
TRANSPORTATION MANAGEMENT FOR CLEAN AIR & EFFICIENT GROWTH: ON THE ROAD TO PROGRESS?

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ABSTRACT

Economic, fiscal, and environmental problems, together with requirements of the Clean Air Act and ISTEA and demands for more livable communities, make it important for states, regions, and communities to develop and evaluate new integrated transportation, land use, and pricing strategies. Institutions organized to expand the supply of highway capacity have been asked to take on broader goals of helping to reduce air pollution, traffic congestion, and forced automobile dependence. This will require fundamental realignment and reinvention of these organizations with a new focus on demand management and integrated planning. Transportation demand management (TDM) in the past has been poorly integrated into transportation planning and operations and hence has had little effect on the growth of automobile dependence. This paper discusses key lessons from past experience with TDM, criteria and benchmarks for multi-modal transportation system performance monitoring and assessment, and new approaches to implementing effective TDM strategies. These strategies can be valuable when searching for ways to do more with fewer tax dollars as well as for helping to improve air quality by slowing the growth of further motor vehicle dependence.

The comprehensive strategies discussed include many non-traditional techniques for reducing vehicle miles of travel and vehicle trip starts, particularly affecting non-work and non-peak period travel. New and emerging concepts are identified, including pay-as-you-go insurance, cash-out of automobile subsidies, and the use of intelligent transportation technologies for electronic road and parking pricing and automated motor vehicle speed limitation. These need to complement improved intermodal integration -- such as expanded bicycle access to public transportation and enhanced freight intermodal systems -- and changes in land use policy to ensure that accountability and responsibility go hand in hand, considering the regional travel demand and air pollution impacts of local decisions.

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INTRODUCTION

Requirements of the Clean Air Act (CAA) and Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 make it imperative for transportation planners and engineers to develop new strategies for the interaction of transportation, land use, and pricing to reduce air pollution and traffic congestion. The old approaches to planning and demand management focused on reductionist engineering approaches to moving more vehicles farther and faster, ignoring effects on latent and induced demand and missing important dynamic interactions between the supply, demand, quality and price of transportation and land use systems that shape travel behavior. State, regional, and local authorities are struggling to make the shift to new institutional relationships and new ways of understanding and planning for community mobility systems.

Traditional transportation demand management (TDM) is widely acknowledged to be limited in its effectiveness. However, new and more comprehensive strategies for TDM, including major pricing and land use policy reforms and a shift of much currently planned highway investment into transit and other management measures, could reduce mobile source emissions related to transportation plans and programs in typical non-attainment regions by one or two percent or more a year between now and 2010, compared with current plans and programs. (1) For this to occur, however, major changes in institutional thinking, policies, and programs are needed. In particular:

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

POLICY CONTEXT

New Legislation

The Clean Air Act (CAA) Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 signaled the intent of the U.S. Congress to promote major reforms in the transportation planning process. In two decades since the 1970 Clean Air Act, federal, state and local transportation agencies avoided giving serious weight to the effects of transportation plans and programs on air quality when making investment and policy decisions. These plans have increased our dependence on the automobile, offsetting the emission reductions from improved vehicles and fuels. In response, the 1990 CAA Amendments were written to make air quality a primary concern in transportation decision-making. The law requires urban areas with high pollution levels to modify their transportation plans and policies to ensure that they themselves contribute to reduced emissions. Congress added these new requirements because many seriously polluted cities are not likely to achieve and maintain healthful air quality without slowing the rapid growth of automobile use.

New Regulations

Unfortunately, federal guidance inconsistent with the law and delays in issuing regulations have encouraged many regions to continue business-as-usual approaches to transportation and land use. As regions prepare new State Implementation Plans (SIPs) to meet CAA requirements, many have discovered that growth in vehicle miles of travel (VMT) since 1990 indeed produces substantial new emissions which they must quickly offset to meet the law. Many ozone non-attainment regions are facing the new challenge of demonstrating NO_x emission reductions from transportation plans and programs to meet the requirements of EPA's December 1993 final transportation conformity regulations and the CAA requirements for ensuring that future emissions are less than the 1990 baseline emissions without taking credit for technological fixes otherwise mandated by the law. This requires a shift from strategies that increase vehicle speeds to other strategies that reduce growth in motor vehicle trips and mileage. However, few regions have recent experience with such strategies, since transportation policy has for so long in the US been dominated by strategies which promote growth of motor vehicle trips and mileage.

A 1993 US General Accounting Office report documents that many Metropolitan Planning Organizations (MPOs) are considering transportation demand management (TDM) and transportation control measures (TCMs) for air quality, but that most MPOs believe that the measures they are adopting will have little effect on traffic congestion or air pollution. Indeed, the TCMs most commonly found in MPO plans are widening intersections and highways, adding HOV lanes, building park-and-ride lots, and retiming traffic signals. Some are channeling greater financial support to public transportation and ridesharing. But thus far, few MPOs are moving forward with changes in transportation pricing and land use policy which are generally recognized as essential to produce substantial reductions in air pollution and to make transit more cost-effective in the suburbs. Few MPOs are looking at ways to increase dramatically the share of daily activities which can be carried out by walking and bicycling. Few are looking at anything other than motor vehicle home-to-work VMT and fixed forecasts of land use which assume that even the longer-term future will bring a sprawled, automobile-dependent, edge-city with declining urban cores. Are we condemned to such a vision?

Many believe not. This old-style approach to transportation planning will fail to provide sustainable reductions in emissions or traffic congestion and in many cases posits an unnecessary choice between clean air and economic growth. At best, it will produce short-term reductions in hydrocarbon emissions, while increasing nitrogen oxide emissions that contribute to ozone problems and stimulating long-term growth in suburban sprawl and automobile dependence.

Need for New Approach and Vision

In response, some are calling for a new approach and vision, with recognition of the synergism and interdependence of transportation, pricing, and land use. Just as we need to reinvent the corporation and government, so too we need to creatively reinvent transportation planning and demand management, the ways we pose and analyze transportation questions, and the very communities in which we live and work.

By developing more resource-efficient communities and transportation systems and reducing wasteful subsidies to the automobile which our communities can no longer afford, we can foster healthy economic growth and revitalization of our cities while expanding the freedom of citizens to choose alternatives to the automobile to meet their daily activity needs. This will be a win-win proposition, if we are clever about it: more jobs and better environmental quality, less congestion and more freedom to choose alternative ways to travel, less urban decay and more preserved open space, with safer streets for all.

Results of the November 1994 election introduced substantial uncertainty about the means by which the Clean Air Act and ISTEA will be implemented in the future, with significant potential for changes in laws and regulations. Several of the more cost-effective programs for emission-reduction have come under heavy attack, with many states reconsidering enhanced vehicle Inspection and Maintenance (I/M), reformulated fuels, and Employee Commute Option programs. Delay or loss of these programs will make attainment of healthy air yet more difficult. Likely major cuts in federal spending on public transportation and other programs that contribute to improved air quality may prompt greater growth in automobile use and related air pollution, worsening traffic congestion problems, sprawl, and urban flight. Regardless of how the new Congress acts on these issues, fiscal pressures on all levels of government are likely to promote ever greater need to pay attention to how to manage the existing system more cost-effectively. The large subsidies that now encourage greater use of the automobile and low-density suburban sprawl will increasingly be exposed as very costly items when communities are witness erosion and collapse of other government services.

LESSONS FROM PAST EXPERIENCE

Prior and ongoing attempts at implementing TDM and congestion management have foundered on six fronts, all of which can be resolved in the U.S. through careful implementation of the ISTEA and CAA legislation. (2)

Need for Comprehensive Rather Than Sequential System Management

Past approaches have largely been sequential, not comprehensive in their examination of ways to improve system performance. A new approach should comprehensively examine the entire range of options including capacity enhancement in an effort to select an optimum mix of demand and supply strategies and actions for inclusion in the plan and program.

Need for Integrated Demand-Side Management Strategies

Prior efforts have focused on the near term, which has not altered the fundamental approach to congestion-- trying to build our way out of it. A long term commitment to operate and manage both demand and supply on the Metropolitan Transportation System is required. Operations and management commitments and continuing support of TDM must be treated in the same way as pavement maintenance or bus replacement, as regular ongoing features of a management program for the Metropolitan Transportation System.

Need to Focus on Activities and Travel, Not Facilities and Vehicles

Attempts to measure congestion have been focused at points on the road network rather than looking at the whole trip from a user perspective. Congestion management systems should attempt to optimize travel from a system wide perspective by looking at travel corridors or subareas and at travel markets or demand sets rather than at specific bottlenecks. A broader focus will tend to weight decisions not towards optimizing vehicular *mobility*, but toward investments that increase multi-modal *accessibility* and expand the freedom to meet daily activity needs with less forced dependence on the automobile and which benefit the performance of transportation networks as a whole and the general public. Travel behavior analysis and models need to shift from a focus on trips to a focus on the activities which give rise to travel if demand management strategies are to be effectively integrated into analysis, planning, and system management.

Need to Diversify Expertise Involved in Transportation Analysis and System Management

Implementing agencies have traditionally been oriented toward capacity expansion. Most state DOTs are overwhelmingly oriented to design engineering in terms of resources. New personnel with non-traditional backgrounds, including the social sciences, should be brought into these agencies to strengthen capabilities to identify and implement new and different types of strategies. In addition, implementing agencies have been biased toward capacity solutions on systems that they own. ISTEA's reliance on the Metropolitan Planning Organizations for planning and funding decisions in urban areas helps to resolve these biases as these agencies can broker among options and between competing agencies. MPOs must include agencies and providers such as ridehare agencies and TMAs who have traditionally not been involved in the State DOT project planning process. MPOs also need to reach out to the broad public affected by transportation and land use decisions, including non-governmental

organizations concerned with environmental quality and community development, transportation and land use decisions, and various community-based organizations representing different segments of the population. These stakeholders should be given fair and equal access to information throughout the planning process to reduce barriers to their effective participation. This should be complemented by establishing support for public intervenor programs designed to assist regional and community-based organizations in their interaction with the planning process.

Need for Tight Linkage Between Demand Management and Funding/Investment Decisions

Past practice has failed to link demand management options to funding and investment decisions. This linkage is critical, as the political imperative to get credit for building new facilities is strong among elected officials. The new ISTEA legislation provides the flexibility to invest in demand management options, but there needs to be an explicit linkage between the management system requirement and the fiscal decisions if a continuing commitment to management is to emerge.

Need for Accountability to Link Land Use, Pricing, Transportation, and Environmental Policy

Land use, urban design, and transportation pricing policies and decisions have not been considered in light of their effects on transportation demand and transportation system performance, including air quality. ISTEA requires consideration of such factors as part of both statewide and metropolitan planning. Effective long-term demand management is highly dependent on creating ongoing integration of these factors across many different agencies and actors. This will require major efforts to reform transportation and land use decision-making structures, increase accountability of different agencies to the effects of their decisions, and improve dispute resolution mechanisms between agencies.

CRITERIA AND BENCHMARKS FOR MULTI-MODAL TRANSPORTATION SYSTEM PERFORMANCE

The integration of TDM strategies into overall transportation and land use decision processes will be most effective if methods are devised for measuring system performance that encompasses the entire multimodal metropolitan transportation system, that focuses upon the needs of the user not the facility, and that allows the evaluation of secondary, tertiary and external impacts of resource allocation decisions. Criteria must be devised for the development of metropolitan transportation system performance evaluation measures to guide resource allocation decisions: they should be simple enough for a layperson to understand; they should be multivariate in nature as we are trying to model a complex system; they should examine system outputs rather than internal facility characteristics and they should be user oriented.

Cost-Effectiveness

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

User Accessibility and Convenience

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

Social and Environmental Impact

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

NEW STRATEGIC ELEMENTS

If the old approaches to demand management yield little benefit at high costs, what are the promising strategies for demand management that could fit within new and more effective planning and management systems? Obviously, different regions will face different needs and opportunities, and plans must be tailored to local realities. However, a new longer-term comprehensive transportation management strategy for many regions might include a large share of the ingredients discussed below.

(3)

Requiring Motorists to Pay their Own Way

If we are serious about managing travel demand, the best place to start is to "cash-out" large existing subsidies which encourage commuters to drive to work and to shift other price signals for both work and non-work travel, with "pay-as-you-go" automobile insurance, smog fees based on how much vehicles pollute and how far they are driven each year, and the development of automated road pricing systems, building on existing Intelligent Vehicle Highway System (IVHS) demonstration projects. These will be best received if they are phased in as revenue-neutral programs, with rebates of surplus program revenues to all the region's citizens, in recognition of the sensitivity of many citizens to new taxes and concerns over their effects on the poor.

Smart Transportation and Community Systems. If we introduce more full-cost marginal pricing in transportation, market forces will encourage more efficient individual transportation choices, long-term development patterns, and the rapid development of job-creating alternatives to the automobile. These alternatives may range from taxis and other forms of paratransit to new transit services, high speed intercity rail, telecommuting and teleshopping, and improved conditions for walking and bicycling. Elimination of transportation subsidies will also help stimulate development and revitalization of neighborhood-based retail and service businesses.

The cashing-out of employer parking subsidies could be implemented nationally by Congress with a simple change to the Internal Revenue Code, as proposed by President Clinton. IVHS could provide an unprecedented opportunity for governments or private operators to efficiently impose trip and road user fees for highway travel, which could be used to manage travel demand to reduce both air pollution and congestion. However, the current IVHS program has focused mostly on technologies to expand highway capacity without managing demand, which threatens air quality attainment. **(4)**

Promoting Livable Communities and Freedom to Choose Alternative Modes

While major changes in land use and urban design take decades to effect, it is possible to restructure street space allocation and street usage rules in a relatively short time, introducing such strategies as traffic calming, sidewalks, bicycle paths and lanes, and reserved or priority bus lanes. Research in Germany shows that slowing down and calming traffic on residential and commercial streets can be highly effective in reducing air pollution emissions from motor vehicles, including not only NO_x, but also CO and VOC emissions. Although traffic calming and other bicycle and pedestrian related transportation strategies are widespread now in Europe, Japan, and Australia, **(5)** the US lags behind in developing, evaluating, and demonstrating these strategies for demand management, with only a handful

of communities having experience in this area. As a result, these strategies are too frequently dismissed by local traffic engineers without knowledge of their true costs, effects, or awareness of how easily they can be implemented. Leadership and targeted training and research initiatives are needed at different levels of government to promote progress in this area. IVHS could also be used to impose automated vehicle speed limitations appropriate to any particular road or area, creating electronic traffic calming for low volume residential streets and busy pedestrian-oriented commercial areas, smoothing traffic flows on arterial roads to match traffic signal timing, and eliminating the increased emissions and safety problems that come from very high speed driving.

It is also possible in a period of several years to begin retrofitting neighborhoods for more transit, pedestrian, and bicycle oriented land use patterns through local, regional, or state growth management incentives and targeted impact fee systems. These can stimulate development of key missing land uses in appropriate locations, with appropriate urban design. Local governments bear a key responsibility for growing automobile dependence by their often exclusionary low-density zoning around transit stations, site design standards, growth management systems, and prohibitions on accessory apartments and businesses in homes which reduce opportunities for integrated pedestrian and transit friendly communities. Changes in land use policy and governance are needed to ensure that accountability and responsibility go hand in hand, considering the regional travel demand and air pollution impacts of local decisions.

Getting Smart About Transit and HOVs

Improved and expanded transit services are important in attaining healthy air quality, but transit investment alone cannot be expected to overcome all the other forces which now promote sprawl, automobile dependence, and growing traffic volume. Transit investments will be most productive when automobile drivers pay the full costs of using their cars, where jobs, houses, and shops are mixed together and clustered in pedestrian and bicycle friendly settings, and when advanced technologies and street space management systems are used to ensure efficient transit dispatching and operations. Setting aside reserved rights-of-way for rail and bus modes in higher density travel corridors, and pre-empting traffic signals for transit vehicles in moderate density corridors can boost schedule adherence and productivity while making transit more competitive with the automobile.

Transit Access and Egress. Low density suburbs are generally inhospitable to conventional transit. However, more attention to transit access and egress systems, such as bike-and-ride, can help expand the market area of transit stops and stations, overcoming some of these problems. **(6)** In European and Japanese suburbs, the bicycle is the predominant and fastest growing means of access to express transit services and provides pollution-free expansion of transit markets. In the US, in contrast, massive investments in automobile park-and-ride systems have made transit dependent on the automobile while doing next to nothing to improve air quality, since trip start related emissions (rather than emissions related to the distance traveled) account for the largest share of the emissions for all but longer distance metropolitan automobile travel.

Many American state and local governments plan major expansions of park-and-ride systems in the 1990s to meet air quality and congestion management goals. However, bike-and-ride appears to offer

far greater cost-effectiveness and long-term potential for strengthening alternatives to the automobile. A 1980 Chicago study found that the installation of secure bicycle parking at rail stations would reduce hydrocarbon emissions at a public cost of \$311 per ton, compared to \$96,415 per ton for an express park-and-ride service, \$214,950 per ton for a feeder bus service, and \$3,937 per ton for a commuter rail carpool matching service. Similar differentials were found for CO reduction costs.

Smart Transit and Paratransit. Real-time transit passenger information systems and introduction of a greater diversity of paratransit services -- taxis, jitneys, and shared-ride subscription services -- can also help to overcome some of the current limitations of current suburban transit services, helping to reduce emissions by expanding traveler mode choice. However, regulatory barriers frequently impede private initiatives to develop new transportation services. These should be removed by state and local governments to permit greater market competition.

HOV or Road Pricing? Many states plan major highway expansions for high occupancy vehicle (HOV) lanes in coming years. While these are less damaging to air quality than expansions of single occupancy vehicle (SOV) capacity in non-attainment areas, they still often contribute to suburban sprawl and mobile source emissions growth, especially when 2-person vehicles are permitted to use them. Only take-a-lane HOV systems which reallocate existing road space can be expected to produce long-term emission reductions rather than emission growth from mobile sources.

While pure take-a-lane strategies are politically difficult to implement, these problems can be addressed by allowing SOV drivers to buy their way into "Smart Express Lanes," using automated toll collection through "smart cards." This automated toll collection technology has already been successfully demonstrated in Kansas, Virginia, Texas, and elsewhere. The price of admission to the lanes can be adjusted periodically to ensure efficient use from opening day onward. As travel demand in a corridor grows, prices can be adjusted to switch more drivers to transit and HOV modes or additional existing lanes can be gradually converted to a pay-as-you-go system. In return for a payment, drivers can expect and get delay-free travel, while those who do not want to pay can choose alternative modes or lower speed routes. If surplus revenues from these tolls are periodically rebated to all residents, there will be a growing constituency for extending the system and increasing the price charged per mile or per trip.

Creating a New Transportation Ethic

Marketing and incentives and adjustments to automobile infrastructure systems are also needed to help adjust public attitudes to new realities and to offer new incentives and disincentives. Just as a new ethic was created regarding recycling, we can create a new ethic regarding transportation in the 1990s. Educational campaigns should be used to influence travel behavior, and might be given extra emphasis during hot weather, when ozone violations are likely, even though the CAA is clear that intermittent measures cannot be credited in SIPs. Campaigns should reach out to children with new ideas about how transportation choices affect the environment, public safety, and the health of our communities. But to be meaningful, such education should be complemented by in-school, on-road bicycle and pedestrian training which can best occur if every child in America is also guaranteed the freedom to walk and ride a bicycle safely in the neighborhood of their school.

PUTTING IT ALL TOGETHER

There are no magic bullets to solve our transportation and environmental problems. Only by integrating mutually supportive strategies can we meet our objectives affordably. Attaining annual emission reductions from transportation plans and programs will require a combination of traditional and non-traditional transportation management strategies. To be effective, this must include significant transportation pricing changes, integrated congestion and growth management programs, and improvements of pedestrian and bicycle conditions, along with ridesharing programs, employer trip reduction programs, parking management, and transit investments.

Analysis of individual measures on their own will show far less effectiveness than analysis of integrated packages of measures with changes in transportation investment policies and plans. Significant investments are needed by metropolitan planning organizations in better data collection, analysis methods, and evaluation of both prospective alternative strategies and ongoing plan and program implementation, but lack of policy-sensitive models should not be cause for delaying initiation of innovative demand management strategies. Rather, professional judgement should be used to devise estimates of the effects of comprehensive strategies, followed by good monitoring of changes in travel behavior, using travel panel surveys, more comprehensive traffic count programs, and other new data collection activities. If the strategies do not produce anticipated reductions in emissions and travel demand, then contingency measures should be available to make up the difference. To the extent that transportation pricing reforms are included in SIPs, contingency measures will be as easy as adjusting the price of certain transportation choices (with rebates of surplus revenues to all residents to develop and sustain a constituency for the pricing strategies).

CONCLUSIONS

Nearly all of the demand management strategies discussed above are based on real working examples drawn from some of the world's wealthiest and economically competitive communities. These can be implemented in America too. Achieving this will require leadership, initiative, and innovation which Americans have demonstrated before and can demonstrate again to meet the challenges of changing times and conditions.

These demand management strategies will provide short-term economic stimulus, provide new revenues for community infrastructure and services, and strengthen America's long-term economic competitiveness. They are part of a new vision of how transportation systems can serve many other goals in addition to mobility -- including enhancing the quality of life, reducing congestion and travel delays, cleaning the air, and contributing to more desirable communities. Development of transportation conformity programs, congestion management systems, and State Implementation Plans (SIPs) under the CAA provide key opportunities for advancing this vision and making America's transportation systems more sustainable.

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