong Kong, electronic pricing successfully monitored 99 percent of passing vehicles in a pilot program. Closed-circuit cameras had no difficulty identifying automobiles for purposes of evaluation and valuation recording (*1*,*2*). However, as with the enforcement of toll road AVI systems, discussed previously, most state laws do not hold the vehicle owner liable for evading tolls. New legislation is needed before enforcement could be effective.

Areawide pricing also presents issues of acceptance and implementation. The concept potentially affects not just travel

corridors, but also large networks of arterials fronting businesses and residences. Unlike toll roads, areawide pricing is an approach that has not been tried in the United States, raising questions about operational and enforcement feasibility. Several jurisdictions rejected attempts by the federal government in the late 1970s to demonstrate the concept. Objections centered on risks to businesses, possible impacts on the poor, and operational and administrative issues of implementation (*2*). More recently, areawide pricing was evaluated for Manhattan in 1986, but no steps toward implementation have been planned by New York City.

One way to overcome problems of acceptance is to insure against some of the risks through a trial period. It probably is unrealistic to expect any downtown or activity center to bear all the risks of distributing visual permits or electronic tags, or both; to cope with enforcement; to meet possible legal challenges; and to structure a comprehensive evaluation. Nor is it realistic to expect businesses in a priced zone to bear all the risks of possible declines in revenue compared with the revenues of competing businesses in other activity centers within the region. To meet concerns about these risks, regional, state, and federal governments may have to share in risks and insure localities against them. Some possible government roles might include the following:

1. The federal government might cover a portion of the operational and evaluation costs for up to 2 or 3 years and perhaps insure against certain net revenue losses (e.g., business taxes and parking revenues after accounting for revenues from the areawide pricing program).
2. Local governments might reduce business taxes to offset possible declines in business revenues. The local transit district might add extra services in the priced zone aimed at commuters and the poor.

Parking Pricing

There are several options for using parking pricing policy to reduce congestion: parking taxes on the *providers* of parking, pricing or taxes on *users* of parking, and increased rates at *municipal* facilities. The most effective approach probably would be pricing of users rather than providers of parking. This approach is more effective than a revenue tax on parking, since the charges are applied directly to the parker. Under a revenue tax, parking operators may well absorb or redistribute the cost burden, as they did in San Francisco after a 25 percent increase in taxes on private commercial and city-owned parking. Parking rates changed at some garages but not at others, and the number of cars parked declined at about half the affected facilities, but increased at the rest (4). A broad user tax would be more effective than a rate increase or surcharge at municipal facilities, which often make up only a fraction of all parking spaces in urban and suburban areas.

Some of the issues surrounding a tax or fee on users include the following:

- Would the fee be imposed only on parkers in facilities owned and operated by private parking businesses (commercial parking)? On parkers in all facilities provided by private providers (e.g., owners of office buildings with parking whether explicitly priced or not, whether open to the public or tenants only)? On parkers in publicly owned and publicly operated facilities (either priced or not priced)?
- Whoever the parkers are who are encompassed by the user fee or tax, what proportion of the total parking population would be priced? Would the tax fall on a significant proportion of the parking population? Clearly, if the tax falls on a small segment of all users of parking facilities, the effects on parking and travel may be small. Presumably, if most of the principal activity centers and employment sites in a region were covered by the parking permit program, significant amounts of traffic in the region could be affected.
- Presuming that the proportion of parkers affected is significant, would the parking prices be sufficient to influence mode choice? Several studies of parking pricing suggest that fairly substantial rate increases are needed to influence mode choice. In one closely evaluated case of federal workers in Washington, D.C., rate hikes in the range of $20 to $30 per month brought only from 1 to 10 percent reduction in automobile use (*5*).
- Would facilities not taxed be priced or managed to complement taxing policies? In particular, if only parkers in private entities were taxed, would meter feeding be illegal and prevented? Would timed-zone parking be enforced? Would neighborhood streets be protected from commuter spillover?

The effectiveness of a user parking tax depends on the application. For maximum potential effectiveness, the tax could encompass parkers in both public and private facilities. As for targeting particular parkers, the tax could be aimed at long-term parkers or parkers receiving employer parking subsidies, or both.

Importantly, the effectiveness of the tax on parkers can be blunted in several ways. For example, effectiveness would be reduced to the extent that employers absorb or reimburse employee parking taxes. Although certain parkers (e.g., parking longer than 3 or 4 hr) may be required to pay the tax (it might be collected by the parking operator), nothing prevents employers from reimbursing employees for the tax through increased wages or other means. In fact, certain labor union agreements with employees may require employers to reimburse employees for all parking costs, including any user fees. Also, if the tax is only on long-term parking, parkers may move their cars at mid-day to avoid the long-term parking restriction.

The tax on parkers raises several implementation issues. The tax could be implemented in the following ways:

1. At the least burdensome level for the public sector, parking operators would be required to collect the tax. Operators might be required to post notice of the tax, separate it from parking fees, and collect the tax. If long-term parking were the focus of the tax, it might be collected only from parkers on monthly leases or those parking over 4 hr.
2. Another option would be for the public sector to sell special permits for long-term parking in certain zones and facilities. In this case, permit sales might be through government offices and retail stores on a commission basis. Parking enforcers would monitor long-term parkers for display of the permit.

Implementation of the tax by either of these options presents certain issues. If operators are responsible for charging and collecting the tax, they can avoid charging some or all of the tax by reporting a lesser number of long-term parkers than actually park in the facility. Or they may lower their rates as an offset to the tax, depending on their desire to be competitive in the parking market. Operators of surface lots without attendants pose a special problem. Legislation might require these lots to have attendants, or a permit might be required for parking long term in these lots. Several electronic parking meters on the market now issue such permits ("pay and display" systems).

A parking permit system operated by the public sector avoids the problems associated with operators administering and collecting the tax. Under such a system, parkers would be required to purchase and display priced permits for parking in public and private facilities. Daily and weekly licenses could be dispensed through retail outlets, banks, post offices, and even vending machines. Annual permits could be distributed most easily through the mail. Self-validating permits probably are preferred, because these can be bought in batches.

Needless to say, such a system is not without complexities:

1. It requires both public and private sales outlets. U.S. experience with parking permit sales and distribution through retail and public offices is limited. As previously mentioned, Eugene, Oregon; Santa Cruz County; and the city of Hermosa Beach, California, require and distribute parking permits through retail establishments and public offices. Of course, state lottery tickets as well as fishing and hunting licenses are also sold through retailers. Outside the United States, parking permit systems with retail distribution are found in Ireland, Scandinavia, France, and Israel. Consequently, large-scale sale and distribution may be manageable, but certainly deserves further analysis.
2. The permit system raises enforcement issues. If permits were required on private property, legislation would be required enabling public-sector enforcers to monitor and issue citations in support of the program.

Legality is important to implementation of parking taxes. A tax on users of parking has legal advantages over a tax on providers. Under most state laws, user taxes are defined as excise taxes, whereas typical taxes on parking providers based on the number or value of parking spaces generally are considered property taxes. As an excise tax, the parking user tax may be varied in line with its purpose as a means to reduce solo driving and traffic. In contrast, property taxes must be uniform within a tax district. Of course, although user taxes can be varied by area, purpose, or situation, the variation must follow reasonable constraints. Taxing variation cannot be so great as to violate equal protection provisions in state and federal law. Generally, variations in tax provisions are allowed as long as the tax applies equally to all persons within a category (area, purpose, or situation) and the variations fit the purposes of the law (e.g., reduced traffic). Still, legal research is needed to determine the extent of variation that might be allowable and at what level such taxes might be challenged as confiscation.

There is an important legal impediment to the application of a priced parking permit scheme to public and private parking. Usually, local jurisdictions do not have the authority to prevent parking violations on private property. This means that enforcement cannot take place without special agreements with property owners or new authorizing legislation.

Finally, there is the issue of acceptance. Acceptance of user taxes or fees is likely to be a problem in the same way as acceptance of congestion pricing. The parking industry, local businesses, automobile associations, employers, and employees will raise concerns and objections. One way to meet at least some concerns is to require permits only for parking during congested peak periods or during the seasons of the worst air pollution.

Resistance also might be lessened if pricing permits are slated for implementation at major activity centers across the region as part of air quality improvement programs. The Puget Sound Council of Governments in the state of Washington recently adopted a 2020 Plan with permit parking pricing at major activity centers. In this way, no individual center, such as a major downtown in a region, is disadvantaged relative to others.

SUMMARY AND CONCLUSIONS

Facility Pricing

Given the many issues surrounding facility pricing, states and localities might first consider a pilot project covering a few facilities. From the standpoint of political feasibility, it is probably best to evaluate opportunities for piggybacking on forthcoming new toll projects rather than on facilities now without any prices. Future new tunnel, bridge, or freeway double-deck projects also may provide opportunities to examine congestion pricing approaches and evaluation designs.

As part of carrying out assessments, local, regional, and state agencies should consider the following actions to evaluate facility pricing:

- Track assistance under the federal toll road and congestion pricing demonstration program, the overall progress of the federal program, and any relevant legislative changes.
- Identify new non-Interstate projects and reconstructions for toll and pricing tests and examine possible congestion pricing on Interstate roads under the new federal congestion pricing demonstration program.
- Analyze code and legislation changes necessary to make vehicle owners liable for evasion of tolls.
- Prepare an evaluation design for possible future tests of congestion pricing, including components to monitor traffic impacts, best AVI options, enforcement procedures, operations, and equity impacts.
- Review state highway department authority to regulate tolls and encourage congestion pricing under any legislation encouraging private toll roads.

Areawide Pricing

Areawide pricing makes sense if the congestion levels are severe on an areawide basis rather than confined to major

corridors. In many regions, activity center congestion is not as severe or as widespread as is freeway congestion, making areawide pricing less applicable than corridor pricing. Furthermore, despite any compensatory or mitigating actions, no area in a region is likely to opt for areawide pricing unless other major competing areas within the region are priced also.

Although areawide pricing can be justified theoretically, particularly if applied to many activity centers in a region, past attempts to demonstrate the concept in U.S. cities suggest that there will be acceptance problems. Experience suggests that business centers within a region often are in competition with one another for development and business expansion. They may perceive themselves at a competitive disadvantage because of pricing that is confined to their area. Consequently, future analysis of areawide congestion pricing should probably focus on joint implementation across the major activity centers in a region.

Local, regional, and state agencies should consider the following steps in carrying out evaluation and assessment on areawide pricing:

- To determine perceptions about areawide pricing, meet with actors and interests, including representatives of local businesses and developers; representatives of outside agencies such as transit, ridesharing, and air quality; and local government officials (police, traffic, parking, revenue, and taxation).
- Identify possible roles of various governments in sharing the costs and risks of a demonstration program, including whether federal demonstration funds would be available for areawide pricing.
- Derive general specifications for the best pricing technology and distribution systems (permits versus AVI, centralized versus multiple outlet sales). The state of California is now attempting to set uniform standards for AVI.
- Track latest implementation lessons from areawide pricing applications in Singapore, Sweden, and Hong Kong, especially lessons relating to permit distribution and enforcement.

Parking Pricing

Although the beneficial impacts of a parking permit program might be smaller than those of an areawide program of the same extent, parking permits might be more feasible in the near future. Because monitoring focuses on parked cars, enforcement is easier than for area pricing, which requires monitoring of moving vehicles. Although it would be necessary to empower jurisdictions to monitor and cite violators on private spaces, such authority might already be inherent in state or federal air quality legislation encouraging parking pricing as an air pollution control measure. Also, travelers may be more willing to accept parking pricing than an areawide congestion pricing approach. In spite of some advantages over congestion pricing, parking pricing cannot be expected to produce the same congestion reductions as facility pricing or even areawide pricing.

Specific assessment actions that local, regional, and state agencies should consider on parking pricing include the following:

- As with congestion pricing, meet with actors and interests to determine perceptions about priced parking. Evaluate regional parking pricing approaches in the context of long-range regional plans, as recently adopted in the Seattle region.
- Carry out legal research to determine the extent of pricing variation that might be allowable across priced zones and at what level parking fees might be challenged as confiscation.
- Determine whether air quality legislation may enable management districts to impose regional parking fees without need for further legislation.
- Determine what authority is needed to enforce parking regulations on private property. Research is needed on the legal obstacles and precedents for such powers.
- Assess the degree of employer-subsidized parking in the region and assess labor union agreements requiring employers to compensate employees for parking charges.
- Flesh out implementation particulars on parking user taxes, including the best permit schemes on the basis of revenues, enforcement, fraud potential, and overall administration.

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